Patterns in Archaeological Monument Loss in East Central Scotland Since 1850

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Chapter 6

6. Cropmarks and the arable landscape

In chapters 4 and 5, this research has concentrated on quantifying monument condition change and monument loss, identifying the processes responsible and examining relationships with environmental variables. According to the calibrated results of the desk-based study, at least 5% of cropmark monuments in the study area have been reduced in extent since 1850, although only about 1% have been destroyed. However, this is certain to be a significant under-representation of actual loss rates at cropmark monuments within the study area, as condition change among cropmarks is very difficult to identify, let alone quantify accurately. Previous research has identified arable farming as one of the largest threats to the archaeological resource (Hinchcliffe & Schadla-Hall 1980; Darvill 1987; Darvill and Fulton 1998; Oxford Archaeology 2002), primarily because its activities fall outwith planning control. Even when a cropmark monument is scheduled under the AMAA Act 1979, the Ancient Monuments (Class Consents) (Scotland) Order 1996 enables 'Agricultural, horticultural and forestry works, being works of the same kind as works previously executed lawfully in the same location and on the same spot within that location during the period of six years (or 10 years in the case of ploughed land) immediately preceding the date on which the works commence...' (HMSO 1996, 3). Although the Class Consents Order enables cultivation to continue at scheduled cropmark monuments, there are two mechanisms under the Act through which cultivation might cease. Under Section 3 (3) of the Act, a class consent can be revoked where there is evidence of detriment to a scheduled ancient monument caused by works undertaken under the Class Consents Order. However, this section of the Act has never been invoked for a cropmark in cultivation in Scotland, primarily due to a lack of conclusive evidence of ongoing damage and because other funding priorities have taken precedence over the compensation payments that would be incurred by such a revocation (Fojut, pers. comm.). Agreements between Historic Scotland and landowners or tenants can be created under Section 17 of the Act, under which payment can be made for the removal of a monument from ploughing. Although legally binding, these agreements (which usually last for five or ten years) are voluntary, and there is no obligation on the part of a landowner or tenant to enter. In any case, Historic Scotland's annual budget for Section 17 Management

Agreements is insufficient to cover a even a fraction of the scheduled ancient monuments in Scotland, and again, funds are directed towards other, more visible priorities. Consequently, although Section 3 (3) and Section 17 of the AMAA Act 1979 provide mechanisms by which the ongoing attrition of cropmark monuments through ploughing can be prevented, in practice, the Class Consents Order ensures that the cultivation of scheduled continues unchecked.

Excavation shows the condition of cropmark monuments to be variable. Without excavation, however, it is seldom possible to assess the condition of a cropmark monument. Even with excavation, unless the excavations are taken over a number of seasons with ploughing between times, condition change is impossible to detect. Some 35% of sample monuments examined in this research are cropmarks. Beneath 150m OD, this proportion rises to 58% of sample monuments. Given the high number of cropmark monuments included in the sample and their vulnerable location, it is appropriate that consideration be given to the impacts of agriculture on cropmark monuments. The following section outlines some of the issues relating to the condition, management and preservation of cropmark monuments, and describes some of the approaches taken in the past to address these issues.

6.1 Studies into archaeology and cultivation

The negative impacts of arable farming on extant field monuments have long been recognised. The Monuments at Risk Survey refers to the observations made by William Stukeley around 1740, when he bemoaned the visible damage occurring to field monuments around Stonehenge (Darvill and Fulton 1998, 57). Within the current study area, the efforts of William Stirling in the late 18th century (described in chapter 1) to prevent plough damage to the Roman fort at Ardoch must rank as one of the earliest recorded cases of archaeological resource management in Scotland (OSA 1793, 495; Christison *et al.* 1897, 426). More recently, the RCAHMS marginal land surveys of the 1950s were undertaken in direct response to the threat posed to archaeological monuments by expanding agriculture in the post-Second World War drive for agricultural self-sufficiency. It is, however, only within the last three decades or so that attempts have been made to address the specific problems posed by agriculture to *buried* archaeological remains.

With the increased mechanisation of agriculture since the Second World War and the discovery of thousands of previously unrecognised cropmark monuments throughout Britain within the same space of time, archaeological concern for monuments in the rural landscape has broadened to include this invisible resource. In the mid-1970s, a number of pilot projects (mostly funded by the Department of the Environment) were undertaken in order to define the extent of the problem posed by ploughing to archaeological sites and to re-consider criteria used for undertaking archaeological excavation in response to plough damage (Lambrick 1977, vii). Following this increase in awareness of the threat posed by cultivation to archaeological remains, a seminar on plough damage and archaeology was held in February 1977 in an attempt to examine the practices damaging the archaeological resource and identify means by which the problem might be addressed. The papers presented at the conference were published in 1980 under the title *The Past Under the Plough* (Hinchcliffe and Schadla-Hall 1980). The topics covered varied in scope from the direct assessment of the effects of cultivation (Hinchcliffe 1980, Lambrick 1980, Nicholson 1980, Spoor 1980) to regional studies of plough damage (e.g. Manby 1980, Drewett 1980, Miles 1980). Some papers examined the possible benefits of minimal cultivation and direct drilling at cropmark monuments (Hughes 1980, Whitaker 1980), while others examined possible directions for research into the quantification of the effects of ploughing on archaeological material (Reynolds and Schadla-Hall 1980). In this volume, Miles argued that in order to convince farming bodies, archaeologists needed to produce concrete evidence of the effects of agriculture on archaeology, based on systematic research. It was not until the late 1990s that the systematic research Miles had called for in 1980 was drawn together, with a comprehensive study undertaken for DEFRA by Oxford Archaeology (formerly Oxford Archaeological Unit) in conjunction with the Council for British Archaeology, Oxford University and Reading Archaeological Consultants (Oxford Archaeology 2002). The project, entitled *The Management of Archaeological Sites in Arable Landscapes*, was designed to "... establish the basis for developing a management strategy for preserving archaeological sites on arable land that will focus on where damage is most serious and will provide sustainable remediation of the problem." (Oxford Archaeology 2002, 1). The project made use of the findings of a large number of regional studies (including interim results from this research), and resulted in the development of both site-specific and regional methods of assessing plough damage risk to cropmark monuments.

The review of literature undertaken for this research has shown that almost all British research into the effects of cultivation on cropmark monuments has been undertaken in England. Hinchcliffe and Schadla-Hall's (1980) volume *The Past Under the Plough* contains only one paper based on work in Scotland (Mercer 1980), and this is concerned with forestry ploughing rather than arable cultivation. Similarly, Oxford Archaeology's *Management of Archaeological Sites in the Arable Landscape* project main report and supporting documentation make very few references to Scottish material, citing only Historic Scotland's Technical Advice noted on burrowing animals and archaeology (Dunwell and Trout 1998), Wordsworth's excavations at Kinbeachie (Wordsworth 2001), and unpublished preliminary results from the present research. This lack of Scottish material in these two English-funded projects is no indictment of the publications. Rather, it simply reflects a lack of systematic research in Scotland at the times these projects were published.

There are, however, two very recent Scottish projects that have examined issues relating to cropmarks and cultivation. One of the main research themes examined by The South Aberdeenshire and Angus Field School conducted by CFA Archaeology Ltd (formerly the

Centre for Field Archaeology) has been the management of cropmark archaeology (Finlayson *et al.* 1999, 30). Specifically, the project has sought to examine the degree and rate of attrition of cropmark sites as a result of recent farming practices, though a combination of excavation, examination of aerial photographs, and the examination of previous excavations within the same area (ibid, 30). Although a number of the excavations undertaken as part of the project have been published (e.g. Alexander 2000; McGill 2003; Strachan *et al.* 2003) and provide some indication of the overall findings of the project, the final report is still in preparation (Dunwell, pers. comm.). Meanwhile, Bowes (2003) has assessed the threat posed to cropmark monuments by soil erosion in part of the study area examined by this research. Bowes has modelled water erosion and tillage translocation of ploughsoil, using the Cs^{137} tracer technique as a validation tool. This research has been undertaken within the same department at Stirling University as the current research, and some of Bowes's results and outputs are used later in this chapter.

6.2 The conflict between cultivation and archaeology

Agricultural activities, particularly those associated with arable production, are now widely recognised by archaeologists as being among the most significant threats to archaeological monuments (e.g. Hinchcliffe and Schadla-Hall 1980; Darvill 1987; Berry 1994; Macinnes 1997; Wordsworth 1999; Oxford Archaeology 2002). MARS found that arable agriculture accounted for approximately 10% of observed cases of monument destruction and about 30% of observed cases of monument damage in England from 1945 to 1995 (Darvill and Fulton 1998). The various agricultural practices known to damage monuments are well documented (e.g. Hinchcliffe and Schadla-Hall 1980; Darvill 1987; Wordsworth 1999). *The Management of Archaeological Sites in Arable Landscapes* project report includes lengthy and detailed discussion of a plethora of processes responsible for damaging monuments in the arable zone (Oxford Archaeology 2002). Because many of these apply only to extant monuments, not all are examined in detail here, as this section of the current research is intended to examine issues pertaining to cropmark monuments. The following sections of this chapter briefly outline some of the agricultural activities known to damage cropmark monuments, the effects of these activities on the archaeological remains, and some of the approaches taken by other projects to address the problems posed to the archaeological resource by agriculture.

6.2.1 Ploughing

The primary source of damage to cropmark monuments is ploughing. Mouldboard ploughing, the most commonly used ploughing method, involves the inversion of the topsoil in order to bury vegetation and expose fresh soil for cultivation. Other types of ploughing include rigid tine or chisel ploughing, which breaks up the topsoil rather than inverting it, and usually works to a shallower depth than mouldboard ploughing (Lambrick 1977). Mouldboard ploughing does not usually exceed about 20cm in depth (Halley & Soffe 1988, 506). A number of recent excavations of cropmark sites within the study area have noted damage to archaeological features caused by ploughing and other agricultural activities (e.g. Strong 1985; Barclay 2001; James and Duffy 2001; Cameron 2002), although quantification of the depth of plough damage is seldom made in excavation reports.

6.2.2 Compaction, deep ploughing and subsoiling

Ploughing can create pans caused by the smearing and compaction of the soil at the base of the plough, and the potential for the creation of pans is increased by repeated passes by machinery (Lambrick 1977, Oxford Archaeology 2002, 6). Panning is problematic in that it restricts drainage, inhibits root growth, and can prevent water rising to the soil surface in dry weather. It is also believed to lead to decreases in crop yields and the number of small invertebrates in the soil (MacKenzie 1998). Some farmers are thought to increase plough depth in order to break up pans (Oxford Archaeology 2002, 6) or because they believe it might increase soil fertility (Wordsworth 1998b). Although a rare example of excavation in advance of pan-busting has been noted at Belhie near Auchterarder in Perthshire (Ralston 1988), such activities and the damage they cause to archaeological deposits normally takes place unchecked. This has very serious implications for archaeological sites, as features in the subsoil, though previously undisturbed, might be completely truncated without being recorded first. The problem of panning and soil compaction is most commonly dealt with through the use of subsoilers. Subsoiling is designed to crack and loosen compacted soils upwards from the blade in a V-shape, creating fissures and aiding drainage (Lambrick 1977; Halley & Soffe 1988; Soffe 1995; Farmers Weekly Interactive 1998). Recent research by White (2001, 2) in Herefordshire suggests that subsoiling may reach depths of up to 90cm. Although subsoiling involves little soil movement, it does create significant soil disturbance, and is thought to be especially damaging to archaeological sites, due to the depth of working and volume of soil disturbed (Lambrick 1977; Oxford Archaeology 2002, 6).

6.2.3 De-stoning

Although deep ploughing is sometimes used to break up pans, deep cultivation to create seed beds for root crops is known to be particularly damaging to archaeological deposits (Oxford Archaeology 2002, 5), particularly when accompanied by de-stoning. De-stoners separate stone from the ploughsoil within raised seedbeds created by bed tillers (Netagco Reekie 2000), which scoop the ploughsoil into raised beds and operate at depths of up to 50cm (ibid.). De-stoners can compound the damaging effects of deep cultivation by separating artefacts further from their original contexts. Geake (2003, 16) has described the effects of de-stoning on Anglo-Saxon cemeteries in Norfolk, while Halkon (2001, 14) has suggested that deep cultivation and de-stoning in advance of potato planting in Yorkshire has disturbed archaeological deposits at depths of up to 50cm.

6.2.4 Drainage

Although agricultural drainage has been in operation for many centuries, the main stimulus for improved drainage did not occur until the introduction of tiled drains from the early 19th century (Wordsworth 1998b; O Grada 1991, 1). Modern pipe drains are laid in trenches at depths of between 0.75m and 1.25m, whereby a trenching machine cuts a trench 20cm – 30cm wide, the pipes are laid and the trench backfilled (Oxford Archaeology 2002, 8). The insertion of new drainage can affect buried archaeological remains in two distinct ways. Firstly, the digging of drainage trenches can cause turbation of archaeological deposits. For example, Woolliscroft found that the insertion of tile drains had damaged features at a number of suspected Roman temporary camps in Perthshire, and that at one site in particular (Upper Cairnie), modern land drain tracks also affected the interpretation of geophysical survey (Woolliscroft *et al.* 2002, 32). Secondly, waterlogged archaeological deposits often contain well-preserved palaeoenvironmental and organic remains, such as seeds, wood and textiles, due to the anaerobic conditions within the deposit. The drainage of these deposits causes the removal of anaerobic conditions, leading to desiccation, oxidisation and increased micro-faunal decay (Taylor 1994; Oxford Archaeology 2002, 9). Drainage is often aided further through mole ploughing. This involves the dragging of a cylindrical unit through the subsoil at a depth of between 40 cm and 60 cm in order to create small drainage channels, usually perpendicular to the direction of the field drains (Halley & Soffe 1988; Soffe 1995; Farmers Weekly Interactive 1999a; Oxford Archaeology 2002, 8). Mole ploughing is thought to cause turbation to archaeological deposits, but as it is not designed to move soil, its effects are likely to be less serious than those created by subsoiling or deep ploughing (Lambrick 1977; Oxford Archaeology 2002, 6). A number of other agricultural practices or processes attributable to agricultural practices are known to affect buried archaeological remains. The *Management of Archaeological Sites in Arable Landscapes* project report discusses (among other things) projects examining the effects of wetland drainage (Honner and Lane 2002), peat shrinkage, the physical and chemical damage to artefacts, various cultivation systems, and the effects of various crop rotation systems (Oxford Archaeology 2002).

6.2.5 Identifying new and ongoing damage

Although the practices outlined are known to have negative impacts on buried archaeological deposits, because these deposits are not visible except though archaeological excavation, it is difficult to ascertain whether or not damage is ongoing. The dragging to the surface of fresh artefacts, such as those described by Geake (2003) and Plouviez (2003) may be a reliable indicator of ongoing disturbance. However, the rich material cultures of Roman southern England and Anglo-Saxon East Anglia are not replicated in Scotland, where surface remains in the ploughsoil seldom consist of more than lithic scatters, and so identifying ongoing agricultural damage through surface finds is seldom possible. The main difficulty in any research designed to record changes in the condition of cropmark monuments is that excavations are required over a number of seasons and the data recorded extremely accurately. Dunwell (pers. comm.) has pointed out that most cropmark excavations are stripped using mechanical diggers, and consequently, slight variations in the effectiveness of machine operators in different seasons can have a considerable effect on the survival of features. Furthermore, trench walls are rarely preserved between seasons so that sectional information is seldom observable over more than one season. However, recent excavations by Woolliscroft at a prehistoric cropmark enclosure at East Coldoch in Stirlingshire illustrated the potential for damage through a single season's ploughing. All excavation at East Coldoch was by hand, and between the excavations of 2000 and 2002, the field was ploughed once. Prior to backfilling in the 2000 season, a plastic membrane was placed over some fragile archaeological features, and extra topsoil had been imported to the site to ensure that topsoil depth across the site was approximately 30cm (Woolliscroft, pers. comm.). Upon re-opening trenches in 2002, parts of the membrane were found to have been dragged to the surface by the plough, and some archaeological features had suffered visible damage through a single episode of ploughing. On the advice of the archaeologists, the farmer had deliberately reduced the ploughing depth over the site, but this action (coupled with the importing of extra topsoil to the site after the 2000 excavations) had not prevented considerable plough damage from occurring, including the partial destruction of a small cist (Woolliscroft, pers. comm.).

Although the example of East Coldoch is a rare case where ongoing damage has been noted through hand excavation of a cropmark site in successive seasons, the most common indicator of ongoing agricultural damage in Scotland is the disturbance of stone structures such as cists (e.g. Proudfoot 1997; Taylor *et al.* 1998; Ballin-Smith 1999) and souterrains (e.g. Coleman & Hunter 2002) by ploughing or other agricultural activities. There are two mechanisms by which this increase in depth of disturbance can occur. Firstly, deeper cultivation can occur intentionally, either through a change to larger or more invasive machinery, or simply through a farmer's decision to increase ploughing depth. Secondly, the erosion of topsoil (through a number of processes) can lead to a lowering of the soil profile, causing the effective (if unintentional) deepening of cultivation, even where plough depth remains constant.

6.2.6 Deeper cultivation of already cultivated monuments

A change to deeper cultivation can occur through a change of crop and the corresponding change in ground preparation required. For example, preparation for the planting of cereal crops may consist of mouldboard ploughing to a relatively constant depth of 15-20cm, with occasional subsoiling to up to about 50cm to reduce compaction and improve drainage. A change to cultivating root crops will alter the degree of subsoil disturbance significantly, however, owing to the increased subsoiling, increased depth of cultivation and de-stoning required to create suitable seed beds. Research into the effects of potato cultivation in Herefordshire (White and Cotton 2001) suggests that a site may need only be farmed once for potatoes for shallow archaeological features to be completely destroyed. Although sudden change in cultivation system may cause irreversible damage to archaeological remains in a short space of time, it is likely that much of the damage that has occurred to cropmark monuments has occurred gradually with the steady development of farming technology and larger machinery, particularly since the Second World War. Examination of existing literature and agricultural statistics from the late 19th and throughout the 20th century illustrates just how marked this increase in farm mechanisation (and correspondingly, threat of damage to buried archaeological remains) in the latter part of the 20th century has been.

6.2.7 Changes in British farming technology

Although the rapid increase in British farm mechanisation has occurred only in the last 60 years or so, most of the agricultural practices noted as being damaging to the archaeological resource today have been in use for a great deal longer. For example, the benefits of subsoiling were first noted in 1831 (Wordsworth 1998b), while Primrose McConnell, author of a large number of books on British agriculture, noted in 1910 that mole ploughing had "...long been successfully practiced" (McConnell 1910a, 37). McConnell also recommended in 1908 that "Land for potatoes should be stirred deeply with the steam cultivator, or deeply ploughed and horse cultivated..." (McConnell 1908, 60), and advocated deep ploughing as a method of breaking up plough pans and pulling fertile manurial matter closer to the surface (McConnell 1910b, 88). Perhaps McConnell's most telling observation was his statement in 1910 that "The next generation will probably see the evolution of 'motor' work much beyond anything we have yet attained to by horse-power, and the farming of the future will gradually reach a pitch of perfection that, as yet, we can only begin to realise and foresee" (McConnell 1910a, 104).

The increase in mechanisation McConnell predicted advanced slowly in the first half of the 20th century. Holderness (1985, 3) has noted that tractor ownership grew slowly in the 1920s and 1930s, and although numbers of horses used in Scottish agriculture diminished steadily from 140,000 in 1919 to about 100,000 in 1939 (MAFF 1968, 129), in 1950, horse-drawn ploughs still outnumbered tractor-drawn ploughs in Scotland by 76,390 to 3700 (Moore 1953, 508). From the early 1950s onwards, however, the mechanisation of farming gathered pace, so that by 1960-1, the number of tractors in Scotland had risen to nearly 60,000, while numbers of horses kept for agricultural use in Scotland had dropped to fewer than 10,000 (MAFF 1968, 129). Although this increase in tractor numbers demonstrates the rapid mechanisation of agriculture following the Second World War, the development of more powerful tractors since the 1950s has increased the potential for disturbance of archaeological remains. Between the late 1950s and 1980, although tractor numbers in the UK rose by only about 15%, average horsepower increased from 14 horsepower to 45 horsepower (Holderness 1985, 114). A marked episode of cist discoveries in Perthshire, Fife and Angus in the 1950s has been partially attributed to increases in mechanisation of farming (RCAHMS 1994, 11; Taylor *et al.* 1998). More recently, data from the December Agricultural Census in Scotland show that between 1992 and 2001, the number of tractors of 134 horsepower or greater increased by over 400%. Within the same period of time, tractors of 108-134 horsepower increased by over 200%, while 4WD tractors (which provide greater traction) increased by about 38% (Scottish Executive 2001). This trend towards larger, more powerful machinery is further attested to by the fact that numbers of all smaller tractors diminished, particularly those in the 35-80 horsepower brackets (ibid.).

Many authors (e.g. Dormor 1996; Darvill 1987; Darvill and Fulton 1998; Oxford Archaeology 2002) have pointed out that with the increase in the size and power of tractors, the size of the tillage equipment they pull has increased, and correspondingly, the potential for damage to buried archaeological remains has increased. For example, in 1977, most subsoilers had a maximum of three legs, which were spaced at over a metre apart, leaving much of the soil undisturbed (Lambrick 1977). By contrast, subsoilers exist today with up to 13 legs, spaced at as little as 60cm and capable of working to depths of 90cm (Farmers Weekly Interactive 2000). Others have two rows of legs, creating even greater subsoil disturbance (Farmers Weekly Interactive 1999b).

6.2.8 Deepening of cultivation caused by topsoil erosion

The *Management of Archaeological Sites in Arable Landscapes* project has identified the erosion of ploughsoil as a key variable in increasing the risk to buried archaeological deposits, as subsoil (and any archaeological deposits contained within the subsoil) will be disturbed annually to maintain topsoil / ploughsoil depth (Oxford Archaeology 2002, 6). Ploughing does not normally exceed 20cm in depth (Wordsworth 1998b), and in normal circumstances, should not disturb the subsoil. This situation will change, however, when there is a gradual loss of topsoil from a site. Ploughing is a well-documented agent in the accelerated erosion of topsoil (e.g. Tyler *et al.* 1999; Wilkinson & Thorpe 1999; Bowes 2003; Davidson & Grieve 2003), and recent research has suggested that localised soil loss on arable land in parts of Perthshire may be in excess of 2mm per annum (Tyler *et al.* 1999; Davidson and Grieve 2003). In these circumstances, within ten years the topsoil will have lost 2cm in depth, and so if ploughing takes place to a depth of 20cm each year, there will be gradual incorporation of subsoil into the topsoil, and archaeological features will be truncated. Bowes, meanwhile, has suggested that some 63% of cropmark features within his study area are situated on land which experiences ongoing erosion (Bowes 2003, 287), illustrating that this threat to cropmark monuments in Eastern Scotland is genuine and ongoing.

While studies of this type provide indications of likely levels of truncation of archaeological deposits over specific periods of time induced by topsoil erosion, direct archaeological evidence of damage attributable to erosion of topsoil is scarce. The excavation of a souterrain at Shanzie Farm in Perthshire (which was discovered when ploughing dislodged a side-slab of the souterrain) provides a rare indication of levels of truncation and potential information loss attributable to ploughing (Coleman & Hunter 2002). The souterrain is situated on a pronounced knoll, but was until recently traversed at its east end by a field boundary. Excavation showed that beneath the former field boundary (where the course of a drystane dyke ran over the souterrain), the souterrain walls survived to a height of 1.6m. Elsewhere, the souterrain walls seldom survived as more than one course of stonework, leading the excavators to estimate that as much as 1.5m to 2m of the upper parts of the souterrain had been lost since the dyke had been erected in the late 18th century (ibid, 81). Meanwhile, Geake (2003, 16) has suggested that ploughsoil levels have lowered by as much as 18 inches (c. 45cm) at Anglo-Saxon cemeteries in Norfolk since the 6th century, and notes that about seven new cemeteries are identified in Norfolk every year, suggesting the continued disturbance of fresh archaeological deposits on an annual basis (ibid, 17).

6.2.8.1 Factors influencing erosion rates

A number of variables influence rates of erosion in cultivated land. Bowes (2003, 56) and the *Management of Archaeological Sites in Arable Landscapes* project (Oxford Archaeology 2002, 11) have identified topography, climate, land use, soil type and landscape features as key factors. Examples of erosion are frequently associated with long or pronounced slopes (ibid.), while Bowes (2003) Davidson and Grieve (2003, iii) have noted that the risk of gullying is increased in fields which have been ploughed or are under autumn-sown cereals. No attempt is made here to examine the mechanisms of ploughsoil erosion in any depth (see Davidson & Grieve 2003 and Bowes 2003 for detailed summaries), but two particular observations are worth noting in relation to ploughsoil erosion. Firstly, Bowes (2003, 288) has concluded that land surface curvature is the fundamental factor controlling the magnitude of soil loss. Excavations have also shown topography to have a bearing on levels of agricultural damage to archaeological features. As part of the Angus and South Aberdeenshire Field School, Strachan *et al.* (2003, 58) noted that topsoil variation was considerable across the area of excavation at Hawkhill, Angus, where topsoil depth across a knoll summit was found to be only 10cm, increasing to about 80cm at the slope base. At this location, the landowner had also indicated that he had been aware of significant topsoil movement within the field (ibid.). As part of the same project, excavations at West Mains, Lunan Bay in Angus (Alexander 2000) were designed to examine areas of apparent differential preservation of an enclosure ditch. The (cropmark) enclosure was located across a natural hollow which was found to correspond to a large dark area on aerial photographs. The excavations showed that within the hollow, the enclosure ditch was sealed beneath a paleosol, which in turn lay below a deposit of buried ploughsoil beneath the topsoil (ibid, 24). Furthermore, preservation of the enclosure ditch was better towards the base of the natural hollow, although this difference in preservation was not as marked as had been expected.

6.2.8.2 The role of field boundaries in counteracting erosion

Bowes's research has also suggested that field boundaries play a significant role in controlling rates of water based erosion and deposition, acting as buffers across which sediment flow is restricted (Bowes 2003, 288). This is illustrated in figure 6.1, which shows build-up of sediment in February 2000, adjacent to a field boundary near Methven in Perthshire, although it should be noted that some sediment has crossed the field boundary.

Figure 6.1. Sediment build-up adjacent to field boundary near Methven. Reproduced with kind permission of Dr Jonathan Bowes.

This characteristic of field boundaries to act as barriers to erosion is significant, as one of the well documented by-products of the drive for increased arable production during the 1960s, 70s and 80s was the removal of field boundaries as farmers sought to increase arable area and the efficiency of farming operations. Bowes's research shows that the removal of field boundaries will have increased the potential for topsoil erosion, thus increasing the potential for the effective deepening of cultivation over cropmark monuments. However, the negative effects of soil erosion on the archaeological resource can be at least partially offset by the potential benefits of colluvial deposition which deepen topsoil, providing additional protection to buried features from agricultural activities. It is encouraging that Bowes (2003, 287) has suggested that over 30% of cropmark features in his study area are situated in areas experiencing net deposition. Pollock has noted the potential of hillwash and colluvium in forming a protective layer over archaeological deposits found in arable land, and has argued that exploratory trenches should be opened in areas of colluvium close to cropmarks in an attempt to locate better preserved features than those represented by the cropmarks (Pollock 1997, 357).

6.2.9 <u>The effects of cultivation on buried archaeological remains</u>

While understanding of the types of damage caused to archaeological features by cultivation has been advanced significantly by the *Management of Archaeological Sites in Arable Landscapes* project, it is equally important to recognise the effects that this damage has on the *interpretation* of excavated remains. At its most drastic, cultivation can mean the total destruction of archaeological deposits, precluding entirely the possibility that they will ever be interpreted through observation and excavation. Many deposits preserved in the subsoil survive only to shallow depths, and so this possibility cannot be ignored. For example, Gibson and Tavener (1989, 83) found that a number of the badly damaged archaeological features they excavated at Dundee High Technology Park survived to depths of no greater than 30cm. Barclay (2002, 8) found equally ephemeral archaeological features at Nethermuir near Meikleour, Perthshire. Upon excavating two Iron Age buildings at Ironshill, in Angus, Pollock (1997, 339) found that both structures and a number of adjacent post-holes had been truncated to such an extent that no direct stratigraphic relationships could be identified. Similarly, Gibson and Tavener (1989) found that no stratigraphic relationships could be established between a number of negative features at Dundee High Technology Park. While it is unquestionable that cultivation will seriously hinder the survival and interpretation of shallow or ephemeral archaeological features, it is worth remembering that information loss will vary greatly depending on the nature of the archaeological remains. For example, trial excavations of a souterrain at Fletcherfield near Kirriemuir in Angus (Dick 2002, 104) found general topsoil depth to be about 30cm deep, but that agricultural damage had occurred to the subsoil over much of the area examined. Some of the top surviving course of the souterrain walls had been displaced, but below this upper level, the souterrain was found to be well-preserved.

The vulnerability of certain types of archaeological features to destruction and the impact this can have on interpretation of excavated remains has been described by Guilbert (1975, 214-217). Following the discovery of evidence suggesting the presence of stake-walled structures at the hillfort site of Moel y Gaer, Clwyd, Guilbert attempted to account for the lack of excavated parallels of these, claiming that destruction of stake-holes by ploughing would mean that evidence of this nature would seldom survive in cultivated land. In order to illustrate this, he produced a version of the site plan with the top 24cm of recorded archaeological features removed. This hypothetical site plan contained only a fraction of those features shown in the genuine site plan, and illustrated the severity of information loss which can be attributed to cultivation at cropmark monuments. Irrespective of variations in information loss between cropmark monuments, ultimately, the damage caused by cultivation to archaeological remains means loss of information from a finite resource. Consequently, understanding of this resource is (and will continue to be) hampered.

6.3 Towards a method of assessing ongoing agricultural damage to cropmark monuments

Wordsworth (1999) has suggested that within the next 50 years, the majority of cropmark sites in Scotland will either have disappeared or become so truncated that their archaeological value will be lost. Some excavated examples appear to corroborate Wordsworth's sentiments and studies such as Bowes (2003) and the *Management of Archaeological Sites in Arable Landscapes* project (Oxford Archaeology 2002) point towards the ongoing erosion or attrition of archaeological deposits. Even with excavation, however, it is seldom possible to quantify levels of ongoing damage. To ensure their effective management, it is vital to be able to identify damage to cropmark sites where it occurs, and to identify cropmark sites at greatest risk of ongoing and future agricultural damage. To be able to do this without excavation would represent a significant step forward in their successful management. Furthermore, with a site under cultivation, it is difficult to assess the success of any management measures prescribed, or indeed to monitor any ongoing agricultural activities at the site. In managing the buried archaeological resource, therefore, the identification of ongoing damage is vital.

When the methodological strategy of the current research was being devised in late 1999-early 2000, the *Management of Archaeological Sites in Arable Landscapes* project was still at an early stage, and so the methodologies employed in the project were untested. A number of approaches to identifying ongoing agricultural damage though the current programme of research were explored.

1. Consideration was given to the re-excavation of previously excavated cropmark monuments, particularly some of the Roman temporary camps (of which there are at least 35 in the study area) examined over the last 50 years by prominent Romanists such as Crawford, Feachem and St Joseph. It was hoped that by doing so, data on feature survival and topsoil depth from the older excavations could be compared directly with data provided by the re-excavations undertaken as part of this research. The option was quickly discounted, however, as the data provided by the older excavation reports would not have enabled the accurate location of trenches or comparison of the condition of the archaeological remains (Barclay, pers. comm.). Even with more recent excavation reports, plough scarring is often

excluded from drawings, and discussion will generally concentrate on the nature and significance of the archaeological remains rather than their recent condition and future management.

2. Consideration was also given to a programme of burying markers in the subsoil and subsequent monitoring of movement of these markers caused by ploughing and other agricultural activities. Although a technique of this type has been used successfully elsewhere using glass chips (McAvoy 2002), it was felt that for effective use in this research, such a technique would require monitoring over a number of years, and consequently, this approach was discounted.

Owing to the short length of time that could be allocated to invasive fieldwork as part of this research (two seasons), it was concluded that attempting to monitor changes in the condition of cropmark monuments through direct observation would not be practical. Instead, efforts were made to identify other types of readily available information that could provide indicators of past, ongoing and future damage.

The *Management of Archaeological Sites in Arable Landscapes* project has discussed a number of tools that might be used to identify ongoing damage and risk of damage to buried monuments (Oxford Archaeology 2002, 15), including aerial photography, geophysics, surface collection survey, metal detecting, topographical survey, augering and visual inspection. However, the project has also acknowledged that although many of these methods may be valuable tools at site-specific studies, costs prohibit their wider application (ibid.). In developing a site-specific approach to assessing plough damage risk assessment to buried features, the *Management of Archaeological Sites in Arable Landscapes* project has identified a number of intrinsic site factors which are likely to influence damage and risk to buried features. These include:

1. The nature of the archaeological remains and the quality of their survival.
2. Depth of the current ploughsoil and the extent / thickness of any previous cultivation soils, colluvium and alluvium overlying the archaeology.
3. Soil characteristics such as erodibility, drainage requirements, and susceptibility to compaction.
4. Topography

The project has also used management factors such as cropping patterns and cultivation methods to create a site-specific decision tree method of assessing risk to buried archaeological features without the need for costly or invasive ground works (Oxford Archaeology 2002, 16-18). The method has been tested in the field with excavations, and it has been suggested that although in several cases, the risk assessment method has underestimated actual damage levels (as subsequent excavations have shown), where this has occurred, there have usually been good explanations in the form of "factors that could not have been foreseen in advance" (ibid, 18).

The potential of using surface topography in assessing damage and risk to buried archaeological features has been noted elsewhere. For example, on the basis of research undertaken into the effects of potato cultivation on archaeological sites in Herefordshire, White (2001, 41) has suggested that using land use data and information on slope and topography, predictive modelling of accelerated damage and risk to buried archaeological features might be possible. The Angus and Aberdeenshire Field School (Finlayson *et al.* 1999; Alexander 2000; Strachan *et al.* 2003) has examined surface topography as a variable for consideration in assessing damage to cropmark features. Furthermore, Bowes (2003, 288) has concluded that land surface curvature is the fundamental factor controlling the magnitude of soil loss on cropmark sites.

Because change in the condition of cropmark monuments is difficult to observe directly, this research has used alternative methods to estimate past damage and risk of ongoing damage to cropmark monuments. Although a small programme of excavation has been undertaken, this has been limited by available time and resources. However, by complementing these excavations with topographic survey and data on soil depths and site management histories, it has been possible to develop a technique to estimate the likelihood of past damage to cropmark monuments in the study area. Furthermore, the technique used has been developed to estimate the risk of ongoing damage to cropmark monuments, both at site-specific and regional scales. Although the results produced are likely to be subject to a number of inaccuracies (section 6.15), the technique itself has considerable potential for use in the ongoing management of cropmark archaeology.

6.4 Research Objectives

In keeping with the desk-based study described in chapters 3, 4 and 5, the ideal objective for this section of the current research would have been to quantify cropmark monuments damaged and destroyed in the study area since 1850 and to identify the specific processes responsible. Owing to the restrictions of the data available for analysing condition change at cropmark monuments, however, it has been necessary to adapt the research objectives used to drive the desk-based study for this section of the research. While the desk-based study has sought to quantify and analyse monument loss since 1850 such detailed analysis of the cropmark resource is impossible. Most cropmarks in the study area have been discovered only in the last 30 years, and only a small proportion have been examined through excavation. Given the lack of baseline data against which condition change can be assessed, it has been necessary to use an alternative approach in assessing condition change among cropmarks. Rather than attempting to compare current condition with past observed condition, this section of the current research has sought to establish how the condition of a cropmark site *is likely* to relate to three key variables: management history, micro topography, and topsoil depth. This has been addressed through a programme of limited excavations. Using the results of these excavations, basic modelling in Arcview GIS has been undertaken to identify areas at site scale where damage is likely to have been greatest and correspondingly, where risk of ongoing and future damage is greatest. These site-specific observations have then been extrapolated to a regional scale in an attempt to identify those cropmark monuments which are likely to have been subject to greatest damage. Specifically, this section of the research has sought to

1. Identify relationships between the condition of a cropmark monument and its management history, topography and topsoil depth characteristics through the collection of field data from a number of locations.

2. Identify the parts of a cropmark monument likely to have been subject to the greatest levels of damage through ploughing and other agricultural practices.

3. Extrapolate from the results of 1 and 2 to identify cropmark monuments (and parts of cropmark monuments) at greatest risk from ongoing and future agricultural damage.

6.5 Research Framework

The research objectives outlined have been approached using a combination of excavation, statistical analysis and basic computer modelling. The framework for this approach is summarised in figure 6.2.

