CIRCULAR SILAGE SILO, WEST SHAW FARM, SLEDDALE, NEAR HAWES, NORTH YORKSHIRE

ARCHAEOLOGICAL SURVEY

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1 INTRODUCTION

Reasons and Circumstances of the Project

1.1 In July 2015, Ed Dennison Archaeological Services Ltd (EDAS) were asked by Mr Robert White, Senior Historic Environment Officer of the Yorkshire Dales National Park Authority (YDNPA), to undertake an archaeological survey of a circular structure believed to be an early silage silo at West Shaw Farm, Sleddale, near Hawes, North Yorkshire (NGR SD 86398 87949). The structure is not Listed as being a Building of Special Historic or Architectural Interest, nor does it lie within the boundary of a Scheduled Monument, but it is noted on the YDNPA Historic Environment Record (MYD 60971).

1.2 The archaeological survey was required to enhance the YDNPA Historic Environment Record, and as a piece of research by EDAS. The extent of the project was defined by discussions between Mr Robert White of the YDNPA and EDAS.

Site Location and Description

1.3 The silo is located at West Shaw Farm, Sleddale, near Hawes, some 1.50km to the south-west of the hamlet of Gayle, at an elevation of c.318m AOD (see figure 1). At the time of the EDAS survey, the farm was owned by Chapman Brothers, who were in the process of selling up.

1.4 The West Shaw farm buildings are set either side of the unclassified Beggarman's Road which runs south from Gayle along the eastern slope of Sleddale, eventually crossing the watershed and descending into Langstrothdale. The circular silo stands within the main group of farm buildings, which includes the farm house, on the west side of the road, at the south end of the yard, adjacent to the gateway opening into the hay meadow to the south (see figure 2). The silo lies entirely on private land; it is visible from the adjacent road, although it is not a prominent structure. It was roofless at the time of the survey, and in variable structural condition, with some parts demonstrating substantial movement. A small number of bales of silage were stored adjacent to the west side of the structure.

2 SURVEY METHODOLOGY

2.1 The extent of the project was defined by discussions between Mr Robert White of the YDNPA and EDAS. The structure was visited and surveyed on 3rd July 2015.

2.2 A ground floor plan, a cross-section and two external elevations were produced at a scale of 1:20, with all measurements being taken using traditional hand-held recording equipment. The resulting drawings show all significant detail such as openings (blocked or unblocked), fittings, joist sockets etc. The drawing was produced according to the guidelines established by English Heritage (now Historic England) (2006, 8-10 & 19-21). Sufficient notes were also taken in the field to prepare a detailed written description.

2.3 The drawn record was supplemented by a colour digital photographic record, using a camera with 10 mega-pixel resolution. English Heritage photographic guidelines were followed (English Heritage 2006, 10-12) and each photograph was provided with a scale where practicable. All photographs were clearly numbered and labelled with the subject, orientation, date taken and photographer's name, and were cross-referenced to digital files etc.

2.4 The results of the site survey work have been used to produce this EDAS archive archaeological survey report, which is illustrated by reduced versions of the survey drawings and a selection of photographic plates. A properly ordered and indexed project archive (paper, magnetic and plastic media) was deposited with the YDNPA at the end of the project (EDAS site code SWF 15).

3 HISTORICAL BACKGROUND

3.1 No original documentary research was undertaken as part of the archaeological survey, and indeed the silo (and similar structures) appear to be very poorly covered by documentary sources in general. The majority of information concerning their use therefore comes from oral testimony, gathered locally in Sleddale, either by Shaun Richardson of EDAS or previously by a Dales Volunteer (Frances Bland). However, some background is provided from secondary sources on the early use and production of silage in England; by far the most comprehensive account is given by Brassley (1996), and the following text draws heavily upon his work.

Early Production and Use of Silage in Britain

3.2 The basic principle of silage making is that cut grass continues to respire, converting sugars into carbon dioxide and water, whilst giving off heat in the process. The actions of the enzymes which enable respiration to occur can be prevented by changing the acidity of the ensiled material by the absence of oxygen. Bacteria present on the crop ferment the sugars it contains into lactic and other acids, which in effect 'pickle' the ensiled material as long as oxygen is excluded; in this way, silage can be preserved for use as a fodder for a very significant period of time. Silage has the advantage of not relying on dry weather for effective production (as hay does) and, since drying is less important, the grass can be cut younger and leafier, with a resulting higher feed content. However, making good silage is no less technically demanding than making good hay (Brassley 1996, 64).

3.3 The impetus for silage making in Britain grew out of a series of wet summers in the later 1870s and 1880s, during which the farming press began to carry stories about a technique called 'ensilage', which promoted winter fodder in the absence of sunshine to make hay. John Wrightson, Professor of Agriculture at the Royal Agricultural College, published a report on the preservation of fodder crops in the Austro-Hungarian empire, and subsequently an article which may have been influential. In 1881, Lord Walsingham persuaded his steward Henry Woods to build a small experimental silo on his home farm at Merton, near Thetford in Norfolk, and there were apparently also successful experiments in Hampshire, Kent and Suffolk. During the 19th century, the trench or pit in which the silage was buried was often called a 'silo' and so the term should not necessarily be taken to mean an above-ground tower-like structure, as it subsequently did (Brassley 1996, 63 & 66-67).

3.4 In the 1884 edition of the Royal Agricultural Society's *Journal*, the editor H M Jenkins published a report on silage (Jenkins 1884). He had begun his report by sending out a questionnaire to 36 farms in Britain, 15 of which were in Cheshire, Yorkshire or further north. Most of those who responded had covered silos in which the ensiled material was compressed by portable weights; the weights used were mainly concrete blocks, bricks, loose earth, wooden logs and iron blocks. Jenkins concluded that it was unnecessary to have excessively thick walls for a silo structure, and that many barns could easily be converted into silos; for new silos,

brick, stone or concrete were the preferred construction materials. There were no great advantages in having the silo below rather than above ground, but there was a decided advantage in having it on a slope, so that it could be filled from the top and emptied from the bottom; it was also better for the silo to be roofed. Chopping of the ensiled material was thought desirable, and treading down was important. Jenkins considered weighting as being necessary, but thought that a foot of soil was as good a cover as any other. Overall, he regarded silage as "a valuable addition to the resources of the English farmer, but not as a complete substitute for the old haymaking process". Lord Walsingham also headed the government's influential 'Ensilage Commission' which reported in May 1886, and the main advantage of silage was still seen as its relative independence of the weather (Brassley 1996, 67-70).

