Carshalton & District History & Archaeology Society

Local History Note 21

The Carshalton House springhead and the structures in the bed of the lake

Revised 18 June 2025

Site code CAL84

1 INTRODUCTION

This is an attempt to understand the culverts and other structures in the bed of Carshalton House Lake which were excavated and recorded by the River Wandle Survey, a Manpower Services Commission archaeological project led by Hugh Waterhouse mostly in 1983-4. The work on the lake was done in 1984-5 and was given the site code CAL84. Hugh died unexpectedly which prevented him completing a report. His drawings and context sheets have survived but his slides were destroyed by damp. The photos in the report were taken by other people who visited the site including Andrew Skelton and John Phillips.

The Carshalton House landscape has been extensively researched by Andrew Skelton who has published the results in *Tall Hedges and Artificial Slopes* (2017) and in other papers listed in the bibliography. These detail the history of the house and its owners and the development of the landscape. This note supplement to them.

2 THE FEATURES AND THEIR FUNCTION

The features consist of culvert and wall foundations which are located in the bed of the southern part of the Carshalton House Lake to the northeast of the island about TQ 2765 6442. The features form a somewhat irregular square which is mostly aligned to the east of north. I have, for simplicity, described the structures as if they were aligned north-south.

Each feature was given a three-figure number and the deposits within it were given context numbers which were in circles. I have changed these to square brackets. This summarises the information on the two series of context sheets. On one set of context sheets the layers are numbered +, 2, 3 etc. I have changed + to 1. The numbering of the features on the drawings is sometimes inconsistent. I have in general followed the numbering on the Paper Plan (figure 1).

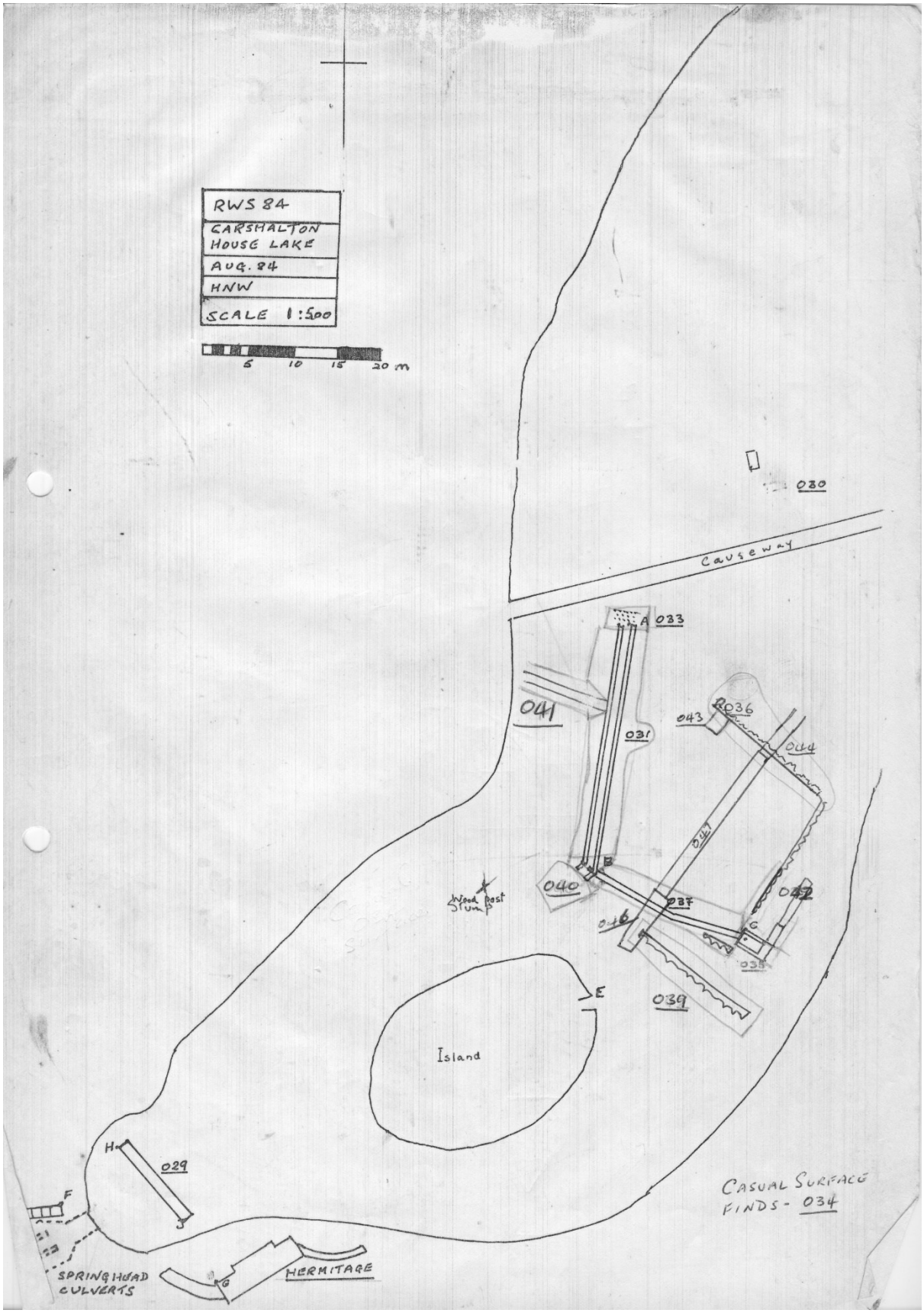


Figure 1. Site plan from file of context sheets. This is on paper and is referred to as the Paper Plan.

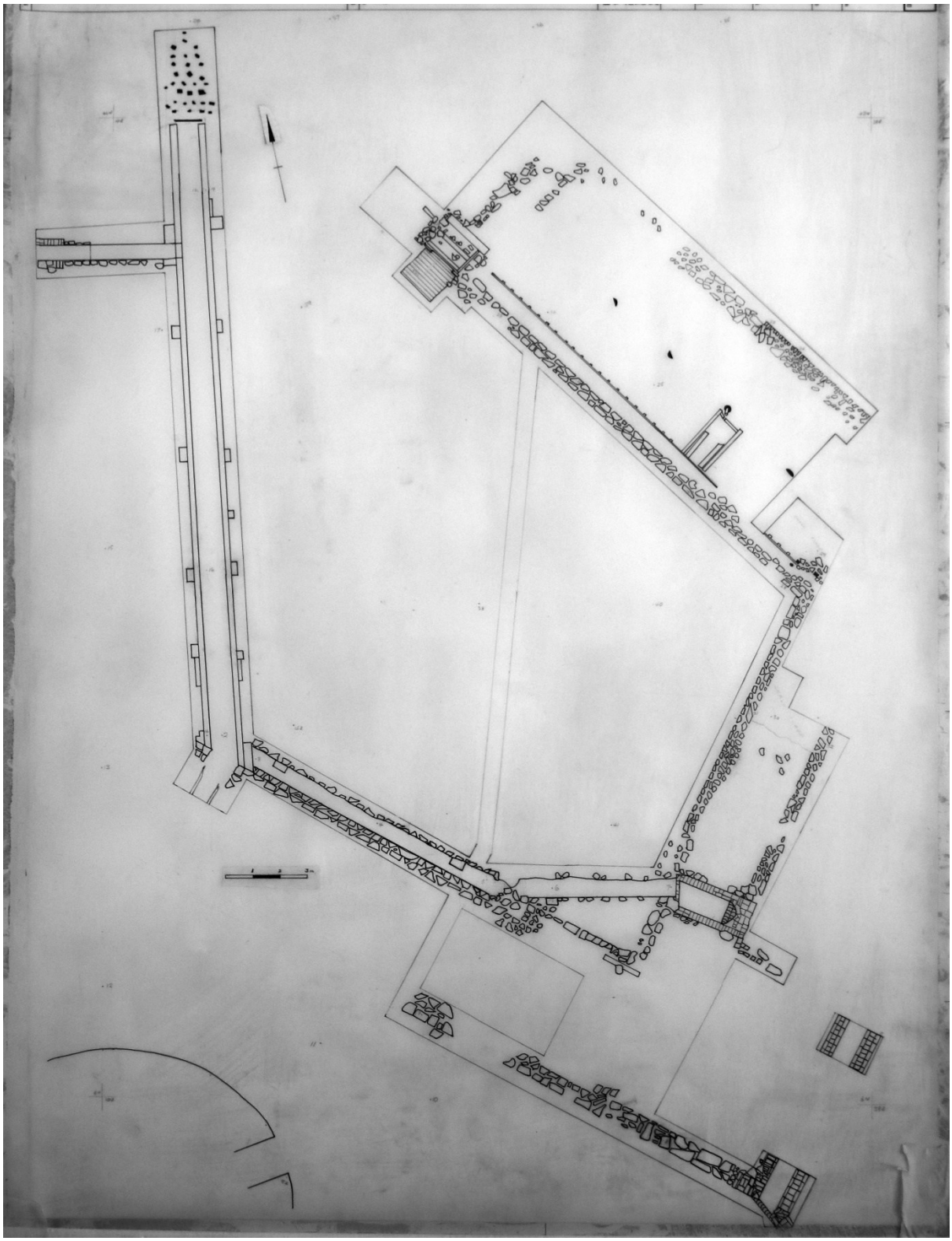


Figure 2. Photograph of a site plan on plastic drawing film which is referred to as the Film Plan.