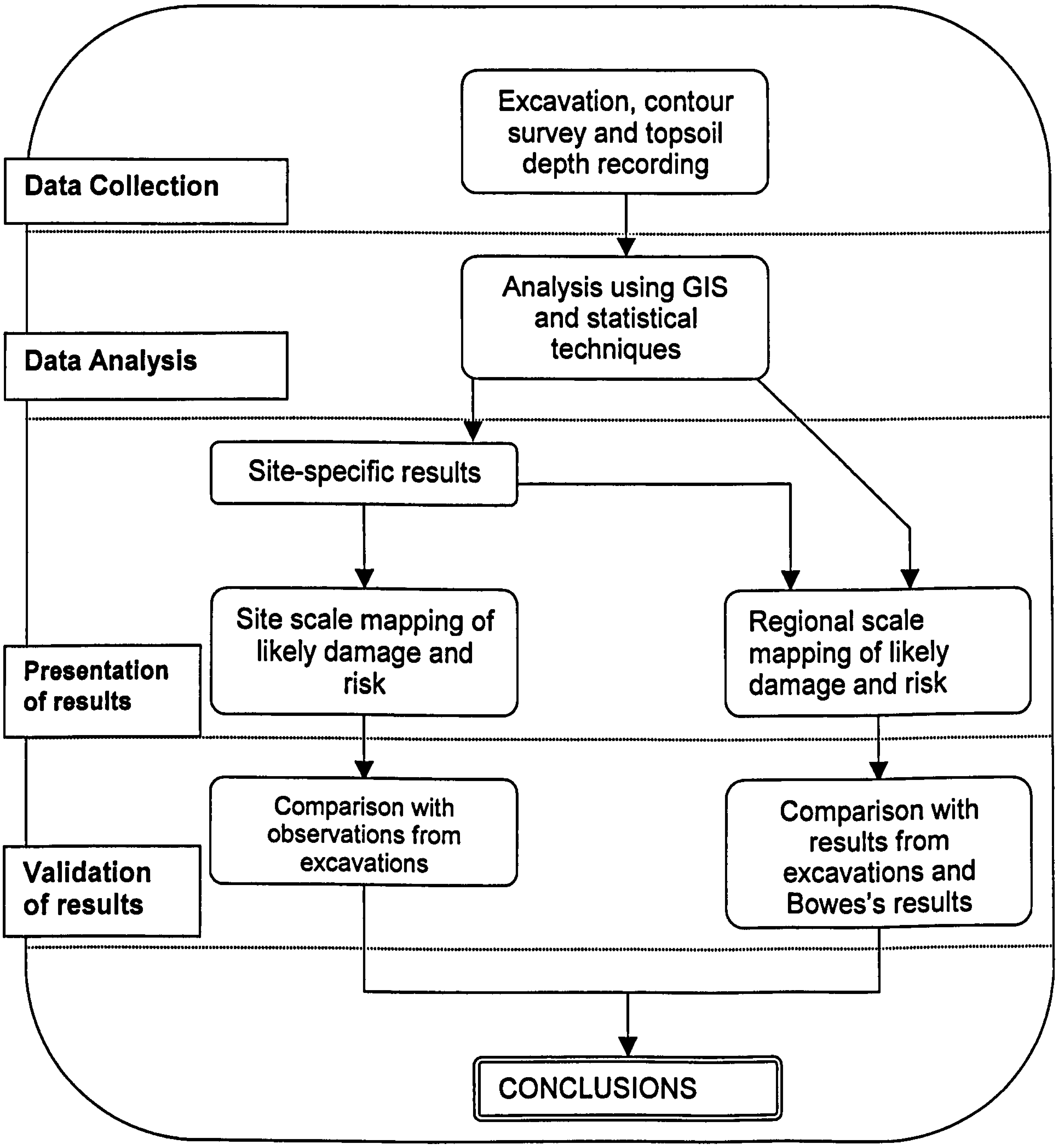

Figure 6.2. Structure of approach used in addressing research the research objectives outlined in section 6.4.

As figure 6.2 shows, the excavations, combined with the recording of topsoil depths and detailed contour surveys, have provided the raw data on which this section of the research is based. The data have been analysed using a combination of computer software packages including Arcview 3.2, SPSS 10 for Windows and Microsoft Excel. This analysis has enabled the formulation of predictive maps displaying probable monument condition at each of the sites examined. Furthermore, the analysis has enabled the identification of cropmark monuments within the study area likely to have experienced greatest damage from agriculture and at greatest risk from ongoing and future agricultural damage. A limited validation of the predictive results produced both at site-specific and regional scales has been undertaken, using the excavation results and the results of Bowes's (2003) erosion modelling within the same study area. Conclusions are presented in section 6.16.

6.6 Excavation and Survey Methodology

The excavation and survey methodology was designed to ensure the rapid retrieval of sufficient data on management history, topography, topsoil depth and observed monument condition to enable the observation and analysis of statistically viable relationships. Time and labour constraints and characteristics particular to each of the sites examined ensured that the approach taken was slightly different at each location, but the underlying methodologies were consistent throughout.

1. At each location, an area of interest was defined on the basis of topographical variations, to ensure that the land surface within each area examined included plane surfaces, convexities and concavities. Within each defined area of interest, elevation points were recorded using an Electronic Distance Measurer (EDM). These recorded data points would later be interpolated using a spline method in Arcview 3.2 to create a contour map and digital terrain model (DTM) of each defined area of interest.

2. Within each defined area of interest, topsoil depths were recorded along a number of transects with the use of an auger. The location of each topsoil depth sample point was recorded using and EDM. Again, these recorded data points would later be interpolated using a spline method in Arcview 3.2 to enable mapping of topsoil depth across each area of interest.

3. Two trenches measuring 2m x 2m were opened at each location, one located on a plane (though not necessarily horizontal) surface above a convex break of slope, with the other located on the convexity itself. At two of the five locations, a third trench was opened at the base of slope. Within each trench opened, topsoil was removed carefully by hand to expose the interface between subsoil and topsoil. Any observed agricultural damage to the subsoil was recorded by photography and drawing. Next, a box section was excavated within each trench to enable the observation of the depth to which agricultural damage penetrated the subsoil. Again, any observed agricultural was recorded by photography and drawing. The position of each trench and section was recorded using an EDM.

4. At each location examined, attempts were made to establish recent management history through discussions with landowners. Although the degree of detail recorded for each management history varied between locations, it was possible to determine a number of important facts pertaining to past agricultural use at each site.

The methods described have proved successful in obtaining sufficient data on management history, topography, topsoil depth and observed monument condition to enable the observation and analysis of statistically viable relationships. The methods of analysis used are described later in this chapter. First, however, site choice is described, followed by an account of the results of each excavation.

6.7 Site choice

The choice of locations at which to undertake excavations was limited by two factors. Firstly, to undertake the excavation of archaeological features would have entailed a commitment to post-excavation analysis, finds processing and the prompt publication of excavation results. Such commitments would not have been realistic, given the range of the overall programme of research being undertaken. Secondly, the level of manpower available for excavations was limited to two or three individuals, all of whom worked on a voluntary basis. To help overcome these limiting factors, these excavations were undertaken in conjunction with existing archaeological projects. This enabled the small-scale excavations necessary for this research to be carried out alongside larger, better resourced excavations, and also helped reduce some logistical difficulties of the excavations, such as arranging site access and equipment hire.

Five locations in Perthshire were investigated over the autumns of 2000 and 2001 (figure 6.3). Four were being examined as part of the University of Stirling's First Farmers Project to investigate Neolithic settlement in East Central Scotland. At each of these four locations, a lithic scatter had been identified through fieldwalking by the Fieldwork Group of the Archaeological and Historical Section of the Perthshire Society of Natural Science (Hallyburton and Brown 2000a; Hallyburton and Brown 2000b). The First Farmers Project was seeking to investigate the range of activities represented by these scatters through extensive trial trenching (Barclay 2002, 1), and the excavations required as part of this research were carried out alongside those of the First Farmers Project. The locations examined were: 1. Mount Stewart, Forgandenny parish (NGR NO 107 175); 2. Upper Gothens, Lethendy parish (NGR NO 167 415); 3. Duncrub, Dunning parish (NGR NO 011 153); 4. Nethermuir of Pittendriech, Lethendy Parish (NGR NO 156 411).

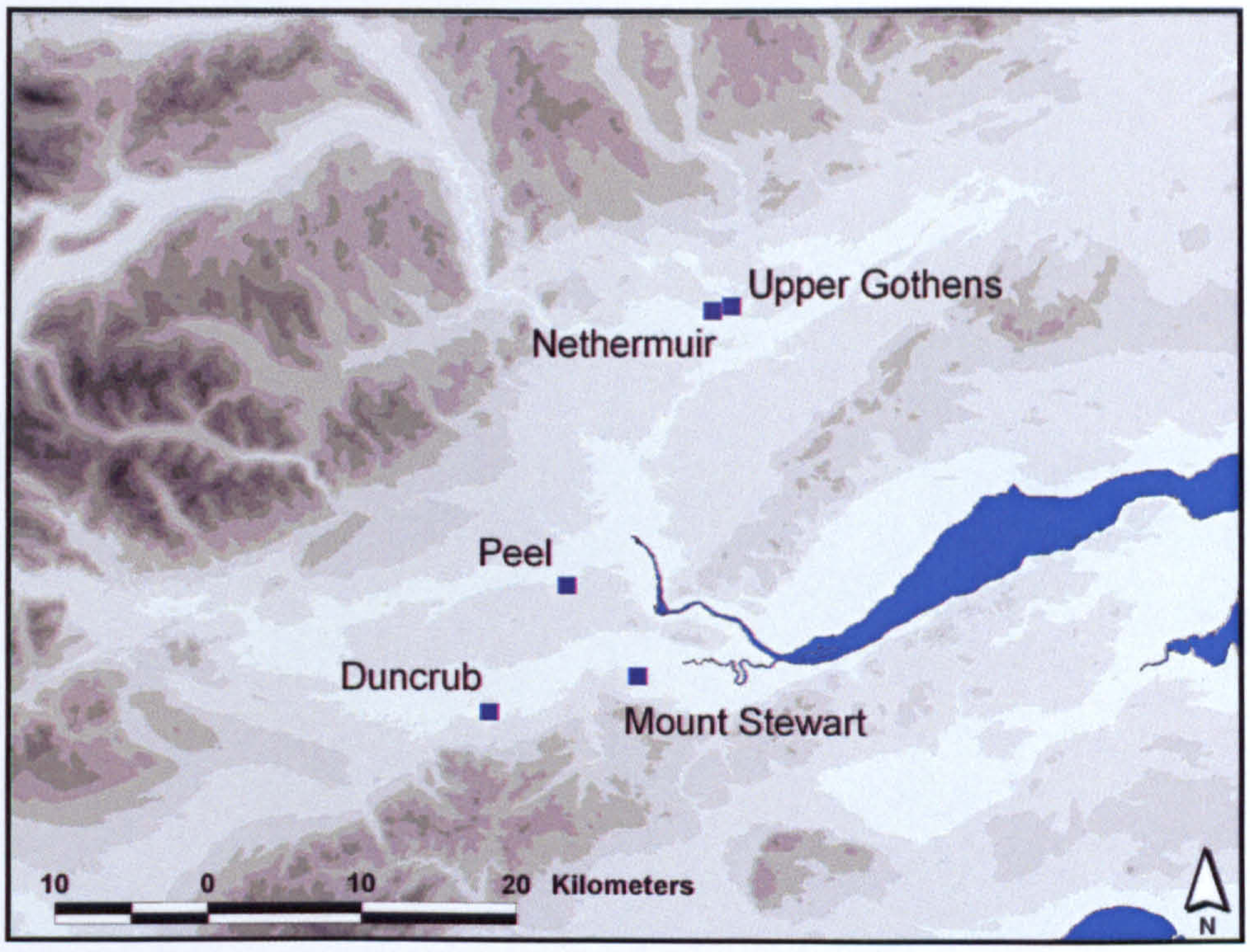

Figure 6.3. Location map showing each of the sites examined.

Limited excavations were commenced at a fifth location in conjunction with the Roman Gask Project, conducted at that time from the Department of Art History and Archaeology, University of Manchester, during October 2000 (Woolliscroft 2002b). This location was at Peel, Tibbermore Parish (NGR NO 060 232). Unfortunately, weather conditions were to prove so adverse that the area being investigated quickly became saturated with rainwater and surface run-off flooded the first trench opened. The excavations were abandoned, and the access restrictions caused by the foot and mouth outbreak of Spring 2001 precluded the possibility of a return the following year. In spite of this, some useful data had been retrieved in October 2000, and these are described later in this chapter. It was hoped that a minimum of six locations would be investigated to ensure a wide range of data was collected. In the event, however, the outbreak foot and mouth outbreak curtailed fieldwork opportunities during 2001, and time constraints ensured that no further excavations were undertaken as part of this research.

6.8 Mount Stewart

6.8.1 Excavations and survey

Mount Stewart is located at NO 107 175, approximately 5km to the south of Perth. A lithic scatter had been identified through fieldwalking in the winter of 1999-2000, though upon excavations by the First Farmers Project, no archaeological features were located (Barclay 2002, 2). A detailed cultivation history for the field examined at Mount Stewart was not established. Through informal discussions with the farmer, however, it was possible to establish that the field had been ploughed regularly for arable cropping in living memory. Furthermore, the field had never been subsoiled.

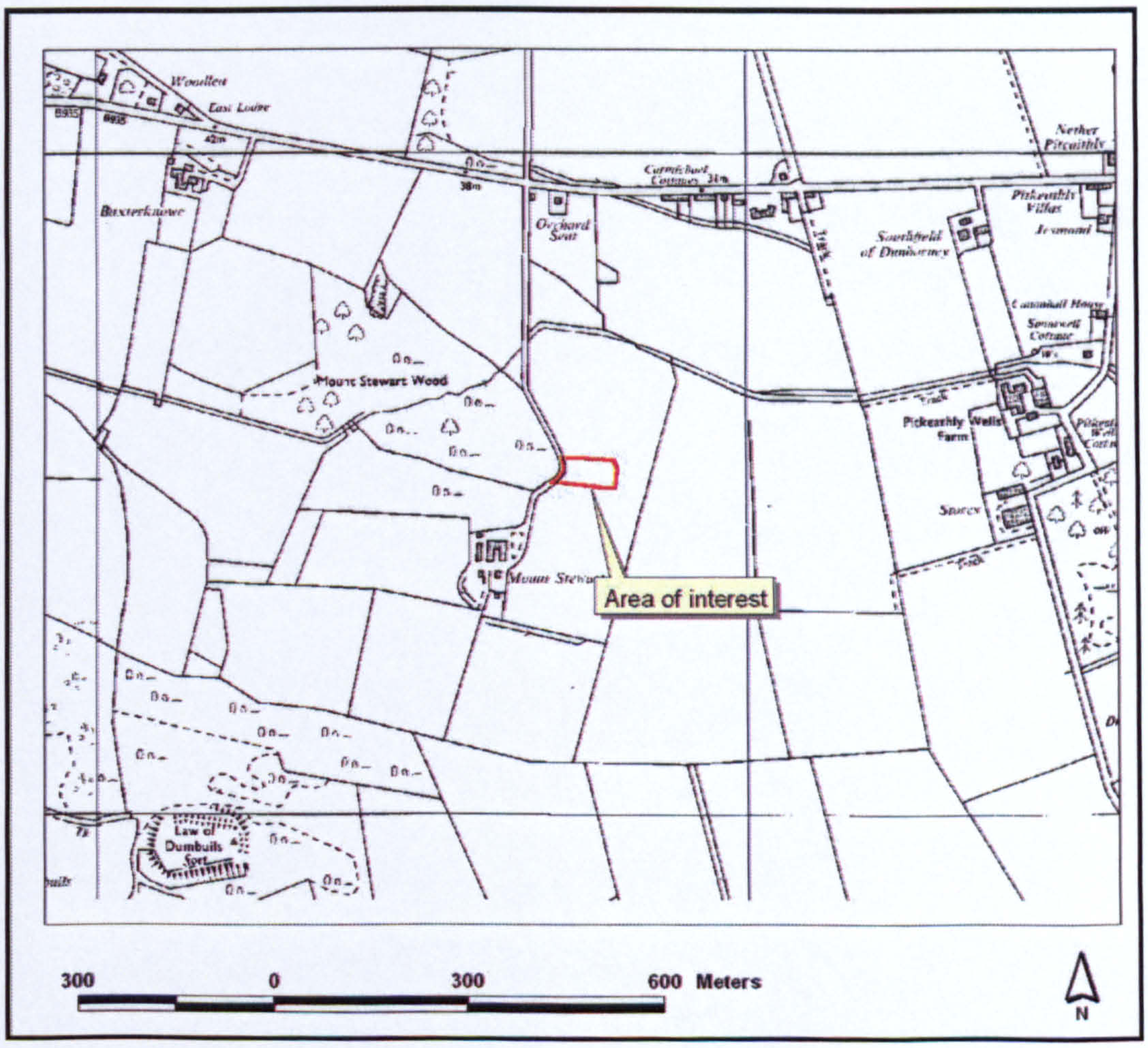

Figure 6.4. Map showing the extent of the area examined at Mount Stewart. ***Base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].***

The area of interest defined at Mount Stewart measured about 80m E-W by about 40m transversely, as shown in figure 6.4. The area, which was in straw stubble at the time of excavating, exhibited considerable variation in topography, with an average slope of approximately 8° running from an elevation of about 50m OD at the west end to just under 40m OD at the east end. At the top of the slope, there was a distinctive convex 'shoulder', while the base of the slope was marked by a gentle concavity before the ground levelled to horizontal.

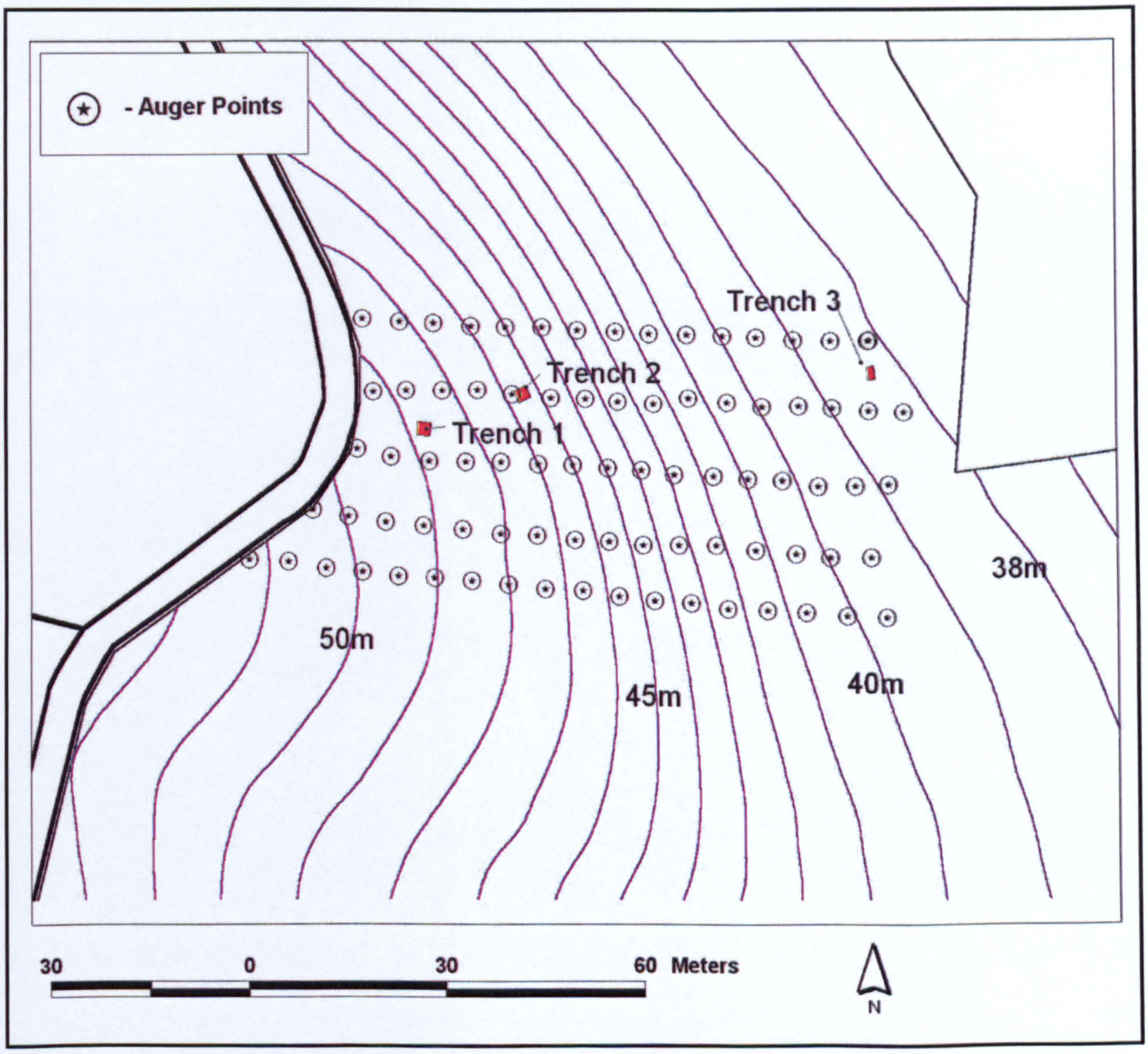

Figure 6.5. Map showing trench positions and auger points at Mount Stewart. Although the contours are accurate relative to each other, the elevation values shown are approximate.

A detailed contour survey of the area of interest was undertaken, with over 500 elevation points recorded. Next, a total of 82 topsoil depths were recorded at 5m intervals along five transects spaced about 10m apart, as shown in figure 6.5. Average topsoil depth across the area examined was found to be 27cm. Three trenches were opened by hand. Trench 1 was located on a relatively level plateau at the top of the slope, Trench 2 on the convex break of slope, and Trench 3 in a flat area beyond the base of the slope, as shown in figure 6.5.

6.8.1.1 Trench 1

Trench 1, measuring 2m x 2m, revealed three distinct parallel plough scars in the stony clay subsoil, running perpendicular to the field boundary, as shown in figure 6.6.

Figure 6.6. Photograph of Mount Stewart trench 1, showing plough scarring.

Upon excavation, these plough scars were found to penetrate about 2cm into the subsoil. The topsoil in Trench 1 was about 23cm in depth, suggesting that the field had been ploughed at least once to a depth of 25cm.

6.8.1.2 Trench 2

Trench 2, also measuring 2m x 2m, was located on the shoulder of the slope, where the topsoil was found to measure between 18cm and 21cm in depth. Two separate sets of parallel plough scars were recorded, each aligned at a slightly different angle, suggesting at least two separate episodes of ploughing where the subsoil had been scarred by the plough, as shown in figure 6.7. These scars were found to penetrate to a depth of about 24cm.

Figure 6.7. Photograph of Mount Stewart trench 2, showing plough scarring.

6.8.1.3 Trench 3

Trench 3 was located on level ground at the base of the slope, and measured 2m x 1m. Here, the topsoil was some 35 - 40cm in depth, and there was no evidence of plough scarring on the surface of the subsoil. In contrast to the subsoil identified in Trenches 1 and 2, the subsoil at this location was light and sandy in texture.

6.8.2 Mount Stewart excavation summary

The degree of agricultural damage recorded in each trench was found to be related to topsoil depth, which in turn appeared to be related to the topography of the area examined. In Trench 1, a relatively level plateau, the topsoil measured approximately 23cm in depth, and in this trench, evidence of at least one episode of plough damage to the subsoil was recorded. By contrast, the topsoil at Trench 2 (on the shoulder of the slope) measured between 18cm and 21cm in depth. In this trench, greater levels of plough damage to the subsoil were recorded, with at least two separate sets of plough scars noted. In Trench 3 (situated in level ground at the base of the slope) the topsoil was about 35 - 40cm deep. In this trench, no agricultural damage was noted. Although no archaeological features were recorded at Mount Stewart, the differing degrees of agricultural damage to the subsoil (in which archaeological deposits might be expected to survive) illustrate the topographic locations at which archaeological deposits might have suffered greatest damage.

6.8.3 Soil depth variation and topography at Mount Stewart

The results of the contour survey have been interpolated using a spline method in Arcview GIS 3.2 to create a DTM of the area examined. By the same method, it has been possible to map land surface curvature and slope, derived from the DTM. Furthermore, the topsoil depths recorded using an auger have been input to the software and interpolated to enable the mapping of topsoil depth across the area of interest. Figures 6.8 and 6.9 show interpolated topsoil depth and land surface curvature at Mount Stewart. Visually, the relationship between the two sets of data is striking, with topsoil the shallowest at the convex western half of the area examined and deepest at the concave eastern end. This relationship is demonstrated more clearly in figure 6.10, which shows topsoil depth in relation to topography along the middle transect running from west to east across the area of interest. As figure 6.10 shows, topsoil depth remains between 20cm and 25cm at the top of the slope, but begins to increase markedly at the foot of the slope, where typical topsoil depth is about 35cm.

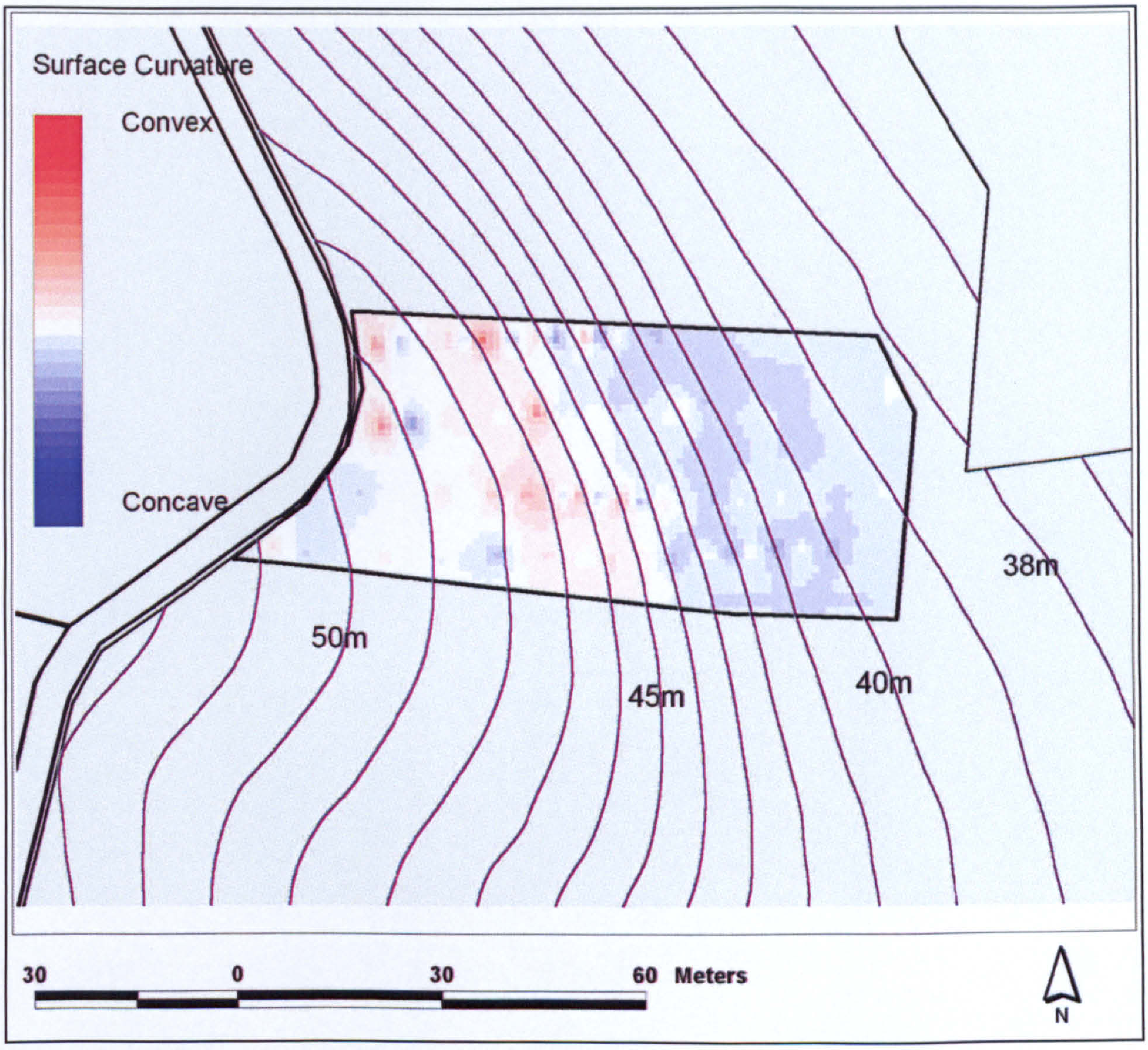

Figure 6.8. Map of interpolated land surface curvature across the area examined at Mount Stewart.

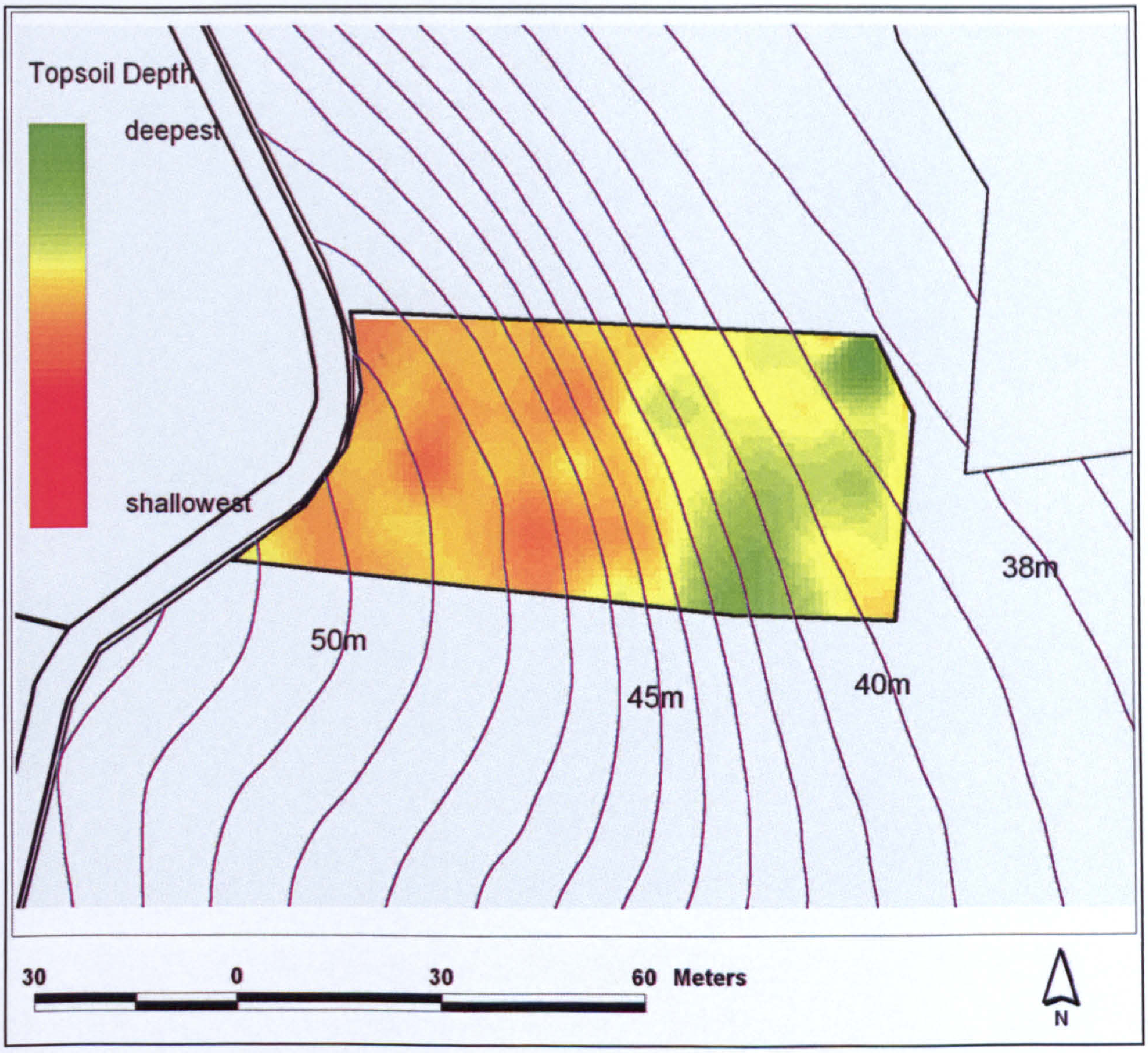

Figure 6.9. Map of interpolated topsoil depth across the area examined at Mount Stewart.

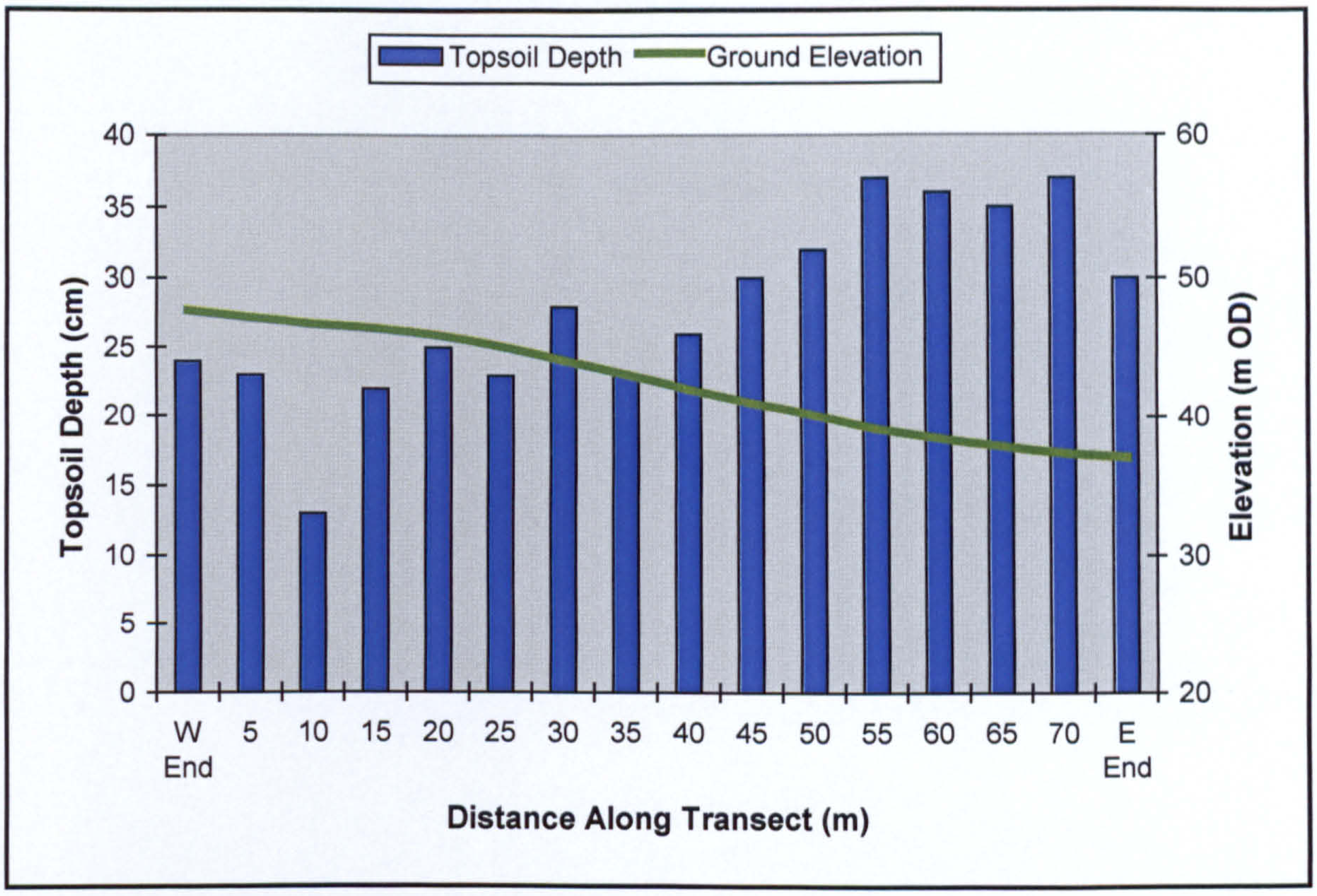

Figure 6.10. Chart showing topsoil depths recorded from a single auger transect at Mount Stewart in relation to topography.

Two statistical tests have been applied to the data retrieved at Mount Stewart to test the significance of the relationship between topsoil depth and land surface curvature. The data retrieved are not normally distributed, and transformations to normalise the data have proved unsuccessful. As a result, it has been necessary to apply nonparametric statistical tests. Figure 6.11 shows a scatterplot with regression line produced using SPSS 10 for Windows with interpolated land surface curvature (independent variable) plotted against recorded topsoil depth (dependent variable). The r^2 value of 0.3523 suggests that about 35% of variation in topsoil depth can be attributed to variations in land surface curvature. To test the relationship further, a Spearman's rank correlation coefficient was obtained for the data. The r_s value of –0.652 is significant at the 0.01 level, and shows, therefore, that there is a significant negative correlation between land surface curvature and topsoil depth at Mount Stewart ($r_s = -0.652$, $n = 82$, $P < 0.01$).