3.5 Interest in silage dwindled from the late 1890s, with some of the structures like wooden silos that had been erected for the purpose falling into disuse or being turned over to other uses (Dunstan 1910, 59; Woodforde 1983, 56). Silage making in the 19th century was heavy work compared to haymaking (which was itself physically demanding), because of the extra weight of moisture in the grass that had to be moved by men and horses, and this remained the case until more widespread mechanisation of the process in the second half of the 20th century (Hanley 1949, 142-144). In addition, the capital requirements of silage mean that many farmers did not or could not afford to build silos (although wooden structures were generally cheaper than stone or brick ones), and so as a process it tended to be adopted on the larger farms first. Finally, making good silage from grass is also a skill, not one that all farmers or their advisors possessed at the time (Brassley 1996, 78-79). Dunstan, writing in 1910, summarised the general attitude by stating that even the most enthusiastic advocate of silage would concede that it cannot be compared with good hay, but when good hay could not be made due to weather conditions, silage as a fodder could be valuable (Dunstan 1910, 58). Although there was a revival of interest in some counties such as Northumberland after the First World War, most farmers remained unenthusiastic (Brassley 1996, 72-74; Brunskill 1999, 142). Some of the silos that were built were atypical, such as a thatched cylindrical stone structure erected in 1927 at the Node Dairy and Stud, at Codicote in Hertfordshire (Fowler 1983, plate 67).

The Second World War and After

3.6 Silage production again came to the fore during the Second World War, one of the slogans employed being "Make Silage, Make Sure" (Woodforde 1983, 58-59). Cheaper silos also became available, the two principal forms being constructed of either concrete slabs or woven wire mesh lined with sisalcraft paper (John Russell 1943, 40; Hanley 1949, 114-115; Brassley 1996, 74). The former were made of pre-cast concrete units and were generally small, usually 10 feet (c.3m) in diameter and between 8 feet to 12 feet (2.44m-3.65m) in height. For every foot of height, a silo of this diameter would hold rather less than 1½ tons of silage, assuming a silage weight of 40lb per cubic foot (Hanley 1949, 114-115). The latter had been introduced in 1938, although according to some farmers they were difficult to fill, they sometimes collapsed, and could only be regarded as a wartime expedient (Brassley 1996, 84). It was also stated at the end of the war that timber silos had been popular with farmers for many years, normally being constructed of wood creosoted under pressure (MAF 1945, 160).

3.7 Towards the end of the Second World War, and in the early post-war period, farming guides and the general agricultural press often include a short section on silos for the storage of silage. The following is typical:

"Silage (which, the layman may require to know, is green fodder cut and stored in compact mass in airtight enclosure) is a valuable winter fodder and is less used in this country than it might be. In favoured districts having light soil, silage may be made in stacks or pits, but the usual provision is a tower or drum silo. The commonest form is the stave fir-timber silo, consisting in effect of a tall, cylindrical barrel, hooped externally with metal binding, covered by a conical roof, and fitted on one side with a chute. The chute is enclosed externally, but communicates with the interior at successive levels by a series of removable shutters by which the stored silage may be reached and delivered via the chute to the mixing floor. There is a delivery door at roof level, by which the fresh-cut silage is blown into the silo, and the interior of the chute contains a cat-ladder by means of which the top level is reached for the extraction of silage. It should be realised that the weight of green silage when consolidated exercises considerable bursting pressure on the silo, for which reason the circular form is most suitable, and stout binding essential.

Both mass and reinforced concrete have also been employed for building silos, and very good silos can be built of these materials. It must not be overlooked, however, that silage is on occasion hot, moist and acid, and there have been occasions when the cement in concrete silos has been attacked and the structure deteriorated. In any event, the construction of tower silos, whether timber or concrete, is work for the specialist." (Gunn 1945, 63-65).

3.8 In terms of siting and location, it was recommended that a silo should be placed so it gave easy access to vehicles, for both bringing in the fresh material and removing the made silage. It was also important that they should be near to where the silage was to be used, and that the site was well drained, to facilitate the drainage of any effluent. In limestone, chalk and other hard soil formations, an unlined pit would suffice as a silo, providing that the site was dry all year round or sharp drainage could be provided for the pit (MAF 1945, 156-160). It was not even necessary to dig a new pit; at Colburn Hall, near Catterick in North Yorkshire for example, the earthwork of a medieval building was re-used as a silage clamp (Richardson & Dennison 2012a, 83-94; Richardson & Dennison 2012b).

3.9 In 1947, the Ministry of Agriculture launched a four year plan which envisage the expansion of silage production from 750,000 tons to 2,000,000 tons annually, and dried grass from 100,000 tons to 500,000 tons, both at the expense of hay output, which it was envisaged would fall from seven to five million tons by 1952. Farmers were encouraged to make silage in pits, and to match the size of their pits to the output of their grassland. This drive was helped by the example of expert farmers such as Rex Paterson, who invented and popularised the use of the buckrake, a more manoeuvrable device that could be mounted on the hydraulic three-point lift of cheaper tractors (Anon 1951, 85-90; Paterson 1951, 177-182; Brassley 1996, 74-75 & 84).

3.10 The 2,000,000 ton target set by the Ministry was met by 1952, but the quality of the silage was not always high. Vacuum silage, where the silage was wrapped in polythene to exclude the air, began to be used in Britain during the early 1960s, and this method was improved upon during the 1970s. Silage production boomed between 1970 and 1980. Hay production peaked at 9,692,000 tons in 1971 (a similar tonnage of silage was made that year) and thereafter fell steadily to less than 4,000,000 tons in 1989 (Brassley 1996, 75-77 & 85).

Silage in North Yorkshire

3.11 Early silage making in North Yorkshire, and indeed more specifically within the Yorkshire Dales, is not well covered in secondary sources. It is probable that there were instances of early usage in the 1870s and 1880s as described above

elsewhere in the country. For example, in July 1875 the farm bailiff on the Earl of Cathcart's farm near Thirsk in North Yorkshire, recorded in his farm diary: "Finished leading Grass to make it into 'pickeled' Hay". Some of the Yorkshire respondents to Jenkins' 1884 survey, already noted above, included a Mr Stocks of Cleckheaton (West Yorkshire) who had developed a small wooden portable silo, capable of holding about 25 tons, in which the top could be screwed down, while a Mr Stobart of Pepper Arden, near Northallerton (North Yorkshire), had a tap at the bottom of each silo by which means the silage juice was drawn off and used for feeding to pigs (Brassley 1996, 67-68). By 1889, there were 178 silos in the West Riding of Yorkshire (out of a total of nearly 3,000 in Britain). However, despite the high numbers, most silos across the country were small - at between 2600 and 2900 cubic feet, they would have held about 45 to 50 tons of silage each (Brassley 1996, 70-71). Local newspapers of the time, for example the *York Herald* on 19th August 1893, publicised the Board of Agriculture's leaflet describing the value of the ensilage process in their various agricultural columns, and the regional press of the early 20th century, particularly the Whitby Gazette, espoused the benefits of using silage to feed cattle and pigs in winter. In 1948, it was reported that "few districts offer greater relative advantages to silage or drier grass over hay than the Dales, where so much depends on the success of converting the surplus summer grass into nutritious winter food", and that some of the methods used in the USA might solve a very real problem in Swaledale (Long & Davis 1948, 89).