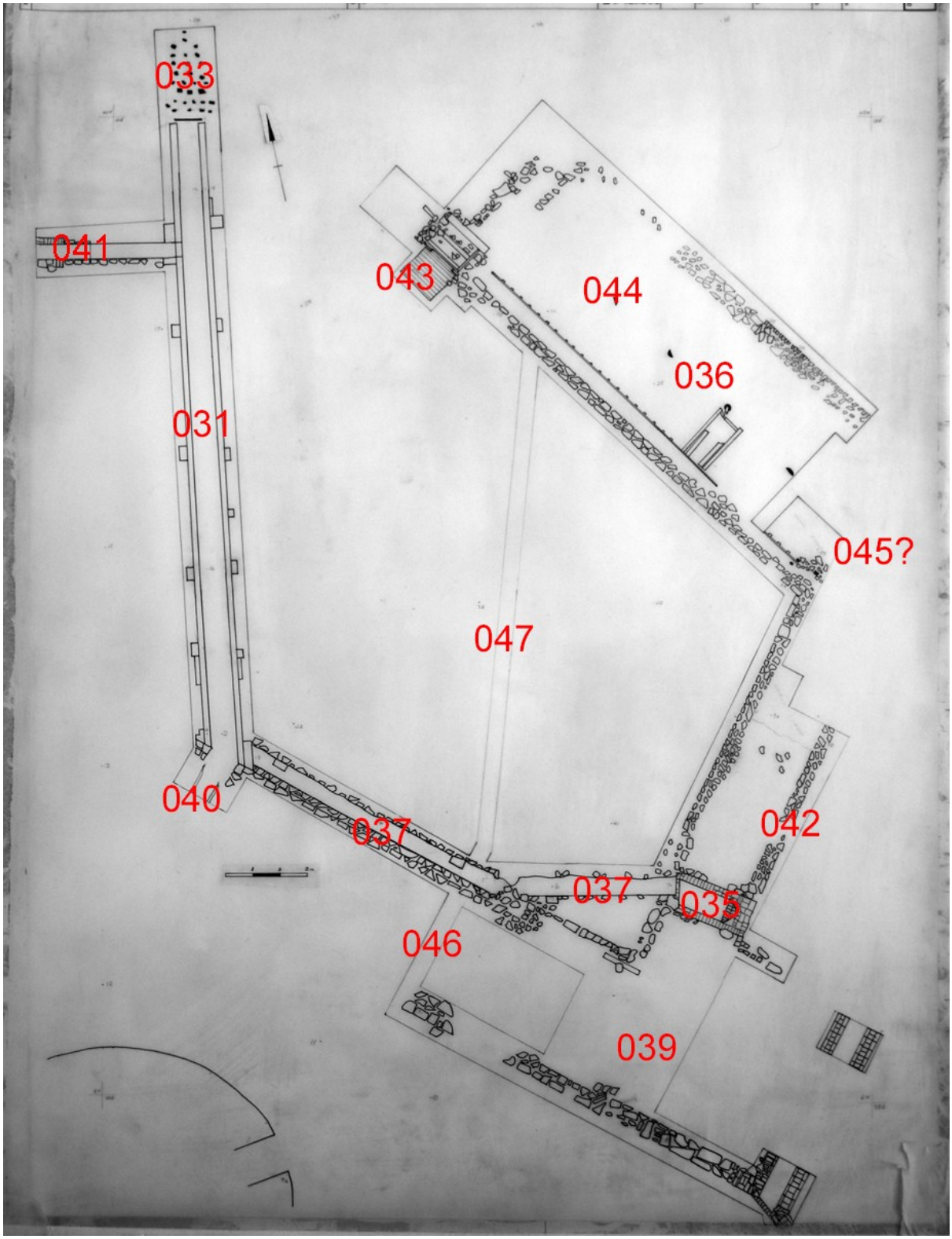


Figure 3. The film plan with added feature numbers.

2.1 The western area

The main feature here was a culvert (031) which was aligned roughly north-south. The channel was 92cm wide. The sides consisted of four courses of brick with mortar on the top suggesting that they had once been higher. The tops were 12cm below the bed of the lake. The bricks were red, without frogs and were 22.5cm long, 6cm high and 10cm wide.

The site archive contains an unlabelled section drawing which is probably of this channel. It shows that the channel was cut into the natural chalk and that side walls were constructed of chalk blocks faced and covered with brick. There were three longitudinal timbers, one in the centre of the channel and the others partly under each side wall. These appear to have supported a plank floor which was held in place with iron nails. The areas between the longitudinal timbers were filled with sand resting on clay. There was a thin gravel deposit below the clay and then chalk.

It is not clear whether the channel in the chalk was excavated at the time the timber-floored structure was built or at some earlier date.

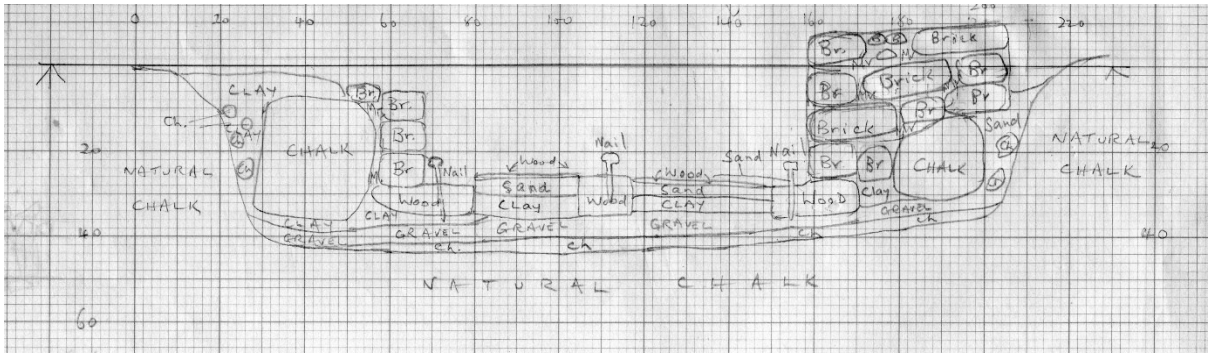


Figure 4. An unlabelled section drawing probably of channel 031.

An excavated section showed that the channel contained the following deposits:

[1]	Black silty soil or organic earth with medium-sized flint nodules, chalk and broken brick. The top of this was about 8cm above the brick side walls, while the bottom was about 14cm below, giving a total depth of about 22cm.
[2]	Grey-brown fine silt with a large amount of broken and complete brick, flint, chalk and a lens of clay. Thickness about 15cm. The finds included a piece of 19th century pottery.
[3]	Three wooden beams aligned approximately north-south along the length of the channel. One (A) in the centre was at a slight angle to the channel. The other two (B) partly under the side walls. There were large iron nails set at about 10cm intervals in the upper surfaces which held transvers planks of which there were only faint traces. Timber A was 7 by 15.5cm and the nails were said to be “proud of the base material” by 6, 8 5 and 6.5 (cm?). The timbers B were 9.5 by 20.5cm and the nails were said to be “proud of the base material” by 10.5, 7.5, 11 and 8 (cm?).
[4]	Clay which rose up between the beams. It contained some small flint. It was 3cm deep below the beams (B) along the side of the channel and 5cm tick below the one in the centre (A). No finds were noted.
[5]	Sandy gravel 4cm thick. No finds were noted.
[6]	Chalk.

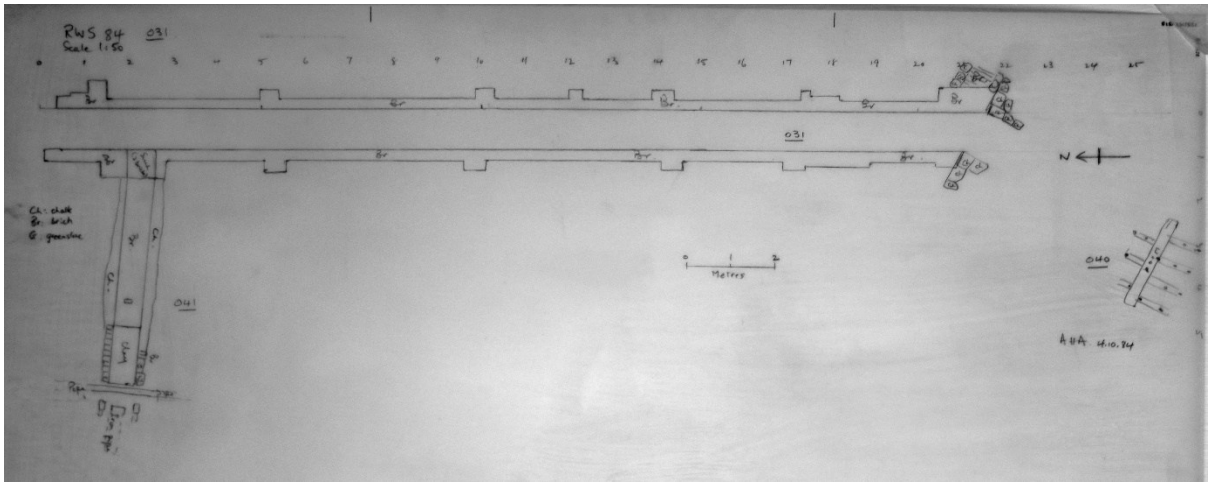


Figure 5. Culvert 031 with north to the left.

Figure 6. Culvert 031 looking approximately south.

Figure 7. An excavated section of 031.

At the north end of 031 there was an area of wooden posts set in chalk (033). There are two photos of the area (figures 6 and 7) and two plans. The former appear to have been taken before the excavation of the stakes was complete and only show part of the area. One drawing (figure 8) shows the end of culvert 031 with four rows of posts of variable size and shape and uneven distribution. Some were split logs without bark. A second drawing (figure 9) shows a more extensive area of posts and was presumably made after further excavation. The posts were set in chalk and extended up into black silt or soil.

The following contexts were recorded:

[1]	Black soil with small flints. Some horizontal pieces of rotted timber, but with no recognisable connection to the vertical posts. 15cm thick.
[2]	Black earth with flint about 3 to 5cm but deeper in the crevasses of [3] with some broken brick and tile, large chalk blocks and crushed chalk.
[3]	Sandy silt with large chalk blocks to variable depth up to 40cm. Smaller chalk lumps and compressed chalk at least 25cm where soil became intermixed. 18th century pot.