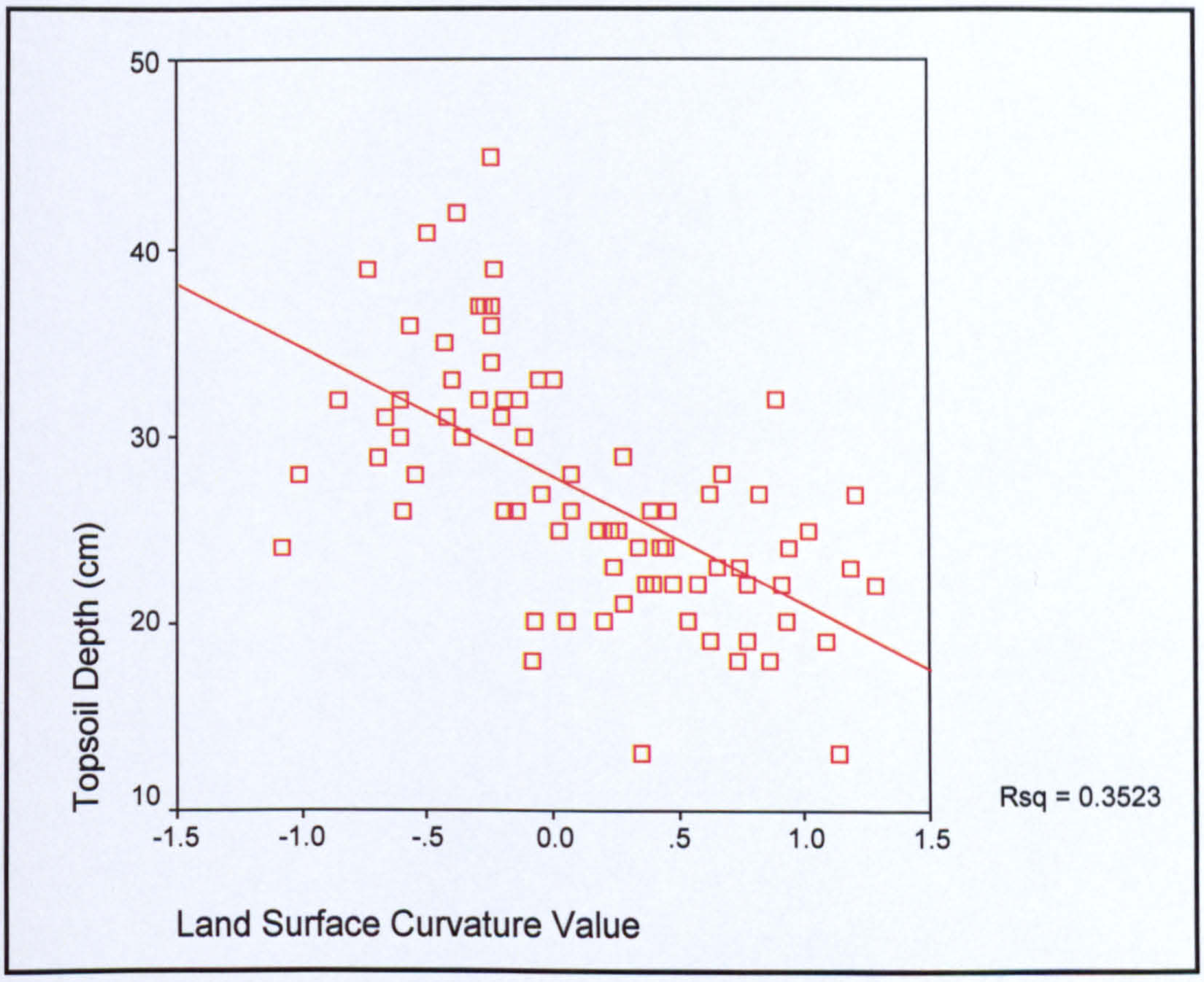

Figure 6.11. Scatterplot of interpolated land surface curvature values against recorded topsoil depths at Mount Stewart. N = 82.

6.9 Upper Gothens

6.9.1 Excavations and survey

Upper Gothens is situated at NO 167 415, approximately 3km south of Blairgowrie, at an altitude of about 55m OD. As with Mount Stewart, Upper Gothens was excavated as part of the First Farmers Project, as the site incorporated both a cropmark enclosure (NMRS no. NO14SE 43) and a flint scatter (Barclay 2001, 35). The enclosure, visible as a sub-circular cropmark measuring about 60m in diameter, was found upon excavation to be early medieval in date. Again, a detailed management history for the site was not established, but discussions with the landowner demonstrated that the field had been used for the growing of cereals, root crops and raspberries, and had been subsoiled on several occasions. The excavations undertaken both as part of this research and under the auspices of the First Farmers Project confirmed much of the known management history, with significant modern agricultural damage noted across the site.

The area of interest selected for examination as part of this research measures about 140m NNW – SSE by about 50m transversely (figure 6.12). The north end of the area, which was in straw stubble at the time of excavating, includes the summit of a low knoll on which the cropmark enclosure is situated. The slope away from this knoll is gentle (about 5° at the steepest point), running for a distance of about 70m before gradually levelling off at the south end of the area of interest. Although this slope incorporates both a convex 'shoulder' and a broad concave area, these are far less pronounced than at Mount Stewart.

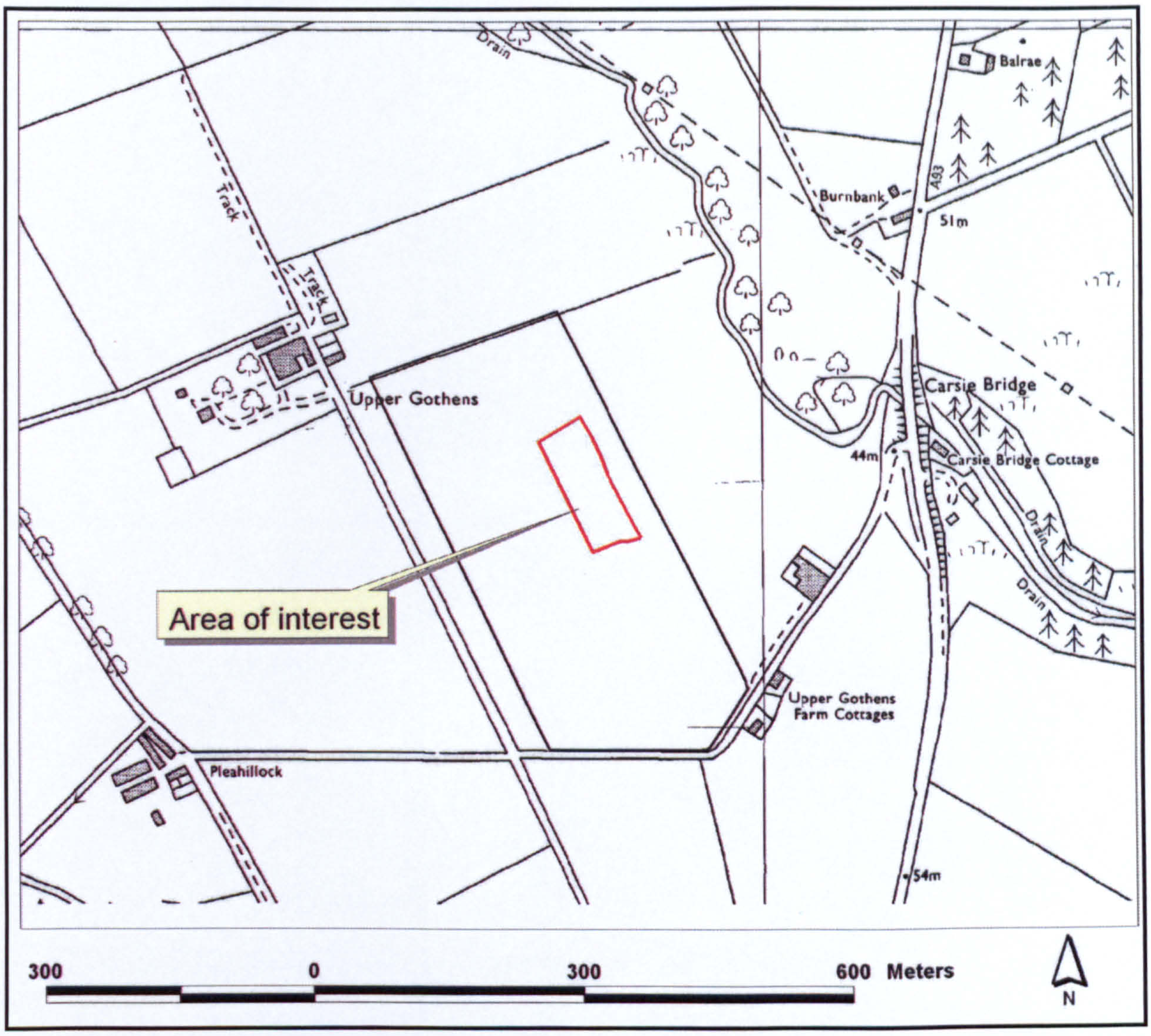

Figure 6.12. Map showing the extent of the area examined at Upper Gothens. ***Base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].***

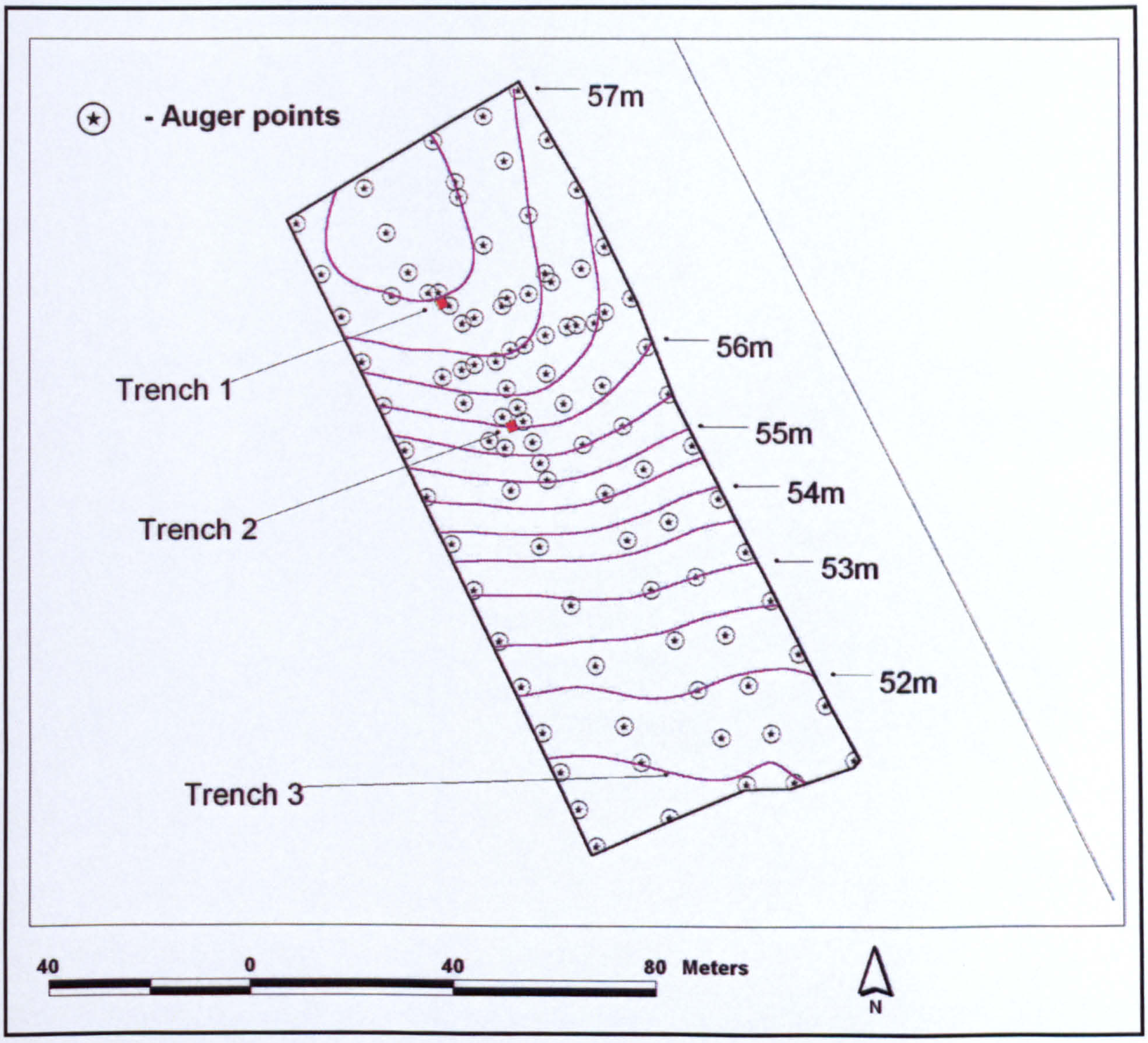

Figure 6.13. Map showing trench positions and auger points at Upper Gothens. Although the contours are accurate relative to each other, the elevation values shown are approximate.

Elevation was recorded at 166 points within the area of interest to create a contour map and DTM. Topsoil depths were recorded at 70 points using an auger, as shown in figure 6.13, and an additional 28 topsoil depth readings were made using baulks within the large excavation trench opened by the First Farmers Project.

Because Upper Gothens is a scheduled ancient monument, the excavations undertaken were in strict accordance with conditions included in the scheduled monument consent (SMC) granted for the excavations by the Scottish Ministers. It was necessary, therefore, to conduct the excavations for this research within the large trench used by the First Farmers Project. As a result, Upper Gothens was the only location examined at which a machine was used to open the areas examined in this research. The first of these areas (referred to here as Trench 1) measured 2m x 2m and was situated within the interior of the enclosure at the north west corner of the First Farmers Project trench, as shown in figure 6.13. This area was on a very slight slope close to the summit of the knoll. The second area examined (referred to here as Trench 2) was situated midway down the gentle slope running south from the knoll. There was no pronounced convexity at this location. A third trench (Trench 3) measuring 2m x 1m was opened in a flat area at the base of the slope, outside the scheduled area.

Because the areas examined lay within the larger excavation trench of the First Farmers Project, it was not always possible to observe topsoil depth directly in section. As each of the areas examined was located close to the edge of the First Farmers Project trench, however, it was possible to extrapolate topsoil depth from the adjacent baulks. Given possibility of error in this extrapolation, topsoil depth figures outlined below are approximate.

6.9.1.1 Trench 1

In trench 1, extrapolated topsoil depth was found to be between 20cm and 25cm. On plan, at least five separate plough scars were identified, three running roughly N-S and two running roughly E-W. Only one of these showed clearly in section, however, as figure 6.14

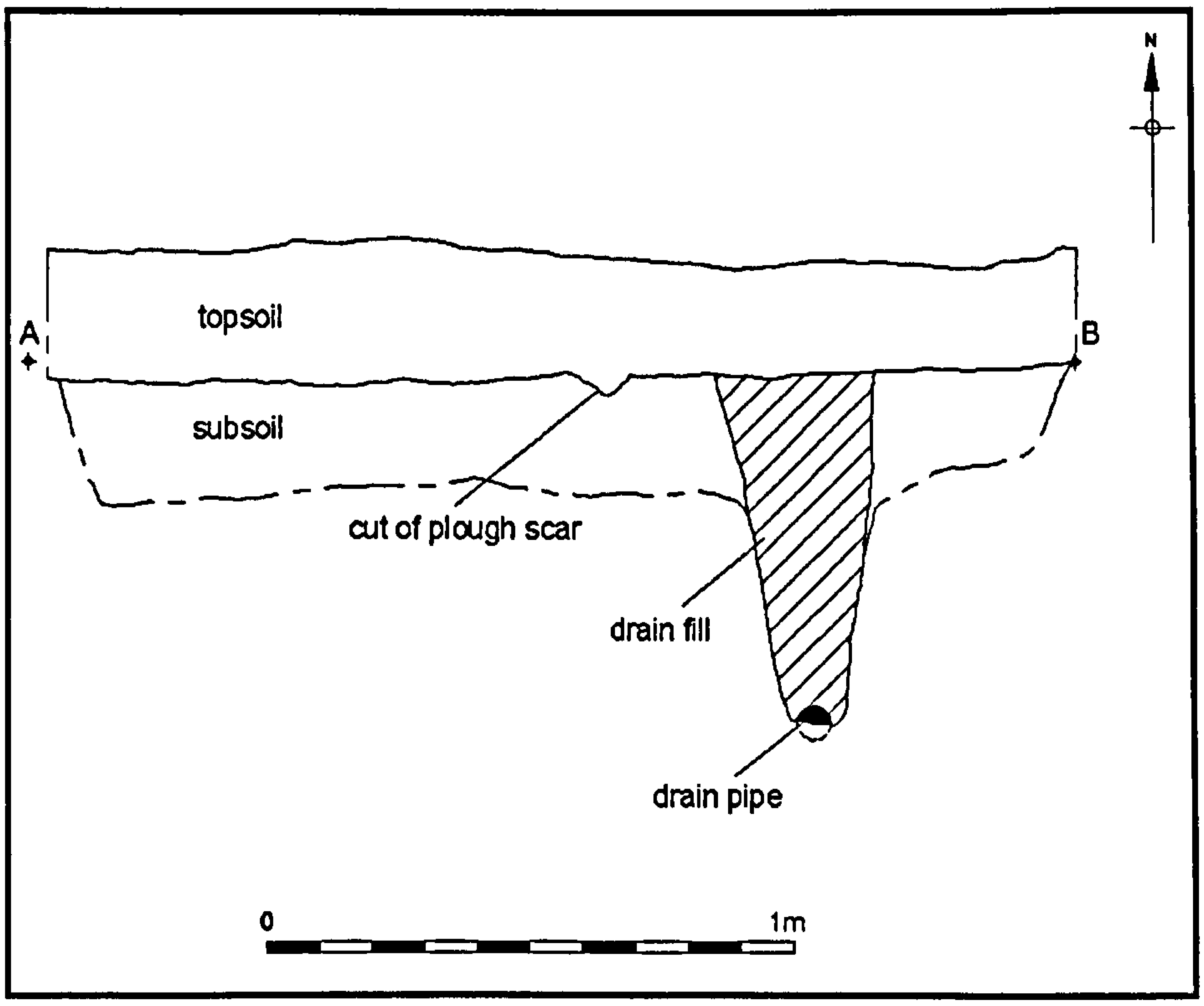

Figure 6.14. Drawing of south facing section of trench 1, Upper Gothens.

shows. The section also demonstrated the presence of a ceramic field drain that had not been immediately apparent on plan. The cut for this field drain, which measured 30cm wide the top, was cut some 90cm – 95cm below ground level (70cm into the subsoil). No archaeological features were noted.

6.9.1.2 Trench 2

Trench 2, positioned within the main trench of the First Farmers Project excavation, measured 2m x 2m. Although it was positioned on a slope, the topsoil was found to be surprisingly deep, measuring between 35cm and 40cm in depth. Although no plough scarring was noted in this trench, a long scar measuring about 7cm in width ran through the centre of the trench, as shown in figure 6.15.

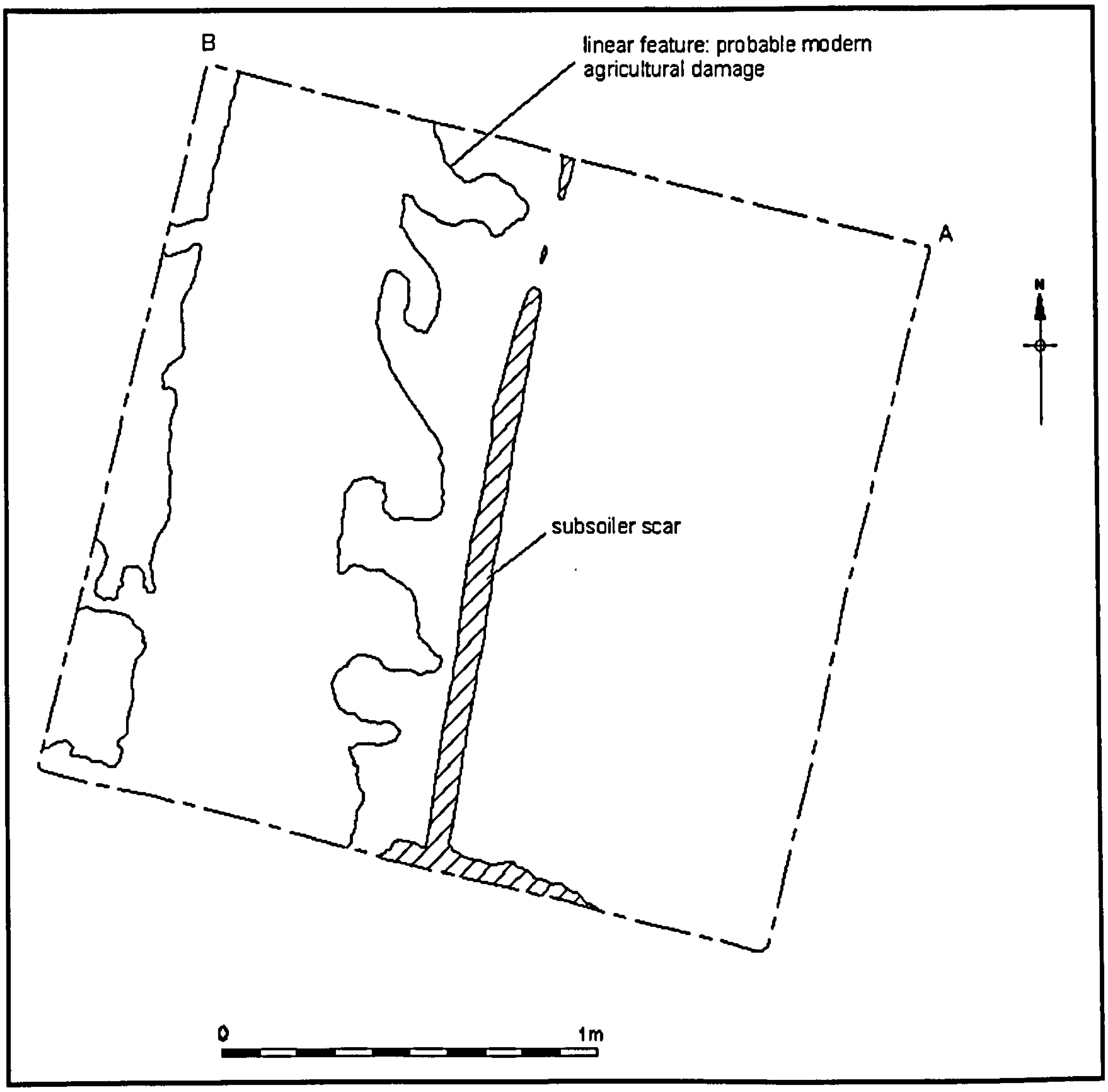

Figure 6.15. Plan drawing of trench 2, Upper Gothens showing subsoiler scarring.

In section, this scar was found to be situated at the centre of a U-shaped area of disturbance penetrating to a depth of about 50cm below ground level and spreading to a width of about 40cm at the subsoil surface. This disturbed area contained a mixture of topsoil and subsoil, and although indistinct, comparison with other agricultural disturbance noted elsewhere on site suggested that this disturbance could be attributed to subsoiling. The only other feature of note in trench 2 was a poorly-defined linear feature measuring between 50cm and 80cm wide, running parallel to the subsoiler scar. Although on plan this feature bore superficial resemblance to a ditch, in section, it was found to incorporate a mixture of topsoil and subsoil and was overlain at its eastern side by relatively undisturbed subsoil, as shown in figure 6.16.

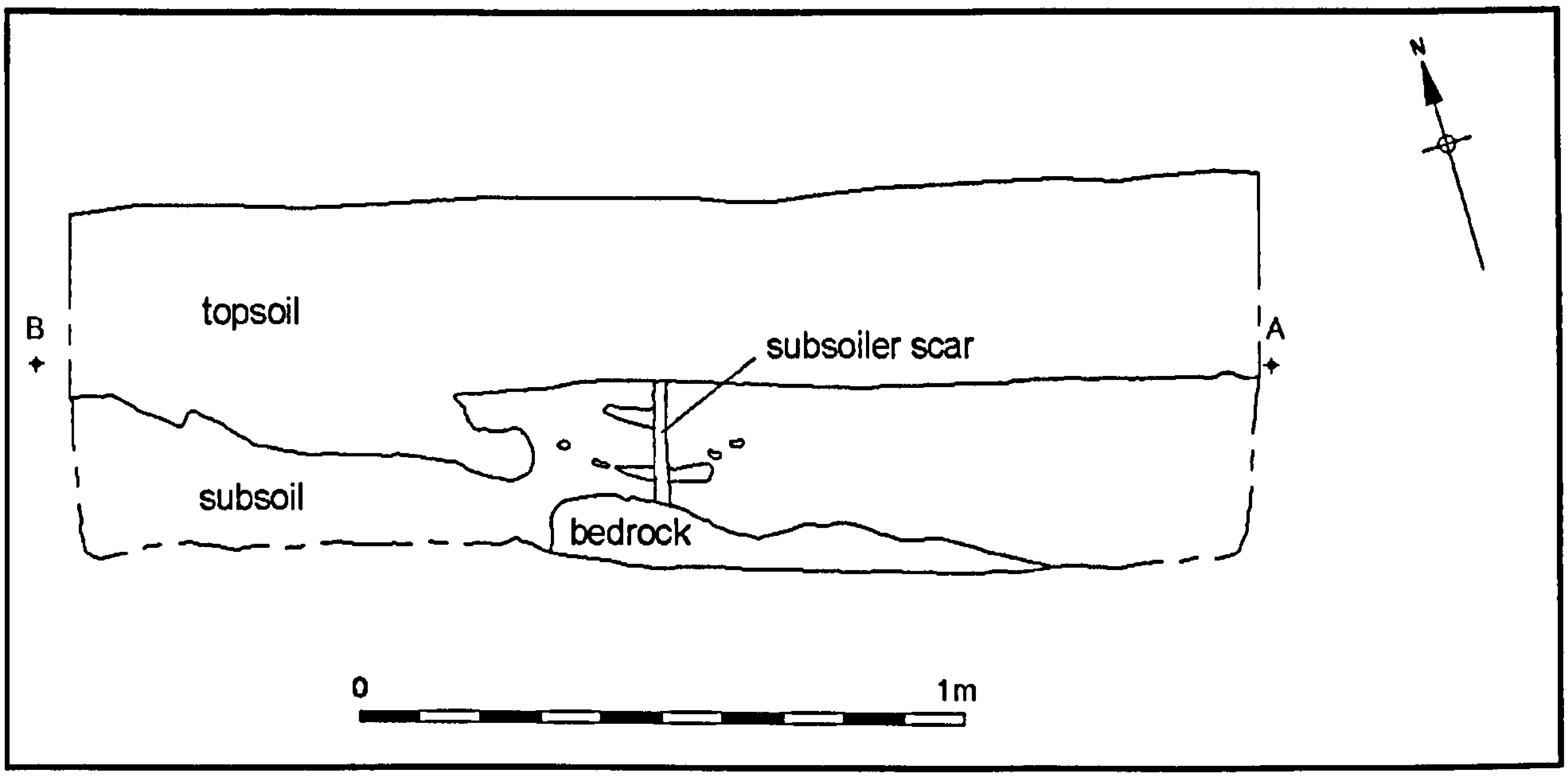

Figure 6.16. Drawing of south facing section in trench 2, Upper Gothens.

Given its content and parallel alignment with the subsoiler scar, this feature was interpreted as modern agricultural damage, although its precise cause could not be demonstrated.

6.9.1.3 Trench 3

Trench 3 was located on level ground at the slope base. The trench was laid out to measure 2m x 2m, but it became apparent at an early stage that the topsoil was significantly deeper than would be practical to excavate. A small pit measuring 20cm x 20cm was excavated instead. The topsoil at this point was found to be 66cm in depth, and lay above subsoil composed almost entirely of sand. No agricultural damage or archaeological features were noted.

6.9.2 Upper Gothens excavation summary

As with Mount Stewart, the degree of agricultural damage recorded in each trench at Upper Gothens was found to be related to topsoil depth, which in turn appeared to be related to the topography of the area examined. In Trench 1, which was situated on a convexity close to the knoll summit, the topsoil measured between 20cm and 25cm in depth. Agricultural damage noted in this trench was significant, with plough scarring evident at depths of about 25cm and a field drain penetrating to nearly a metre in depth. In Trench 2, located midway down the slope, the topsoil was found to measure between 35cm and 40cm in depth. In this trench, no plough scarring was noted, but disturbance to the subsoil caused by subsoiling was evident, penetrating to a depth of about 50cm below the ground surface. Further agricultural damage was noted in this trench, although its precise cause could not be determined. In Trench 3, located in a flat area at the base of the slope, topsoil was found to measure 66cm in depth, and no agricultural damage was noted.

6.9.3 Damage noted in the First Farmers Project trench

Because two of the three trenches examined in the current research were located within the First Farmers Project trench, it was possible to observe further agricultural damage in the surrounding area. In keeping with the observations made within Trench 1, agricultural damage was most pronounced at the summit of the knoll, which was heavily scarred by plough marks, subsoiler scars and field drains. Many of these ran at right-angles to each other, creating a lattice effect on the subsoil surface, as shown in figure 6.17. The excavator estimated that more than 75% of the cleaned surface beneath the topsoil within the First Farmers Project trench was disturbed by modern agricultural activities (Barclay 2001, 34).

Figure 6.17. Photograph of agricultural damage in the trench opened by the First Farmers Project. The three parallel features towards the far end of the trench are palisade slots.

6.9.4 Soil depth variation and topography at Upper Gothens

As with Mount Stewart, the results of the contour survey have been interpolated using a spline method in Arcview GIS 3.2 to create a DTM of the area examined. Using the same method, it has been possible to map land surface curvature and slope on the basis of the DTM. Furthermore, the topsoil depths recorded using an auger have been input to the software and interpolated to map topsoil depth across the site. Figures 6.18 and 6.19 show interpolated topsoil depth and land surface curvature at Upper Gothens. In keeping with the results from Mount Stewart, a visible relationship exists between the two sets of data, with topsoil shallowest at the convex knoll at the northern end of the area examined and deepest at the concave and flat areas at the base of the slope. This relationship is demonstrated further in figure 6.20, which shows topsoil depth in relation to topography along the middle transect running from NNW to SSE across the area of interest. As figure 6.20 shows, topsoil depth varies between about 19cm and 35cm on the knoll and at the top of the slope, but increases to over 60cm at the base of the slope. It is, however, worth noting the variations in recorded topsoil depth within small geographic areas. At the northern end of the transect, figure 6.20 shows that topsoil depth at point 4 (30m down transect) is about 35cm and about 19cm at point 5 (40m down transect). This marked variation in topsoil depth over such a short distance was noted as surprising during the auger survey, but given the high levels of agricultural disturbance to the subsoil revealed by the excavations, variations of this nature are perhaps to be expected.

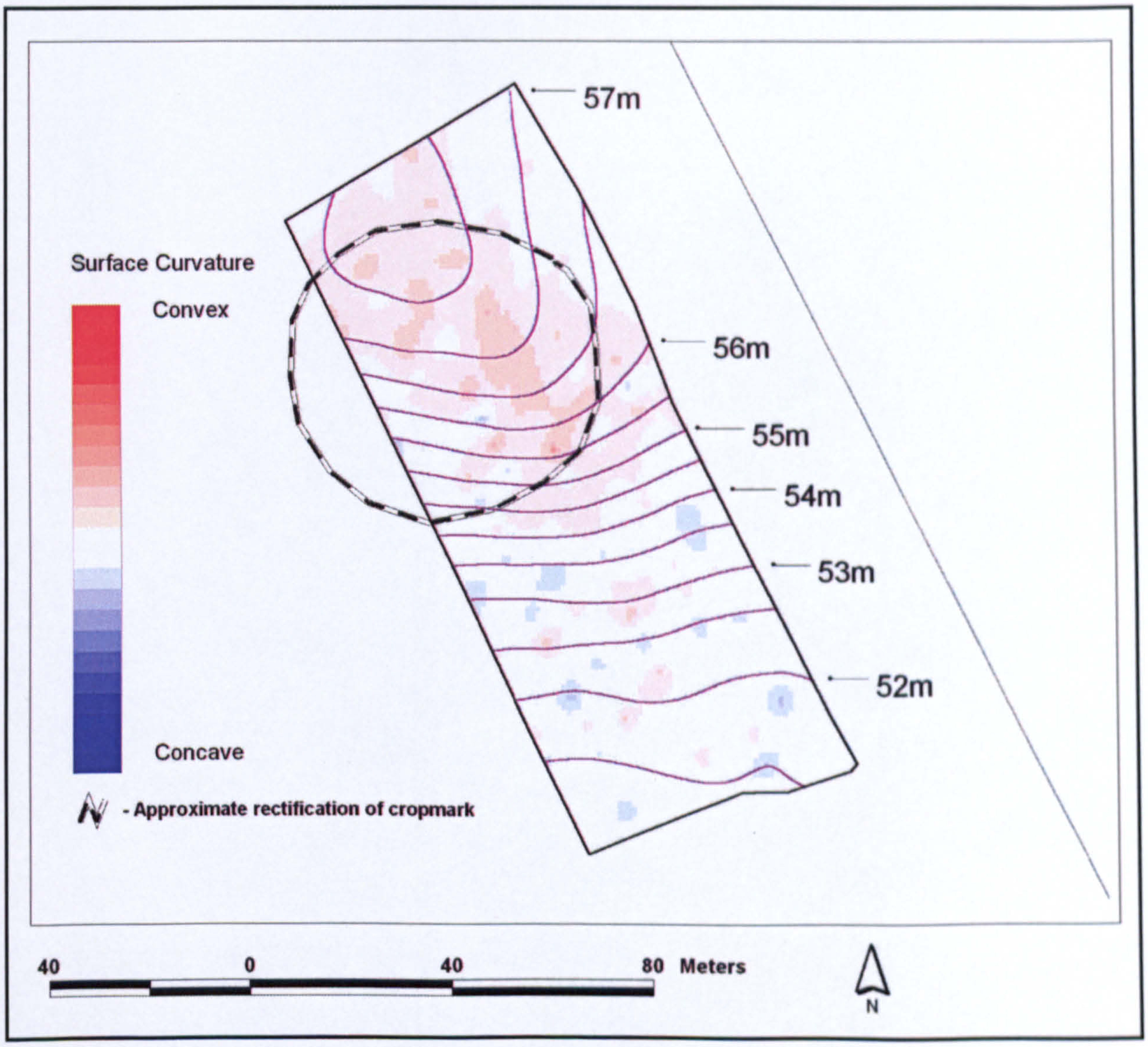

Figure 6.18. Map showing interpolated land surface curvature across the area examined at Upper Gothens.

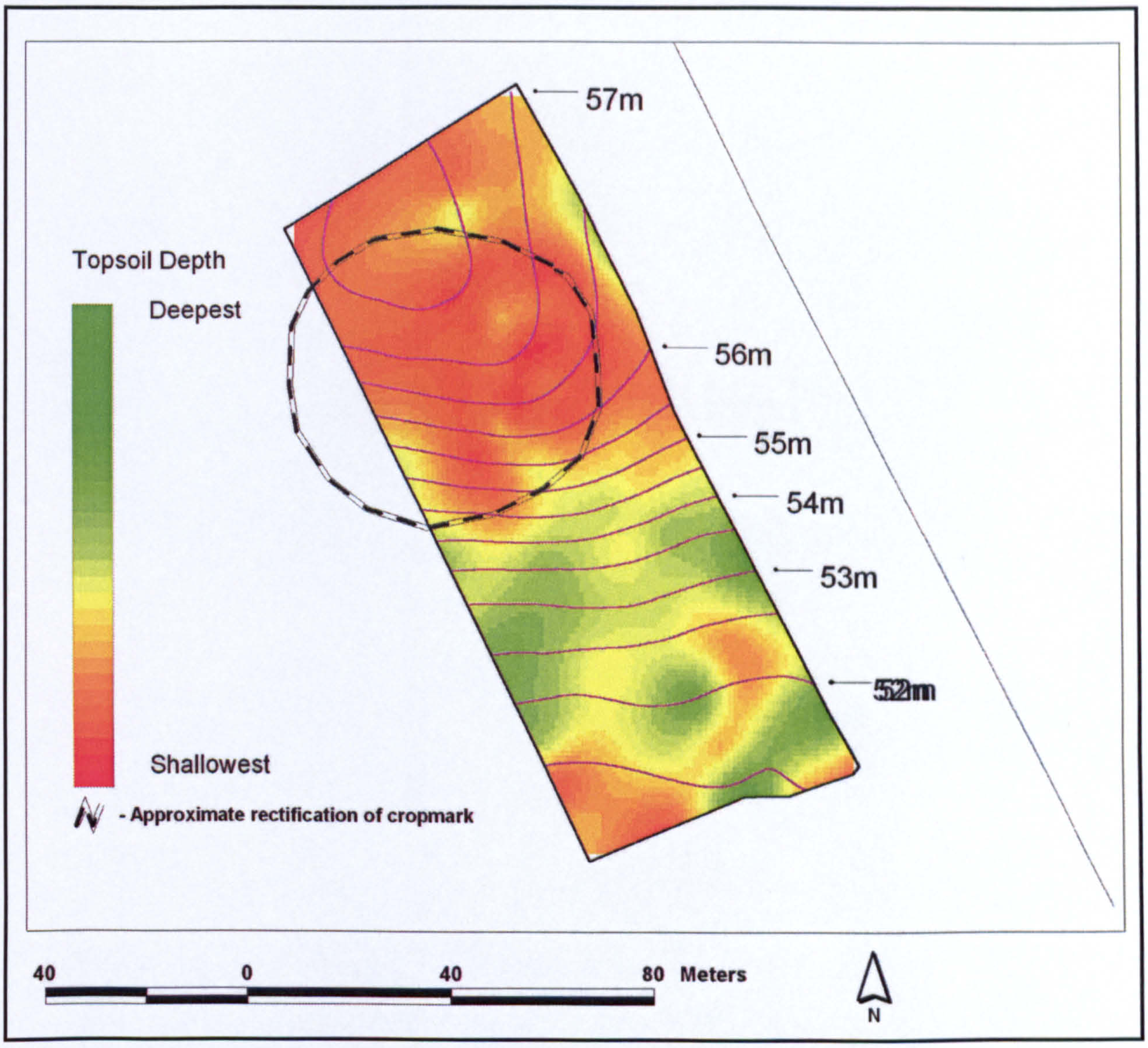

Figure 6.19. Map showing interpolated topsoil depths across the area examined at Upper Gothens.