3.12 Writing in 1972, Cowley (1972, 32) stated that an early form of silage making, in concrete towers, had been used by one or two farmers in Cleveland, as elsewhere in Yorkshire, before the war, but the practice had not spread because machines had not been invented to handle the grass. The first 'modern' tractors (with features such as hydraulic lift systems) appeared in the Yorkshire Dales in 1946, and balers were introduced from the 1950s but the use of hand implements for haymaking, for example, continued on many farms, particularly in individual hay meadows that were awkward to reach with machinery (Gamble & St Pierre 2010, 33-34 & 51; Barrett & Diment 2010, 30). In 1969, it was stated that "Silage has not made as much progress in the Yorkshire Dales as one might have expected in an area of such high rainfall" (Brassley 1996, 76), although it would be foolish to ascribe this purely to traditional conservatism. The size of the farm and local topography also played a part in the decision to make silage. For example, in the Teign valley in Devon in 1960, the slow take-up of silage making was a logical response to the steep topography, poor access and difficult farm layouts; the advantages of silage were greater for bigger farms (Brassley 1996, 76). One could easily imagine that the same factors were significant within the Yorkshire Dales, particularly in Swaledale and the more remote rugged subsidiary valleys.

The West Shaw Farm Circular Silo

3.13 On the basis of oral evidence, the circular silo forming the subject of this survey report is believed to have been built between 1920 and 1946, by the then owner of West Shaw Farm, a Mr Middleton (Mr Chapman senior, the father of the present owners and now deceased, bought the farm in 1946) (information from Frances Bland, Dales Volunteer). This is supported by the available map evidence. In 1856, West Shaw farm comprised only the farmhouse and attached range on the west side of the road, but by 1896 the range on the east side had been added; it is similarly depicted on the more detailed 25" Ordnance Survey mapping of 1893. By 1912, the range on the east side of the road had been extended to the south, whilst a small enclosure had appeared on the west side of the road, but the silo was still not present (see figure 3).

3.14 The Chapman brothers once tried to use the silo (possibly about 45 years ago) to make silage, but it was not a success, as the silage for about 10 inches (0.25m) around the edges was no good, with only the central parts being usable. The structure has never been roofed, nor has any evidence been uncovered for a drain from the base. This circular clamp is presumed not to have been a success from the outset, as it is thought to have been replaced by a rectangular clamp with a single pitch roof on the east side of Beggarman's Road. Oral evidence suggests that the latter may have been built as early as the 1930s (information from Frances Bland, Dales Volunteer), but was definitely present by 1946. However, map evidence shows that a structure in this position was added to the south end of the east range between 1893 and 1912. In the late 1940s, this clamp had a roof of very thick corrugated iron-sheeting, similar to that used to build Nissan Huts. It was never used for silage by the Chapman family, who converted it into a cart shed. They used to make both hay and small bales of silage (wrapped in black plastic) but latterly have only harvested hay.

4 ARCHITECTURAL DESCRIPTION

Introduction

4.1 A detailed description of the silo is given below, based on the records made in the field. It is described in a logical sequence. The setting and plan form are described first, followed by a description of the structure and its architectural detailing. Reference should also be made to figure 4, and to the photographic record which appears as Appendix 1; photographs are referenced in the following text in italics with square brackets, the numbers before the stroke representing the film number and the number after indicating the shot e.g. [*1/32*]. The silo is actually placed on a very shallow north-west/south-east alignment but, for ease of description, it is considered to be aligned north-south/east-west. Where possible, specific architectural terms used in the text are as defined by Curl (1977). Finally, in the following text, 'modern' is used to denote features or phasing dating to after c.1945.

Setting and Plan Form

4.2 As already noted above, the silo stands within the main group of farm buildings on the west side of Beggarman's Road, at the south end of the farm yard. The silo is actually set almost wholly within the corner of a small enclosure to the immediate west of the yard [*1/408, 1/413*], although it was always accessed from the south end of the yard itself (see below). The silo stands adjacent to the gateway [*1/358, 1/361, 1/399, 1/414-416, 1/418*] leading from the yard into the hay meadow to the south [*1/366, 1/401*] (see plates 1 and 5); there is another building opposite on the immediate east side of the gateway, which has a muck midden parallel to its southern wall [*1/417, 1/420*]. Its location means that the silo receives little shelter from wind or weather from any adjacent structures.

4.3 The silo has a sub-circular plan form, flattened to the central part of all four 'sides', with a maximum external diameter of 3.74m north-south (although the east-west measurement is a little different at 3.68m). The maximum internal diameter is 3.08m (north-south). The walls are on average between 0.30m to 0.35m wide, but they increase to 0.60m on the east side. This may be due to the fact that the base of the east side is formed by an earlier drystone wall, although the south side also rises from a drystone wall, and is substantially narrower. Map evidence indicates that the wall beneath the south side was present by 1856, but that that beneath the east side was only added between 1893 and 1912. These differences in width are

maintained to at least the level of the doorway sill in the east side, although it is possible that the wall tapers inwards slightly towards the top of the doorway.

4.4 The silo stands to a maximum height of 3.65m externally on the east side. As a result of collapse and decay, the top of the east side is now set some 0.40m higher than the west side; due to the lower ground level to the west side, if the top of the silo was level, then it would have stood up to 4.00m in height externally. Internally, the walls have a maximum visible height of 3.20m, with the section suggesting that there is a depth of up to 0.80m of decaying vegetation and other material in the base. Oral evidence suggests that the silo has not had any roof structure within living memory, nor is there any surviving structural evidence to suggest that it ever had one.