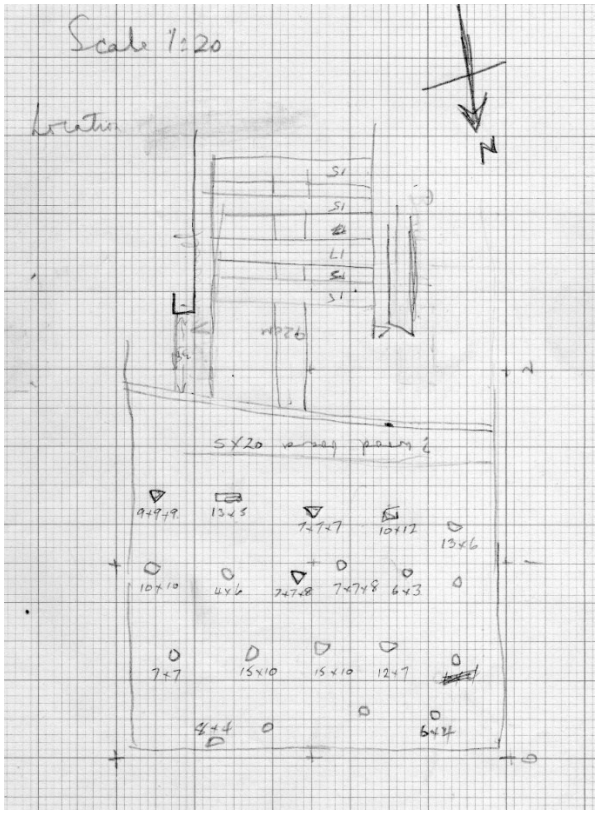


Figure 8. The north end of culvert 031 and the posts 033.

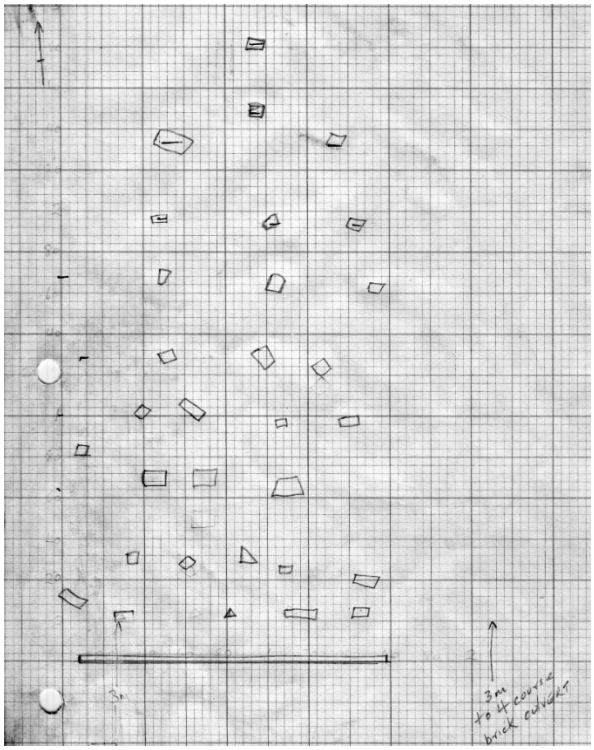


Figure 9. The posts 033. Note that north is at the top of this drawing, the reverse of figure 8.

Figure 10. The north end of culvert 031 with the wooden stakes 033. The drawings suggest that the trench was subsequently enlarged, exposing more stakes.

Figure 11. Detail of the north end of culvert 031 with stakes 033.

A culvert (041) joined the west side of 031 towards the north end. It came from the direction of the house. The junction with culvert 031 was of brick. Upstream it was brick-floored, with chalk side walls. The floor then became clay, and an iron pipe discharged into the end. The context sheet says that it was the outlet of a water overflow conduit running from house basement under the lawn, but the source of this information is not given.

The structure was filled with black earth.

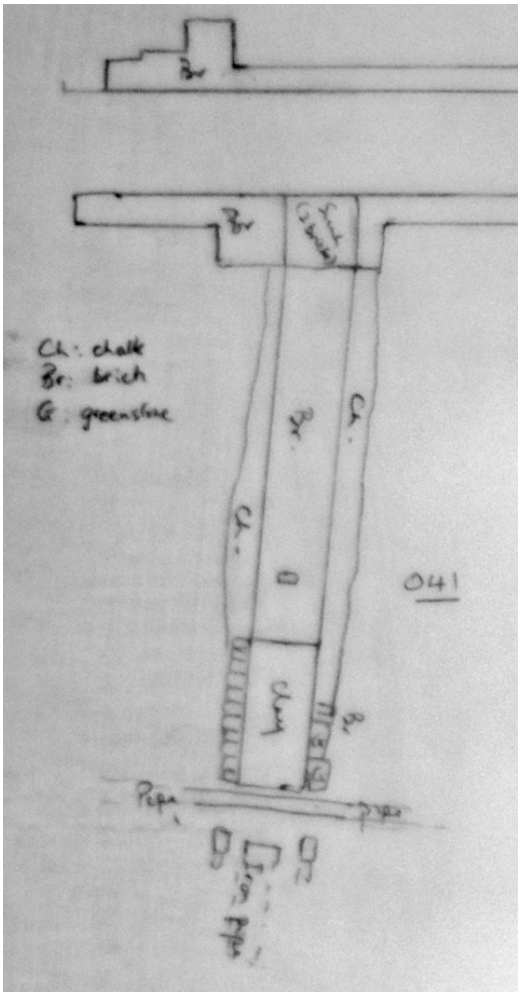
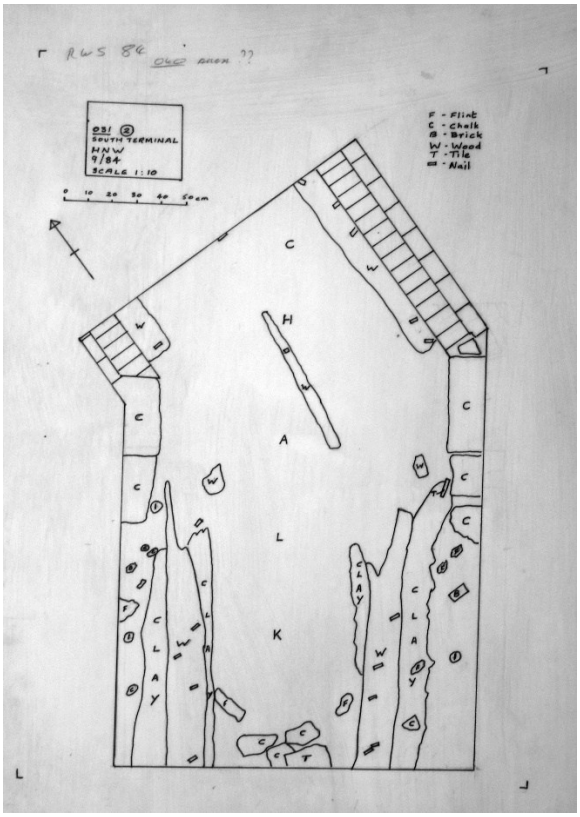


Figure 12. Detail of figure 5 showing culvert 041. North to the left. Culvert 031 at the top.

Figure 13. Channel 041 with the edge of 031 in the foreground. Looking west.

Two channels flowed into the south end of 031. One (040) came from the direction of the spring head. It joined 031 at an angle. Only a short length was excavated but it seems to have been similar to 031 with brick side walls and a wooden floor with clay puddling. The other channel (037) is described in the southern area.



Figures 14 and 15. Channel 040 looking south from the end of 031 and in plan with north at the top.

2.2 The southern area

The main features in the southern area were a culvert (037) which ran from a brick structure (035) more or less west to the south end of culvert 031 (figure 3). There were the chalk foundations of a rectangular structure numbered 039 on the south side of culvert 037. A section (046) was cut through both culvert and foundation.

Culvert 037 had a floor of bricks set on edge, and chalk side walls. It was 0.6m wide. The excavator noticed mortar on the floor of the culvert, and in two places there was a second layer of brick. Hugh Waterghouse suggested that the second layer of brick had originally covered the whole of the culvert floor. However, the surviving bits of the second course are small and do not look convincingly *in situ*, while the mortar could be limescale deposited on the culvert floor.

Both floor and culvert rested on sandy gravel.

The culvert was filled with black earth and flints.

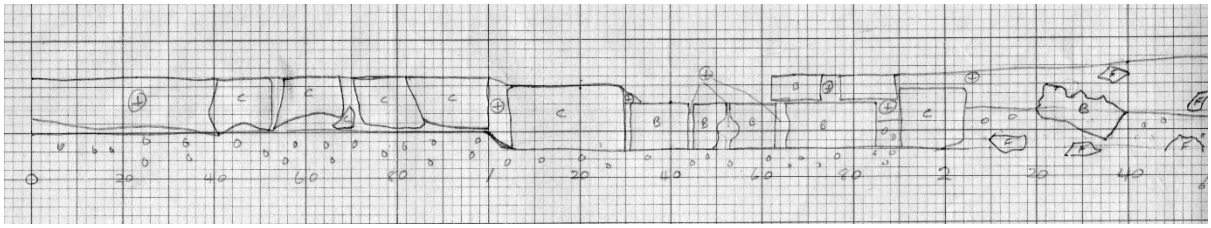


Figure 16. The west side of trench 046 which cut through the floor of 039 to the left, and then the south chalk block wall of culvert 037, its brick floor and chalk block north wall. Drawn at 1:10 on 2mm graph paper.

Figure 17. Culvert 037 looking east. Note that the south side wall is straight while the north is irregular.

Figure 18. The junction of culvert 037 (foreground) with 031 (background).

For much of its length the south wall of culvert 037 butted up against the chalk foundation of a rectangular structure (039). When exposed in 1984 it was in a very fragmentary state, but two photos taken by Dr Peatling in the early 1920s show that the structure originally extended westwards to culvert 040. It had an external width of 5m. The Film Plan (figure 2) shows it extending south beyond culvert 035 to end against another unnumbered culvert aligned southwest to northeast. The structure was about 23m long. The greater part of the interior was unexcavated so there may have been undetected cross walls dividing it into smaller units. The section 046 (figure 16) shows that it had a floor of large chalk blocks.