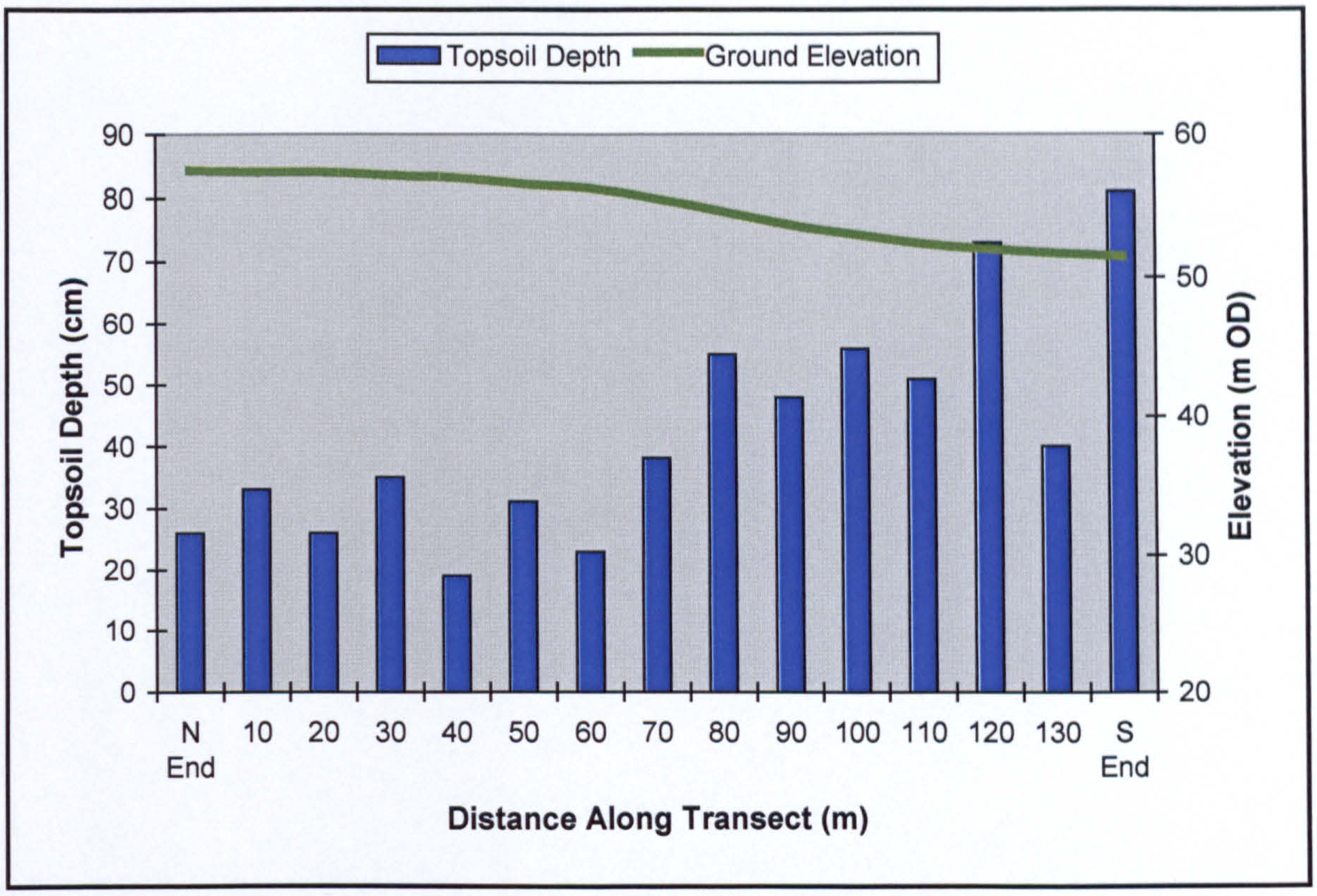

Figure 6.20. Chart showing topsoil depths recorded from a single auger transect at Upper Gothens in relation to topography.

Two statistical tests have been applied to the data retrieved at Upper Gothens to test the significance of the relationship between topsoil depth and land surface curvature. The data retrieved are not normally distributed, and transformations to normalise the data have proved unsuccessful. As a result, it has been necessary to apply nonparametric statistical tests. Figure 6.21 shows a scatterplot with regression line produced using SPSS 10 for Windows with interpolated land surface curvature (independent variable) plotted against recorded topsoil depth (dependent variable). The r^2 value of 0.3415 suggests that about 34% of variation in topsoil depth can be attributed to variations in land surface curvature. Furthermore, the fan-shaped distribution of points in figure 6.21 shows that topsoil depths are consistently shallow in areas of pronounced convexity, but that in areas of where convexity is less pronounced or land surface is planar or concave, recorded topsoil depth is much more variable.

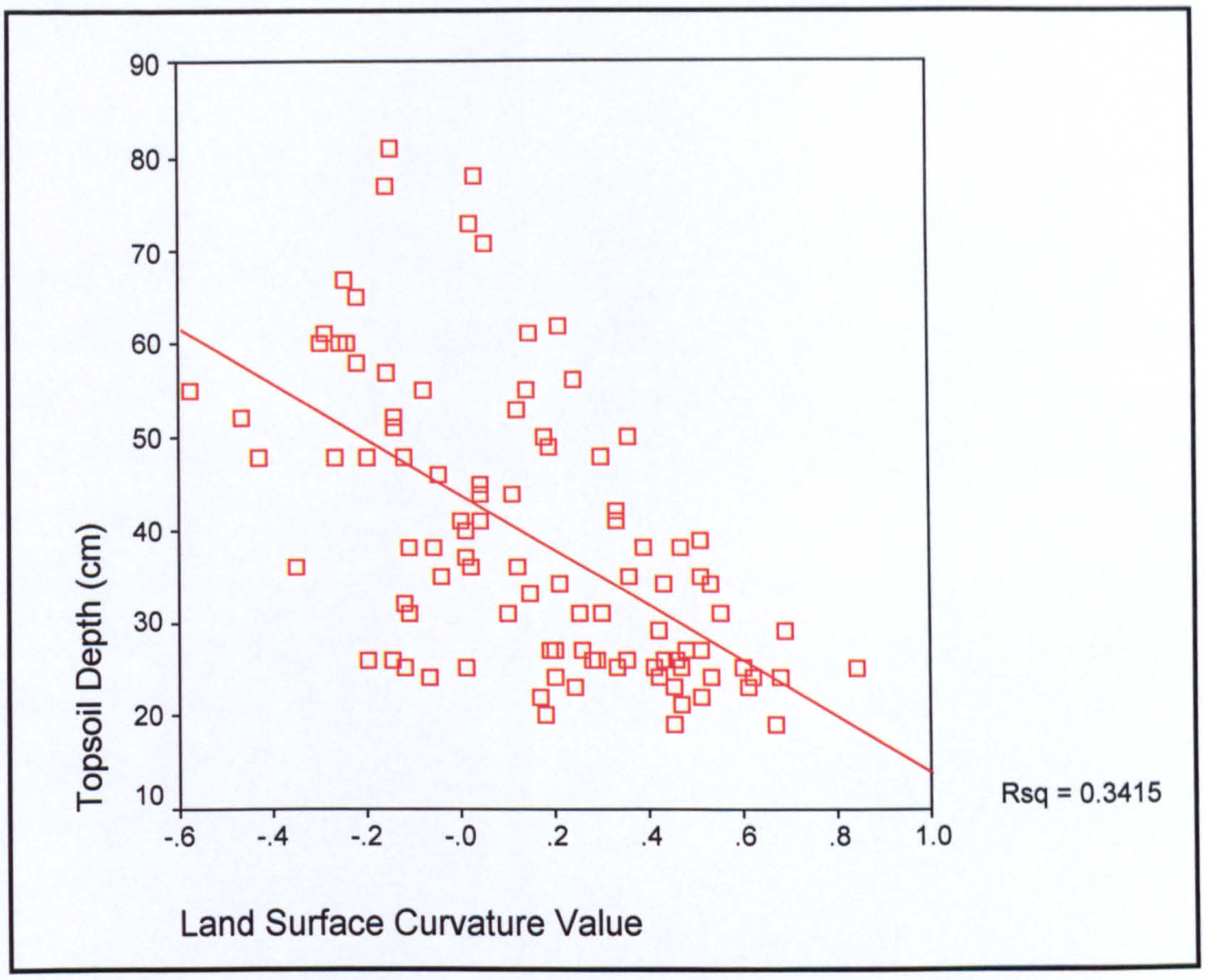

Figure 6.21. Scatterplot of interpolated land surface curvature values against recorded topsoil depths at Upper Gothens. N = 98.

In addition to the regression analysis, a Spearman's rank correlation coefficient was obtained for the data. The r_s value of –0.609 produced is significant at the 0.01 level, and shows, therefore, that there is a significant negative correlation between land surface curvature and topsoil depth at Upper Gothens (r_s = –0.609, n = 98, $P < 0.01$).

6.10 Duncrub

6.10.1 Excavations and survey

The area investigated at Duncrub is located at NO 011 153, approximately 1km to the N of the village of Dunning in Strathearn, at about 45m OD. The flint scatter examined by the First Farmers Project was located on a raised sandy beach at the western side of a former loch. This location coincided with a number of cropmarks thought to represent the remains of prehistoric unenclosed settlement and souterrain (recorded in the NMRS as NO01NW 51). Upon excavation, these cropmarks were found to mark the positions of large holes caused by the removal of parkland trees in the mid-20th century (Barclay and Wickham-Jones 2002, 2), and no archaeological features were found. Discussions with the landowner and current farmer revealed that the area of interest had been used for the growing of cereals and potatoes for at least forty years, and that the field had been subsoiled in recent years.

The area of interest selected for examination as part of this research measured about 50m NNE – SSW by about 50m transversely, as shown in figure 6.21. The western half of the area contained the summit of the raised beach examined by the First Farmers Project, which sloped gently towards the east. This slope broke about 20m from the eastern edge of the area examined, dropping sharply to the flat boggy area of the former loch, as shown in figure 6.22.

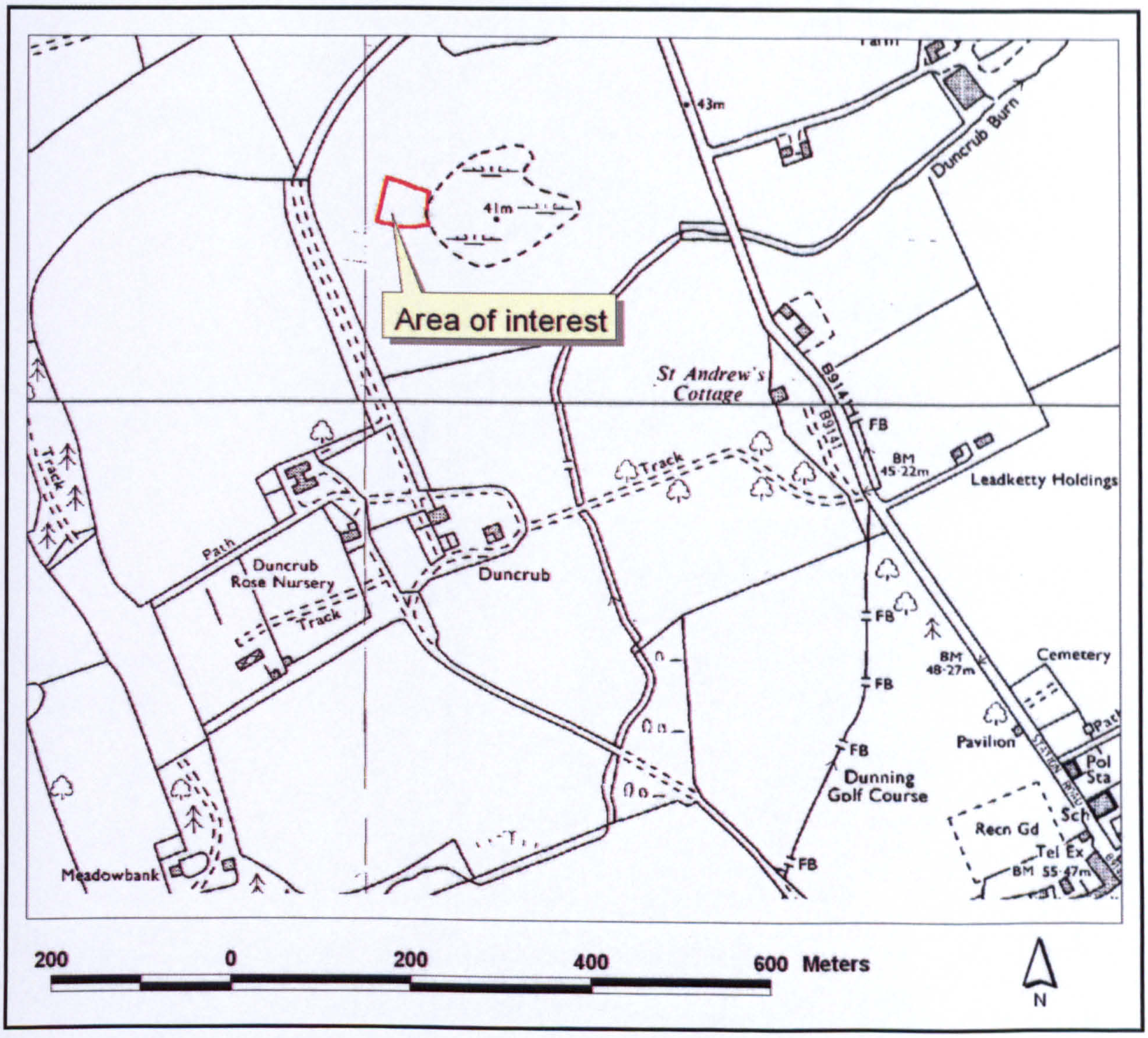

Figure 6.22. Map showing the extent of the area examined at Duncrub. ***Base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].***

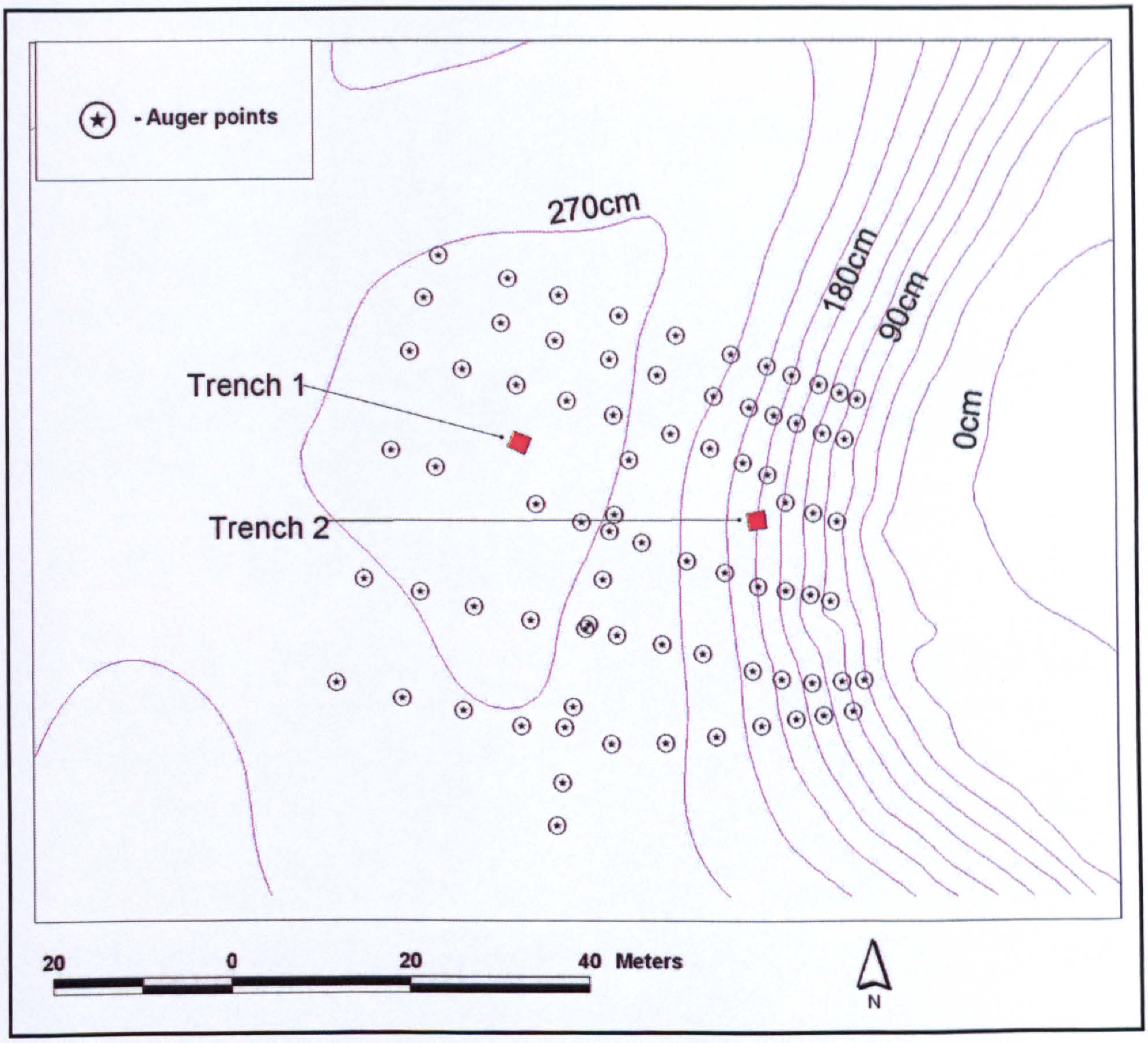

Figure 6.23. Map showing trench positions and auger points at Duncrub. The contours (at 30cm intervals) have not been corrected to a benchmark. They are accurate relative to each other, however.

After the contour survey was completed, topsoil depths were recorded at 76 points (along 7 transects) using an auger and two trenches measuring 2m x 2m were opened. Trench 1 was located at the summit of the raised beach, towards the western end of the area examined, while Trench 2 was situated at the top of the short steep slope at the eastern end of the area examined, as shown in figure 6.22. No attempt was made to open a third trench at the boggy base of this slope, as machine trenching as part of the First Farmers Project had shown this area to be waterlogged, with soil accumulations greater than 90cm in depth.

6.10.2 Duncrub excavation summary

In both trenches opened, topsoil depth was considerably greater than expected, but some variation in topsoil depth was noted between the two. Topsoil in Trench 1 (located on the low knoll) was found to measure between 35cm and 60cm in depth, while the topsoil in Trench 2 (located on the 'shoulder' of the slope) was found to measure between 30cm and 40cm in depth. No agricultural damage to the subsoil was identified in either trench, but the incorporation of subsoil material within the topsoil was noted in Trench 2, suggesting possible recent agricultural disturbance at this location. Subsoil disturbance caused by tree roots was identified in both trenches.

6.10.3 Soil depth variation and topography at Duncrub

The auger survey confirmed some of the observations made during the excavations at Duncrub, showing a relationship between topsoil depth and topography, although this relationship was only apparent at the short steep slope at the east end of the area examined. At the top of this slope, the topsoil depth was found to be about 24cm – 27cm, but in each transect examined, topsoil depth was found to increase rapidly further down the slope. In the western half of the area examined, the topography was much more gentle. In this area, topsoil depth was found to vary between about 25cm and 60cm, but was generally about 28cm - 30cm, as shown in figure 6.23.

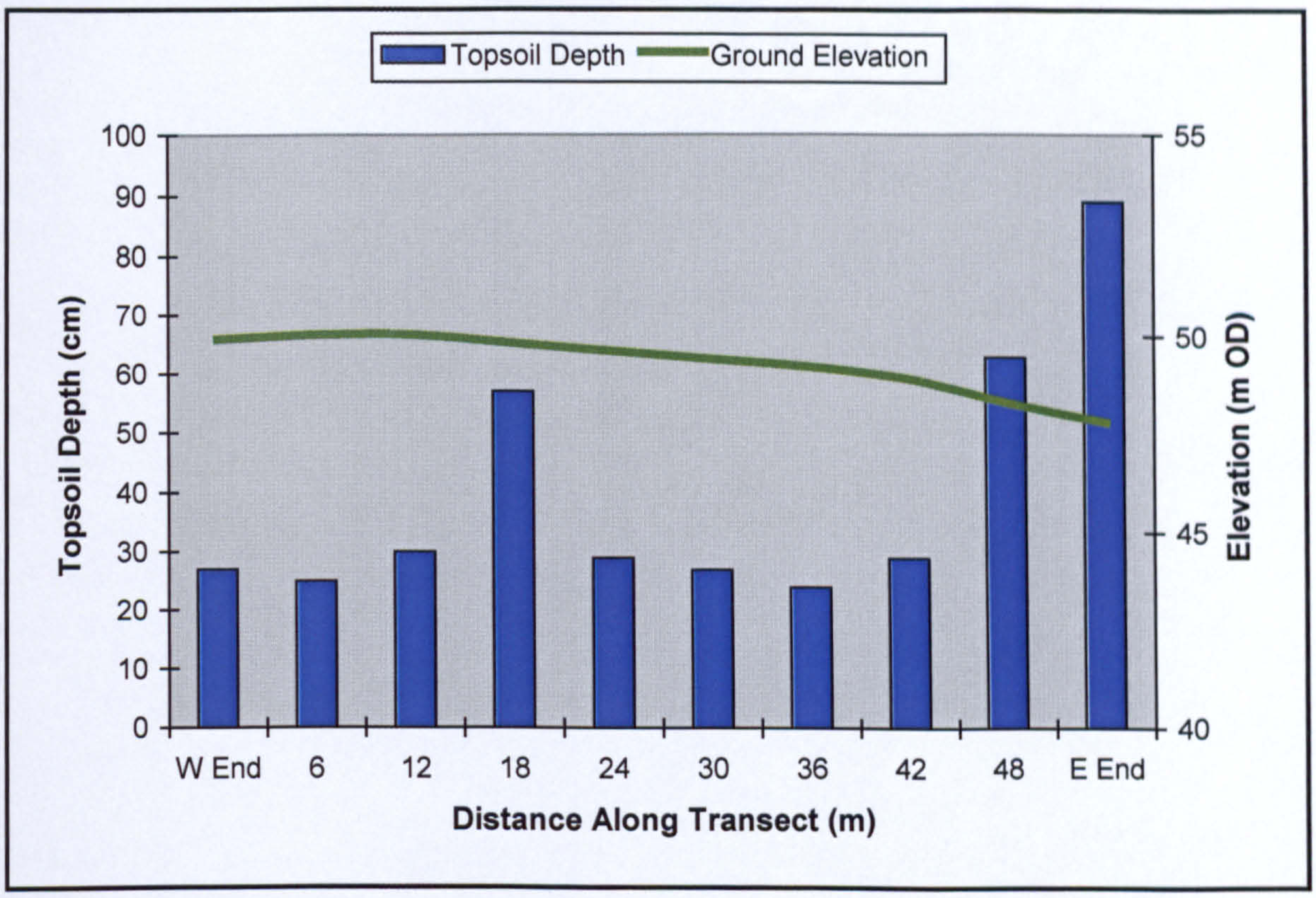

Figure 6.24. Chart showing topsoil depths recorded from a single auger transect at Duncrub in relation to topography.

As with the data retrieved at Upper Gothens and Mount Stewart, attempts to normalise the data failed and nonparametric statistical tests have been used. Figure 6.24 shows a scatterplot with regression line with interpolated land surface curvature (independent variable) plotted against recorded topsoil depth (dependent variable). The r^2 value of 0.2977 suggests that only about 29% of variation in topsoil depth can be attributed to variations in land surface curvature. To test the relationship further, a nonparametric (Spearman's rank) correlation coefficient was obtained for the data. The r_s value of –0.400 produced is significant at the 0.01 level, and shows, therefore, that there is a significant negative correlation between land surface curvature and topsoil depth at Duncrub (r_s = –0.400, n = 78, $P < 0.01$).

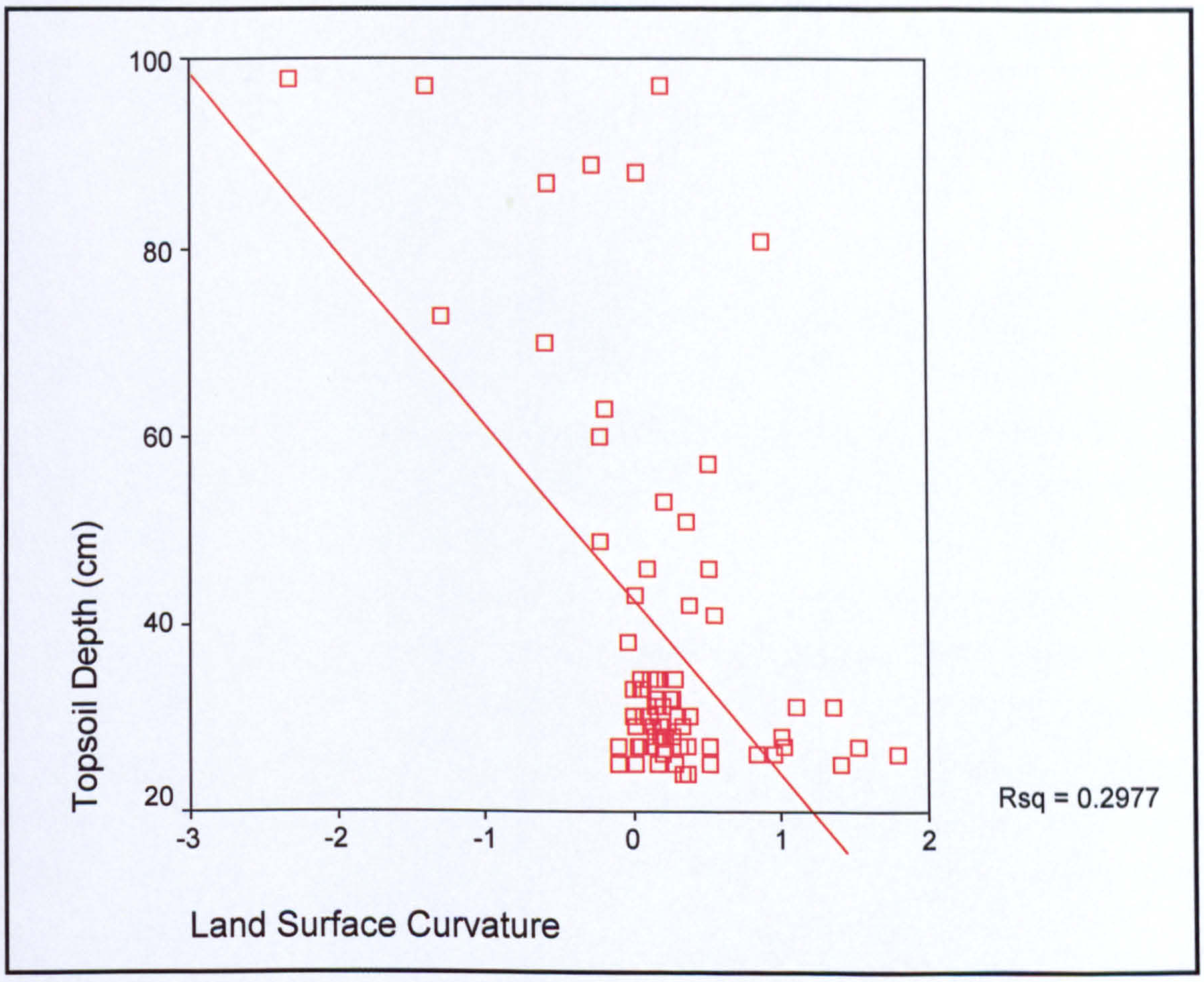

Figure 6.25. Scatterplot of interpolated land surface curvature values against recorded topsoil depths at Duncrub. N = 78.

6.11 Nethermuir

6.11.1 Excavations and survey

Nethermuir is located at NO 156 411, approximately 1.2km to the WSW of the area examined at Upper Gothens, at an elevation of about 45m OD. A pattern of 25 test pits was dug at this location through the First Farmers Project to investigate a lithic scatter. These excavations recovered over 100 pieces of struck stone and exposed three small features within a single test pit, one of which produced prehistoric pottery and charcoal subsequently dated to 3370-3020 cal BC (Barclay and Wickham-Jones 2002, 5). The investigations carried out as part of this research utilised two of the test pits opened by the First Farmers Project. Both measured 2m x 2m and were excavated by hand. It was not possible to determine a precise cultivation history for the area examined at Nethermuir. Based on general observations at the farmsteading and informal discussions with the landowner, however, it would appear that the field has been used regularly for the growing and harvesting of potatoes.

The area of interest defined at Nethermuir measured about 45m WSW-ENE by about 30m transversely, as shown in figure 6.25. The area, which had been harvested for potatoes prior to excavating, sloped gently from north to south. Although this slope increased slightly towards the southern end of the area examined, no pronounced convexities or concavities were identified. A contour survey of the area of interest was undertaken, with 36 elevation points recorded. Next, a total of 34 topsoil depths were recorded along seven transects. Because there was little topographic variation within the area, the locations of the two trenches examined were arbitrary. Their positions are shown in figure 6.26.

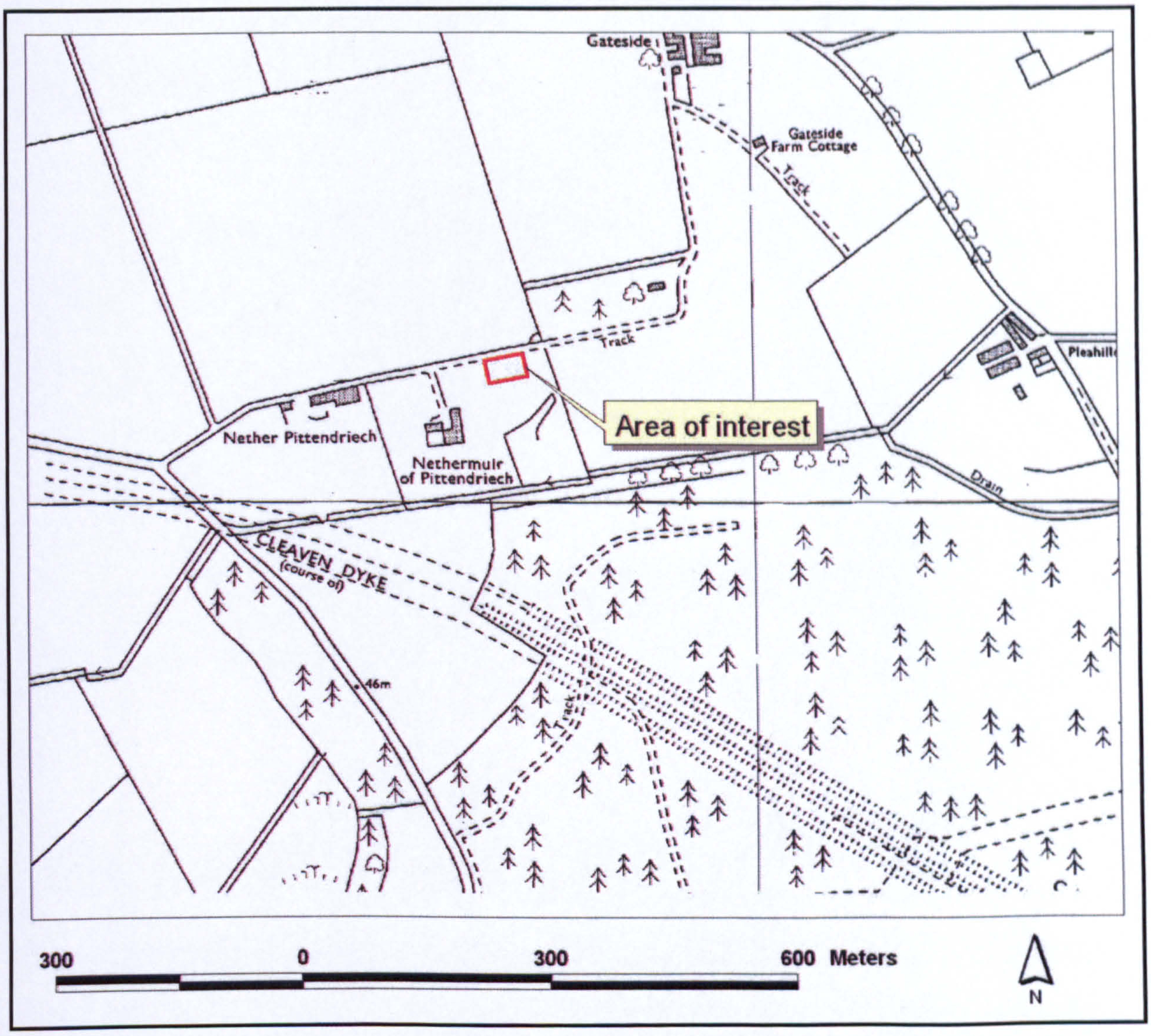

Figure 6.26. Map showing the extent of the area examined at Nethermuir. *Base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].*

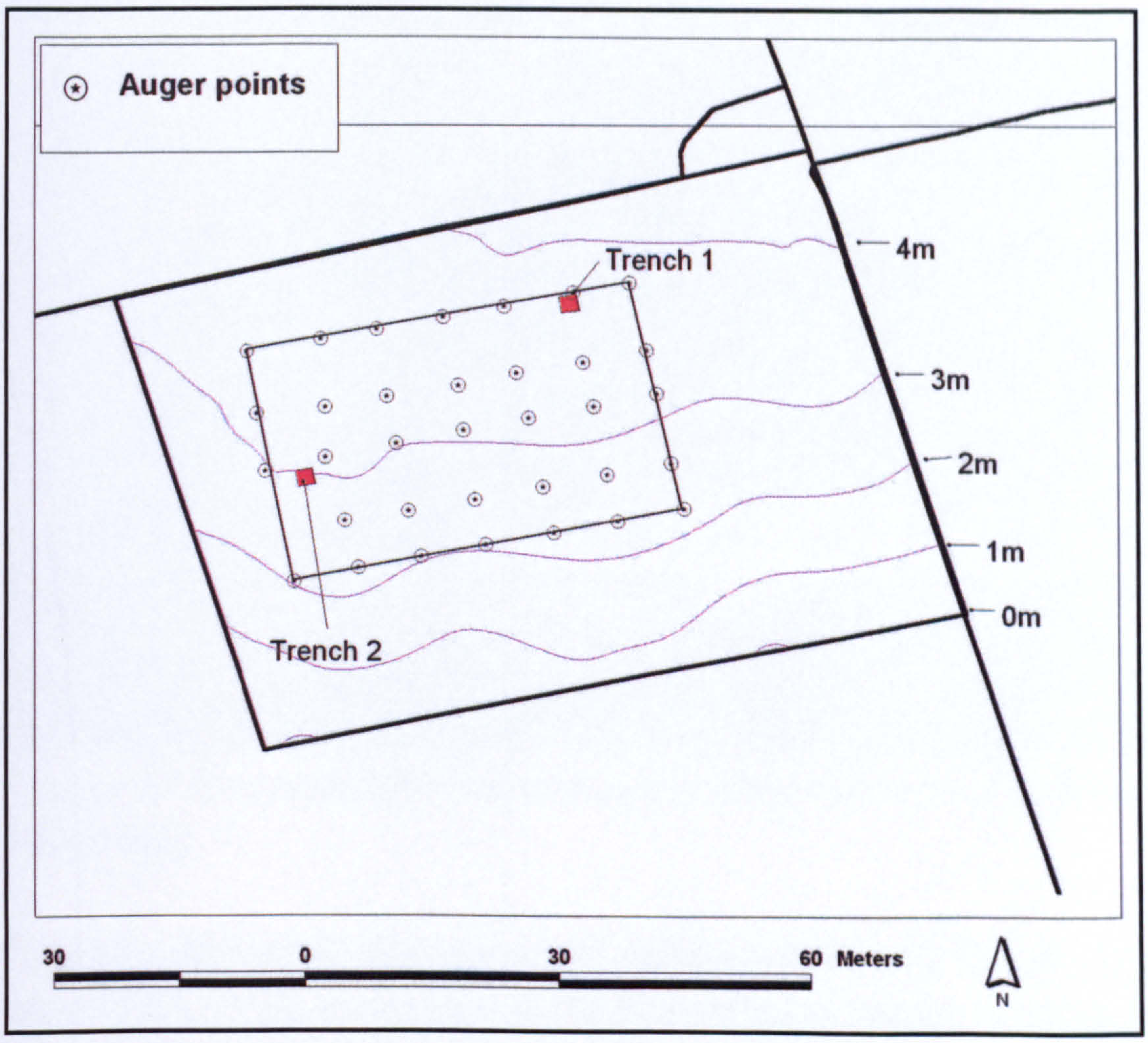

Figure 6.27. Map showing trench positions and auger points at Nethermuir. The contours (at 30cm intervals) have not been corrected to a benchmark. They are accurate relative to each other, however.