Structure and Architectural Detailing

4.5 The external walls preserve evidence for several different phases of construction. As already noted, the east and south sides rise from earlier drystone walls. The wall stands 1.40m high, and is built of roughly coursed and squared limestone rubble. It measures 0.60m across the base and tapers slightly to the upper part, which has some surviving slanted rubble coping. There are no courses of throughstones to the south side [*1/368*], but two intermittent courses to the east side, beyond the limits of the silo [*1/362*]; the south-east corner is an entirely modern rebuild [*1/400*]. To the north [*1/375, 1/377*] and west [*1/369, 1/380, 1/409*] sides of the silo, the lower 2.30m above ground level are built of better coursed and squared limestone rubble, set with a friable light-grey lime mortar (see plate 3); the rubble tends to be laid in bands of roughly squared pieces alternating with thinly coursed bands. There are three courses of intermittent throughstones, set at 0.70m, 1.30m and 2.30m above ground level [*1/376, 1/381, 1/384*]. The uppermost course projects up to 0.30m from the wall face, and rises slightly towards the south side; it is carried around to the south [*1/365, 1/367*] and east sides of the silo. The upper part of the silo appears to be a later heightening. It is built of larger pieces of limestone rubble, which are more poorly coursed than below, and is also set with less mortar, although there is a great deal of mortar around the doorway in the east side [*1/357, 1/359, 1/360, 1/363, 1/364, 1/403-1/406*] (see plate 2).

4.6 The 0.75m wide doorway is the only access to the interior of the silo. The base of the doorway, formed from a stone slab, is set 1.25m above ground level, and the doorway has a total height of 2.40m above the base. It has quoined jambs, and a shallow rebate to the interior [*1/385-1/388, 1/394*] (see plates 4 and 5). The rebate rises only to 1.96m above the sill (i.e. not the full height of the doorway opening) and there are no traces of pintles or other fittings associated with a fixed door; it is therefore assumed that some kind of removable wooden partition was set into the doorway's internal rebate.

4.7 Most of the visible parts of the interior of the silo are rendered to a thickness of 0.03m with what appears to be a lime mortar and sand mix [*1/389-1/391, 1/395*] (see plate 5). There is a horizontal joint to the render, set at the same level as the highest course of throughstones externally. Below the joint, the render has a higher content of hard white lime mortar, whilst above the joint, it is sandier and slightly darker in colour. The uppermost 0.40m of the interior is not rendered, and the top of the render is placed at this same level around the interior [*1/392, 1/393, 1/396-1/398, 1/402*] (see plate 4). It may have stopped because some kind of cover or roof structure was present at this level but, as has already been described, there is no clear surviving structural evidence for one.

West Shaw Farm Rectangular Silage Clamp

4.8 The rectangular silage clamp with the single pitch roof referred to in the Historical Background above was also inspected, but was not recorded in detail. It stands on the immediate east side of Beggarman's Road, and butts the south end of the main building range here. The clamp is aligned east-west, measuring c.5.0m long by 3.0m wide. It is of a single storey, with a single pitch roof, covered in corrugated iron sheeting, sloping downwards from north to south, and built of roughly coursed and squared limestone set with a lime mortar. There is a small window in the east gable, and a wide doorway with a wooden lintel to the west gable; all three external walls preserve evidence for alteration. Internally, the building has partly rendered walls (mainly to the southern half) which indicate where the silage was stored. Sockets to the internal walls are believed to have housed supports, presumably for a wooden frame, associated with the storage of the silage.

5 DISCUSSION

5.1 Oral evidence suggests that the circular silo at West Shaw farm was built between 1920 and 1946, and map evidence indicates that it dates to after 1912. It therefore does not belong to the late 19th century phase of popularity in silage making, but probably pre-dates the Second World War, placing it within the period when silage making had apparently fallen out of favour. Furthermore, it is difficult to find any comparable circular examples, either locally or nationally. The only known comparable stone-built silo within the Yorkshire Dales National Park is at Lodge Hall Farm, north of Selside (NGR SD 77977 78028) (information from YDNPA HER). This stands on the east side of the B6749 Gauber Road, at the north end of the farm complex. It is again located at the corner of a drystone wall, although in this case the wall is a separate structure, rather than being incorporated into it. The silo is sub-circular in plan, with an internal diameter of 3.30m and stands 2.45m in height; the top is open, with no cover or roof structure. The silo is built of roughly coursed and squared limestone set with a lime mortar; there are two intermittent courses of projecting throughstones. The only access to the interior is through a doorway in the south-eastern side, opening straight onto the road. Unlike the West Shaw Farm example, the doorway does not have a raised base, and there is a single piece of timber set horizontally into one of the jambs. The interior retains traces of render, and there is a thick layer of cement mortar and rubble capping the top of the silo's wall. It is not known if this is an original feature, a modern repair or perhaps an indication that the structure has been reduced in height at some point.

5.2 It is interesting that both silos share some common features, suggesting that there was a general idea as to how such structures should be built, even if it was only broadly adhered to. Both are stone-built, circular in plan and with an internal diameter of between 3.08m to 3.30m. The Lodge Hall silo stands 2.45m in height, and the West Shaw silo stood to a very similar height before it was apparently raised. It may also be significant that both silos are located towards the western side of the Dales, within c.14km of one another. It is presumed that stone was used for their construction as it was a more readily-available material, although considerably more work would have been used to build it, compared with a wooden structure. Nevertheless, there are also significant differences in where the silos are located in relation to the farm buildings and in the form of the opening for loading and unloading. The raised doorway to the West Shaw silo is puzzling; as early as 1889, it was stated that "A silo having a cellar from which the silage must by necessity be hoisted is wholly inadmissible"(Kansas State Agricultural College 1889, 58). It may be that this form was adopted because the silo incorporated the

earlier drystone wall, although it would surely have been no problem to have knocked an opening through the wall for ease of loading/unloading. It is presumed that there was a wooden platform or steps adjacent to this doorway to allow material to be forked into the interior.

5.3 Based on the estimates given for Second World War concrete silos (Hanley 1949, 114-115), it is thought that the West Shaw silo could have held approximately 11 tons of silage when 2.3m tall, or approximately 19 tons when 4.0m tall. Given the significant amount of spoilage that occurred within the silo (see below), the actual amount of usable silage made would have been lower; according to post-war figures (Paterson 1951, 177), 20 tons of silage would feed ten cows for two months, although it was thought that unless feeding the equivalent of at least ten cows a day, hay and root crops may be more convenient as fodder than silage. One might also question the ability of the relatively thin walls of the silo to support nearly 20 tons of silage.