When excavated it was covered with black earth with flints and brick rubble.

The Film Plan shows two sections of culvert which ran along the east wall of 039. They were about 0.7m wide and appear to have had brick sides. A plan (figure 19) appears to show some timber at the southeast corner of structure 039 but its nature and purpose is unclear.

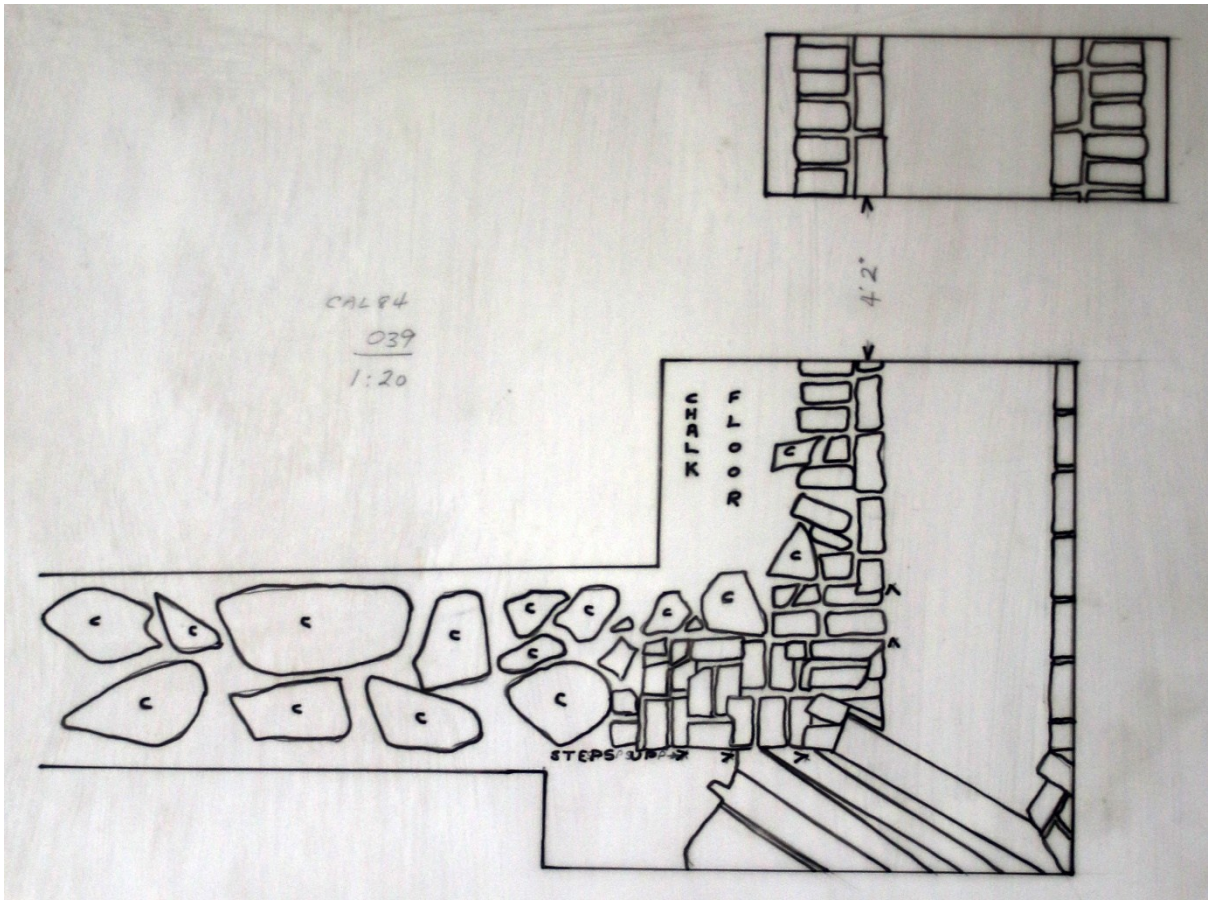


Figure 19. The southeast corner of 039 showing the culvert running across the end wall.

Figure 20. The southern part of 039 with the brick floor of culvert 037 to the right.

Figure 21. Photo taken by Dr Peatling in the early 20th century. Looking east. Culvert 031 is visible on the left with culvert 037 running eastwards from the end of it. The chalk foundation 039 can be seen to the right of it extending from the end of 040 which continues the line of 031.

Figure 22. Another view by Dr Peatling looking north along culvert 031 with foundation 039 to the right.

The eastern end of culvert 037 turned away from foundation 039 and connected to a short brick, walled culvert 035 which it joined at an angle. The plan of this (figure 23) suggests that it had brick sides probably with a wood floor over clay. It had a length of about 2.4m and width of 0.92m. The context sheet says the walls were constructed on chalk blocks. It ended against a brick wall.

There are two section drawings of a pit or channel which are labelled 035. One is described as 'North facing section through the south edge of the feature' and the other as 'South facing section through the centre of the feature' (figures 24 and 25). The show an irregular pit or channel dug into the natural chalk and overlying deposits. The fill is chalk with some flint and brick in a matrix described on one drawing as "chalky rubble with sand or mortar" and on the other as "sandy loam with chalk and brick and some (?) mortar". The pits do not appear on the plan (figure 23) but were presumably in the bed of the channel. The section drawings might be consistent with the pit being an artifact of the excavation. It may be significant that a note on the context sheets says that feature was partly excavated by unauthorised persons whose results are not available.

The following contexts were recorded:

[1]	Black earth with brick and tile rubble. Some finds.
[2]	No context sheet.
[3]	Gravel with a few brick fragments. No finds listed.
[4]	Large chalk blocks and degraded chalk with broken brick. Infill of pit dug into natural chalk.

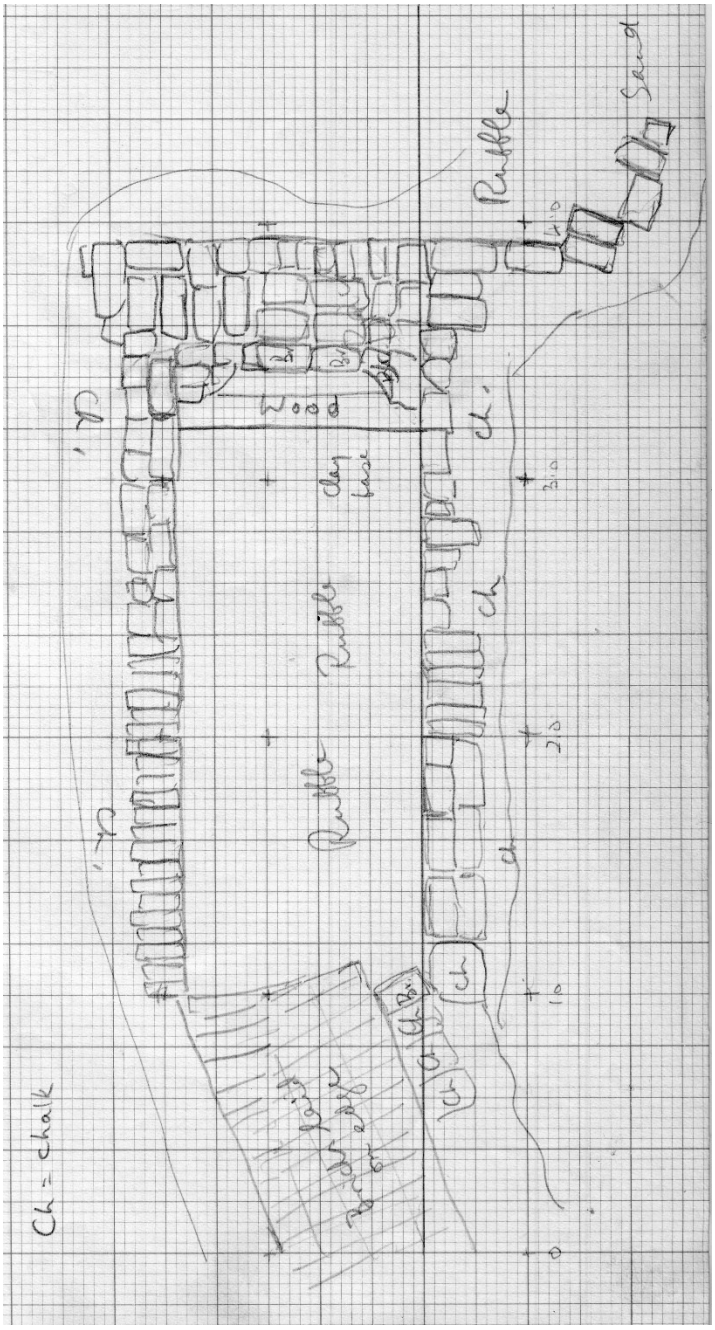


Figure 23. Plan of culvert 035 drawn at 1:20 on 2mm graph paper. North is to the left.