The topsoil and subsoil at Nethermuir were very light and sandy, and the topsoil was found to be very shallow across the site. As a result, damage attributable to potato cultivation was noted in both trenches examined.

6.11.1.1 Trench 1

Trench 1 revealed at least seven parallel scars on the sandy subsoil, running from west to east, as shown in figure 6.27. While some of these are likely to have been plough scars, the most significant area of scarring had been caused by potato seedbed preparation.

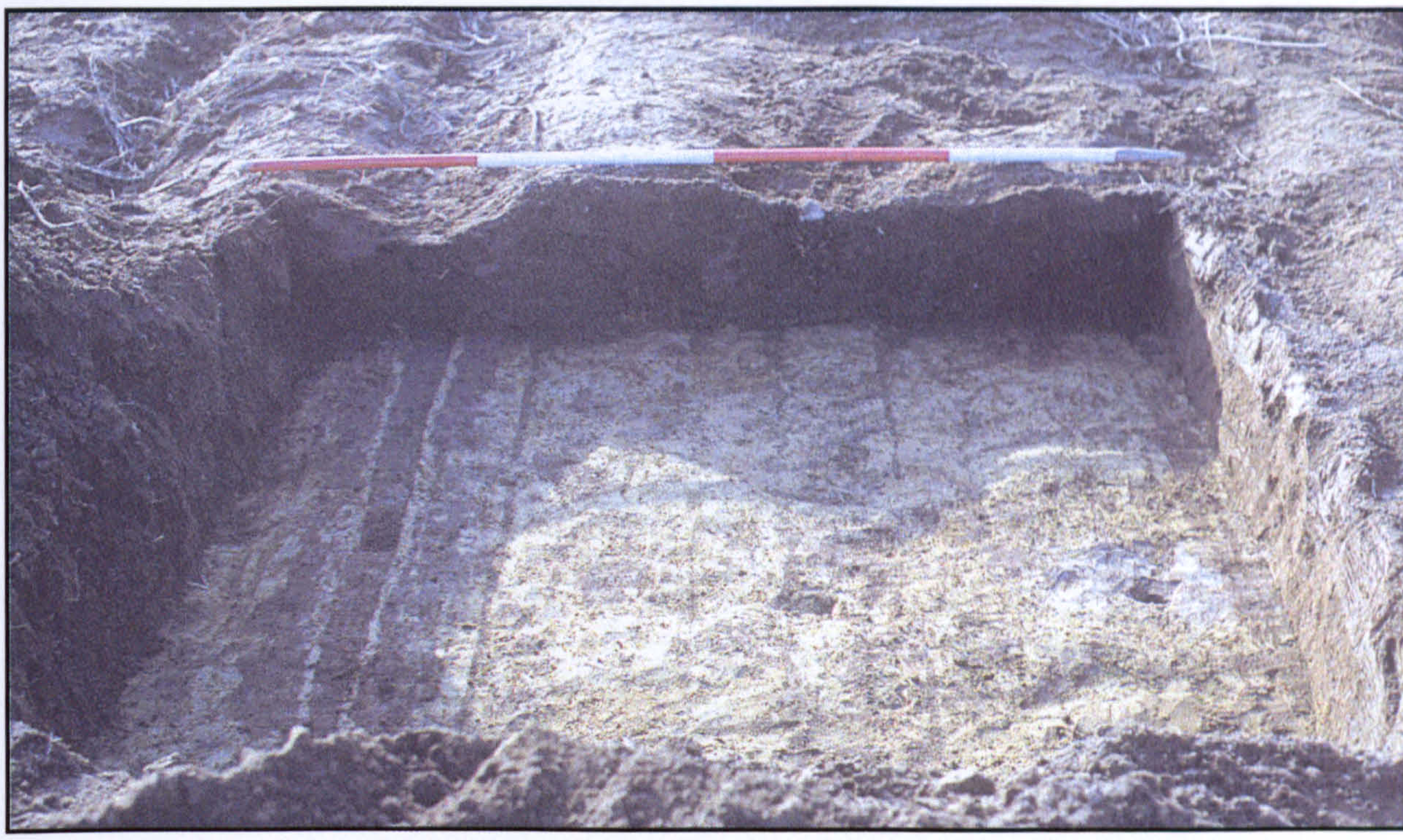

Figure 6.28. Photograph showing extensive subsoil disturbance in trench 1, Nethermuir.

In section, this disturbed area was V-shaped and penetrated some 7cm into the subsoil, as shown in figure 6.28. As the topsoil at this point measured between 23cm and 28cm, this demonstrates damage from seedbed preparation to a total depth of about 30cm - 35cm. A small void caused by animal burrowing was also noted in this trench.

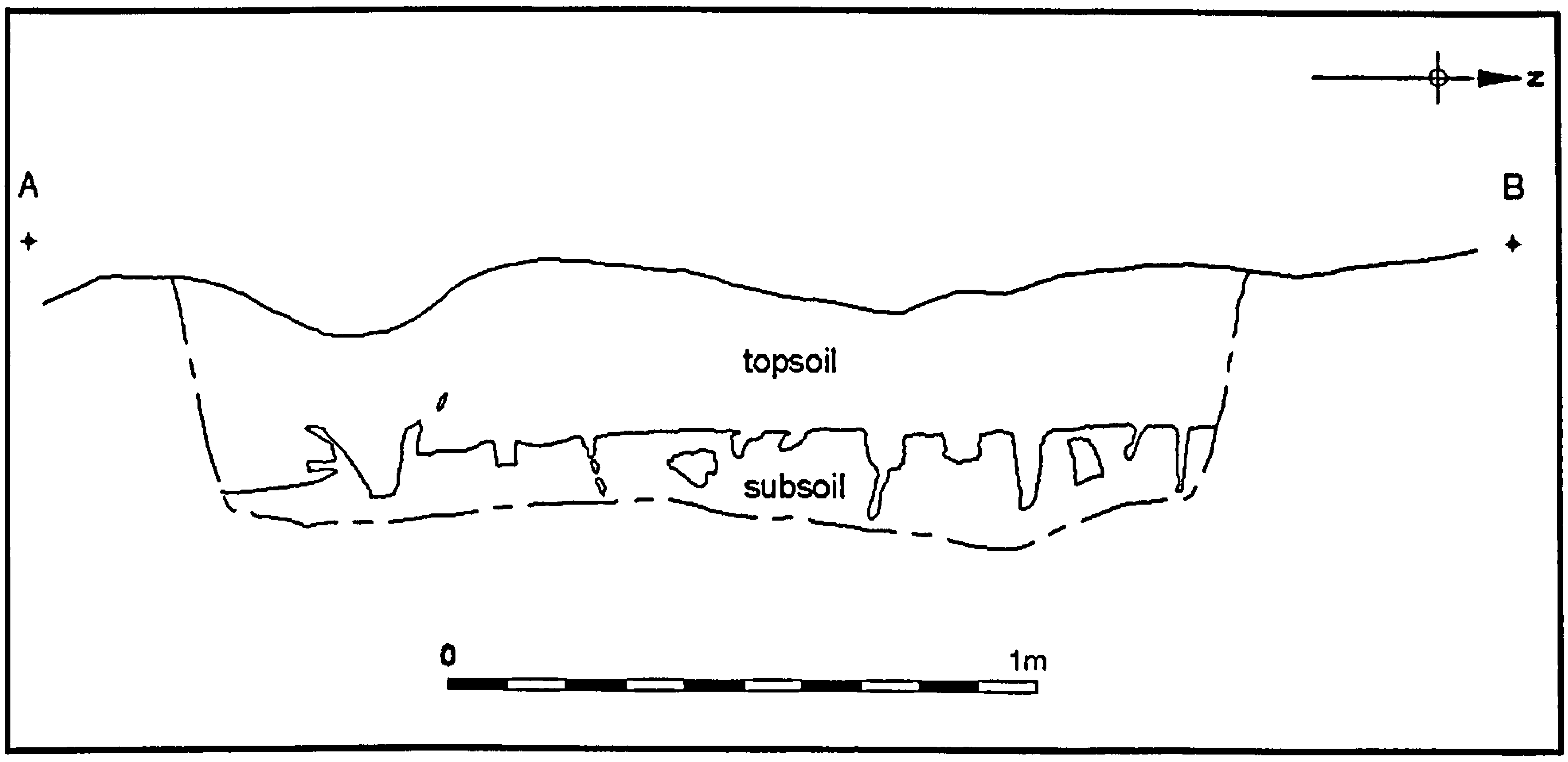

Figure 6.29. Drawing of east-facing section in trench 1, Nethermuir.

6.11.1.2 Trench 2

In Trench 2, agricultural damage was even more pronounced. In this trench, average topsoil depth was found to be 18cm - 20cm. In addition to plough scars and scarring caused by seedbed preparation (figure 6.29), the most striking features noted were two substantial sets of tyre tread marks running across the subsoil surface from west to east. These measured about 40cm in width, as shown in figure 6.30.

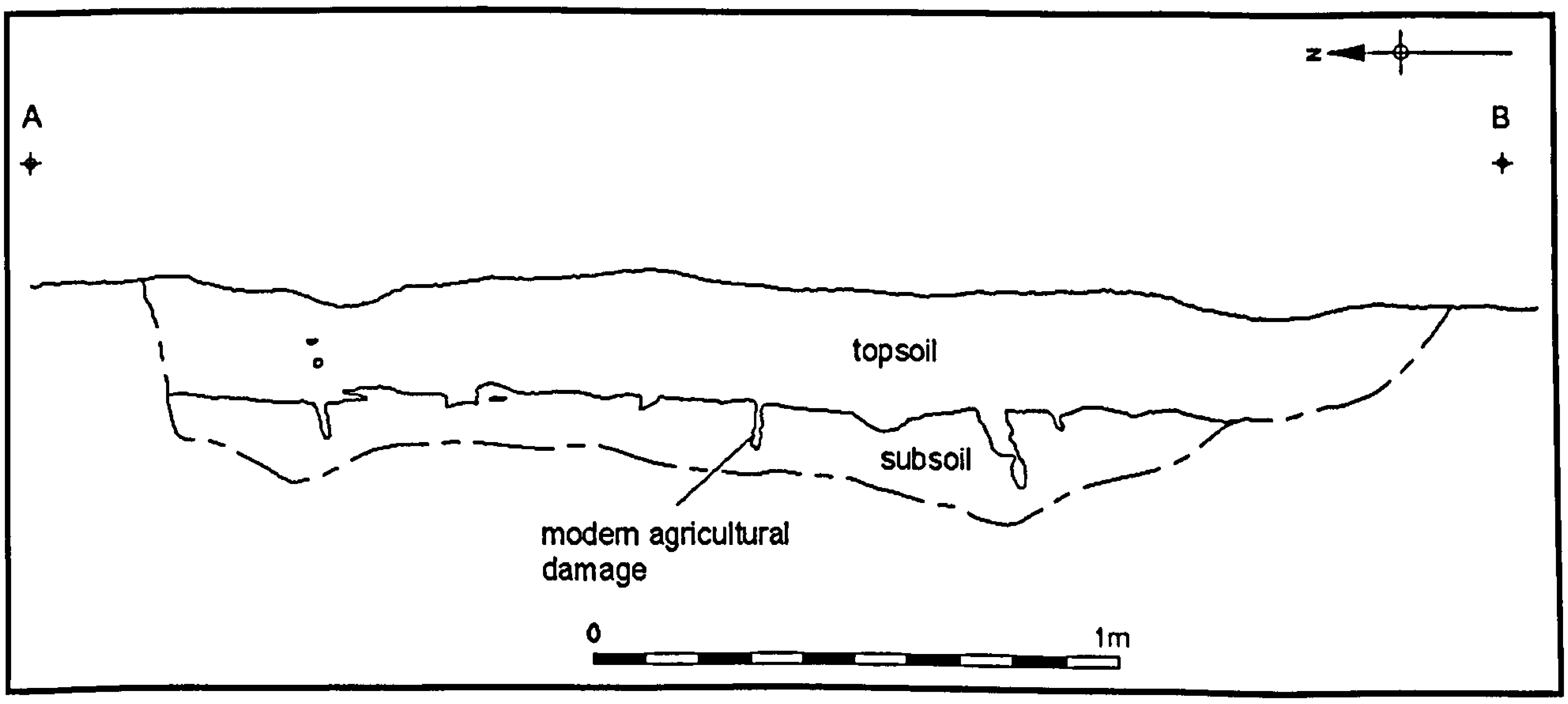

Figure 6.30. Drawing of west-facing section in trench 1, Nethermuir.

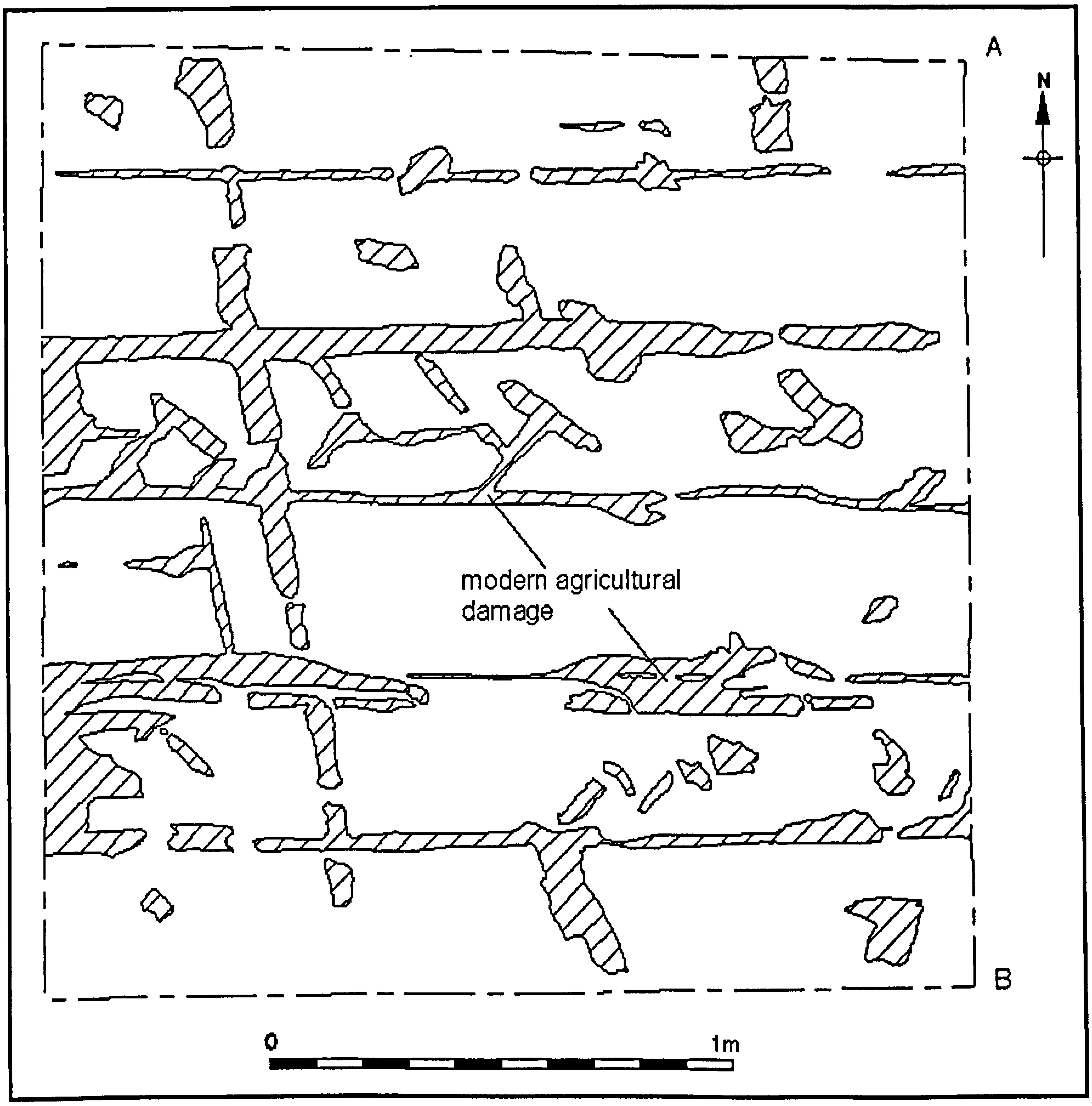

Figure 6.31. Plan drawing of trench 2, Nethermuir. In addition to damage caused by ploughing and potato seedbed preparation, tread marks made by tractor wheels are clearly visible cutting into the subsoil.

6.11.2 Excavation summary

At Nethermuir, it was impossible to relate the levels of damage noted to topography, but across the area examined, the effects of potato seedbed preparation, in conjunction with consistently shallow topsoil, were clearly visible. The significance of this damage cannot be understated. The three archaeological features noted by the First Farmers Project, which were located immediately adjacent to Trench 2, were cut less than 15cm into the subsoil. At this point, topsoil depth was less than 20cm, suggesting that the maximum depth at which these features were located was about 35cm. Evidence from Trench 1 showed disturbance attributable to seedbed preparation at depths of up to 35cm, suggesting that one or two passes with the seedbed cultivator would have been sufficient to remove these archaeological features.

6.11.3 Soil depth variation and topography at Nethermuir

As previously noted, topsoil depth at Nethermuir was significantly shallower than at the other areas examined during this research, with the average topsoil depth across the 34 auger points measured at just over 20cm. At only two auger points did the topsoil depth exceed 30cm in depth, and the minimum depth recorded was 17cm.

The data retrieved at Nethermuir are not normally distributed, and transformations to normalise the data proved unsuccessful. As a result, it has been necessary to apply nonparametric statistical tests. Figure 6.31 shows a scatterplot with interpolated land surface curvature (independent variable) plotted against recorded topsoil depth (dependent variable). The r^2 value of 0.0504 suggests that only about 5% of variation in topsoil depth can be attributed to variations in land surface curvature. This weak relationship is confirmed by the Spearman's rank correlation coefficient obtained. The −0.242 value produced is not significant at either the 0.01 level or 0.05 level. Consequently, it is possible to conclude only that there is no significant correlation between topsoil depth and land surface curvature at Nethermuir (r_s = −0.242, n = 34).

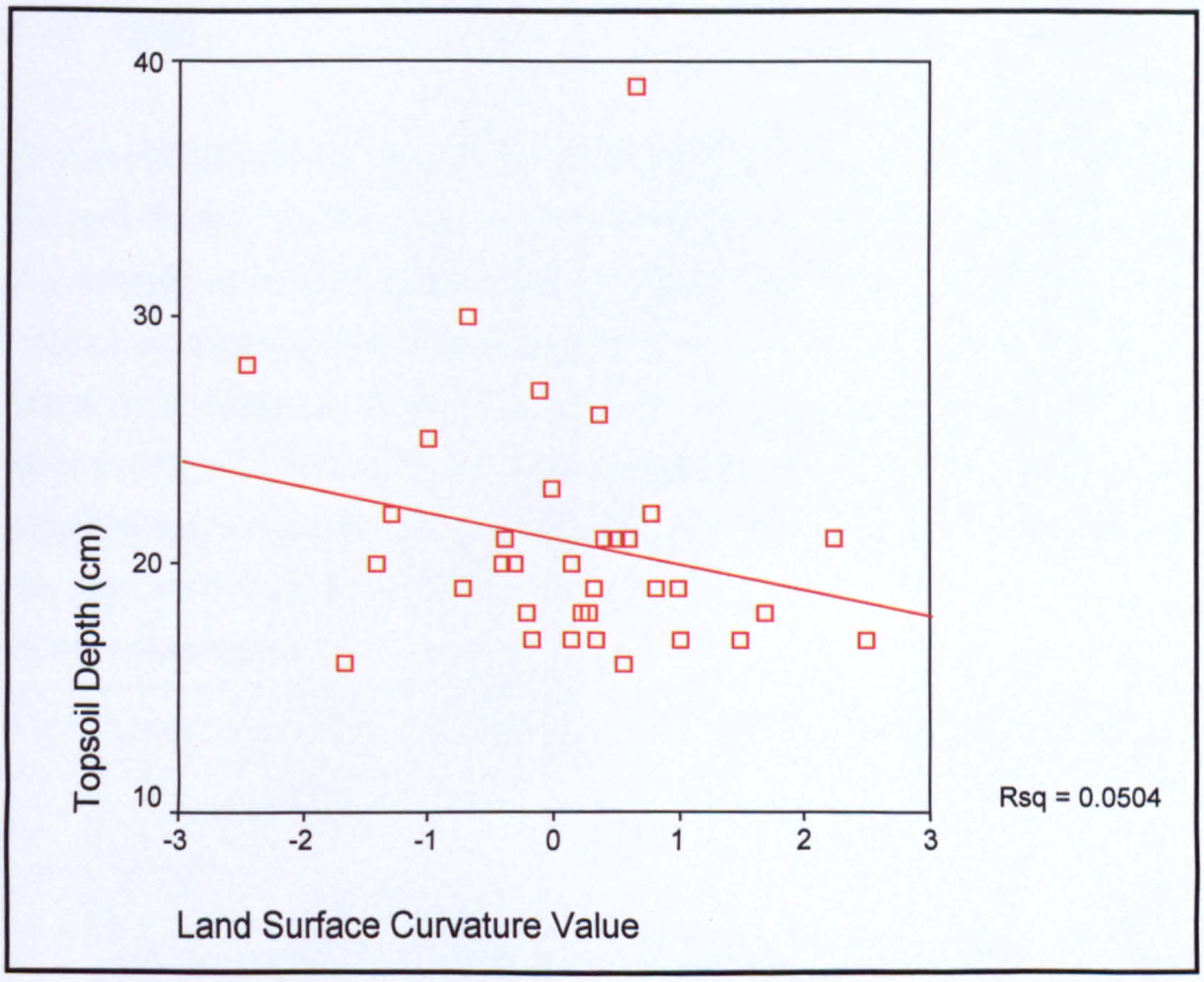

Figure 6.32. Scatterplot of interpolated land surface curvature values against recorded topsoil depths at Duncrub. N = 34.

6.12 Peel

The investigations at Peel, Tibbermore Parish (NGR NO 060 232) were commenced in October 2000 in conjunction with the Roman Gask Project, conducted at that time from the Department of Art History and Archaeology, University of Manchester. The Roman Gask Project excavations confirmed the presence of a Gask System Roman watch tower at the location (Woolliscroft 2002b, 60). Although adverse weather conditions forced the early abandonment of the excavations undertaken as part of this research, a contour survey and auger survey were completed successfully. No management history was established for the area examined, from which a harvest of swedes had been removed immediately prior to the excavations.

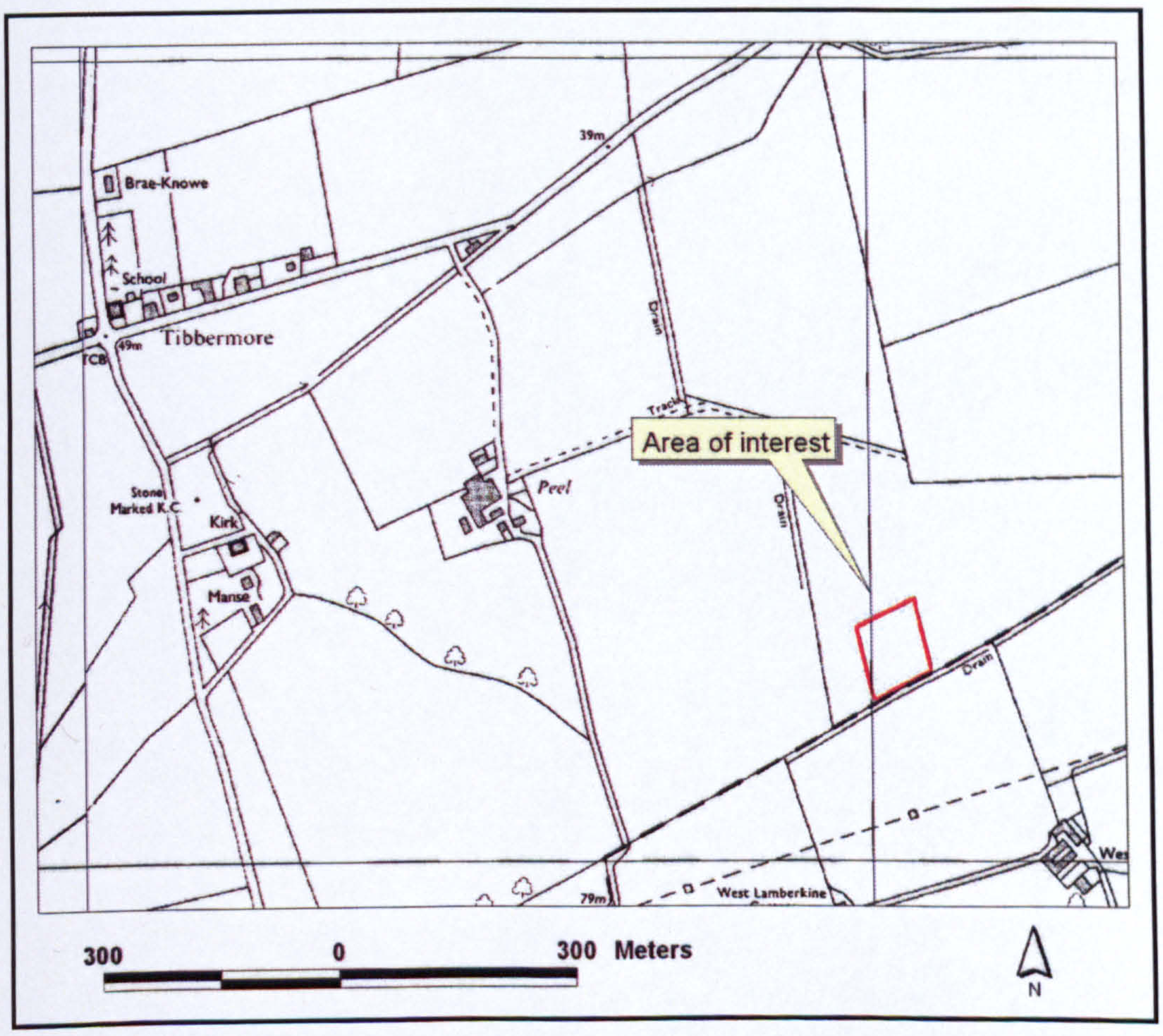

Figure 6.33. Map showing the extent of the area examined at Peel. ***Base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].***

The area of interest defined at Peel was parallelogram-shaped, measuring about 90m NNW-SSE by about 80m transversely, as shown in figure 6.33. The degree of topographic variation within the area was slight, with an average slope of about 2.5° running downhill from south to north. Within the area of interest, topsoil depth was recorded at 25 points, along five transects. The average topsoil depth recorded was about 25cm, with no reading below 21cm or above 29cm. No convexities or concavities within the area examined were immediately apparent, and the DTM created from the contour data has confirmed that the area is almost a plane surface, with only slight concavities and convexities present.

Although one trench was opened to record the condition of the subsoil, this trench flooded during excavation, and was abandoned. As a result, there is meaningful data pertaining to the effects of agricultural practices that can be extracted from the works carried out at Peel. It is, however, interesting to note that recorded topsoil depth, slope and land surface curvature were consistent across the area examined, suggesting that the lack of topographic variation at the site may have contributed to the consistency of topsoil depth.

Although the excavations at Peel proved unsuccessful, regression analysis has been applied to the data retrieved and a Spearman's rank correlation coefficient has been obtained. Figure 6.34 shows interpolated land surface curvature (independent variable) plotted against recorded topsoil depth (dependent variable). The r^2 value of 0.1073 suggests that only about 11% of variation in topsoil depth can be attributed to variations in land surface curvature. Meanwhile, the Spearman's rank correlation coefficient of –0.245 obtained for this data shows that the relationship between the two variables is not significant at either the 0.01 level or 0.05 level, and so the null hypothesis (that there is no significant relationship between topsoil depth and land surface curvature) cannot be rejected. As with Nethermuir, no statistically significant relationship exists between topsoil depth and land surface curvature at Peel.

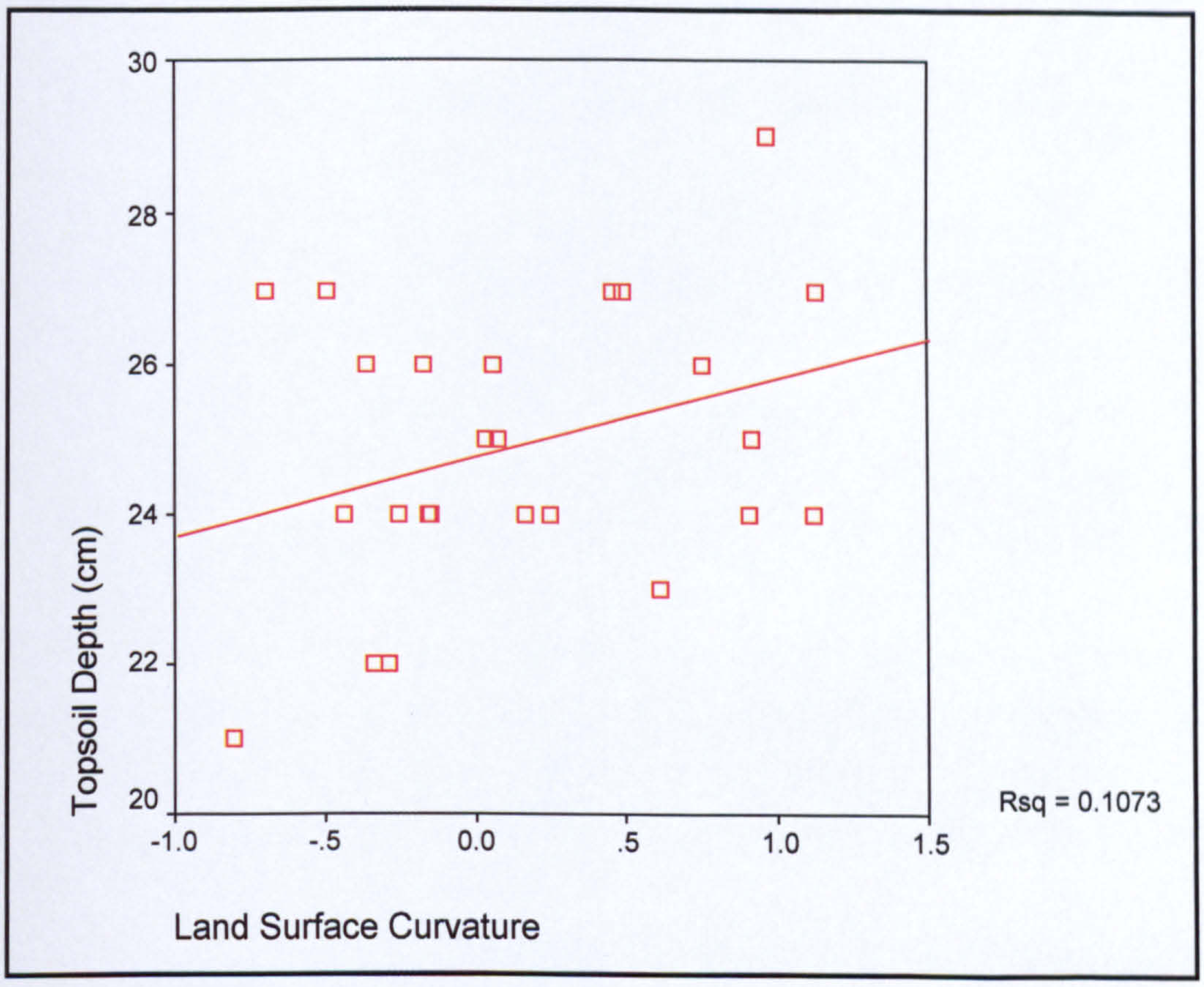

Figure 6.34. Scatterplot of interpolated land surface curvature values against recorded topsoil depths at Peel. N = 25.

6.13 Using the excavation results to map damage and risk

Although only one of the completed excavations was undertaken at a cropmark monument (Upper Gothens), the observations made concerning damage to the upper levels of subsoil at each of the locations examined provide strong indications of likely levels of agricultural disturbance to archaeological deposits at cropmark monuments, according to the variables outlined. The first objective outlined in section 6.4 (to identify relationships between the condition of a cropmark monument and its management history, topography and soil depth characteristics) has been achieved with some success. The excavations have shown that damage to the upper levels of subsoil (and consequently, any archaeological features contained in that subsoil) is closely linked to topsoil depth and management history. Statistically viable relationships between topsoil depth and topography have been also identified for three of the five sites examined, as summarised in table 6.1.

	Regression analysis using land surface curvature as the independent variable	Spearman's rank correlation coefficient	
Site	r^2	r_s	n
Mount Stewart	0.352	-.652**	82
Upper Gothens	0.342	-.609**	98
Duncrub	0.300	-.400**	78
Nethermuir	0.050	-.242	34
Peel	0.107	.245	25
** denotes r_s value is significant where $P < 0.01$			

Table 6.1, showing r^2 and r_s values produced for each of the locations examined.

As table demonstrates, the regression analysis has identified reasonable (if rather unspectacular) relationships between topsoil depth and land surface curvature at Mount Stewart, Upper Gothens and Duncrub. These relationships are confirmed by the r_s values obtained for these three sites, all of which are significant at the 0.01 level. However, the regression analysis suggests a very weak relationship between land surface curvature and topsoil depth at Nethermuir and Peel. The r_s values obtained for these two sites confirm that the relationships between topsoil depth and land surface curvature at these two locations are not statistically significant. It is worth noting that the three locations where significant statistically relationships have been identified are those with greatest topographic variation and slope. Furthermore, the scatterplot produced for the data collected at Upper Gothens suggests that at Upper Gothens, topsoil depth remains consistently shallow at marked convexities but is far more variable at planar and concave locations.

Although the statistical tests have shown that there are statistically significant relationships between topsoil depth and land surface curvature, the excavations have shown that topsoil depth, topography and management history interact with a degree of complexity, so that it will seldom be possible to attribute observed damage to archaeological features to one variable alone. For example, damage observed at Mount Stewart and Upper Gothens varied according to topography, which appeared to affect topsoil depth. The damage observed at Upper Gothens was far greater than at Mount Stewart, however, due to the differences between their management histories. By contrast, at Nethermuir, extensive agricultural damage was noted throughout the site, while at Duncrub, no agricultural damage was noted, despite both sites having been used for the growing of potatoes and subsoiling having occurred at Duncrub. The differences in the subsoil condition between these two locations can be attributed to differences in topsoil depth between the two sites. At Duncrub, average topsoil depth was in excess of 30cm, while at Nethermuir, average topsoil depth was just under 21cm. Nevertheless, the statistical tests prove that at some locations at least, there are statistically significant relationships between topsoil depth and land surface curvature. For this reason, it is not possible to refute the suggestion that the condition of buried archaeological deposits will, in turn, be related to land surface curvature.

The second objective of this section of the research (outlined in section 6.4) has been to identify the parts of a cropmark monument likely to have been subject to the greatest levels of damage through ploughing and other agricultural practices. This has been achieved for each of the locations examined through the recording of topsoil depth across each of the sites. Over the next eight pages, figures 6.35 (Mount Stewart), 6.37 (Upper Gothens), 6.39 (Duncrub), and 6.41 (Nethermuir) show topsoil depths mapped across each location according to likely damage caused by agricultural activities. Interspersed with these are figures 6.36 (Mount Stewart), 6.37 (Upper Gothens), 6.38 (Duncrub), and

6.40 (Nethermuir), which show land surface curvature mapped across each of the areas examined.