5.4 Surprisingly, the only similar structures uncovered during the research undertaken for this report are American, rather than British. It is thought that the first silo was built in the USA in 1873; by the 1890s most dairy farmers used silage and by 1914 it was becoming popular in cattle feeding areas, although it should be noted that maize, rather than grass, was the crop that was often ensiled (Brassley 1996, 63). The northern state of Wisconsin has more silos than any other state, and many early silos were built in stone, sometimes using quarried stone but often using fieldstones thickly set with mortar. Some were square in plan but many of the stone silos were circular, a plan form recommended as early as 1882 to avoid the difficulty of tightly filling and packing the corners of a rectangular or square structure (Marek 2009). They had to be drained, either using a gravel floor or a concrete floor with a drain tile, and consideration had to be given to the pressure exerted by compacted silage, especially towards the bottom of the silo. Some silos were covered, while others had no roof at all. The stone silos were generally deemed to work satisfactorily, but there were some limitations to the form. Firstly, a stone silo would seldom if ever freeze to the centre, but would often freeze along the wall, especially on the cold side. To alleviate this, farmers would often build their silos on the south and east sides of barns for wind protection and sun exposure, and some preferred wooden silos because the contents froze less easily. Secondly, over a long period of usage the silage acids attacked the interior mortar. It was therefore recommended that the interior was lined with a mix that contained a high proportion of cement to sand, and that the interior walls were perfectly smooth. Stone silos, usually connected to the barn by a feeding room, continued to be built into the period 1910-1920 (although at least one was built as late as 1933), but gradually fell out of favour as poured concrete became the preferred construction material. Many of those illustrated appear considerably taller than the West Shaw farm example, although there are a few which are of a comparable size (Otto Wiegand 1989, 2-3; Lee Beadle 2001, 1, 5, 8, 12 & 16); one example at Hutchins, Wisconsin, is an almost exact copy (Marek 2009).

5.5 Of particular relevance to the West Shaw silo is the problem of spoilage encountered in American stone silos. As has been described above, on the one occasion the Chapman brothers tried to use the silo to make silage, the silage was spoiled for about 10 inches (0.25m) around the edges, with only the central parts being usable. A stone silo built in Kansas in the late 19th century had similar problems. It was stated that:

"... for the two years we used a silo of exposed stone masonry, our loss of silage must have been nearly or quite fifty per cent. of its contents. Even where this stone work was brushed over with a thick paste of cement and lime, there was found six inches to a foot thick of rotted silage in contact with the masonry. Afterwards the stone work was sheathed over

with inch stuff, leaving a two-inch air-space between the sheathing and wall. The same silo since has preserved its contents without loss.' (Kansas State Agricultural College 1889, 58-59).
However, Otto Wiegand (1989, 3) stated that in Wisconsin, a certain amount of wall spoilage was accepted in some silo types.

6 CONCLUSIONS

6.1 The West Shaw silo was apparently erected between 1920 and 1946, during a period when little silage was apparently being made either locally or nationally. In some respects it is poorly designed, particularly in respect of loading and unloading, and could only have made small quantities of silage; when it has been used, there has been significant spoilage of the silage. Nevertheless, the silage may still have been valuable as winter fodder for a small number of cows, particularly in a year when the hay crop was poor. If the West Shaw silo was built significantly before the Second World War, then it might have been considered as something of a standby, to be used for making silage in years when the hay crop was poor. Alternatively, given the similarity of its overall dimensions to the concrete silos built during the war (Hanley 1949, 114-115), might it date to 1939-1945 - a vernacular equivalent of the concrete structures raised as part of the drive towards greater silage production during the conflict? If this was the case, then its relationship with the silage clamp on the east side of the road would need re-considering, as map evidence indicates that the latter would pre-date the silo, rather than post-dating it.

6.2 Without the presence of the silo's builder, Mr Middleton, it is impossible to be sure why it was built; in particular, given the similarities of the West Shaw and Lodge Hall silos, it would be fascinating to know if both farmers had perhaps read the same article in the same paper or journal, gone to the same meeting or talk, or if one simply knew the other. The latter would be quite possible, as the structures and farms are not separated by a vast distance. The presence of only two known examples within the National Park might actually be exactly what should be expected. In 1989, in Manitowoc County, Wisconsin, there were thought to be 25 to 50 surviving stone silos out of an estimated total of 5,000 to 6,000 silos within the county (Otto Wiegand 1989, 5). Stone silos were never built in large numbers in Wisconsin, but there are distinctive surviving clusters of them within the state (Lee Beadle 2001, 15). Given the much lower starting numbers of silos within the Yorkshire Dales, it may be that these two are only survivors of a very small number of stone silos that were ever built in the first place. Both are worthy of retention as rare or very rare structures, and the West Shaw example would benefit from some limited rebuilding or consolidation to ensure its survival.