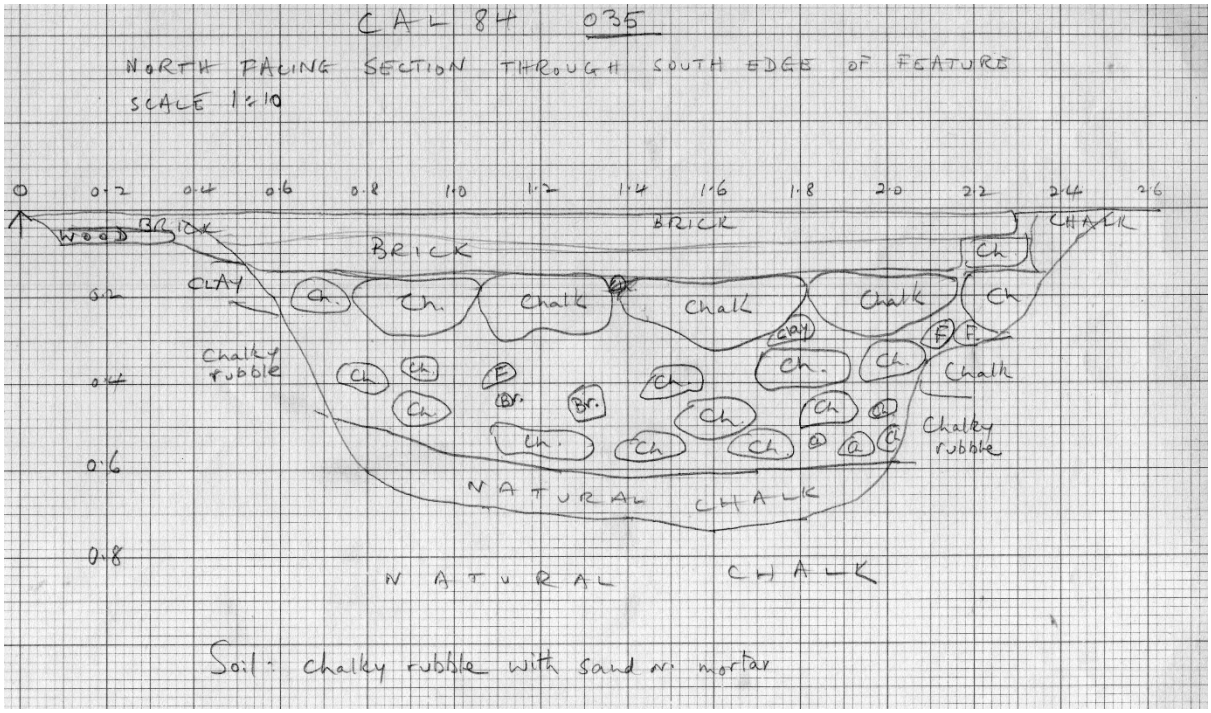


Figure 24. North facing section through south edge of culvert 035. Drawn at 1:10 on 2mm graph paper.

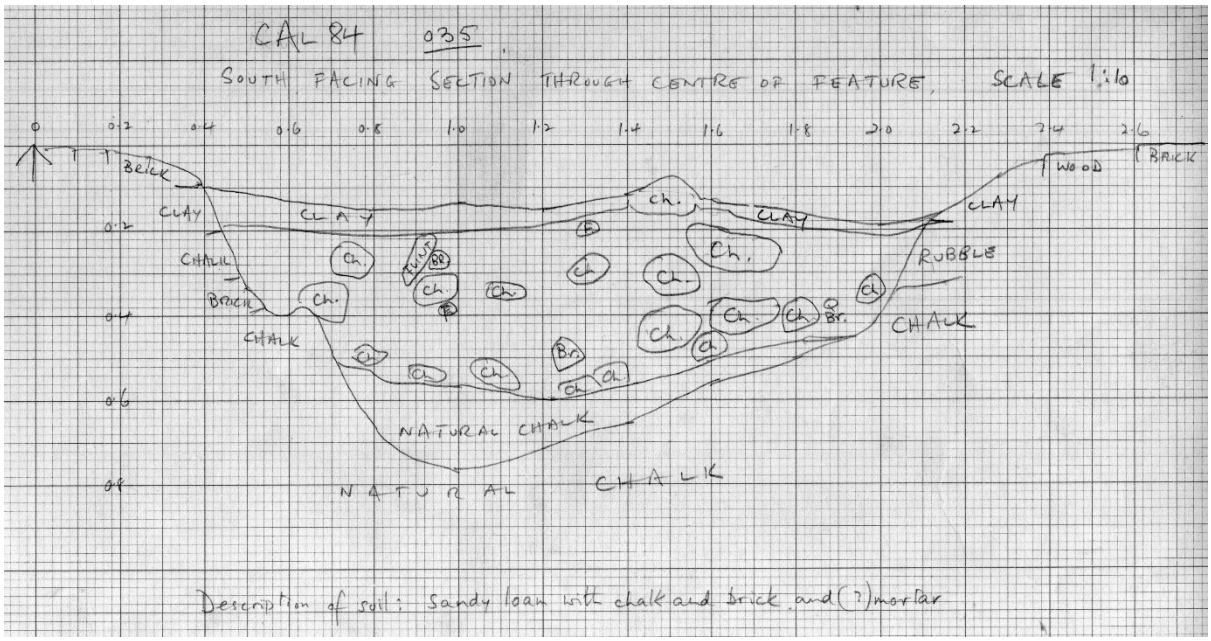


Figure 25. South facing section through centre of culvert 035. Drawn at 1:10 on 2mm graph paper. Ch = chalk, Br = brick, F = flint.

2.3 The northern area

The main feature in the northern area was a rectangular chalk foundation 036. This had an external width of 6.65m and a length of over 9m. The position of the west wall is uncertain and the east end was not excavated.

The foundations were sectioned by trench 044 (figures 28 and 29). This showed that the floor consisted of crushed chalk resting on sandy gravel. There was a cut in the gravel which

contained a timber beam, which ran parallel to the south wall about 0.7m from it. The beam supported a plank which rose from its south edge and was supported by posts at about half-metre intervals. The cut was filled with the crushed chalk that formed the floor. The chalk floor thinned to the north and graduated into the sandy gravel that it rested on. The photo (figure 30) suggests that the floor between the plank and the south wall was slightly lower than that to the north.

There were four posts, probably of split roundwood, in a line a little south of the centreline of the structure.

At the southwest corner of the building there was a timber structure (043). This consisted of a framework within it, and over the foundations, and a timber floor outside and adjacent to it. The floor was about 1.4m north-south by 1.6m east-west and consisted of east-west aligned boards secured by three lines of nails suggesting that it rested on three beams. The framework may originally have been similar but there is not enough remaining be certain.

The following contexts were recorded:

[1]	Black earth, generally fine at the top but larger flints and chalk nodules towards the base. Some finds.
[2]	Puddling clay around and discontinuously above wooden feature. Note says: It is possible that this layer was deposited at two separate times: when the wood was placed and later.
[3]	Sandy gravel with brick fragments, tile and chalk to the south and east of the wood. In places it laps over the wood and clay.
[4]	No context sheet.
[5]	Platform of wooden planks, identified as softwood but excellently preserved, with three supporting timbers beneath, nailed from the upper face. Set in [2]. The only finds listed were iron nails.

There was a second wooden structure in the eastern end of the building but there are no details other than the plans (figures 26 and 27).

Feature 045 is described as a depression in rubble area at the east end of 036. It was filled with black earth which contained broken brick, flints and chalk. At the base was an east-west aligned wooden beam set in clay. The location of this is not clear. The coordinates of the pipe bowl do not fit with the pit to the north of the timberwork on figure 27. There was only one context:

[1]	Black earth with broken brick, flints and chalk. At the east end chalk nodules rise up and it is near this point that a pipe bowl was found 10cm below the rubble top. It was provisionally dated 1660-1680.[1] The layer also contained slate and a pipe stem possibly 19th century.

[1] Find <1>. The context sheet says the find spot was 37.05N 23.67E adjacent to chalk blocks at E of feature above beam. However, the position of the grid is unclear.

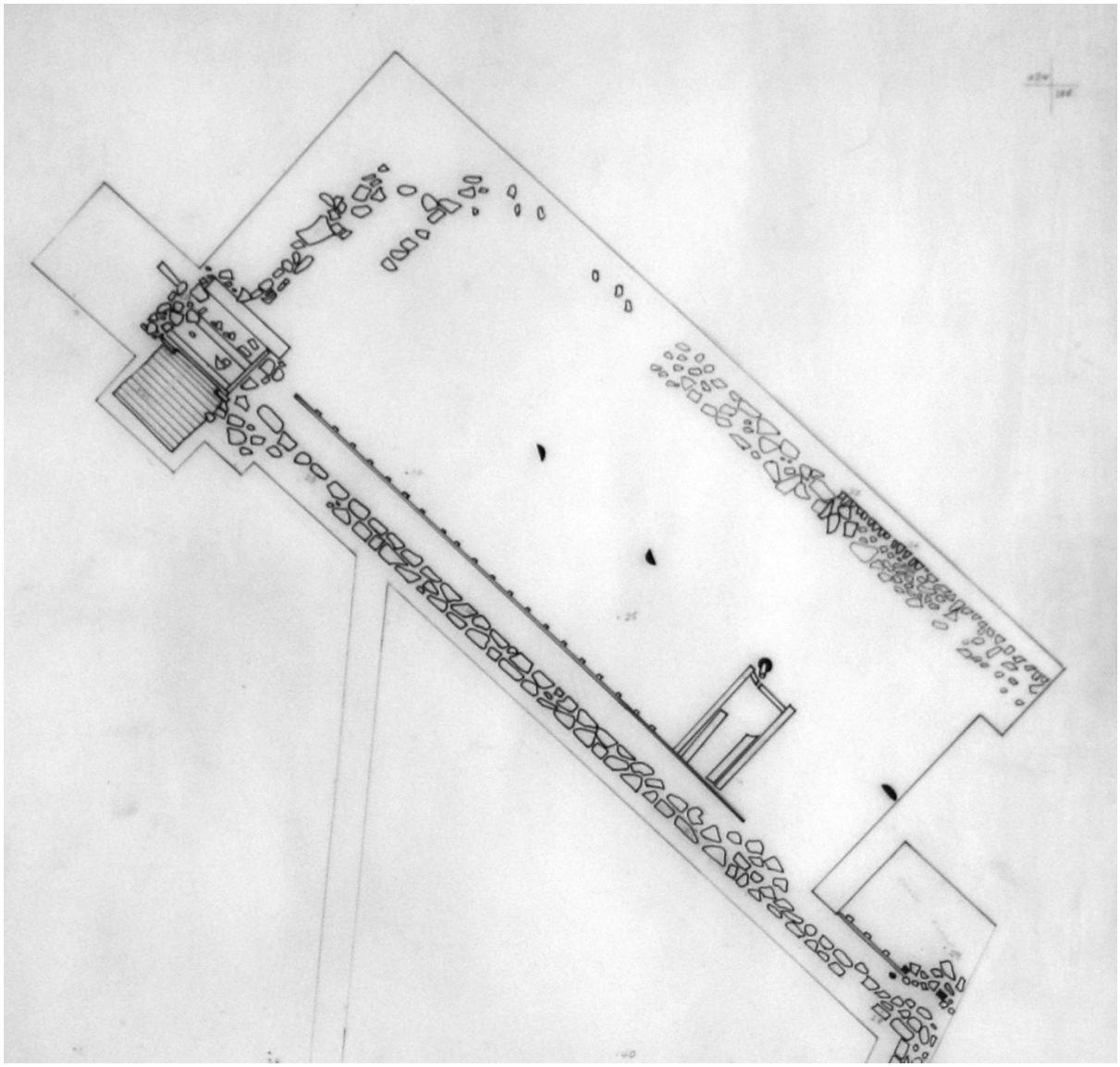


Figure 26. Detail from the Film Plan showing foundation 036 with the wooden floor at the southwest corner.