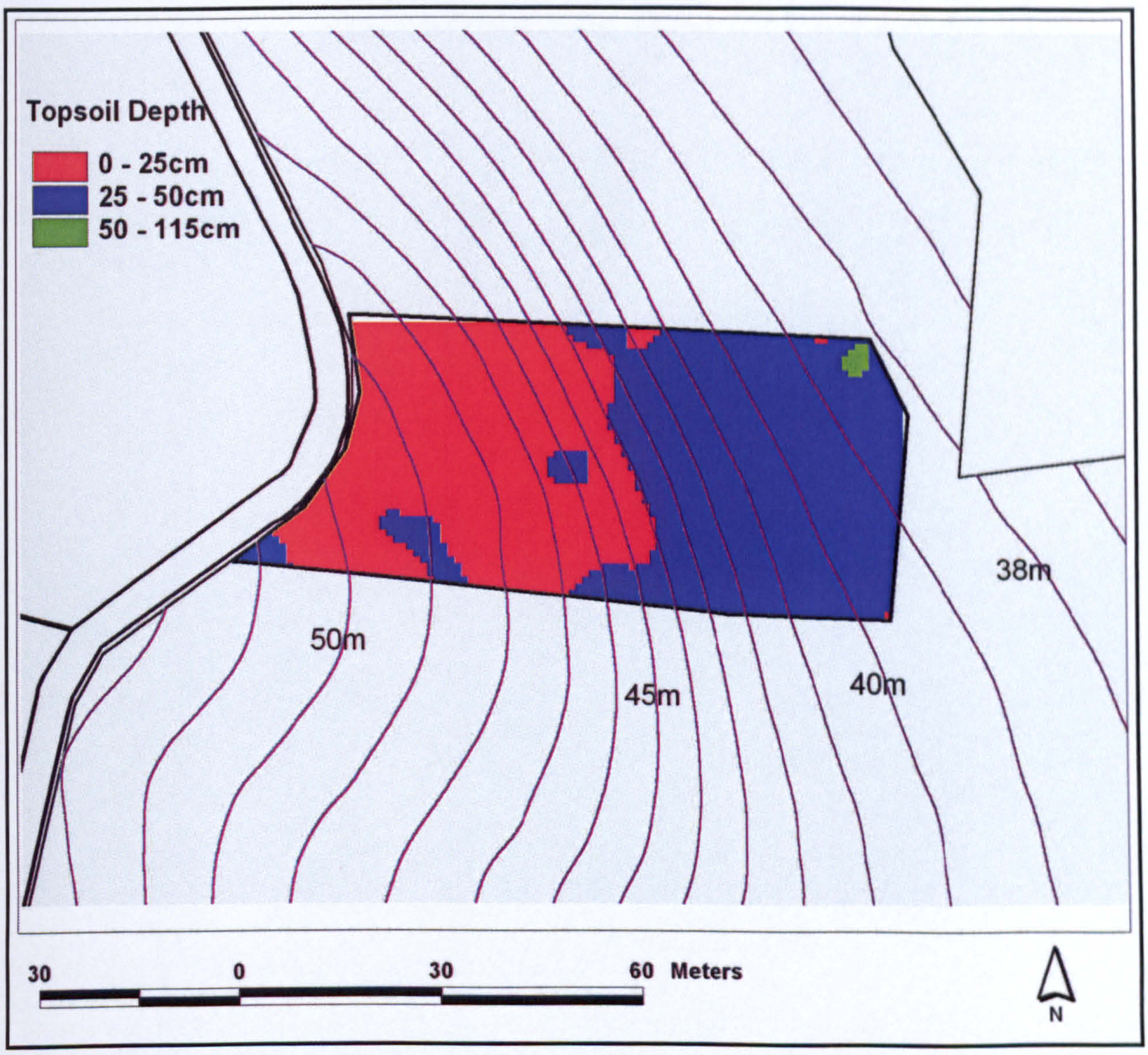

Figure 6.35. Map showing topsoil depth at Mount Stewart mapped according to probable damage levels and risk of damage from various agricultural practices.

As figure 6.35 shows, mapping interpolated topsoil depths across the area examined at Mount Stewart suggests that agricultural damage to the subsoil is likely to have been greatest on the knoll and 'shoulder' areas towards the west end of the area examined. Correspondingly, these areas (coloured red) can be considered as being at highest risk from ongoing damage through ploughing. Areas coloured blue represent topsoil depth in excess of 25cm but less than 50cm, and such areas can be considered at lower risk from ploughing. However, these areas remain at risk from subsoiling, should it ever occur at mount Stewart. Areas coloured green represent topsoil with a depth of greater than 50cm, below depth range of normal agricultural practices except deep subsoiling or the insertion of field drains, and can, consequently, be considered areas at low risk from ongoing agricultural practices.

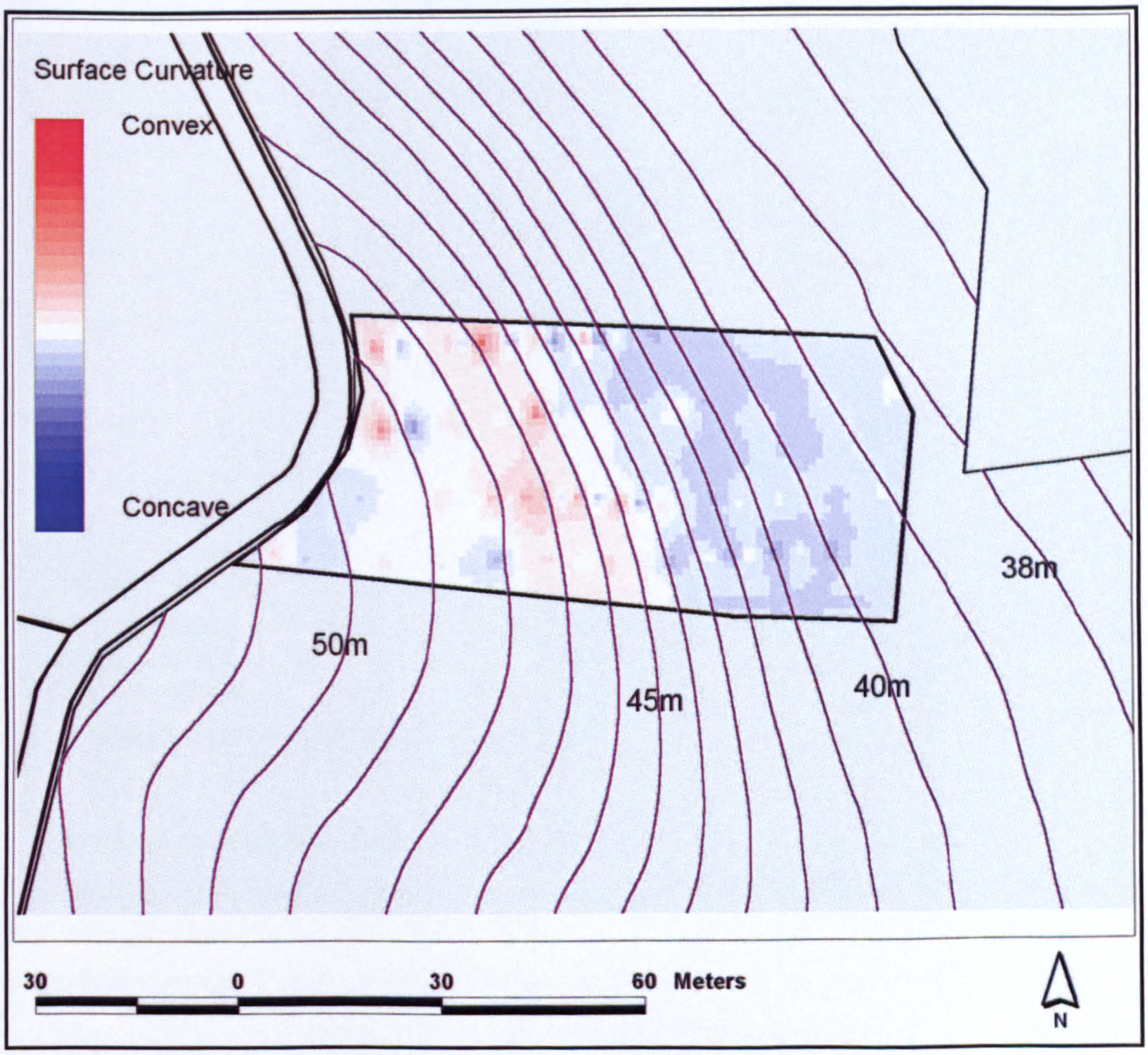

Figure 6.36. Map showing land surface curvature at Mount Stewart.

As discussed in section 6.8.3, the relationship between land surface curvature and topsoil depth at Mount Stewart is statistically significant. Comparison of figure 6.35 (previous page) and figure 6.36 shows that as might be expected, areas at Mount Stewart where subsoil disturbance (and risk of ongoing subsoil disturbance) are highest are generally found on convex parts of the area examined.

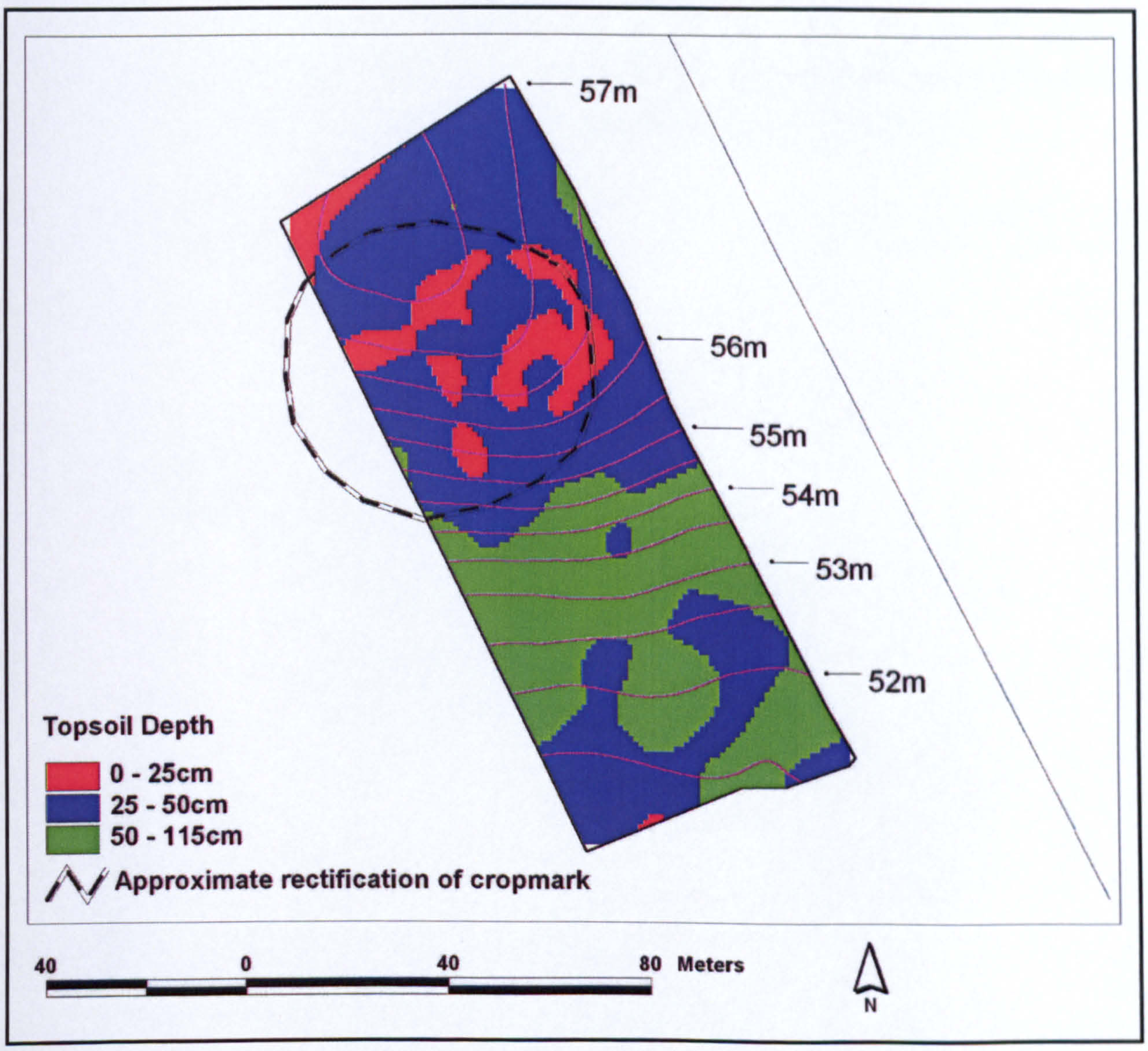

Figure 6.37. Map showing topsoil depth at Upper Gothens mapped according to probable damage levels and risk of damage from various agricultural practices.

As figure 6.37 shows, mapping interpolated topsoil depths across the area examined at Upper Gothens confirms the observation made through excavation that agricultural damage to the subsoil has been greatest on the knoll area on which the cropmark enclosure is located. Correspondingly, these areas can be considered as being at highest risk from ongoing damage. Again, areas coloured blue represent topsoil depths in excess of 25cm but less than 50cm, and such areas can be considered at lower risk from ploughing. However, these areas remain at risk from subsoiling, which the excavations showed had been undertaken on several occasions at Upper Gothens, much to the detriment of the archaeological remains excavated. Although areas in figure 6.37 coloured green represent topsoil with a depth of greater than 50cm (below depth range of normal agricultural practices), a number of field drains were encountered during the First Farmers Project excavations at Upper Gothens. Consequently, it is likely that these areas of subsoil have also been subject to be considerable localised disturbance in the past.

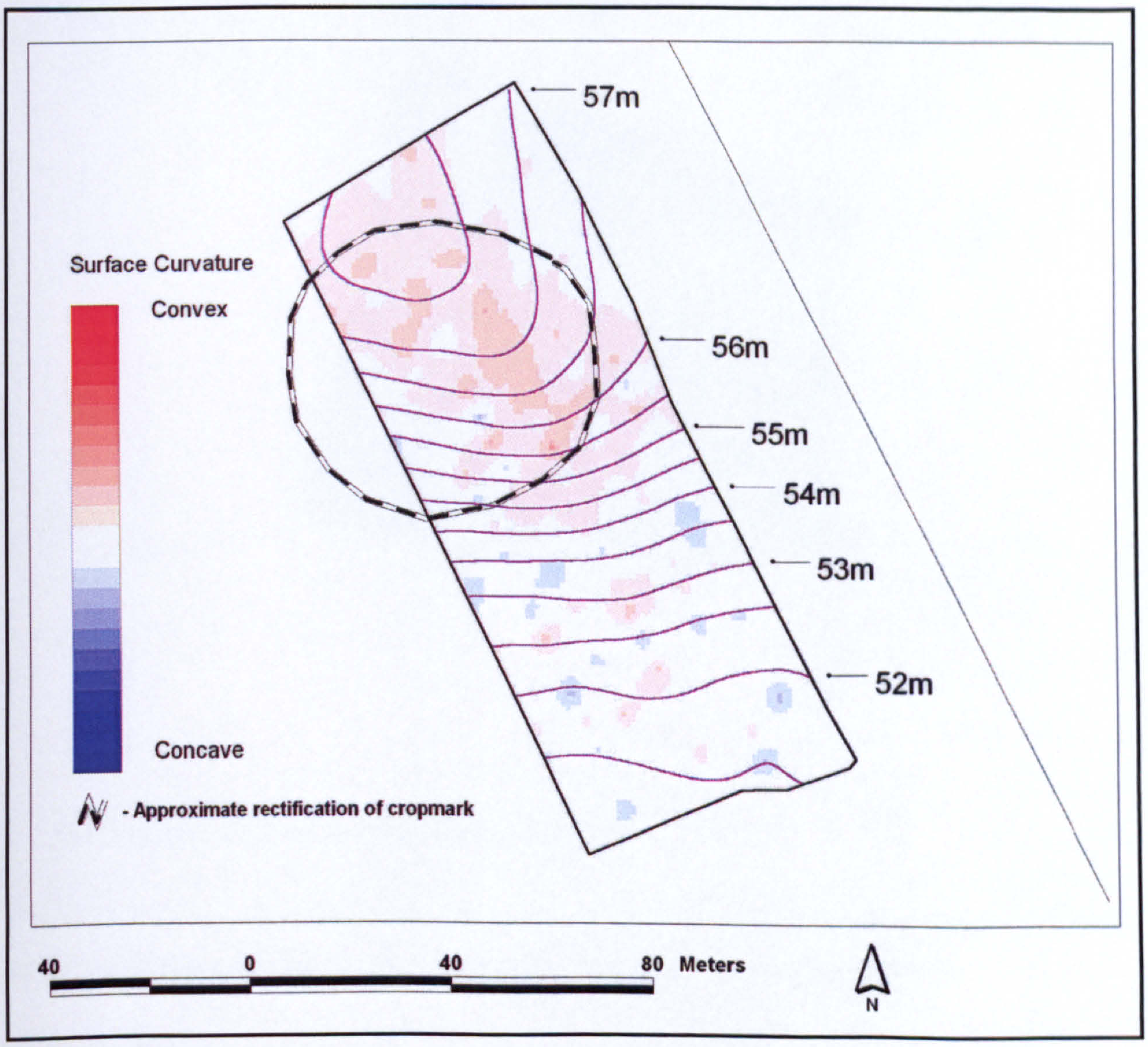

Figure 6.38. Map showing land surface curvature at Upper Gothens.

As discussed in section 6.9.4, the relationship between land surface curvature and topsoil depth at Upper Gothens is statistically significant. Comparison of figure 6.37 (previous page) and figure 6.38 shows that as might be expected, areas at Upper Gothens where subsoil disturbance (and risk of ongoing subsoil disturbance) are highest are generally those areas with convex ground surfaces. Unfortunately, these are also the parts of the area examined at Upper Gothens where archaeological features are known to exist.

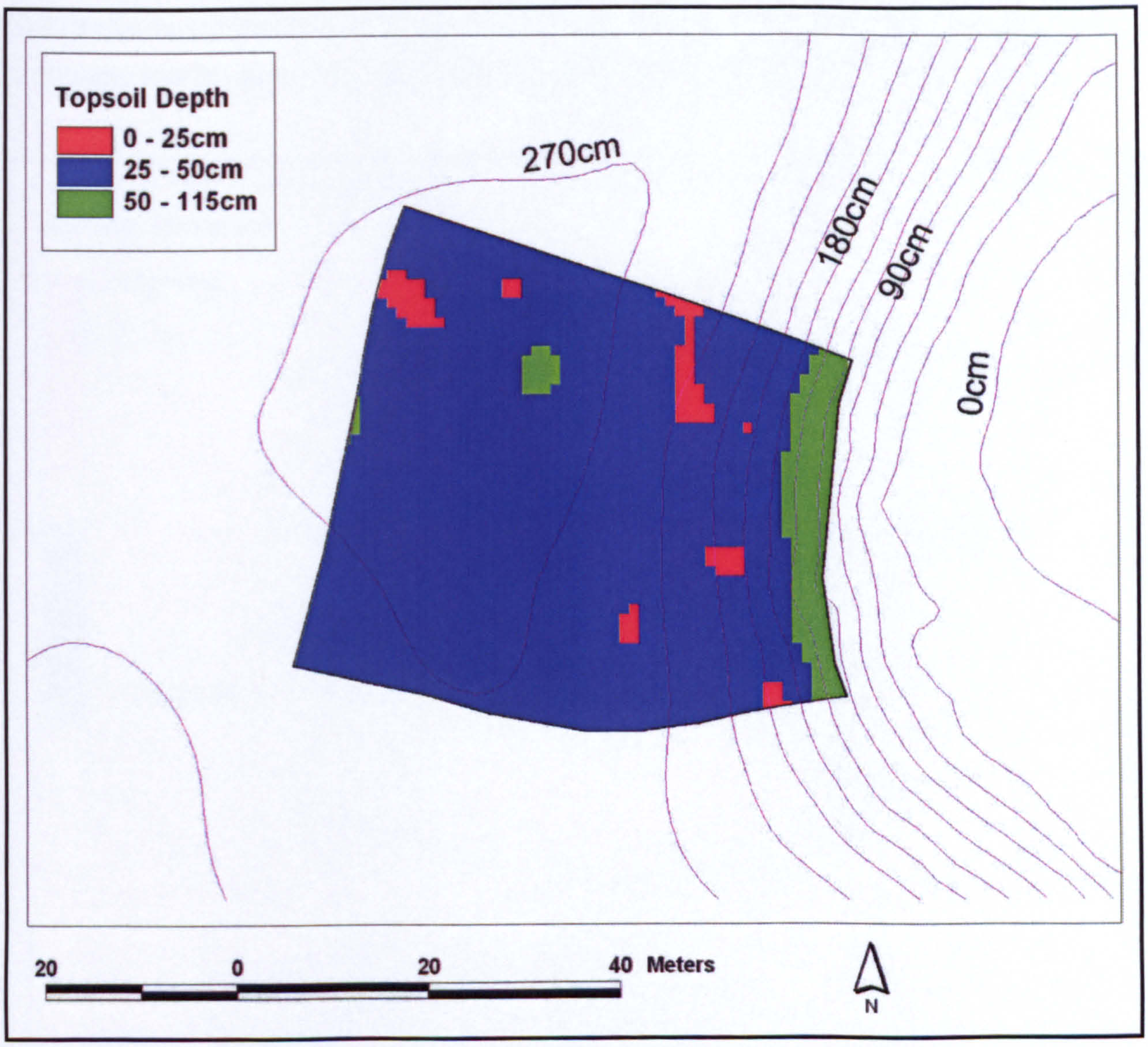

Figure 6.39. Map showing topsoil depth at Duncrub mapped according to probable damage levels and risk of damage from various agricultural practices.

The excavations at Duncrub revealed no subsoil damage directly attributable to cultivation. This was due primarily to the surprisingly deep topsoil encountered across the site. It is little surprise, therefore, that figure 6.39 identifies very little of the area examined at Duncrub as likely to have been disturbed through ploughing in the past. Correspondingly, the risk of ongoing or future subsoil disturbance attributable to routine ploughing can be considered low. This again is reflected in figure 6.39. Discussions with the landowner at Duncrub showed that the area had been subsoiled on more than one occasion. Although the limited excavations undertaken at Duncrub as part of this research could find no direct evidence of this subsoiling, those areas marked in blue in figure 6.39 must be considered as having been subject to past damage through subsoiling. Had any archaeological features been encountered at Duncrub, soil depth mapping of this type could have proved a valuable tool for assessing likely levels of agricultural disturbance.

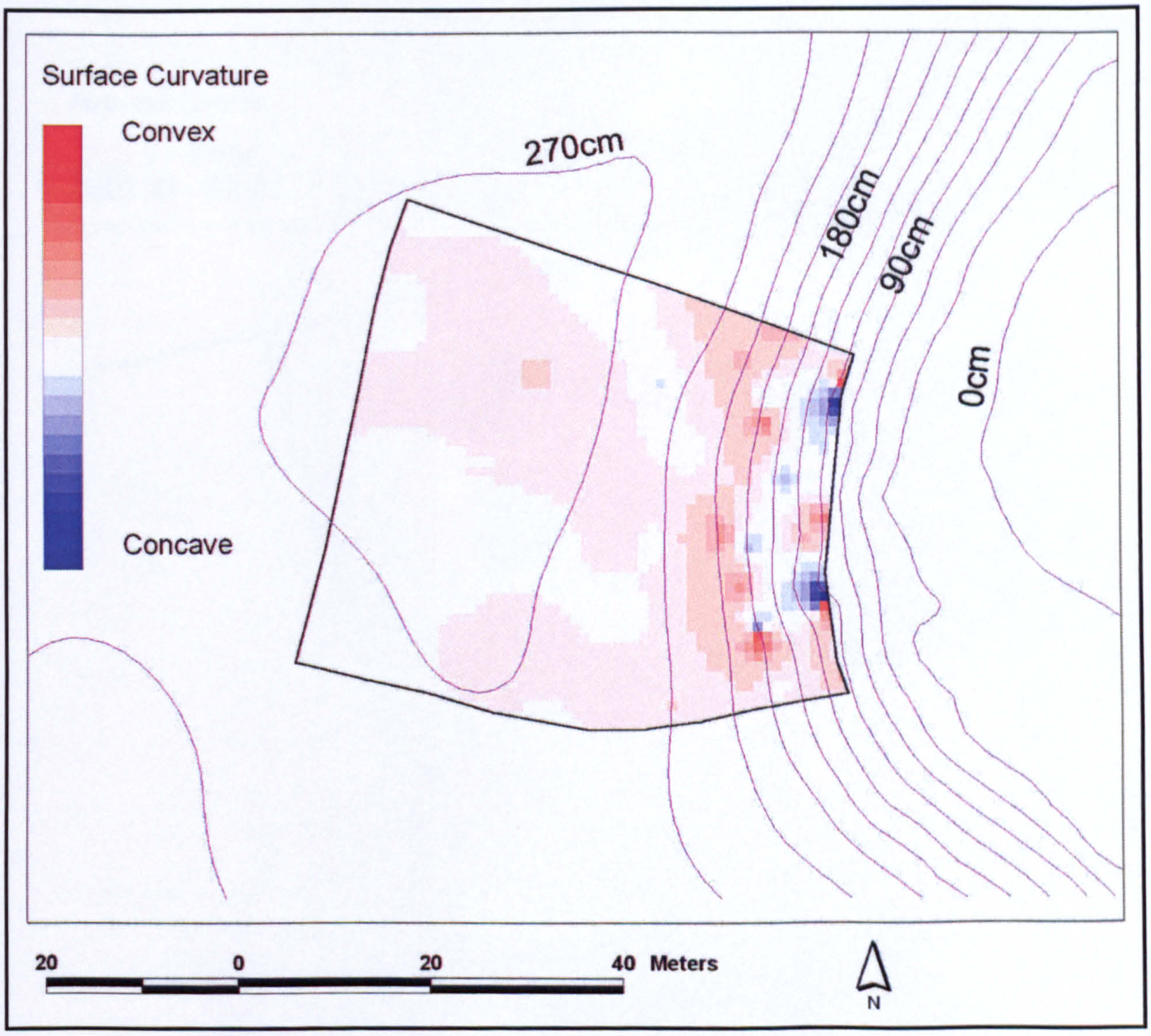

Figure 6.40. Map showing land surface curvature at Duncrub.

As discussed in section 6.10.3, the relationship between land surface curvature and topsoil depth at Duncrub is statistically significant, though not particularly strong. Figure 6.40 shows that the majority of the area examined at Duncrub is slightly convex, with small concave areas recorded at the east (where the steep slope into the former loch begins to level off). Despite the majority of the area being convex, figure 6.39 (previous page) shows that although topsoil is significantly deeper in the concave areas at the base of the steep slope, topsoil across the area examined is consistently deep. Consequently, it is possible to conclude that despite the apparent statistically viable relationship between topsoil depth and land surface curvature at Duncrub, in reality, because of the overall depth of topsoil across the site, land surface curvature has not had a bearing on levels of agricultural damage to the subsoil.

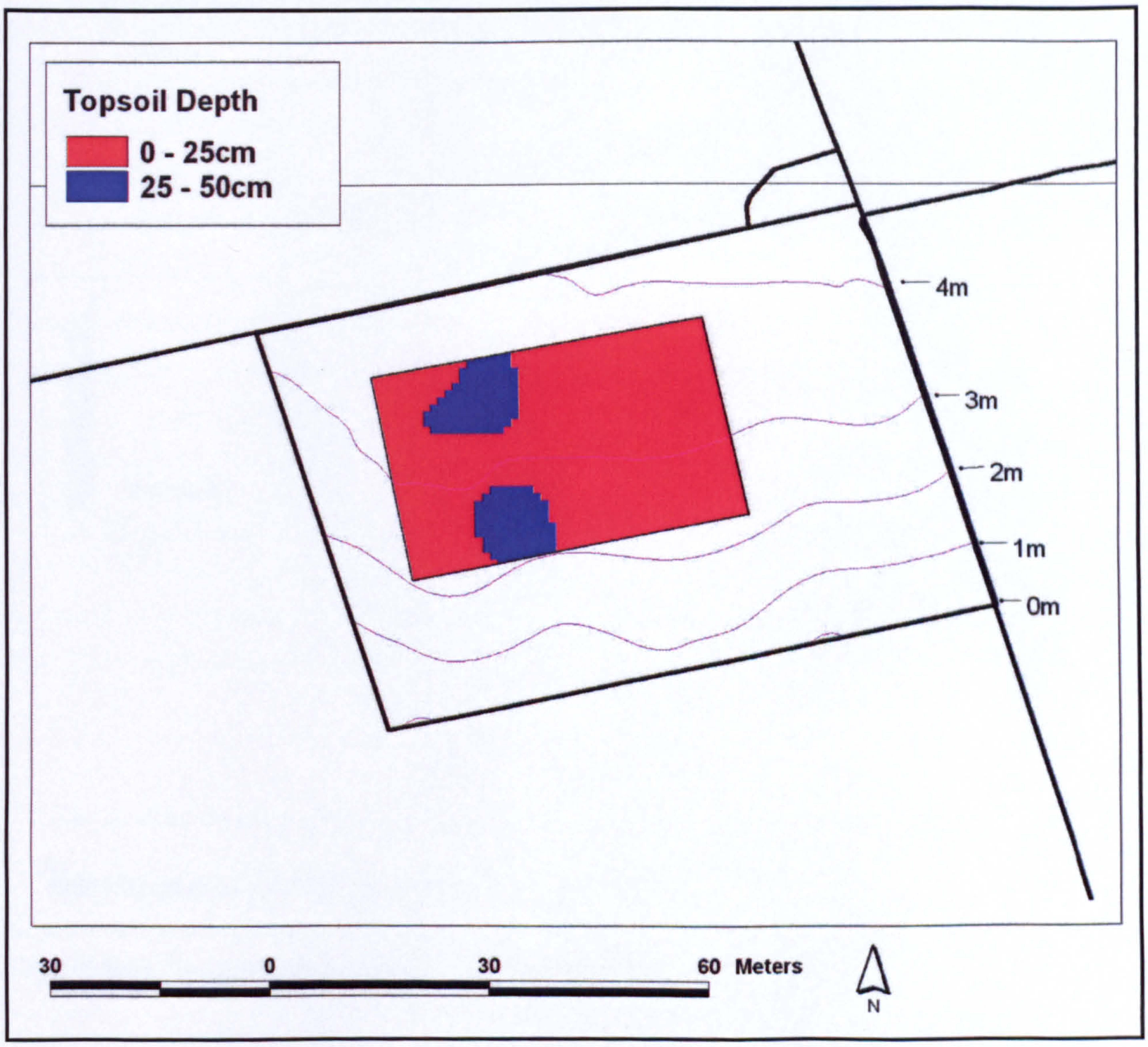

Figure 6.41. Map showing topsoil depth at Nethermuir mapped according to probable damage levels and risk of damage from various agricultural practices.

In stark contrast to Duncrub, the excavations at Nethermuir revealed widespread damage to the sandy subsoil caused by a variety of agricultural practices including ploughing, potato seedbed preparation and vehicular movement. Topsoil depth at Nethermuir was found to be consistently shallow across the area examined, and this is reflected in figure 6.41, which suggests that almost all parts of the site are likely to have been damaged by routine ploughing. Correspondingly, the risk of ongoing and future damage can be considered high. That this risk is so high is directly attributable to the shallow depth of topsoil across the site.

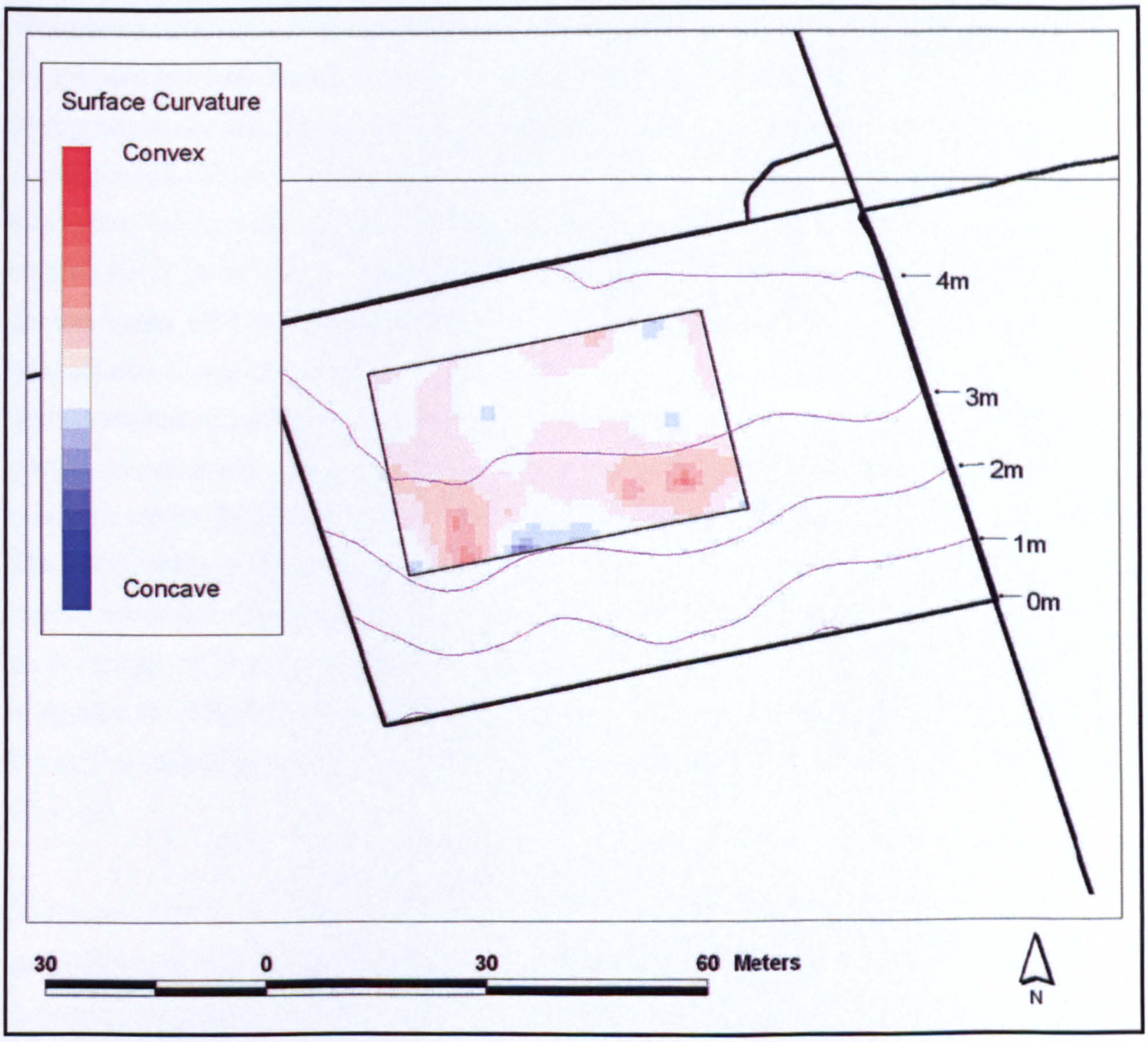

Figure 6.42. Map showing land surface curvature at Nethermuir.

As discussed in section 6.11.3, no statistically significant relationship between land surface curvature and topsoil depth has been identified at Nethermuir. Although figure 6.42 shows that about two thirds of the area examined at Nethermuir is slightly convex, as might be expected, this appears to have had no bearing on topsoil depths across the site. Unlike Duncrub, where no agricultural damage was noted, agricultural damage at Nethermuir was widespread owing to the consistently shallow topsoil.

6.14 Potential for the further application of soil depth mapping

The topsoil depth mapping described so far has been based on a single variable and takes no account of rates of erosion and deposition at the locations examined. As such, it is a temporally static technique which can be used to assess past levels of damage and present levels of risk to cropmark monuments. The potential of this technique for evaluating risk to cropmark monuments would be increased greatly if rates of topsoil erosion could be included in the mapping. It is likely that tillage and water erosion at the convex areas will see the gradual lowering of the topsoil in years to come combined with gradual deepening of topsoil in concave areas. As a result, it is likely that the extent of archaeological deposits at risk from agricultural damage will change over time as topsoil depths across a site change. Figures 6.43 and 6.44 present two versions of topsoil depth maps for Upper Gothens. Figure 6.43 shows topsoil depth and perceived risk across the site, *as currently defined* through the auger survey undertaken. However, research at the nearby cropmark site of Littleour has suggested that localised topsoil loss in this area may be in excess of 1mm per annum (Davidson *et al.* 1998; Tyler *et al.* 1999). The map shown in figure 6.44 is hypothetical, showing risk to the archaeological deposits at Upper Gothens if a similar rate of topsoil loss is assumed for the knoll area at Upper Gothens for the next 20 years.

As figures 6.44 shows, the hypothetical mapping of topsoil depths at Upper Gothens assuming a constant loss of topsoil of 1mm per annum suggests that over time, the area of subsoil (within which archaeological features are located) vulnerable to damage through ploughing will change. Over the knoll at the north of the area examined, a greater area of subsoil will become vulnerable to agricultural damage, while in the concave areas towards the south of the area examined, deposition of colluvium will lead to a heightening in the soil depth profile, thus providing additional protection to any archaeological deposits in the subsoil. While figure 6.44 is hypothetical only and cannot be treated as accurate (indeed, to do so would be misleading if not foolhardy), it does demonstrate a potential application for soil depth mapping. If refined, hypothetical mapping of this type may enable the prediction of future risk to areas of cropmark monuments, even in areas where present topsoil depth ensures that archaeological deposits are currently found below the depth of normal cultivation. Other potential applications of such a technique might include the guidance of excavation strategies. For example, at cropmarks where partial excavation had shown varied levels of damage across archaeological features, mapping soil depth before further excavation might allow the targeting of those locations where the potential for information retrieval was highest. In circumstances where long-term preservation was desirable, then topsoil depth mapping might enable the targeting of specific areas to rescue excavate and the identification of specific areas to target for conservation measures.