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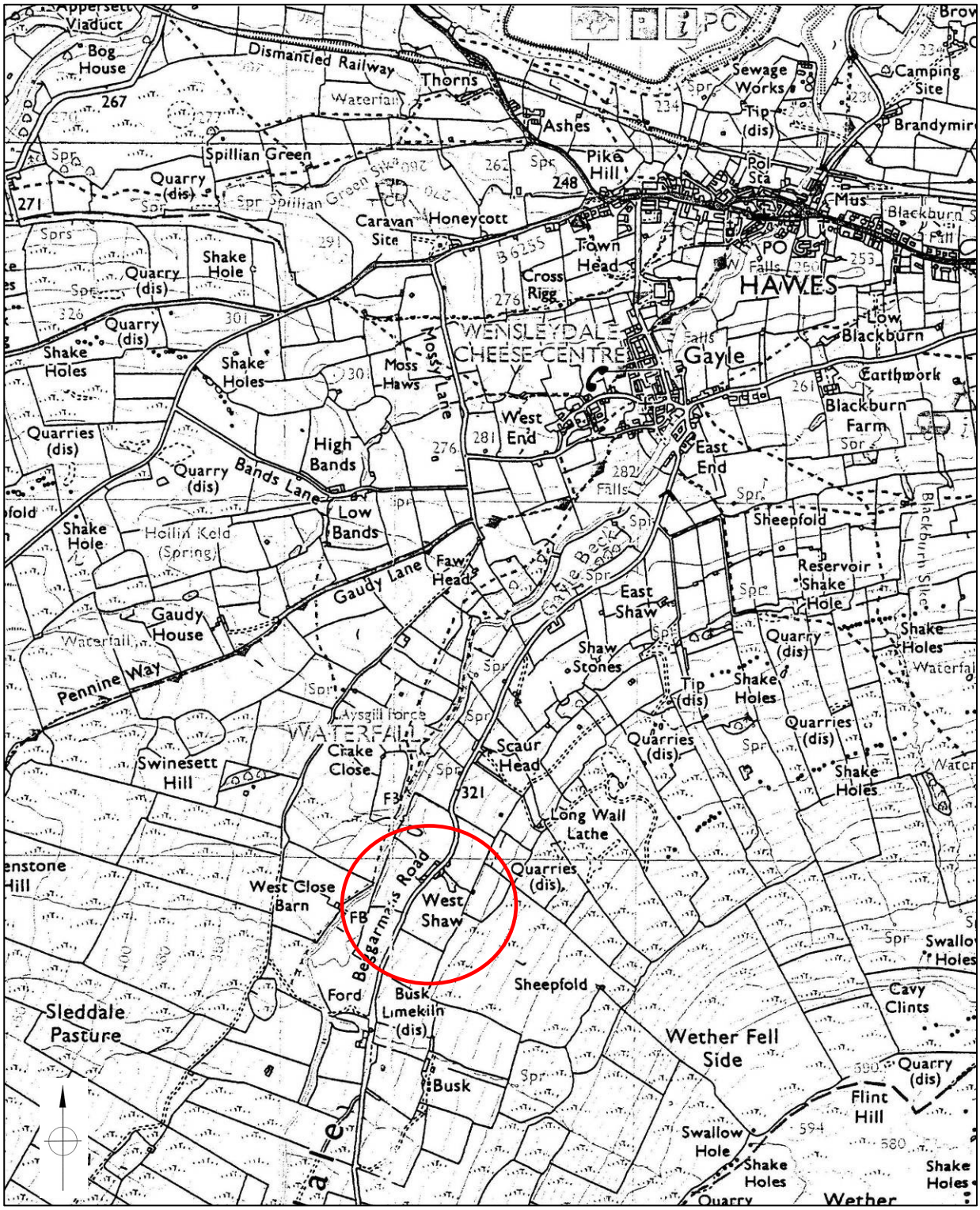
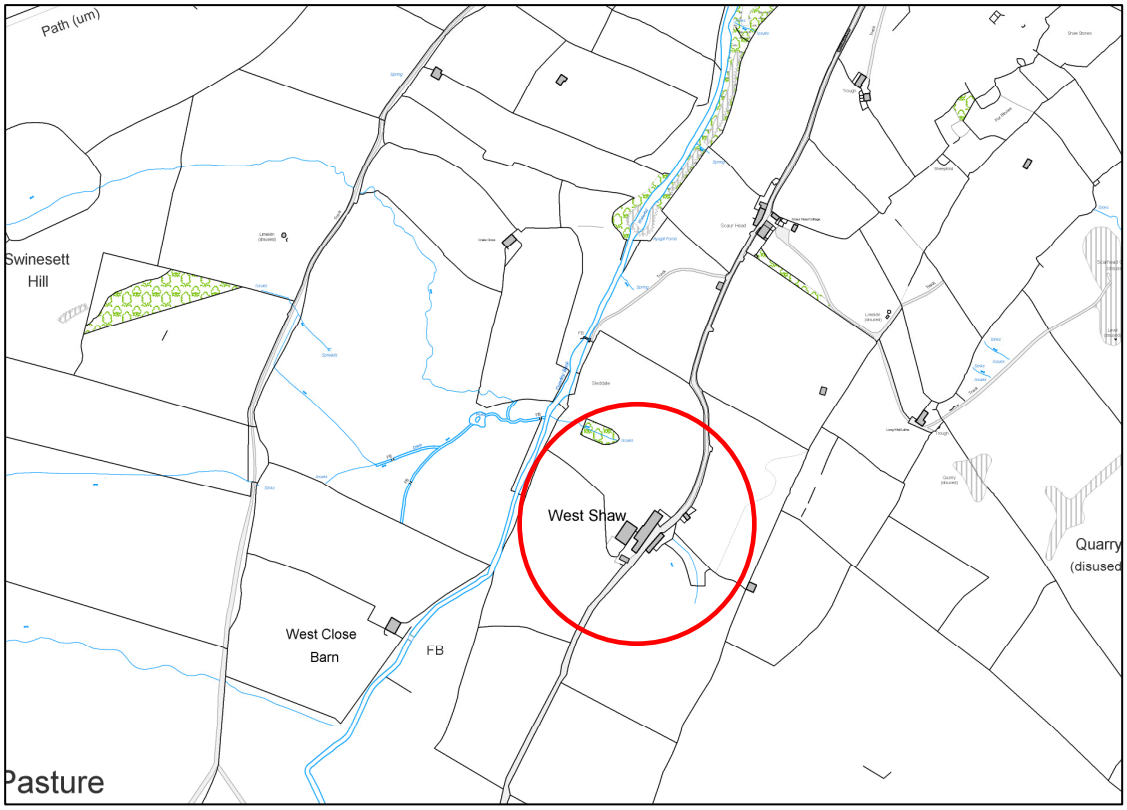
8 ACKNOWLEDGEMENTS

8.1 The archaeological survey was requested by Mr Robert White, Senior Conservation Archaeologist of the Yorkshire Dales National Park Authority (YDNPA), and EDAS would like to thank him for arranging access to the site. Thanks are also due to the Chapman family of West Shaw farm for their assistance and oral information. The work was funded by EDAS. The on-site survey was undertaken by Shaun Richardson, who also produced the fieldwork records. Ed Dennison produced the final report, and the responsibility for any errors or inconsistencies remains with him.



PROJECT: WEST SHAW SILAGE SILO	
TITLE: GENERAL LOCATION	
SCALE: NTS	DATE: SEPT 2015
EDAS	FIGURE: 1



West Shaw circular silage silo
(Source: Google Earth).

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TITLE: DETAILED LOCATION	
SCALE: NTS	DATE: SEPT 2015
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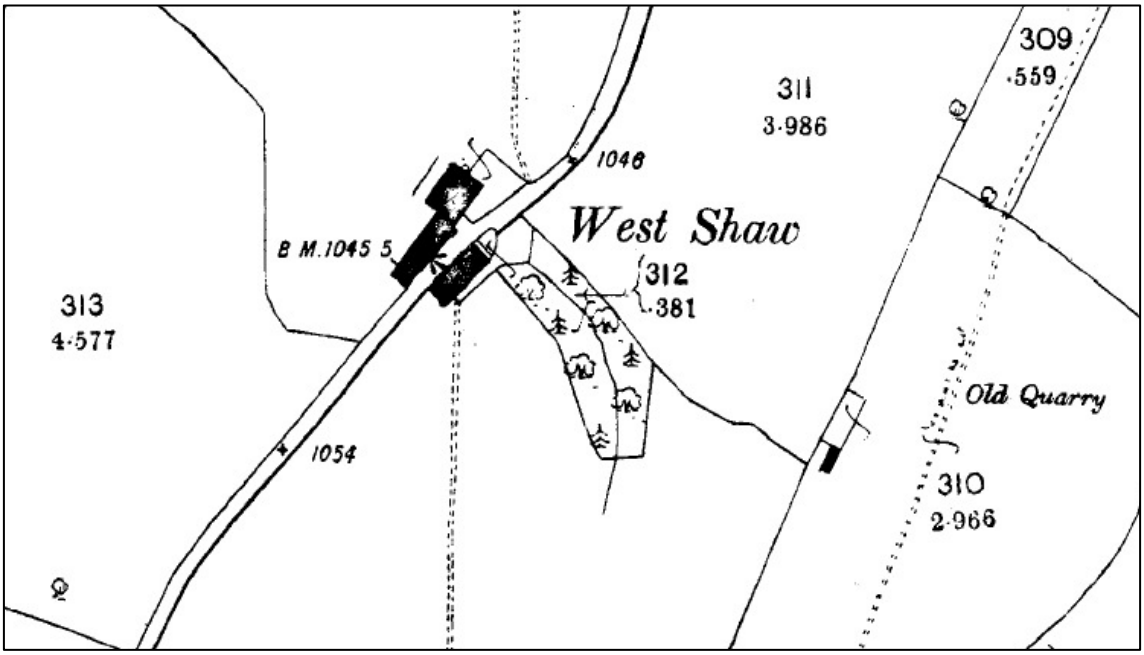