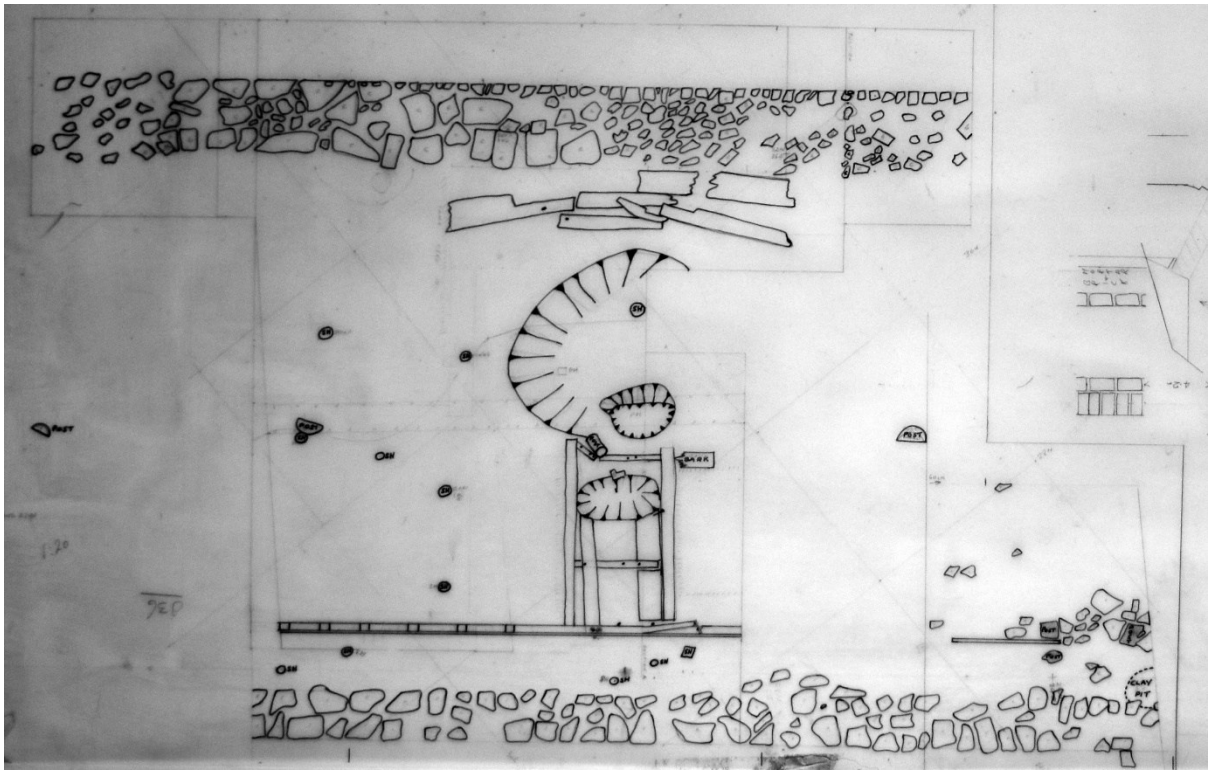


Figure 27. The eastern end of 036.

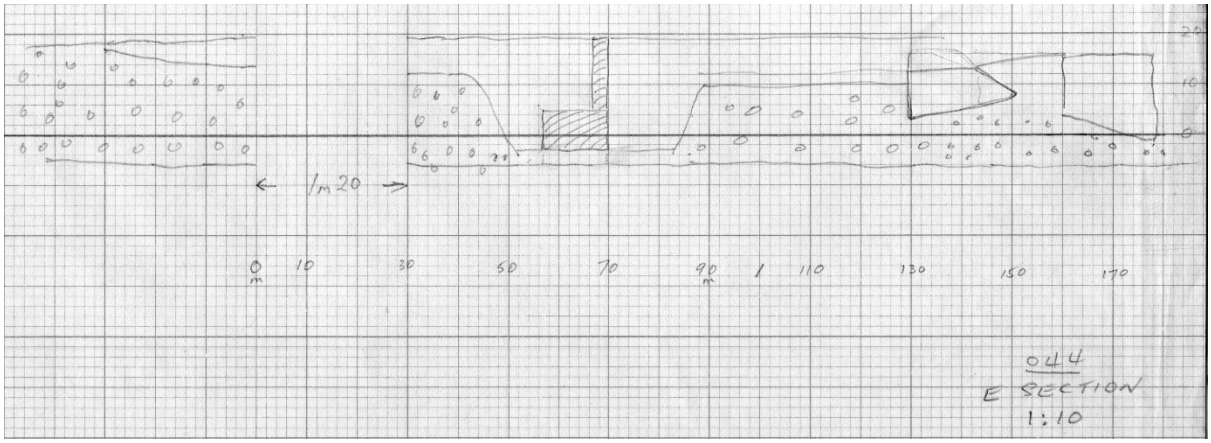


Figure 28. The east side of trench 044 which cut through the foundation of 036. Drawn at 1:10 on 2mm graph paper.

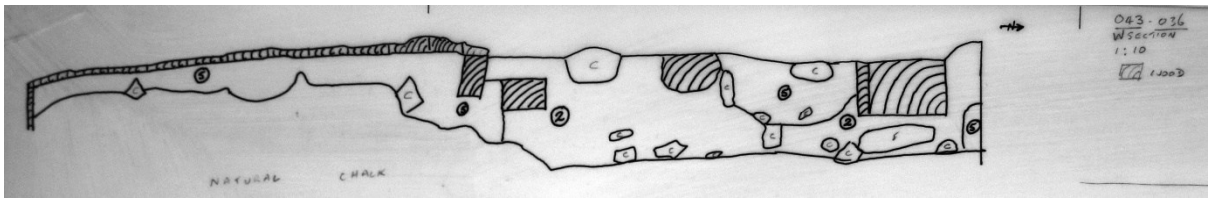


Figure 29. The west side of trench 044 which cut through the foundations of 036.

Figure 30. Feature 036 looking southeast.

2.4 The eastern area

The film plan (figure 2) shows two parallel walls in the eastern area forming a structure with an external width of 3.5m. The length of the western side was 11m. The east side was only partly excavated as the foundation passed into the bank forming the edge of the present lake. The eastern side was numbered 042. I have not found a context number for the western one.

2.5 The trenches in the lakebed

Trench 029

This was also described as trench A. It was 1m wide and about 10.8m long and was dug across the head of the lake as shown on figure 1. It contained three layers:

[1]	Black silt or earth with flints and chalk. No clay present. 8-10cm deep. The finds included modern material.
[2]	Chalk rubble with flint, broken brick and tile. Average depth 20cm.
[3]	Natural chalk.

Trench 030

Also described as trench B. A sketch plan on the back of the context sheet shows that it was rectangular, aligned approximately north-south with the southern edge 9m north of the centre of the present causeway. Section showed black earth, chalk, black earth and gravel.

2.6 The function of the features

These structures clearly predate the construction of the present lake in the mid-18th century. Some such as 031, 037, 040 and 041 are clearly part of a network of water channels. The same appears to be true of 035 and the structure across the east end of foundation 039. The chalk foundations can be seen as forming a somewhat irregular three-sided courtyard. The idea that the foundations supported buildings is, however, questionable. The foundations are fairly narrow. They might be the underpinning for a timber frame but why have watercourses adjacent to them? It would surely lead to serious damp problems. It seems more likely that the walls were the foundations of fishponds to which the channels were feeders and drains. When Edward Carleton went bankrupt in 1713 his estate included 'one wilderness and five fishponds containing by estimation four acres'.[2]

The culvert 031 has brick sides and wooden floor packed with clay and the same construction may have been used in 040 which probably connected the south end of it to the springhead. This method was also used in

- 035 – a short section at the east end of brick floored culvert 037.
- 043 – the timber floored area at the west end of foundation 036 on the north side of the site.

It is possible that both of these were the floors of spillways but not enough remained to be certain.

Some fragments of timber in the culvert at the east end of foundation 039 may also suggest a wooden floor but the evidence is too thin to be certain.

This type of timber-floored culvert was also used for the headrace of the water wheel in the water tower.[3] This structure was created for Sir John Fellowes in 1716-20 and was at the eastern end of a canal or lake which ran from it towards the house.[4] Andrew Skelton has suggested that the timber floor culverts 031 and 040 carried water from the spring head to the canal or lake. This seems very likely, and the other timber-floored culverts may well be modifications or repairs made for Fellowes.

The other parts of the structures are different. Culvert 037 had a brick floor with chalk side walls while the three sets of foundations 036, 039 and 042 have chalk walls. The floor of 036 appears to have been of rammed chalk while that in 039 was chalk blocks which suggests that they may be of different dates. The thin chalk walls and rammed chalk or chalk block floors would be consistent with fishponds. Chalk blocks were used on the floor of a small pond in the northwest corner of the garden at Honeywood. The date of this is uncertain but it may be 18th century.[5] They were also used to floor a medieval fishpond at Merton Abbey.[6]

[2] Skelton 2017 p. 11.
[3] Skelton 2009 p. 14-18 especially p. 17-18.
[4] Skelton 2017 p. 22-36.
[5] Phillips 2015 section 2 and p. 66.
[6] Miller and Saxby 2007 p 63 and 113-5.