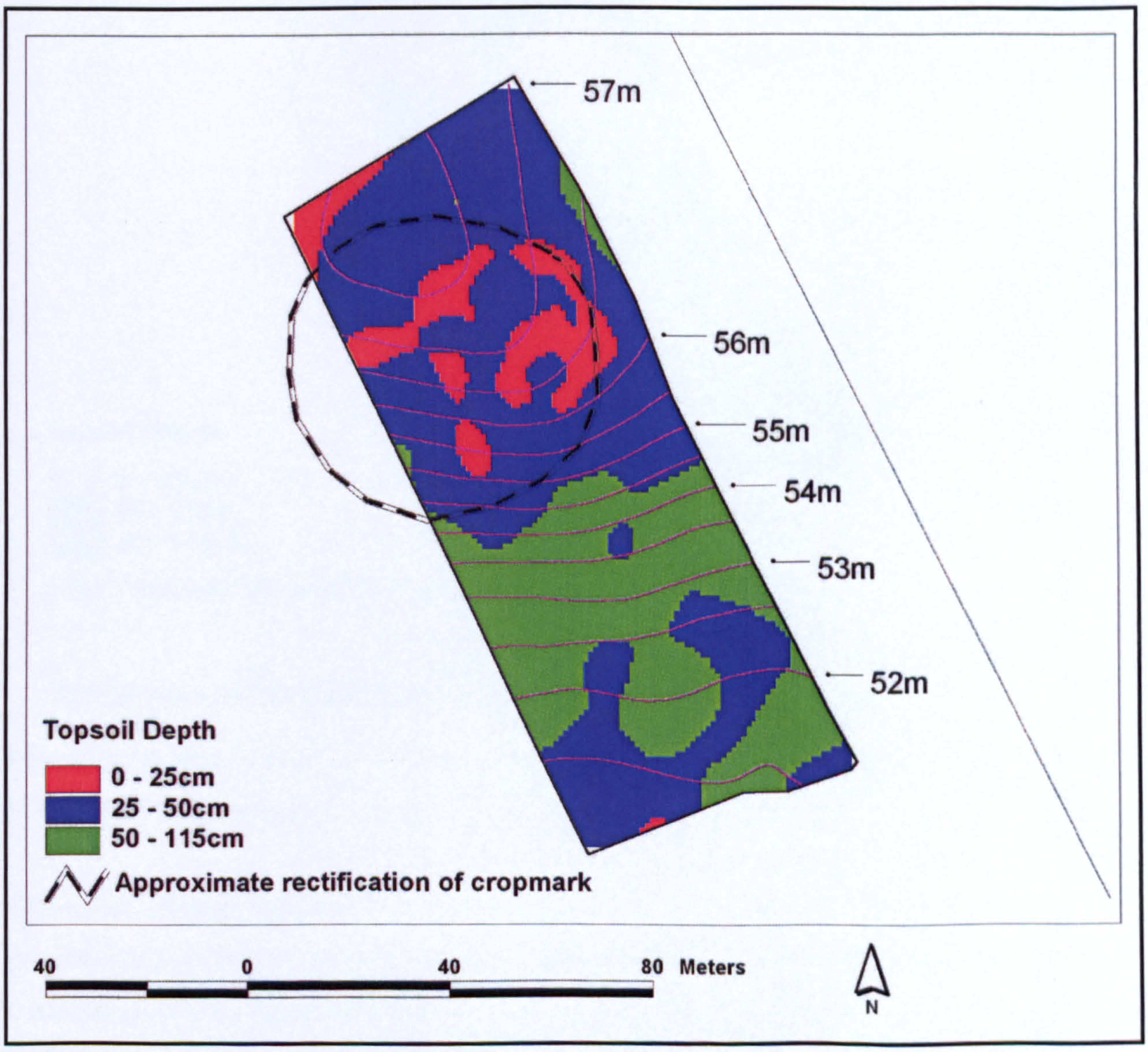

Figure 6.43. Map showing topsoil depth at Upper Gothens mapped according to probable damage levels and risk of damage from various agricultural practices.

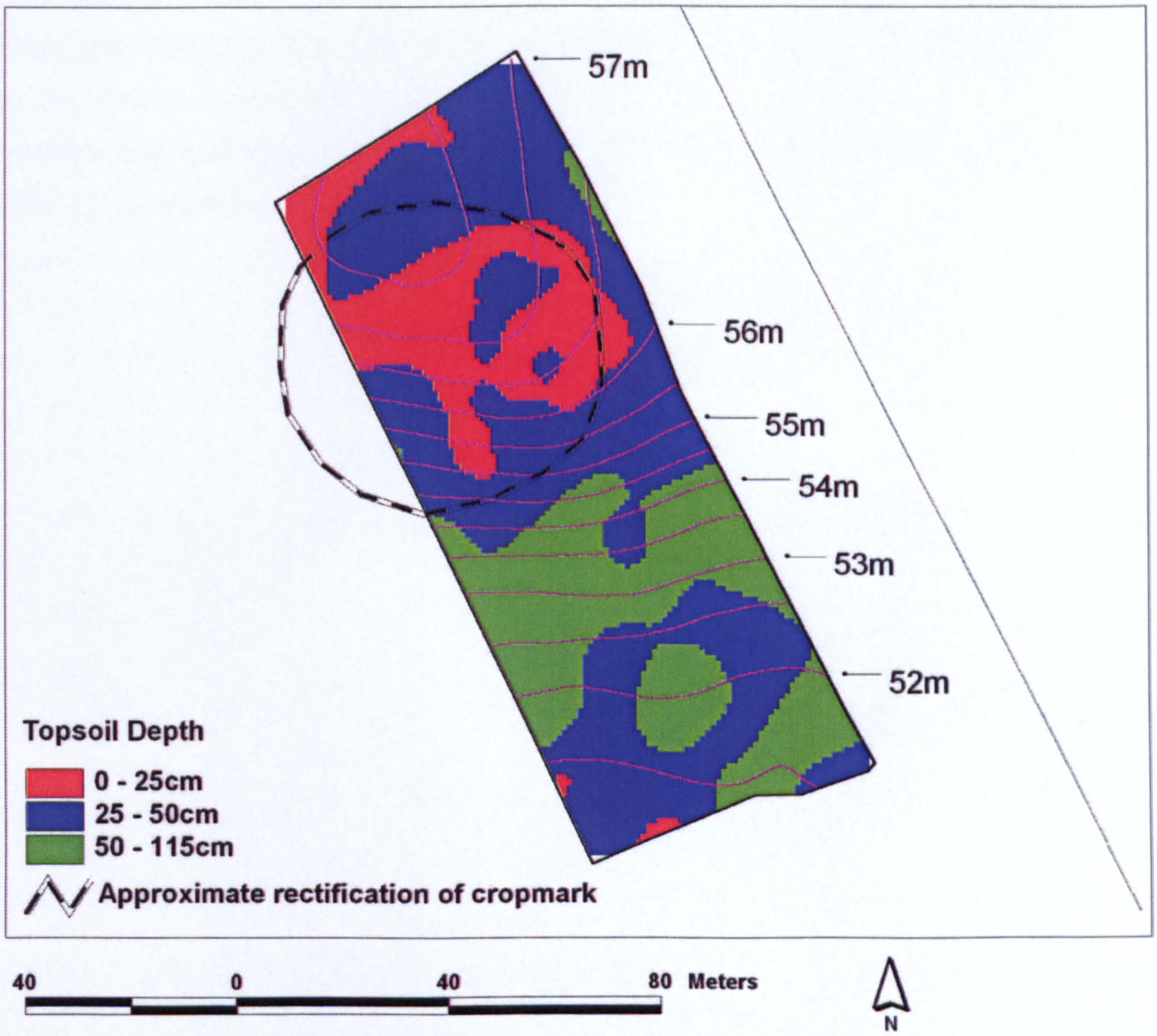

Figure 6.44. Map showing risk of damage from various agricultural practices in 2021 if a topsoil loss rate of 1mm per annum is assumed.

The series of maps presented in sections 6.13 and *6.14 of this chap*ter highlight the potential of soil depth mapping and land surface curvature mapping as resource. Those maps produced for Mount Stewart and Upper Gothens suggest that in keeping with the statistical evidence, there is a viable relationship between levels of agricultural damage to the subsoil and land surface curvature, with damage being greatest in areas of convexity and lowest in areas of concavity. However, the maps produced for Duncrub show that although relative topsoil depth at the site may be loosely linked to surface curvature, where general topsoil depth is high, land surface curvature may have limited value as a means of identifying damage and risk. Similarly, the maps produced for Nethermuir (where no statistically viable relationship between topsoil depth and land surface curvature was identified) show that in determining levels of agricultural damage to the subsoil, general topsoil depth may be of far greater importance than surface topography. Although the results presented show that the relationships between feature preservation, risk and surface topography are complex, there is surely great potential for the use of land surface curvature as a resource management tool.

6.15 Mapping damage and risk at the regional scale

The third objective of this section of the research has been to extrapolate from the excavation results to identify cropmark monuments (and parts of cropmark monuments) at greatest risk from ongoing and future agricultural damage. From the small number of sites examined, it appears that where topography is pronounced (such as at Mount Stewart and Upper Gothens), there is a viable relationship between topsoil depth and land surface curvature, and correspondingly, a relationship with levels of agricultural damage in the subsoil. Where topography is less pronounced, however (such as at Nethermuir), this relationship is less likely to be significant. Nevertheless, Bowes (2003, 288) found that land surface curvature was the fundamental factor controlling the magnitude of soil loss on cultivated land. Similarly, Tyler *et al.* (1999) found that rates of soil erosion at Littleour were highest on slope shoulders. Furthermore, several excavators (e.g. White 2001; Strachan *et al.* 2003; Alexander 2003) have noted relationships between topsoil depth, topography and the condition of archaeological features. The site-specific decision tree method of assessing risk to buried features developed by the *Management of Archaeological Sites in Arable Landscapes* project also uses topography as one of the key variables to be assessed in determining risk to buried features (Oxford Archaeology 2002, 15-18).

Given the strength of evidence to suggest relationships between land surface curvature, topsoil depth and feature preservation, this research has used land surface curvature to map relative damage and risk to cropmark monuments across the entire study area. The next section of this chapter describes how this has been achieved, first by describing the methods used and then examining the results produced.

6.15.1 Methodology

As this section of the research is designed to estimate levels of damage and risk of damage to cropmark monuments through past and present agricultural practices at a *regional* scale, it has not been practical to use site specific data or direct field observations. Indeed, the augering of a large number of cropmark monuments to establish topsoil depth would be labour intensive and probably less cost-effective than opening exploratory trenches using a mechanical digger. In any case, such widespread invasive methodologies would have been far outwith the means of this research. Instead, Arcview GIS has been used to model land surface curvature across the study area. This surface curvature mapping has then been applied to the spatial extents of a large number of cropmark monuments, in the following manner.

The curvature data was derived from a digital terrain model (DTM) created by Bowes for use in his research into soil erosion rates (Bowes 2003). The DTM was generated by Bowes in ARC/INFO GRID using the OS Land-form Profile™ data set, which provides contours at 5m intervals in addition to spot elevation data. The DTM has a cell size of 25m. Although Bowes (2003, 78, 291-2) has noted that this cell size is slightly too large for accurate terrain modelling (a theme examined further in section 6.15.2) limits of computing power available to Bowes dictated that a 25m cell size was used. Land surface curvature was derived from Bowes's DTM in Arcview GIS 3.2, using Thorsten Behren's (2000) DEMAT DEM Analysis extension downloaded from http://arcscripts.esri.com, creating a land surface curvature grid with a 25m cell size for the entire study area.

With land surface curvature data obtained for the entire study area, it was then necessary to secure spatially accurate locational information for cropmarks in the study area. This was achieved by obtaining polygon shapefiles from Historic Scotland of all scheduled cropmark monuments in the study area. Using Jeff Ardon's (2000) grid2pt Avenue script utility in Arcview GIS 3.2 (downloaded from http://arcscripts.esri.com), the land surface curvature grid was converted into a point file, and each point corresponding to a scheduled cropmark polygon was clipped from the point file. Thus each scheduled cropmark in the study area was represented by a number of points spaced 25m apart. Using Jeremy Davies's Get Grid Value Extension 2 ((2000), downloaded from http://arcscripts.esri.com) in Arcview, curvature was then derived from the underlying grid theme for each point, so that each of the scheduled cropmark monuments within the study area was represented by a series of points with curvature values.

6.15.2 Analysis and mapping of land surface curvature in relation to scheduled cropmark monuments

For a variety of reasons, the analysis undertaken on damage to scheduled cropmark monuments in the study area has been limited in scope. Firstly, there is no doubt that the resolution of the DTM from which the curvature data has been derived contains a number of inaccuracies. Figures 6.45 and 6.46 show convexities and concavities at Upper Gothens derived from the contour survey undertaken as part of this research (figure 6.45) and derived from Bowes's DTM (figure 6.46).

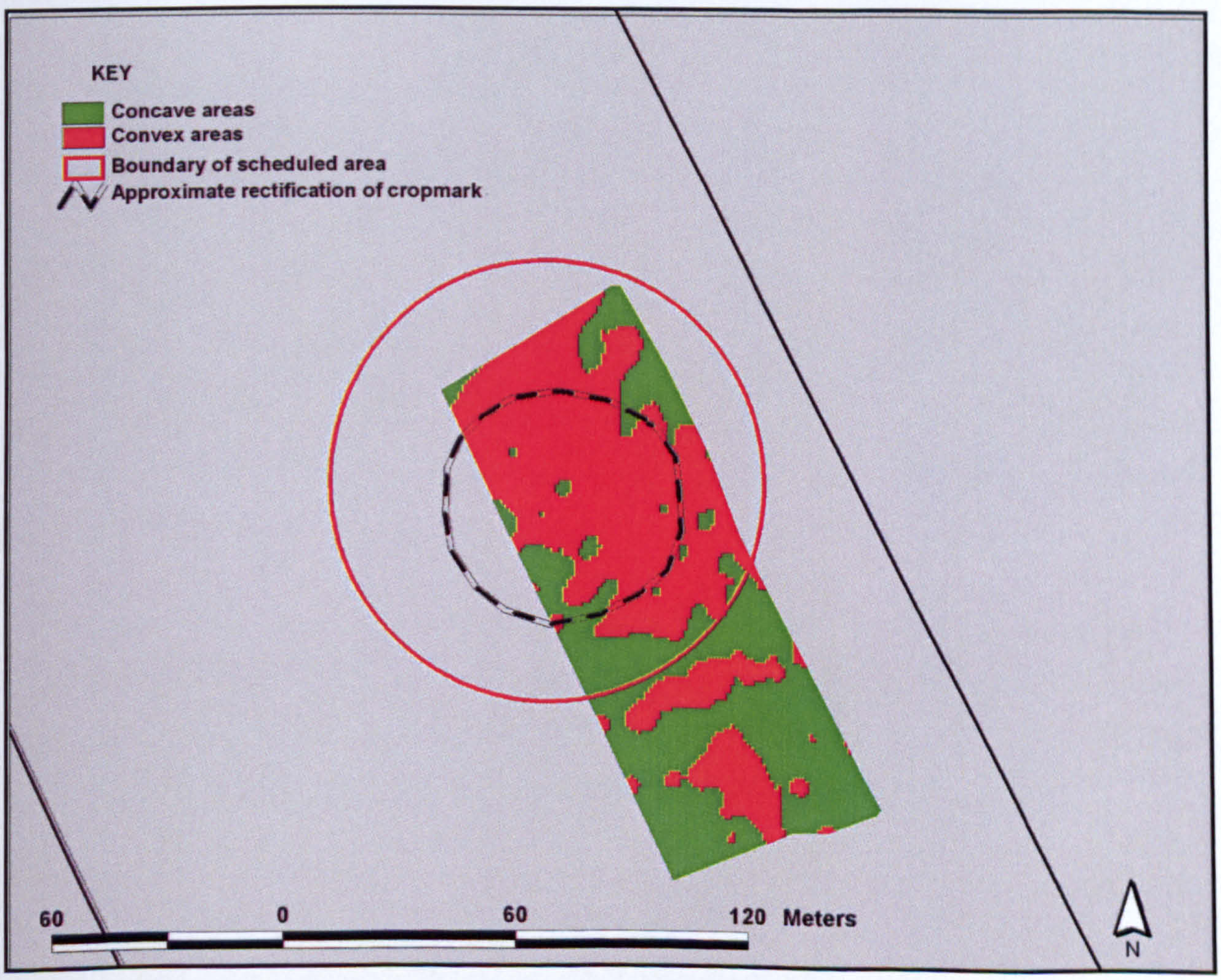

Figure 6.45. Map showing convex and concave areas at Upper Gothens, generated from the contour survey undertaken there as part of the current research.

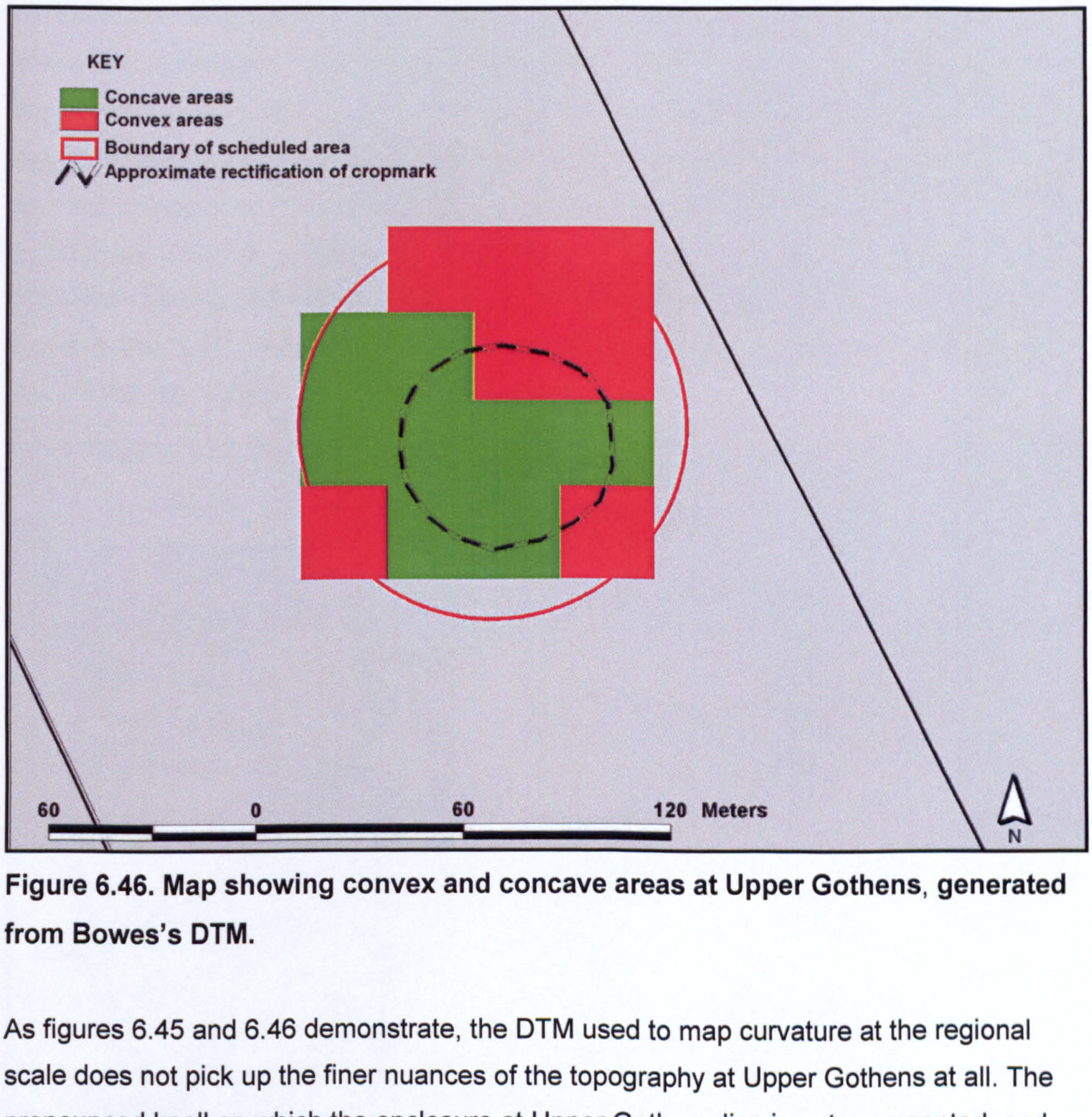

Figure 6.46. Map showing convex and concave areas at Upper Gothens, generated from Bowes's DTM.

As figures 6.45 and 6.46 demonstrate, the DTM used to map curvature at the regional scale does not pick up the finer nuances of the topography at Upper Gothens at all. The pronounced knoll on which the enclosure at Upper Gothens lies is not represented, and the 25m cells which cover the area of this knoll have negative (concave) values.

Furthermore, a number of the scheduled areas are so small that they contain very few data points. Figure 6.47 shows three scheduled cropmark monuments at Castle Menzies, near Aberfeldy in Perthshire. As figure 6.47 shows, the central monument of the three is represented by only five points derived from the DTM. The potential for error is great here, as it would require only one data point to be erroneous for the interpretation of all five data points to be adversely affected. Some of the scheduled areas in the study area are so small that they contain only one data point. To reduce the potential for error, no attempt has been made to interpret land surface curvature for any scheduled monuments that are represented by fewer than 15 data points.

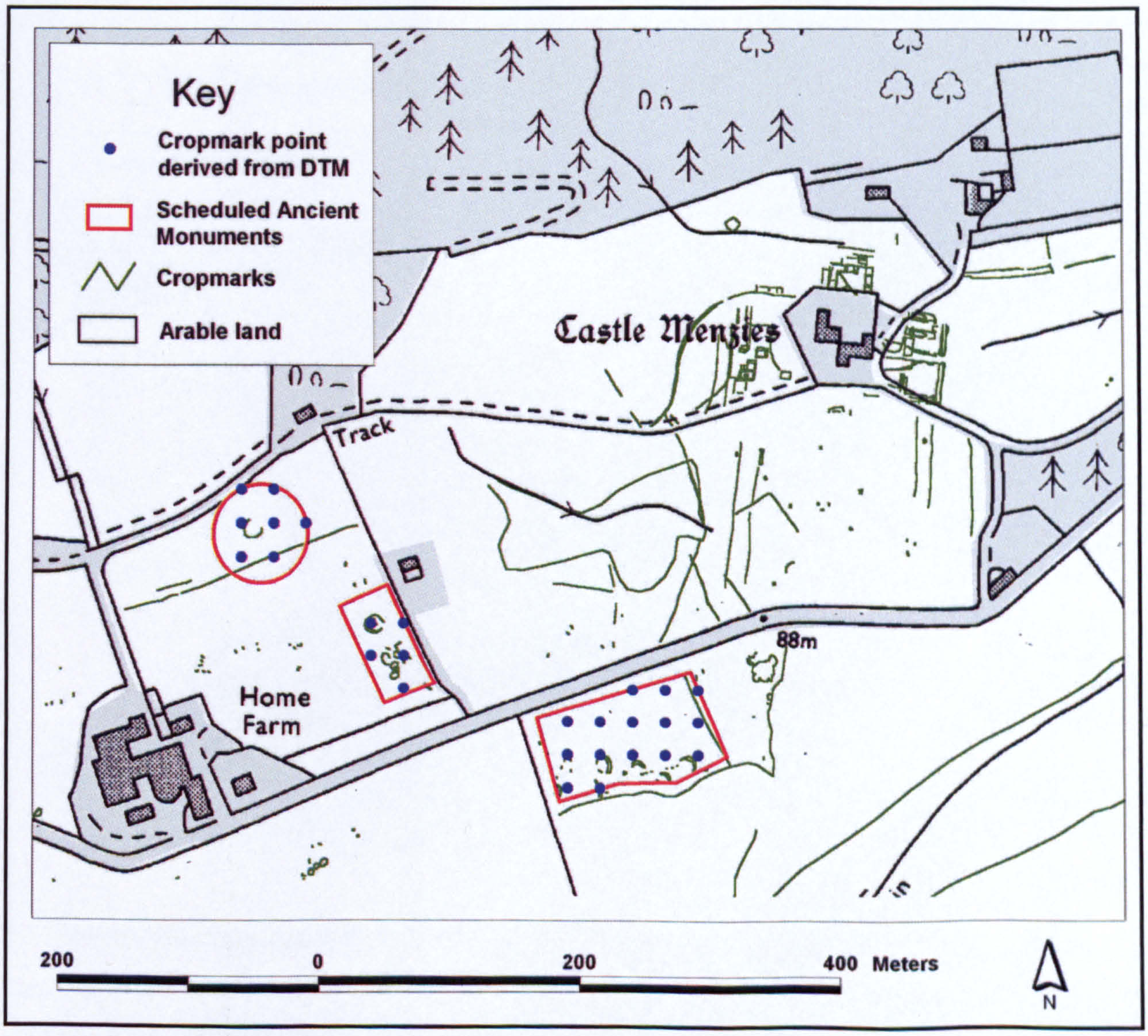

Figure 6.47. Map showing three scheduled cropmark sites at Castle Menzies near Aberfeldy, Perthshire (NGR NN 833 493). ***Base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].***

Lastly, it is common *scheduling practice* to define a larger area (usually of at least 10m larger) than the visible cropmark areas for scheduling, in order to provide *a buffer zone* around the known archaeological remains. As a result, parts of the scheduled areas covering cropmarks in the study area also cover adjacent areas of non-arable land. Furthermore, a number of the scheduled cropmark monuments in the study area also contain extant elements surviving in field margins or areas of uncultivated ground adjacent to the arable, such as the scheduled cropmark enclosure at Loanleven near Perth, as shown in figure 6.48.

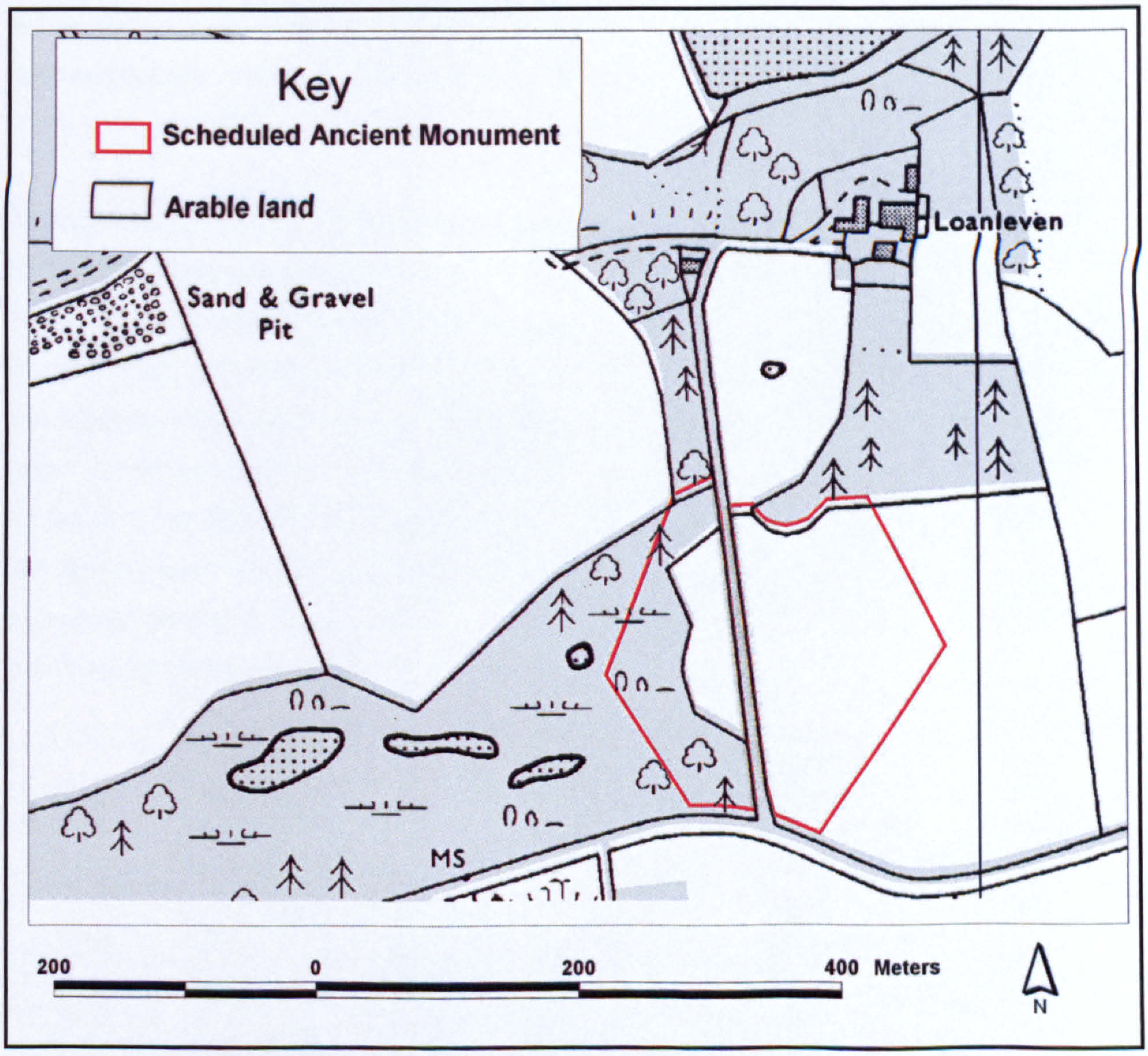

Figure 6.48. Map showing the scheduled area at Loanleven, Perthshire (NGR NO 058 251), which is divided between arable land (to the east of the road) and woodland (to the west of the road). ***Base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004].***

To interpret damage and risk from cultivation for areas of scheduled ancient monuments located on non-arable land would be misleading, and so curvature values have only been examined for those parts of scheduled cropmarks found in land with an arable LCS88 classification.

Despite the limitations of the datasets used here, the potential of a technique of this type is great as a means of rapidly identifying past damage and potential risk to cropmark monuments. Data tables produced in a GIS can be easily interrogated to identify cropmarks situated on pronounced convexities. This rapid interrogation to identify scheduled cropmarks in the study area situated on pronounced convexities (and correspondingly, where damage and risk are likely to be highest) has been possible within the current research.

All scheduled cropmark monuments in the study area which lie in land classified by the LCS88 as arable and contain more than 15 data points have been examined. There are 140 such monuments. Preliminary analysis shows that average land surface curvature within 41 (29%) of these monuments is planar or concave, while the remaining 99 (71%) are situated in land which is predominantly convex. This suggests that the majority of the larger scheduled cropmarks in the study area can be considered (on the basis of surface topography alone) to have suffered agricultural damage in the past and correspondingly, are likely to suffer further agricultural damage in the future. Table 6.2 shows the five scheduled cropmark monuments within the study area identified as containing the most pronounced convex areas.

Monument name	Monument classification	Grid reference	Total number of data points in scheduled area	Maximum curvature value	Minimum curvature value	Average curvature value
Inverquaharity	Roman fort and camp	NO 406 580	35	2.36	-0.44	**0.48**
Damside	Fort	NO 161 311	24	1.81	-0.44	**0.39**
Thorn	Fort	NN 961 120	19	1.85	-2.08	**0.29**
Nether Drums	Fort	NO 274 062	22	1.50	-1.48	**0.26**
Pusk Farm Cottages	Ring-ditch and enclosures	NO 441 209	21	0.86	-0.19	**0.24**

Table 6.2. The five scheduled cropmark monuments in the study area situated on land with the highest average curvature value.

As table 6.2 shows, three of the five cropmark monuments identified as being situated on the most convex ground are forts, which are frequently located in strategically advantageous positions, such as hilltops and promontories, where greater risk of erosion might be expected. Figure 6.49 shows a land surface curvature map for Thorn fort, which has been identified as having the third highest average surface curvature of the scheduled cropmarks examined. As the contour data in figure 6.49 demonstrates, the fort is situated on a headland from which the land drops away on all sides except to the west.

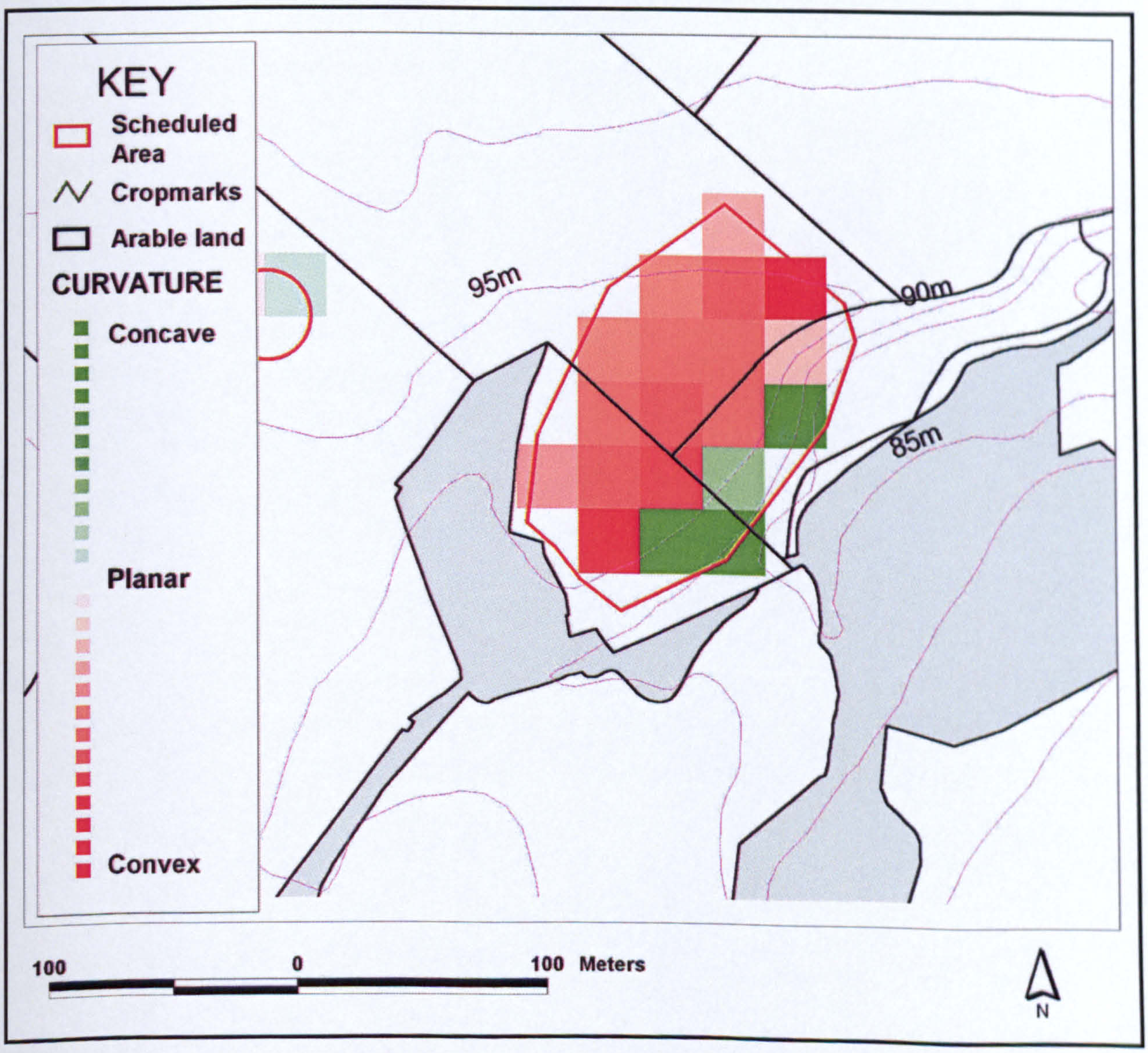

Figure 6.49. Map showing the scheduled area of Thorn fort (NGR NN 961 120) with land surface curvature mapped.

It has been possible also to identify those larger scheduled cropmarks in the study area containing the most pronounced concavities (and correspondingly, where damage and risk are likely to be lowest), as shown in table 6.3.

Monument name	Monument classification	Grid reference	Total number of data points in scheduled area	Maximum curvature value	Minimum curvature value	Average curvature value
Wester Kinnear	Ring-ditch and cursus	NO 397 226	38	0.80	-1.25	**-0.11**
Mylnefield	Souterrains	NO 337 303	16	-0.01	-0.24	**-0.09**
Gannochy	Unenclosed settlement	NO 130 248	19	-0.03	-0.21	**-0.08**
Mains of Brigton	Enclosure	NO 427 487	26	0.24	-0.97	**-0.06**
Graystane Lodge	Cursus and barrows	NO 340 308	27	0.07	-0.33	**-0.05**

Table 6.3. The five scheduled cropmark monuments in the study area situated on land with the lowest average curvature value.