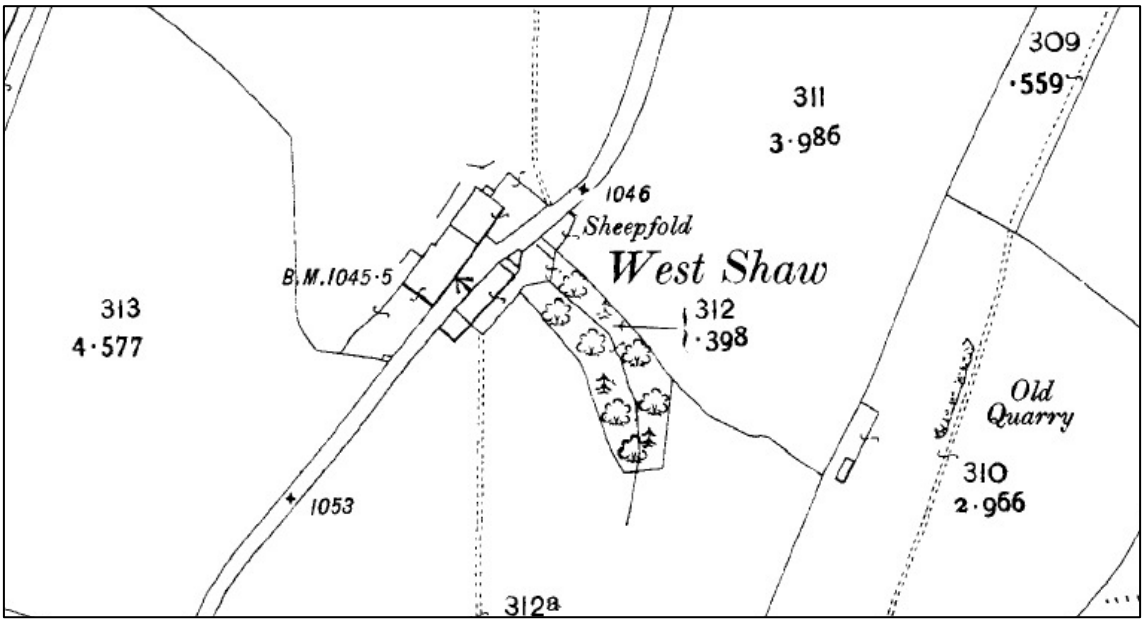

Top: 1893 Ordnance Survey 25" to 1 mile map Yorkshire sheet 65/12 (surveyed 1891).

Bottom: 1912 Ordnance Survey 25" to 1 mile map Yorkshire sheet 65/12 (revised 1910).

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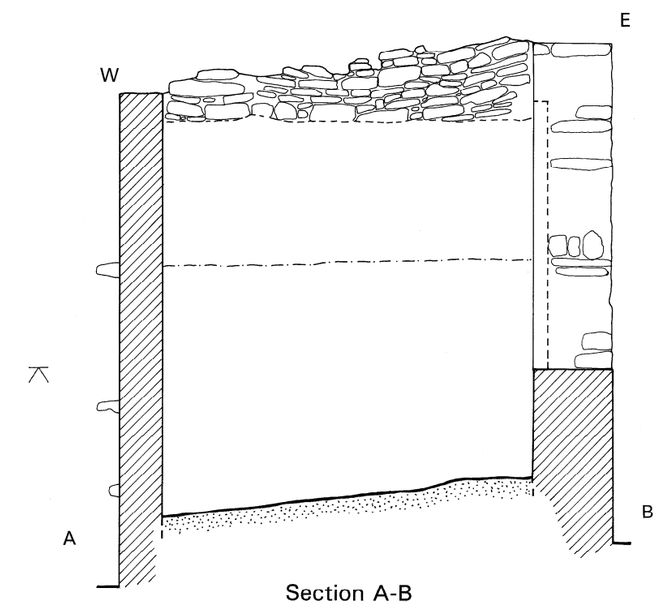

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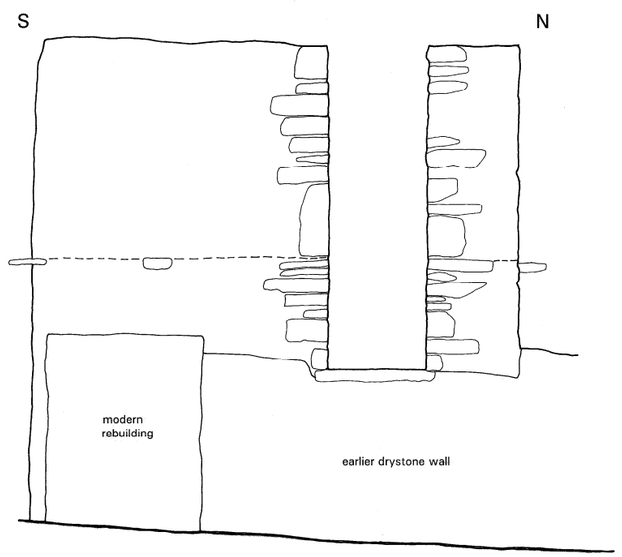
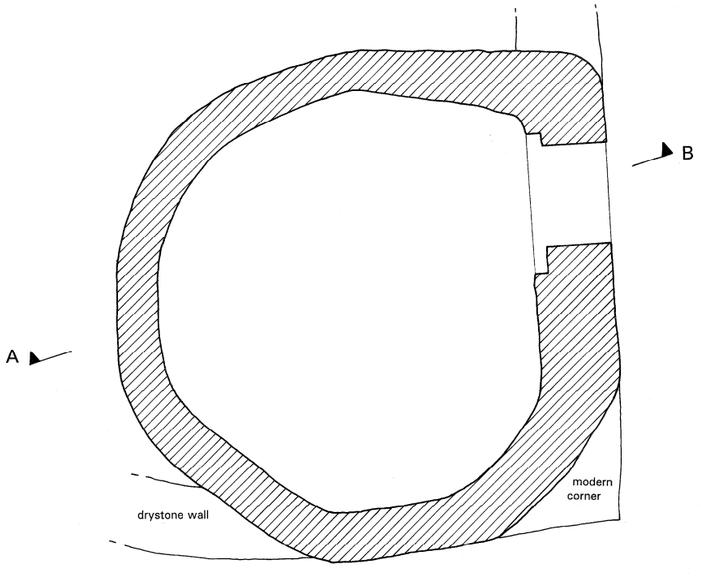
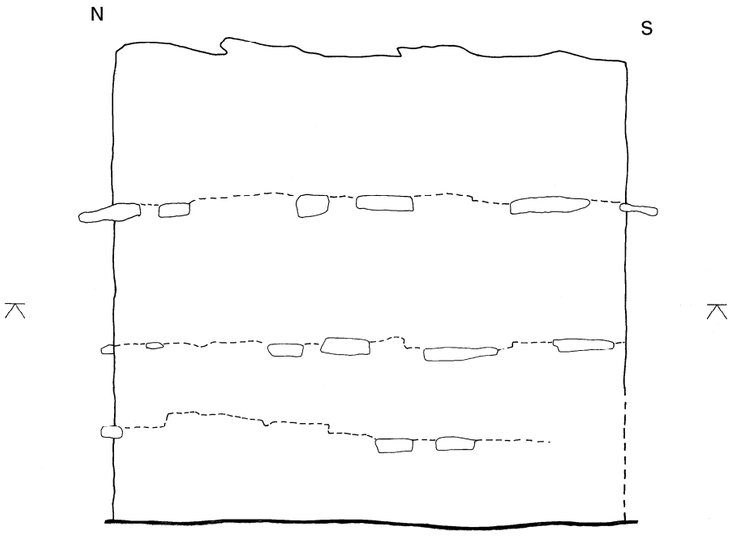