3 THE CONTEXT

3.1 The springhead

If the structures were fishponds how did they fit into the springhead? Three dry valley networks run down to Carshalton (figure 31). The westernmost, and by far the largest, runs from The Oaks along the western side of Carshalton House grounds to the vicinity of the Shorts Road railway bridge. The second is a single shallow valley which runs from the vicinity of the former Queen Mary's Hospital down to the spring head at Carshalton House Lake. The third and east-most starts as two valleys which merge and then descend to the grotto spring head in Carshalton Park. In the past the springs at the last two of these flowed more or less permanently and were the source of the Carshalton Wandle. The largest valley coming from The Oaks is not known to have fed a permanent spring. I have not heard of a bourne in it although it is possible that one used to emerge at Spring Field in the valley bottom near the north end of Oaks Park.

The shallow valley running down to the Carshalton House spring more or less follows the line of Carshalton Park Road. It crosses Beynon Road which is raised on a low embankment. At this point the valley bottom is around 43.6m OD. The line then runs a little east of the Carshalton House gates. The valley is not visible in Pound Street probably because it has been realigned and regraded to provide an imposing entrance to the house.

In 1987 Andrew Skelton excavated a trench against the north side of the Pound Street wall on or close to the line of the valley bottom.[7] The trench was excavated from 43.57m OD and the bottom was at about 41m OD. The bottom of the wall foundation was not reached and it likely, but not certain, that the trench bottom was still in made ground. If it was made ground the valley floor would have dropped about 2.5m in the 120m from south side of Beynon Road or about 1:48 which is not hugely different from the gradient of up-valley between the 50 and 55m contours.

The lakebed at the excavated structures is at about 36.4m OD, a drop of about 4.6m over a distance of 120m giving a gradient of about 1:26. This dramatic steepening is unlikely to be natural and suggests that the lake and spring head are in a significant excavation. The Arundel map shows that, in 1620, the spring head was much closer to Pound Street (figure 32). If the spring head was at about the present lake level it would have been in a substantial excavation. The rising ground would have meant that the west side of it had a depth of around 7m.[8] There seems little point in making the huge excavation implied by the lake width on the Arundel Map so the springhead may have been in an old chalk pit. The other possibility is that the springhead had been deliberately widened to tap multiple fractures in the chalk. The rock has a fine grain which soaks up water but prevents rapid movement. Most of the flow in chalk is through fractures which are frequently associated with valleys.[9] It seems likely that The Oaks dry valley has a far more extensive fracture network than the small valley coming down to the springhead. There could be fractures in the chalk which run to the springhead from the bottom of the dry valley near Shorts Road. However, there is no direct evidence for them, and it seems unlikely that people in the past would be aware of their existence. If water is flowing

[7] Skelton 1995 p. 10-16.
[8] Derived from the contour map in Skelton 2017 p. 6.
[9] Edmunds et al, 1992 p. 22.

that way, it is more likely to be the accidental result of the creation of a chalk pit than deliberate design.

Figure 31. Lidar scan showing the dry valleys to the south of Carshalton. Vertical exaggeration 10x.

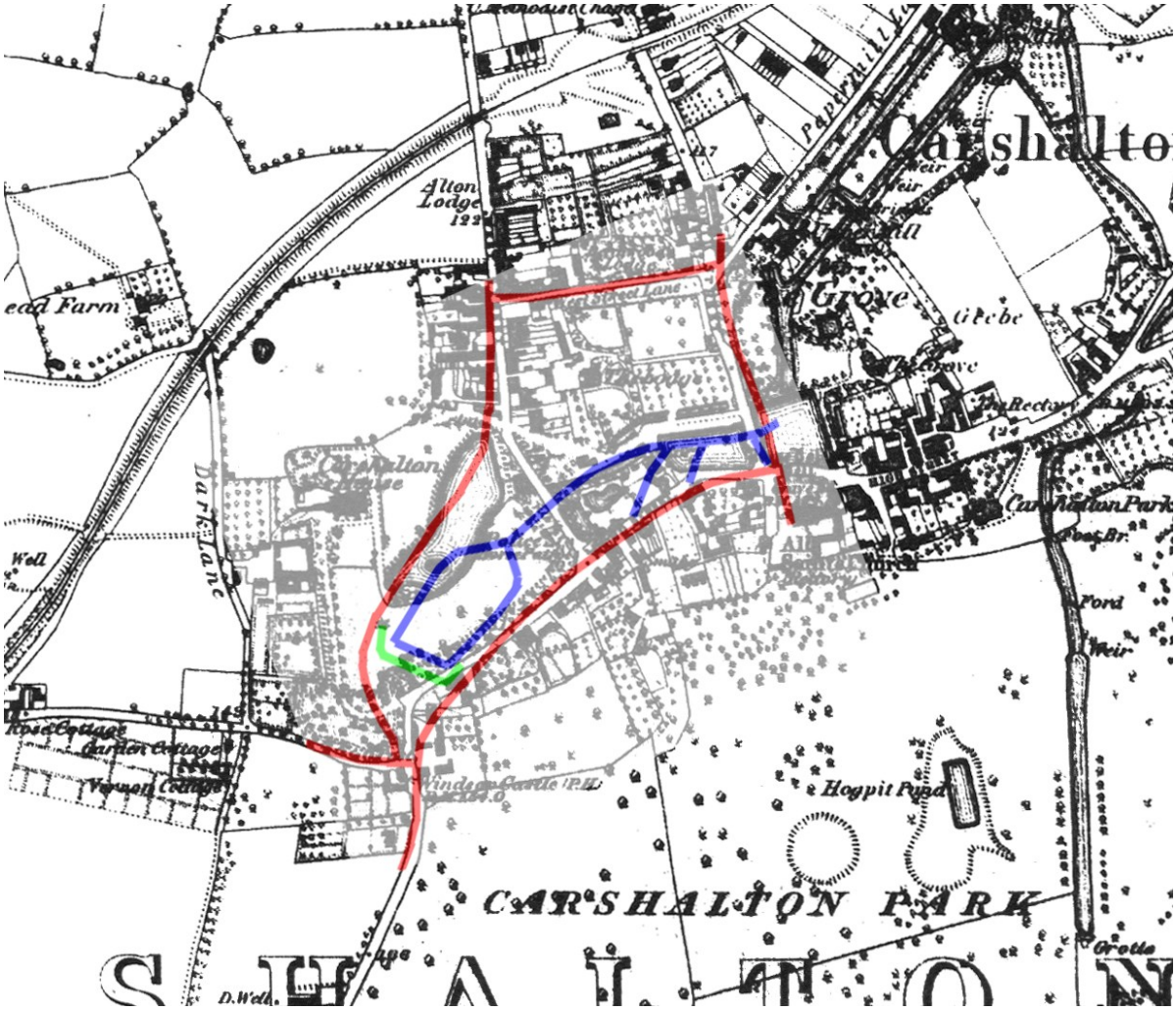


Figure 32. The outline of the springhead lake, watercourses and roads from the Arundel map on the first 6in OS map.

3.2 Downstream

The key feature on the downstream side of the site is the Water Tower which was built for Sir John Fellowes about 1716-20. It contained a water wheel which drove pumps to lift water into a large cistern in the tower. The tower was originally at the end of a canal which ran between it and the house and probably served as an ornament, a fishpond and a mill pond. The canal was replaced by the present informal lake in the second half of the 18th century.[10]

The waterwheel in the Tower is breast-shot with a cast iron frame and metal buckets. The upstream end of the wheel pit is brick with a straight bonding break between it and the side walls. It has a height of 1.14m and is curved to fit the wheel. The use of breast-shot wheels in close fitting pits was popularised by John Smeaton in the mid-18th century. The arrangement would be unusual in the 1720s and the cast iron wheel is certainly later – probably 19th century.

A section drawing through the mill race and wheel (figure 33) shows that the back of the wheel pit rises from the floor of the headrace. This and the bonding breaks between it and

[10] Skelton 2017 p. 75 and following.

the side walls suggest that it is an insertion probably made for the iron wheel. The original wheel is likely to have been undershot.

The headrace to the waterwheel was investigated when it was repaired in 1992. The headrace culvert consisted of a brick arched culvert originally with a clay-packed wooden floor at about 35m OD.[11] This is likely to have been at or close to the height of the bed of the early 18th century ornamental canal. It was covered by 0.34m of later silt.

At the beginning of the 19th century the tail water from the wheel flowed into a long ford which covered West Street from the Water Tower almost to Pound Street. This is clearly shown in two paintings by Gideon Yates one of which is dated 1825 (figures 34 and 35). The pond was fed by two culverts running from the Water Tower. These were presumably the tail race and the bypass channel around the wheel which still exists beneath the building.

A map of 1832 shows the ford reduced to a short water splash close to the junction with Pound Street (figure 36). It is not clear whether this was the normal state at that date, or that the map was made at a time of low water. It suggests that there may have been a culvert flowing from Carshalton House grounds close to Pound Street. This might be the predecessor of the spring fed drain which still runs into the southwest corner of Margaret's Pool. The ford was finally removed in 1844 reducing the pond to the form shown on the tithe award map of 1847.[12]

Today the water level in the tail race is set by a low weir at the west end of the Festival Walk channel. The top of this is at about 35.04m OD, close to the height of the original floor of the headrace. The water level in the Festival Walk channel is maintained by a weir at the east end. If these two weirs did not exist there would be a significant drop along Festival Walk which would probably largely drain a ford in West Street. Festival Walk was part of the grounds of the Old Rectory and the western weir may have been created to keep the channel full and make the garden more attractive. The cellars of the Old Rectory are prone to ground water flooding which would be less likely if the Festival Walk channel was lower. It probably was in the early 18th century leaving a better fall away from the water wheel.

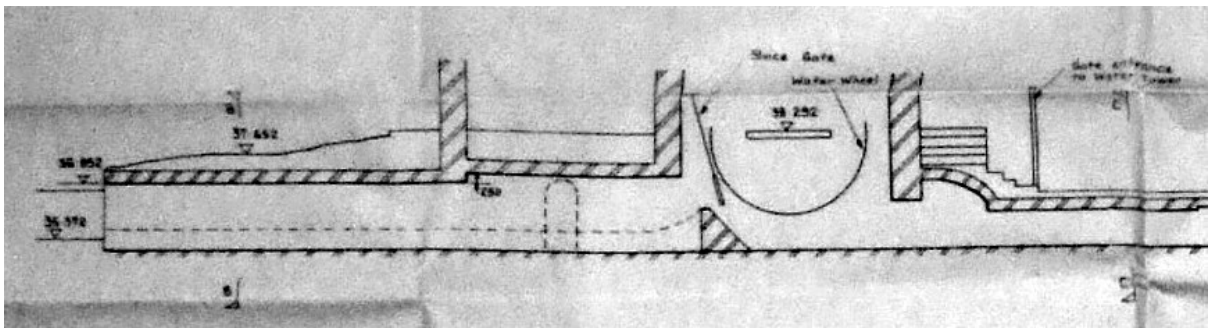


Figure 33. Section along the Water Tower wheel pit and culverts. From a plan by the London Borough of Sutton.[13]

[11] Skelton 2009 p. 12-18.
[12] Brightling 1872 p. 46
[13] From a photograph of the plan on my computer. I don't know the source.

Figure 34. Gideon Yates. North view of the Waterhouse, Carshalton, Surrey. Sutton Museum and Heritage Services CA.059.

Figure 35. Gideon Yates. Carshalton, "N W. view of the Waterhouse". The view looks northwest. Sutton Museum and Heritage Service CA.088.

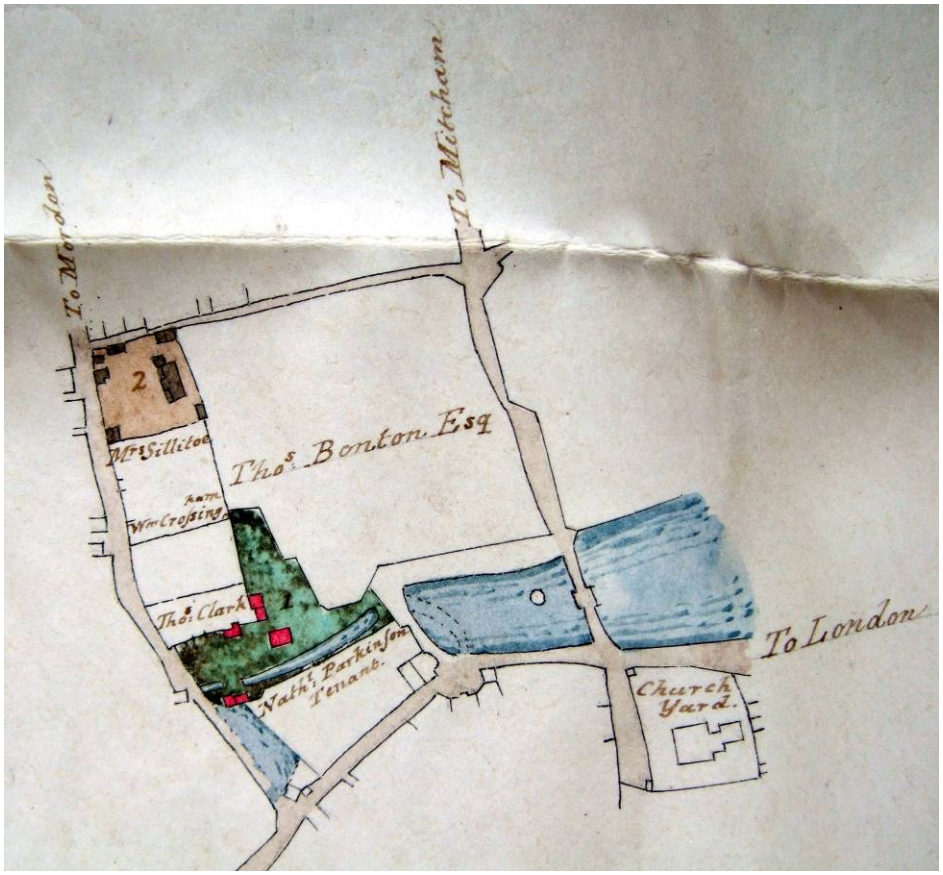


Figure 36. Enhanced detail from a plan made for a faculty relating to an exchange of land involving the rector, 1832.[14]

3.3 Chalk and gravel

The present springhead is dug into the chalk and would have to be below the water table to function. However, channel 031, which appears to have connected the springhead to the Fellows lake, had a wood and clay floor presumably for waterproofing. This suggests that it was expected to be above the water table at least intermittently.

The British Geological Survey map shows the edge of the chalk a little south of the causeway across the lake. The lakebed to the north of this is marked as Lambeth Group (formerly called Woolwich and Reading Beds) with gravel around it. The Festival Walk Channel runs across gravel which was seen to be at least 0.5m deep when the sides were repaired in 1995. Water can rise in the channel so the bed is clearly open to the water table. The bed of Carshalton House Lake is no lower and it seems likely the north end of this rests at least partly on gravel. If so it would have need to be lined with either clay or rammed chalk to keep it full in dry weather.

3.4 The Arundel springhead and the present one

The 19th century water level in the Carshalton House Lake seems to have been at about 37.3m OD.[15] The trench excavated against the estate wall on the line of the dry valley bottom

[14] London Métropolitain Archives DW/OP/1832/002.

[15] The floor of the Hermitage is at 37.88m OD according to Sketon 2007 p. 37. The photo of the Hermitage in

reached about 41m OD and was probably still in made ground.[16] This was 3.7m above the estimated water level in the 19th century lake. The present springhead appears to be just beyond the north end of the one shown on the Arundel Map (figure 32). It is not clear why it was moved. It may have been to facilitate the construction of the Hermitage in a position set by the design of the wider landscape, or it might have been to improve the water supply. The water would have flowed into the springhead through various cracks some of which may have been larger and more productive than others.

If the Arundel springhead was an old chalk pit it would need a huge volume of material to fill it, and the obvious source would be the excavation of the early 18th century lake. This may suggest that the Hermitage was made for Fellowes.

The present lake is probably higher than early 18th century one as the water covers the CAL84 structures.

It seems likely that the early 18th century garden had a springhead pond by the Hermitage and the water then flowed from that through culverts 040 and 031 to the main lake between the house and Water Tower, as suggested in Skelton 2017. This would mean that the level of the main lake was somewhat lower than the spring head. This is entirely consistent with the height of the headrace in the Water Tower. The construction of the informal lake would then involve raising the whole water level to that of the springhead pond. A good deal of additional excavation would be necessary but not as much as keeping the level at the height of the 18th century canal. The additional spoil from the informal lake was presumably dumped at the south end of the garden deepening the early 18th century deposits.

If the ponds and culverts in the lakebed were of more than one period as the different construction methods suggest, then they were probably created for Carleton or one of his predecessors and modified by Fellowes. If the argument about the earth movement is correct the Carleton ponds were fed from the Arundel springhead and were probably ancillary to the larger pond there. After Fellowes's changes they would have been fed from the exiting springhead and would have been ancillary to that and the new lake. This could be partly checked by levelling the CAL84 features to the existing spring head. Unfortunately, the existing levelling is too problematic to be certain.

The fish in small ponds were easily poached and a location by a road would be undesirable although not without precedent. The ponds would be safer if West Street had been diverted from the line shown on the Arundel map.

3.5 The edge of the formal lake

The eastern end of culvert 031 could have been on the edge of the formal lake but there was no obvious sign of the lake edge. I would expect a wall or timber revetment at the splash line to prevent the erosion of the bank. The edge cannot have been further south as it would cut the culvert from the house (041). The function of the posts (033) is unclear. They seem to have been deeply embedded in what is presumably a rammed chalk floor. This looks fairly solid and it seems unlikely that the posts would be needed to stabilise any overlying structure.

the 1920s reproduced in Skelton 2017 suggests a water level about 0.5m below this.

[16] See section 3.1 above.

Could the stakes have supported a barrier which prevented large predatory fish such as pike entering the culvert and going to the spring head pond which may have held young fish? The number of posts seems excessive for this purpose.

3.6 The waterflow and the waterwheel

If the original water wheel in the Tower was undershot it would extract a lot less power than the existing breast-shot one – perhaps 20% as opposed to 60%. This would mean that three times the amount of water would be needed to pump a given volume. The lake – both formal and informal – would act as a mill pond which could be drawn down in operation. A great deal would depend on the size of the flow from the springs for which we have no reliable data.

3.7 Two pond systems or one?

In the early 1620s the Countess of Arundel made a fishpond in Carshalton which is probably the predecessor of the present Upper Pond in front of Honeywood. Her son Thomas and his son Henry continued to work on the site into the 1640s.[17] It is possible that Margaret's Pool and the rectangular pond in the northwest corner of Honeywood's garden were remnants of this system. Did the Arundel work extend upstream to the spring head and incorporate the ponds in the lake bed? They key evidence against this is that in 1691 the Carshalton Court Rolls assert that the pond abutting spring belonged to Old Farm. There is no evidence that Arundel ever owned this. It is therefore likely that there were two sets of fishponds: one at the springhead belonging to Old Farm and another downstream belonging to Arundel.

4 APPENDIX: OTHER CAL84 FEATURES

Feature 032

This was the "archway at north end of lake" now generally known as the Folly Bridge. The context sheet records the find of large pieces of glazed brick alternating with large flints which form the facing of the arch. There are no other details.

Feature 034

Described as 'surface finds'.

Feature 038

North lake sluice entrance to the Waterhouse. Context sheet says that the culvert appears to have been constructed in the same manner as 031 with sleeper beams half under the inner side of the brickwork and with similar large nails.

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