East side external elevation



Ground Plan



West side external elevation

0 3m

PROJECT: WEST SHAW SILAGE SILO	
TITLE: PLAN, SECTION AND ELEVATIONS	
SCALE: AS SHOWN	DATE: SEPT 2015
EDAS	FIGURE: 4

Plate 1: General view of silo in corner of yard, looking SW (photo 1/361).

Plate 2: East side of silo, looking SW (photo 1/359).

Plate 3: West side of silo, looking E (photo 1/380).

Plate 4: Interior of silo, looking N (photo 1/388).

Plate 5: Interior of silo, looking E (photo 1/386).

Plate 5: General view of silage silo, looking NW (photo 1/414).

APPENDIX 1
PHOTOGRAPHIC RECORD

WEST SHAW SILAGE SILO PHOTOGRAPHIC CATALOGUE

Film 1: Colour digital photographs taken 3rd July 2015

Film	*Frame*	*Subject*	*Scale*
1	357	Silo, looking SW	1m
1	358	Silo, looking S	1m
1	359	Silo, east side, looking SW	1m
1	360	Silo, east side, looking W	1m
1	361	Silo and gateway, looking SW	1m
1	362	Silo and drystone wall, looking SW	1m
1	363	Silo doorway, looking S	-
1	364	Silo doorway, looking NW	-
1	365	Silo, south side, looking N	1m
1	366	Adjacent hay field, hay rowed up, looking S	-
1	367	Silo, south side, looking N	1m
1	368	Silo and drystone wall, looking E	1m
1	369	Silo, west side, looking E	-
1	375	Silo, north side, looking S	1m
1	376	Silo, typical throughstones, looking E	-
1	377	Silo, north side, looking S	1m
1	380	Silo, west side, looking E	1m
1	381	Silo, west side, looking S	1m
1	384	Silo, west side, looking S	1m
1	385	Silo doorway, interior, looking E	1m
1	386	Silo doorway, interior, looking E	1m
1	387	Silo doorway, interior, looking NE	1m
1	388	Silo doorway, interior, looking N	1m
1	389	Silo, interior, looking N	-
1	390	Silo, interior, looking W	1m
1	391	Silo, interior, looking SW	-
1	392	Silo, interior, looking W	-
1	393	Silo, interior, top part, looking N & E	-
1	394	Silo doorway, interior, looking NE	1m
1	395	Silo, interior, looking N & E	-
1	396	Silo, interior, top part, looking NW	-
1	397	Silo, interior, top part, looking NE	-
1	398	Silo, interior, top part, looking W & S	-
1	399	Silo, looking NW	1m
1	400	Silo, south side, looking N	1m
1	401	Mr Chapman haymaking, with tractor, looking SW	-
1	402	Silo, interior, looking W	-
1	403	Silo, east side, looking W	1m
1	404	Silo, east side, looking W	-
1	405	Silo, east side, looking W	1m
1	406	Silo, doorway, looking W	-
1	408	Silo, looking E	-
1	409	Silo, looking E	-
1	413	Silo, looking NE	-
1	414	Silo, looking NW	-
1	415	Silo, looking NW	-
1	416	Silo, looking NW	-
1	417	Muck midden, looking N	-
1	418	Silo, looking NW	-
1	420	Muck midden, looking E	-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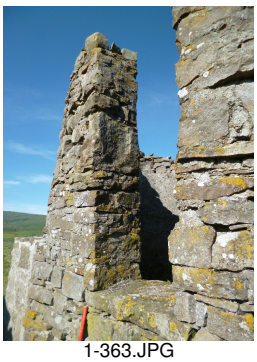
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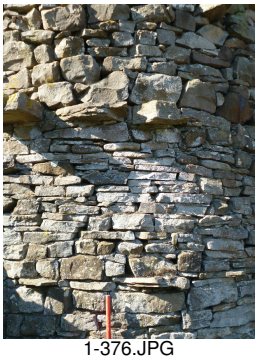
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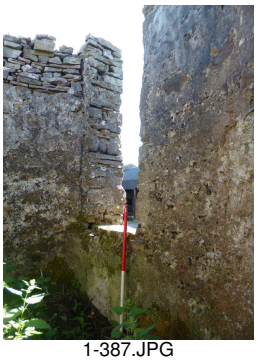
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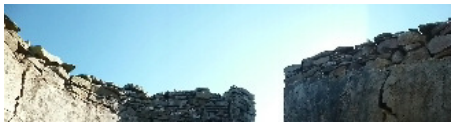
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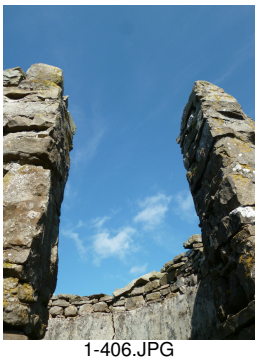
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