As table 6.3 shows, two of those monuments identified as being situated in predominantly concave areas are cursus sites, while two more are undefended settlement sites, probably dating to the first two centuries AD (though on the basis of cropmark evidence, this cannot be assumed). This provides an interesting contrast to those monuments identified as being situated on convexities, which are likely to have been predominantly defensive in function. While this pattern is likely to reflect a past preference for certain topographic locations depending on the function of the monument constructed, it would be dangerous to make any archaeological inference on the basis of so few sites. This does, however, suggest that certain types of monument may at greater risk of damage from cultivation, purely because of the topography of the land on which they have been constructed. As figure 6.50 (overleaf) shows, the contours of the land in which Gannochy unenclosed settlement are gentler than those at Thorn fort. The entire scheduled ancient monument is situated in a concave area, and consequently, levels of agricultural damage and the risk of future damage to the monument are likely to be considerably less than those at Thorn.

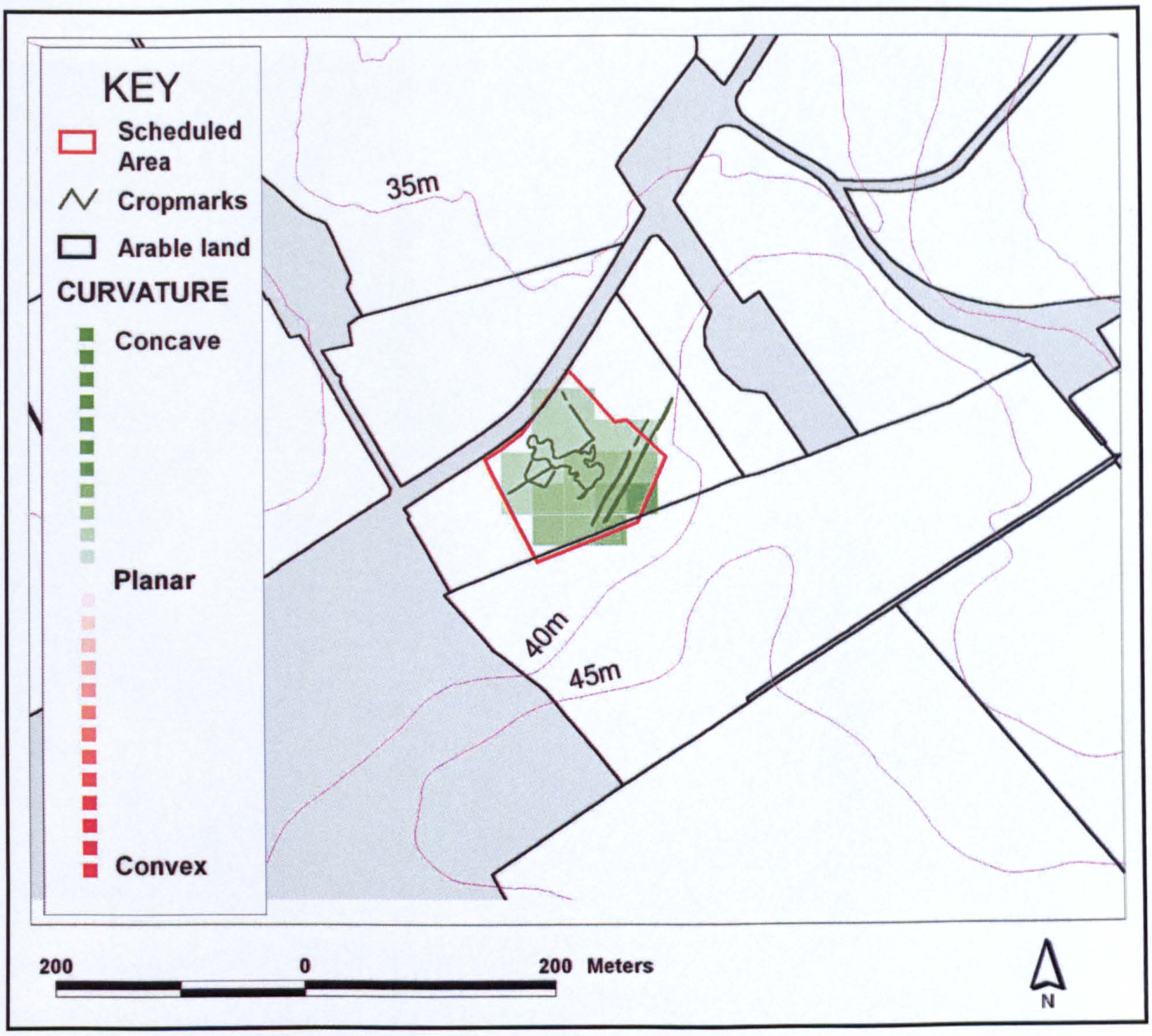

Figure 6.50. Map showing the scheduled area of Gannochy unenclosed settlement (NGR NO 130 248) with land surface curvature mapped.

Given the likely inaccuracies in the land surface curvature data, the results presented in tables 6.2 and 6.3 cannot be treated as particularly reliable. These tables do, however, illustrate the potential for a technique of this type. With better land surface curvature data to work from, such an approach could prove valuable to resource managers as a means of rapidly assessing damage and risk to buried archaeological remains. The potential of land surface curvature mapping as a means of identifying likely damage and risk to cropmark monuments (and parts of cropmark monuments) can be further appreciated by examining maps produced for some of the larger scheduled cropmark monuments in the study area. Figure 6.51 shows an aerial photograph of the enclosures and pit-circle at Leadketty, near Dunning in Perthshire.

Figure 6.51. Leadketty enclosures and pit-circle (NGR NO 021 162). Reproduced from photograph PT/15085. Copyright © RCAHMS. Reproduced with permission of the Royal Commission on the Ancient and Historical Monuments of Scotland.

As the varying colour bands in crop growth around the archaeological cropmarks in figure suggest, there is considerable variation in the topography at Leadketty. However, the aerial photograph is of little help in defining the precise topographic variations of the area. Although a site visit might help assess the nature of the topography across the site, this would be time-consuming. By interrogating a GIS with an accurate DTM, however, this information would be readily accessible. Figure 6.52 shows land surface curvature mapped across the scheduled area at Leadketty, while table 6.4 summarises the characteristics of the land surface curvature within the scheduled area.

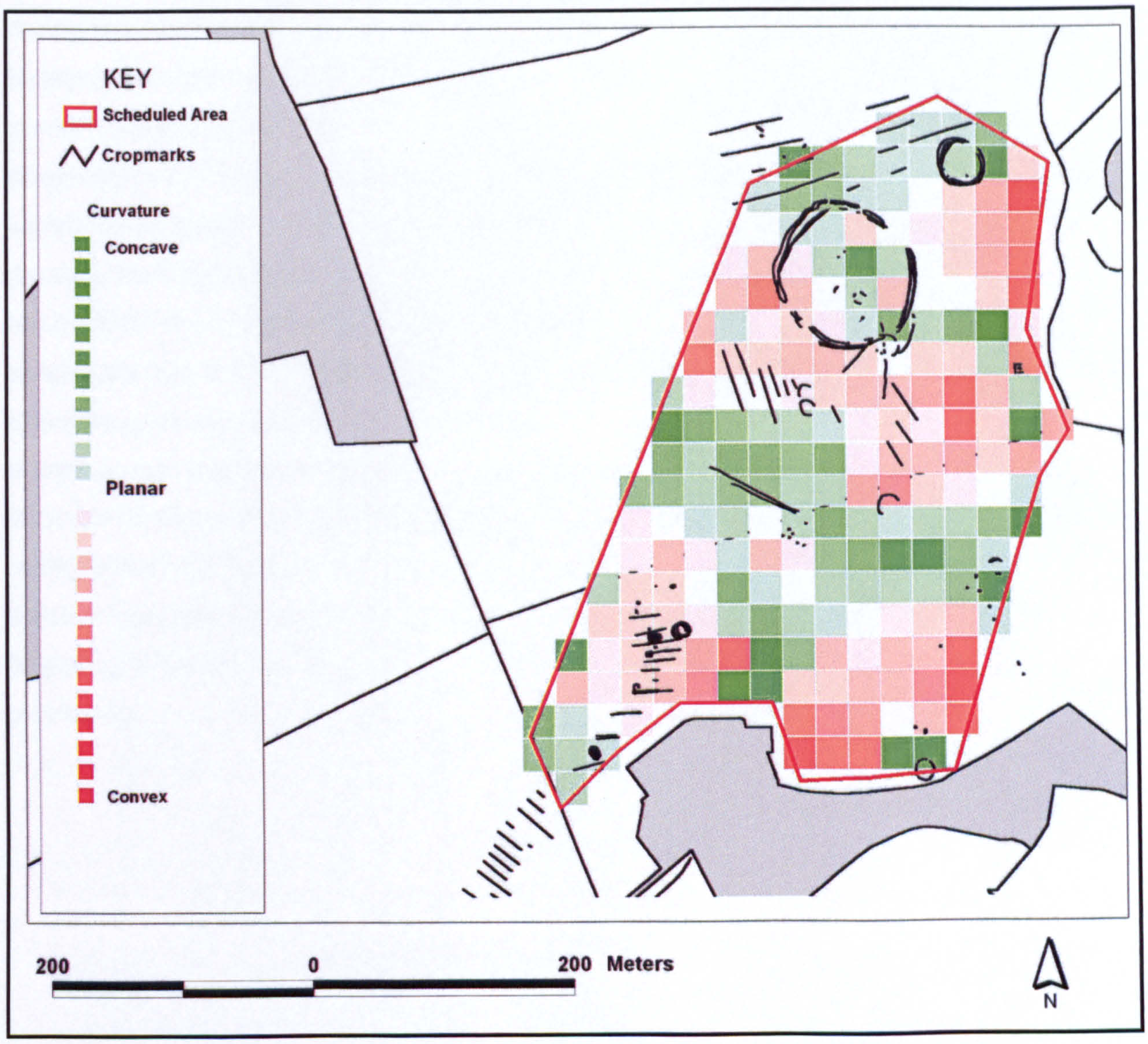

Figure 6.52. Map showing the scheduled area of Leadketty (NGR NO 021 162) with land surface curvature mapped.

Monument name	Monument classification	Grid reference	Total number of data points in scheduled area	Maximum curvature value	Minimum curvature value	Average curvature value
Leadketty	Enclosures & pit-circle	NO 021 162	219	0.74	-0.88	**0.04**

Table 6.4. Land curvature characteristics of the scheduled ancient monument at Leadketty.

Examination of figure 6.52 and table 6.4 shows that although the average land surface curvature at Leadketty is only 0.04, curvature varies markedly across the area of the monument. Visually, this is evident in figure 6.52, but when complemented by the statistics presented in table 6.4, the precise characteristics of the scheduled area can be far better understood. As described in section 6.12, the limited programme of excavation undertaken during the current research and subsequent statistical analysis have suggested that where topography is pronounced, there is a statistically viable relationship between land surface curvature and topsoil depth. Consequently, analysis of land surface curvature across areas where cropmark monuments are recorded (such as Leadketty) should help identify variations in topsoil depth and consequently, the likelihood of damage and risk of further damage from agricultural activities. As with the site-specific mapping illustrated in sections 6.13 and 6.14, in addition to providing a crude assessment of damage and risk, mapping of land surface curvature at a regional scale might assist in the formulation of excavation and management strategies. For example, at cropmarks where partial excavation had shown varied levels of damage across archaeological features, mapping land surface curvature before further excavation might allow the targeting of those locations where the potential for information retrieval was highest. In circumstances where long-term preservation was desirable, then land surface curvature mapping might enable the targeting of specific areas to rescue excavate and areas to target for conservation measures.

6.16 Validation of results

Neither the site-specific soil depth risk mapping nor regional scale land surface curvature mapping techniques developed in this chapter have been tested against field data. Consequently, their accuracy remains untested. Here, a measure of the accuracy of the soil depth risk map produced for Upper Gothens is determined through comparison with observations made in the adjacent excavation trench of the First Farmers Project. However, the accuracy of the regional scale land surface curvature mapping as a means of identifying damage and risk to cropmark monuments is more difficult to ascertain, as the mapping is based on a single variable derived from a computer generated DTM. The potential inaccuracies in the 25m resolution of the data points used to map this land surface curvature are assessed further here through comparison with a high-resolution land surface curvature map produced for Duncrub. Accuracy issues pertaining to the resolution of the mapping notwithstanding, further assessment of the accuracy of the curvature mapping is addressed here through the comparison of the land surface curvature dataset with the corresponding dataset produced by Bowes (2003) when modelling soil erosion in the same study area.

6.16.1 Topsoil depth mapping

Comparison of the soil depth risk map produced for Upper Gothens with the results of the adjacent excavations undertaken through the First Farmers Project suggests that the soil depth mapping provides a reasonably accurate estimate of levels of agricultural disturbance. As figure 6.53 (overleaf) shows, the soil depth map produced for Upper Gothens identifies likely damage and risk as being greatest at the north end of the area examined, both within and around the trench opened for the First Farmers Project. In figure 6.53, areas marked red (topsoil 0-25cm deep) represent parts of the site likely to have suffered damage from ploughing operations. Areas marked blue (topsoil 25-50cm deep) represent parts of the site where damage from subsoiling might be expected, while areas marked green (topsoil >50cm deep) represent areas where the topsoil / subsoil interface is deeper than normal subsoiling depths.

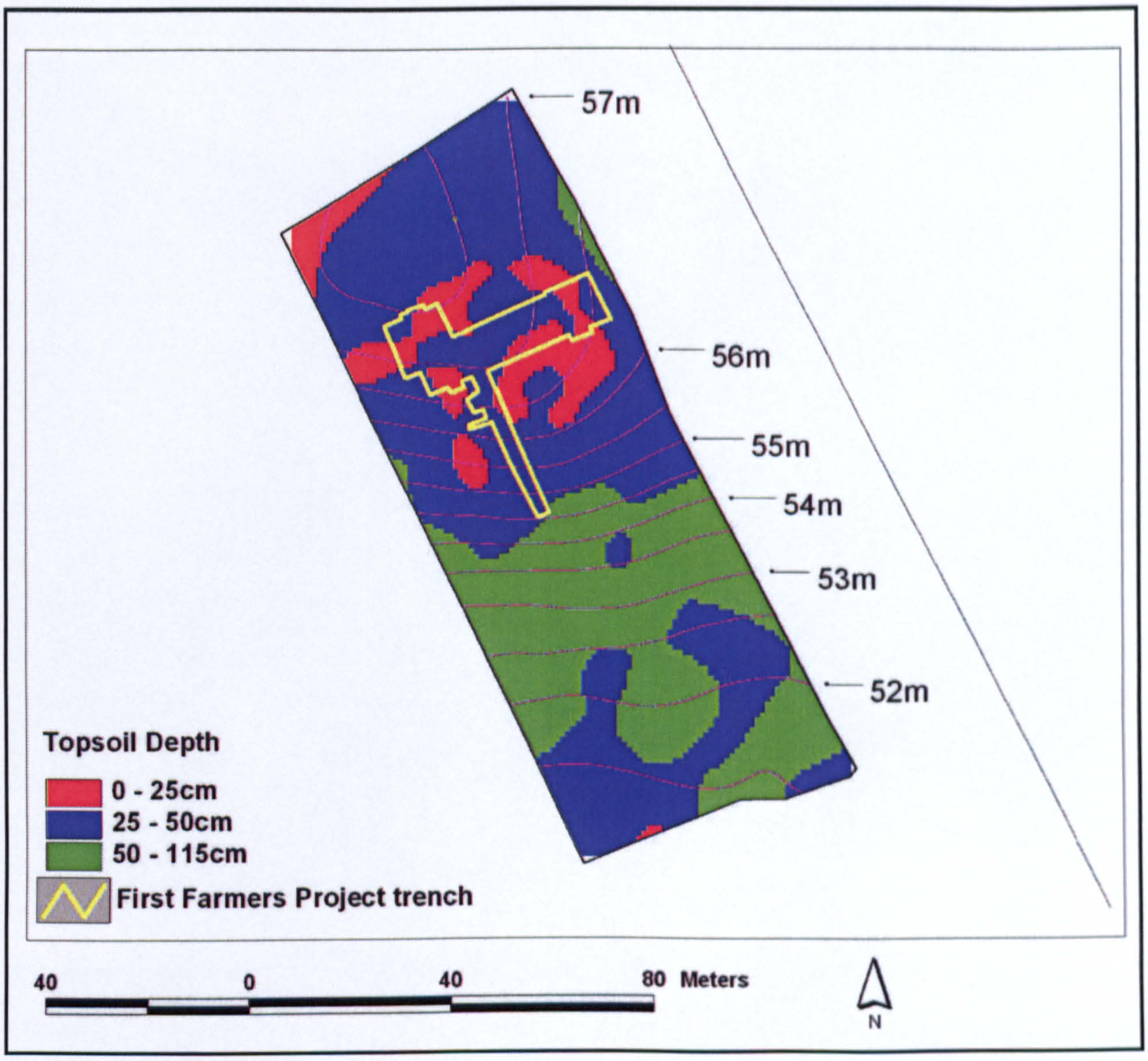

Figure 6.53. Map showing topsoil depth at Upper Gothens mapped according to risk to features in the subsoil from agricultural activities. The First Farmers project trench is shown at the knoll area towards the north end of the area examined.

As figure 6.54 (overleaf) shows, the high levels of damage at this northern end of the area predicted in figure 6.53 were confirmed by the excavations of the First Farmers Project. However, plough damage across the extent of the First Farmers Project trench was far in excess of the discrete areas marked red in figure 6.53. Plough scarring was noted across the entire length of the WSW-ENE aligned main area of the First Farmers Project trench, despite the topsoil depth mapping predicting that much of this area would have sufficient depth of topsoil to protect archaeological features in the subsoil. That the topsoil depth mapping failed to predict this damage can probably be best attributed to localised variations in topsoil depth at Upper Gothens which the spacing of auger points (c. 7-10m spacing) failed to recognise.

Figure 6.54. Photograph showing subsoil disturbance in the NW part of the First Farmers Project trench, cutting through a series of palisade slots.

A further limitation of topsoil depth mapping of this type is illustrated in figure 6.55, which shows an area of intersecting channels cut into the subsoil in the middle section of the WSW-ENE aligned main area of the First Farmers Project trench. This disturbance (for which no definite cause could ascertained) penetrated to over 60cm beneath the ground surface and was confined to one part of the trench. Because no such disturbance was encountered in the trenches examined through the current research, the topsoil depth map for Upper Gothens has assumed high levels of damage to 25cm deep with further damage from subsoiling at depths of up to 50cm. As figure 6.55 illustrates, however, on parts of the area included in the soil depth map of Upper Gothens, damage has occurred at far greater depths than predicted by the mapping.

Figure 6.55. Photograph showing extreme localised subsoil disturbance noted in the First Farmers Project trench at Upper Gothens.

In summary, comparison of the soil depth mapping at Upper Gothens with the excavated evidence shows that with significant localised exceptions, the soil depth mapping provides a reasonably accurate estimate of levels of agricultural disturbance. However, the comparison also demonstrates that although general damage levels can be predicted, localised variations in topsoil depth reduce the potential for the precise prediction of agricultural damage. Localised topsoil depth variations of this type were noted at all of the locations examined except Peel, lending weight to the notion that topsoil depth mapping technique of this type will require further validation and refinement before being put to any rigorous application.

6.16.2 Regional scale mapping

No attempt has been made to validate any of the regional scale curvature maps in the field. The term 'regional' scale has been used throughout this chapter to describe the land surface curvature mapping. Although it is acknowledged that visually, the map outputs need to be examined at site scale (as no detail would be visible in maps presented at the regional scale) the interrogation and analysis of the data on which the mapping is based has been undertaken very rapidly for the entire study area, using Arcview GIS. This brief interrogation and analysis has identified those scheduled cropmark monuments with highest and lowest average curvature values, which have then been presented in site scale mapping. As the technique used here has interrogated and analysed the curvature data for each cropmark monument at the regional scale, the term 'regional scale' remains valid in describing the mapping technique.

As discussed in section 6.14.1, the DTM on which the land surface curvature mapping has been based was generated by in ARC/INFO GRID using the OS Land-form Profile™ data set, which provides contours at 5m intervals in addition to spot elevation data. The DTM uses a cell size of 25m, and consequently, curvature data for each of the cropmark monuments examined has been available only at 25m intervals. Examination of two map outputs from Duncrub illustrates that the land surface curvature values produced using the 25m resolution data simply cannot replicate micro-topographic characteristics.

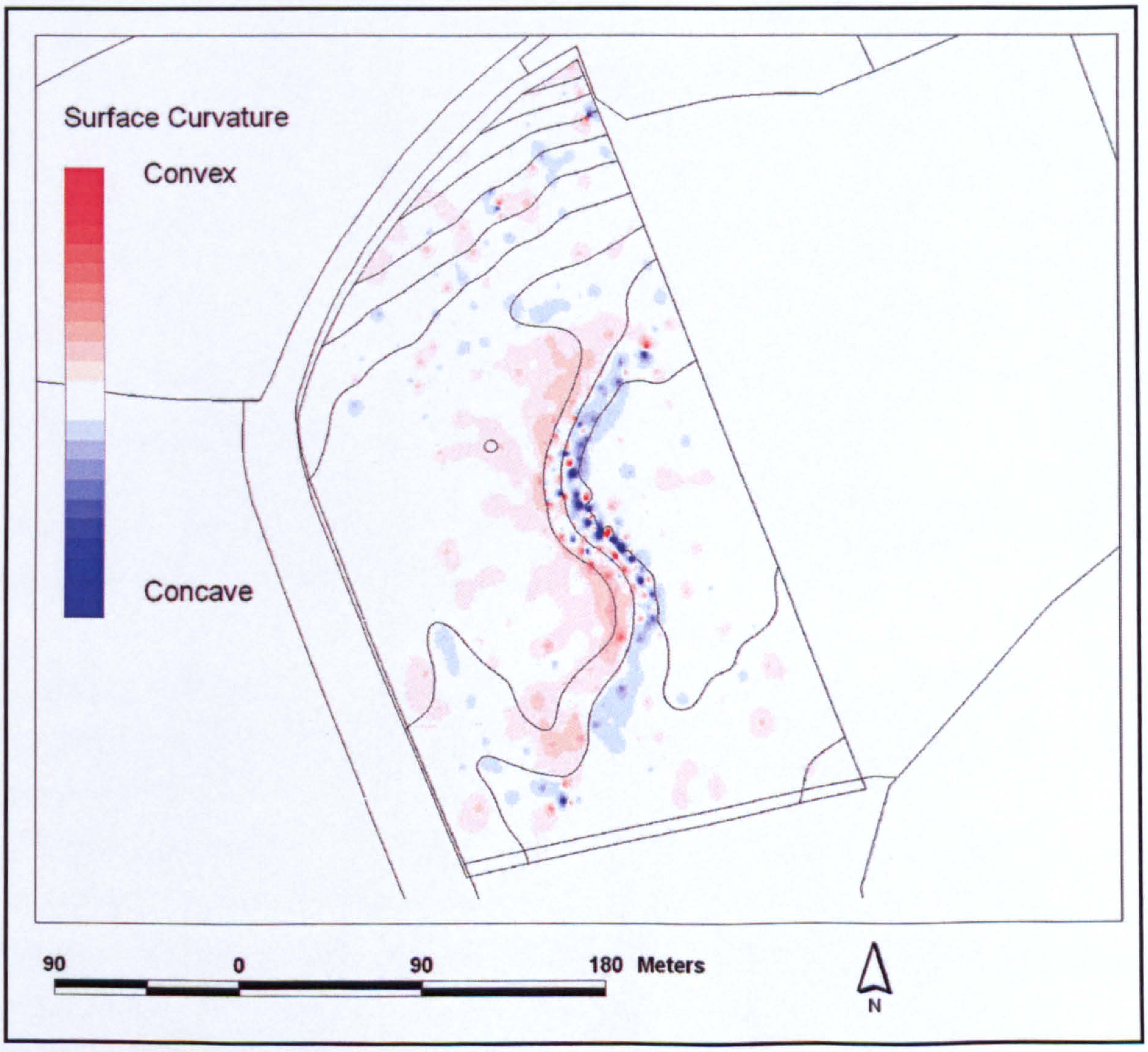

Figure 6.56. Map showing land surface curvature at Duncrub derived from the EDM contour survey undertaken as part of the current research. Contours are at 1m intervals.

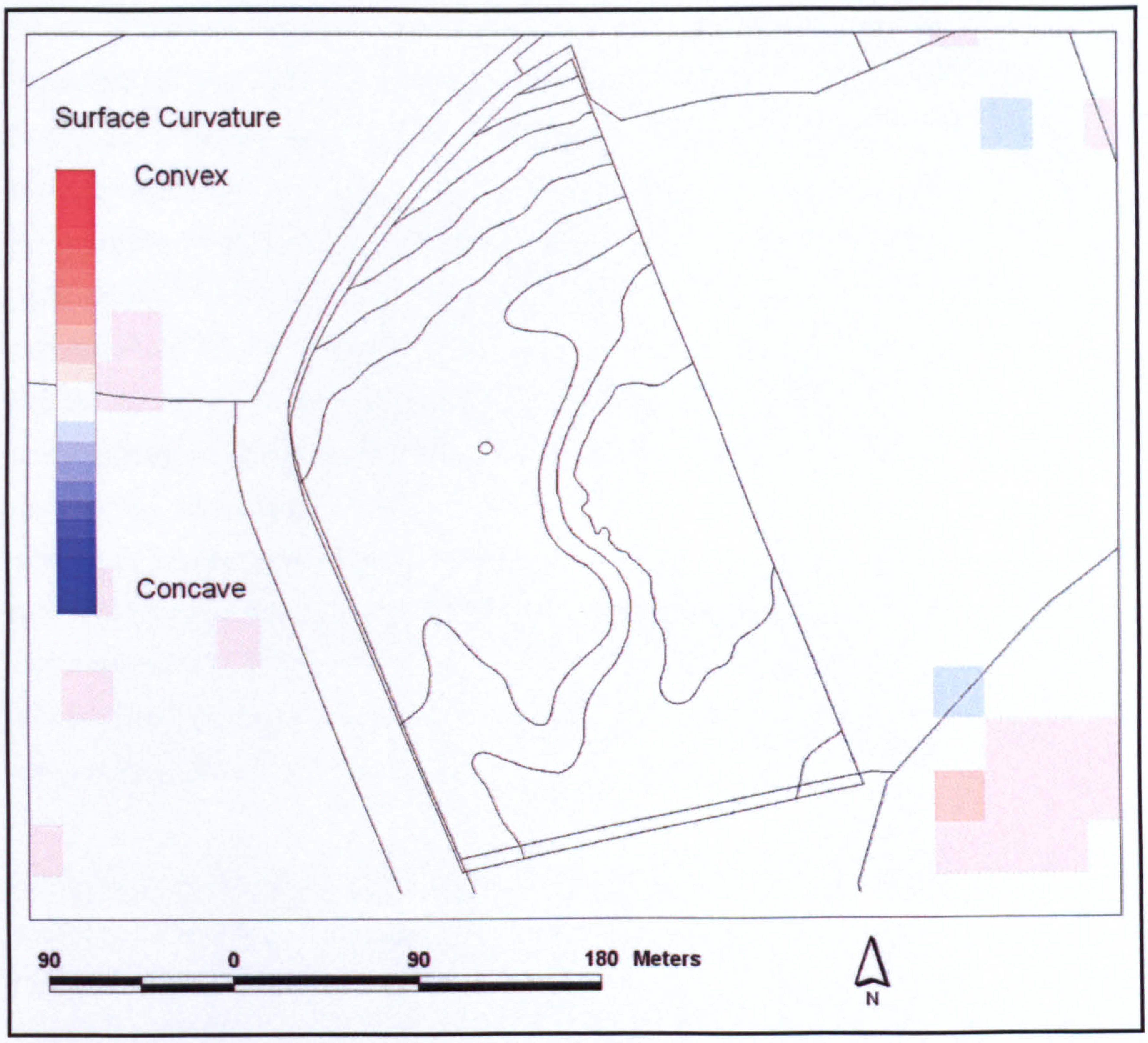

Figure 6.57. Map showing land surface curvature at Duncrub derived from the 25m cell size DTM. Contours are at 1m intervals.

Comparison of figures 6.56 and 6.57 illustrates that the mapping derived from the contour survey undertaken using an EDM exhibits detailed variation in land surface curvature, with the convex raised beach and the concave slope base displayed with great clarity. However, the map derived from the 25m cell size DTM has failed to register any topographic variation within the area of the contour survey. Consequently, mapping derived from the 25m cell size DTM has limited potential for identifying subtle landscape features such as knolls or, in the case of Duncrub, raised beaches. As many cropmark monuments (such as Upper Gothens) are found on low knolls, it must be concluded that as a means of identifying damage and risk to cropmark monuments, the resolution of the dataset used in this research is inadequate.

Issues of dataset resolution aside, examination of the land surface curvature maps produced for each of the locations examined through auger survey and excavation shows that in some cases, damage to the subsoil is heavily dependant on general topsoil depth and management history and not closely related to land surface curvature. At Nethermuir, for example, shallow topsoil throughout the area examined had enabled significant disturbance of the subsoil. By contrast, topsoil depth at Duncrub (which had a similar management history to Nethermuir) was so great that no damage to the subsoil attributable to agriculture was noted during excavations. This suggests that in some cases, land surface curvature will have no real bearing on relative condition of (or risk to) buried archaeological deposits. Furthermore, the observations from Duncrub and Nethermuir show that unless general topsoil depth across a site is known, likely variations in damage to archaeological deposits attributable to land surface curvature will be difficult to assess. Consequently, it is possible to suggest that the mapping of land surface curvature to identify likely damage and risk to cropmark monuments would be best undertaken in conjunction with complementary works such as test pitting or augering.

Perhaps the greatest shortcoming of the mapping approach used here to identify damage and risk to cropmark monuments is that the technique is based upon a single variable. A number of variables are known to contribute to levels of damage to buried deposits, however, including management history, climate, erosion rates, slope and soil type (Oxford Archaeology 2002, 10). Consequently, an approach using a single variable may be too simplistic to produce accurate assessments of damage and risk. In a basic attempt to evaluate the accuracy of the curvature mapping approach to identifying damage and risk to cropmark monuments, two statistical tests have been used to test the significance of the relationship between land surface curvature values derived from the 25m cell size DTM and the corresponding optimised net soil erosion values produced by Bowes (2003). Although Bowes's erosion modelling was based upon the same DTM as used in this research, Bowes used a number of variables in his modelling, including tillage translocation, hydrology, field boundaries and topography. Furthermore, Bowes's outputs were optimised using the Cs^{137} tracer technique (Bowes 2003, 2). There is merit, therefore, in testing the significance of the relationship between the crude output of the land surface curvature values and more refined output of Bowes's research.

Figure 6.58 shows a scatterplot with regression line with land surface curvature value (independent variable) plotted against Bowes's optimised net soil erosion value expressed in kg/m² (dependent variable). The r^2 value of 0.3096 suggests that about 31% of variation in Bowes's optimised net soil erosion values can be attributed to variations in land surface curvature.

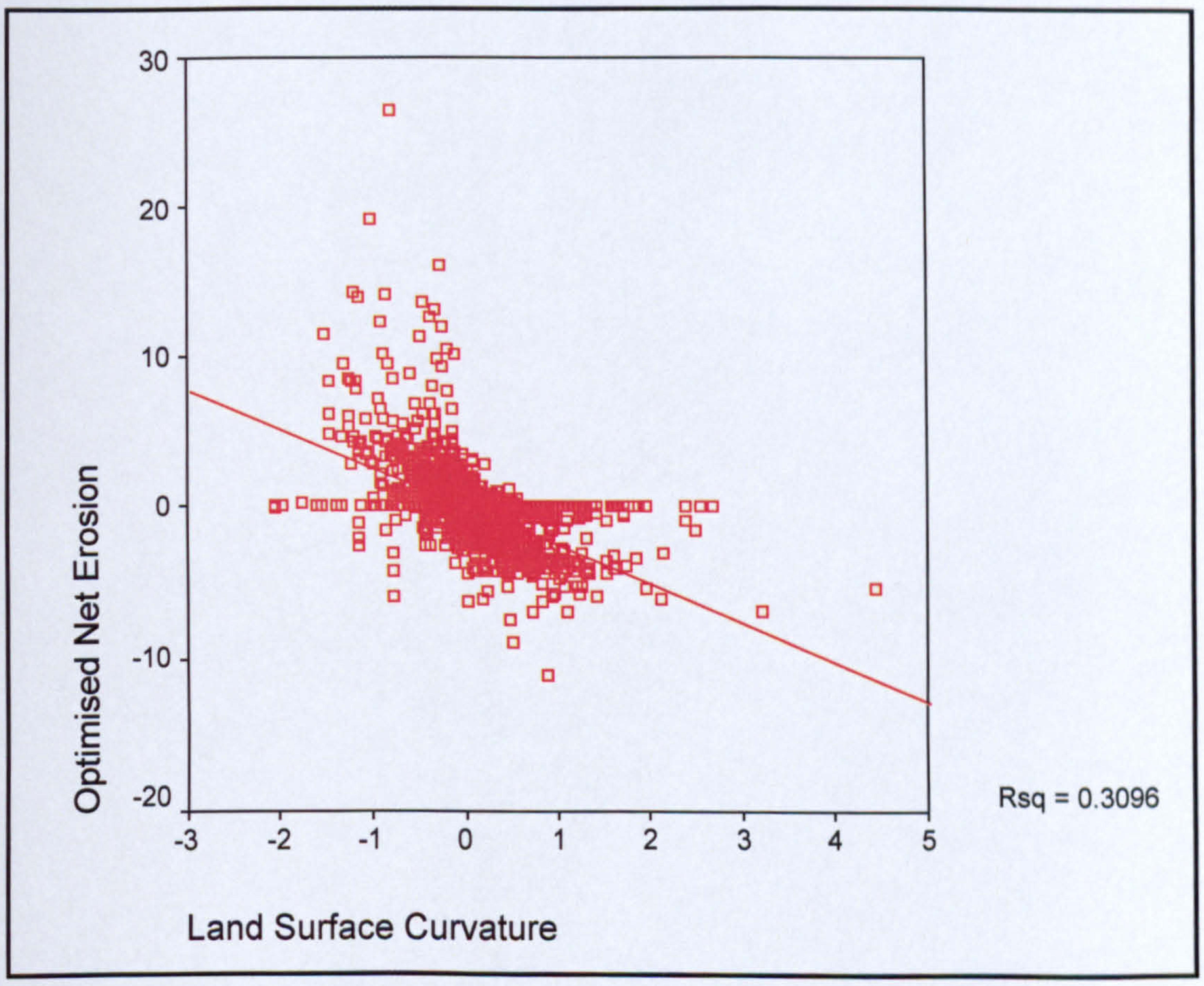

Figure 6.58. Scatterplot of land surface curvature values against Bowes's optimised net erosion values. N = 10659.

To test the relationship further, a Spearman's rank correlation coefficient was obtained for the data. The r_s value of -0.589 obtained is significant at the 0.01 level, and shows, therefore, that there is a significant negative correlation between land surface curvature and Bowes's optimised net soil erosion values (r_s = -0.589, n = 10659, $P < 0.01$). This suggests that despite the crudity of the approach used in this research, the single variable used (land surface curvature) is of considerable importance in determining soil erosion. As a result, its use as a preliminary indicator of likely damage and risk to buried archaeological features in cultivated land can be justified.

6.17 Conclusions

The methodologies employed in examining damage and risk to cropmark monuments in this chapter have been varied, ranging from the direct observation of damage to the subsoil and archaeological features, to estimating damage to cropmark monuments using land surface curvature in a GIS environment. Analysis of data recorded at three of the five locations examined has shown that there is a statistically significant relationship between land surface curvature and topsoil depth. Furthermore, excavations at three of the locations showed a strong relationship between topsoil depth and observed damage to the subsoil. As topsoil depth is determined in part by topography, it can be concluded that there is considerable potential for the identification of damage and risk to cropmark monuments at site-specific level, using land surface curvature as an identification tool.

At the site-specific scale, maps of interpolated topsoil depth have been produced, which have been shown to identify areas of likely damage and risk with some success. However, comparison of the soil depth map produced for Upper Gothens with the excavated evidence shows that there is considerable potential for inaccuracies in the interpolated topsoil depths. Nevertheless, the potential applications of such a technique in archaeological resource management are great, provided that its limitations are understood. These potential applications are discussed in greater depth in chapter 7.

Extrapolating the results of the excavations to a regional scale, the development of the approach used here has been hindered by problems in the reliability of the DTM on which the regional scale analysis and mapping have been based. However, it is likely that by using an accurate DTM (such as the DTMs generated for each of the sites excavated), the potential applications of such a technique would grow considerably. The statistically significant relationship between the land surface curvature values and Bowes's optimised net soil erosion values shows land surface curvature is of considerable importance in determining soil erosion. Furthermore, the premise that damage and risk to buried archaeological features at cropmark monuments are determined (at least in part) by topography is based upon statistically significant evidence collected during archaeological excavations at Mount Stewart, Upper Gothens and Duncrub. Consequently, this is a technique which could prove valuable as a future management tool, primarily because it is based on the interrogation of quantitative, readily available data and enables a rapid preliminary risk assessment without the need for excavation.

Chapter 7

7. Conclusions, discussion and recommendations

In chapter 1, four general objectives were outlined for this research. These were:

1. To provide a sample-based census characterising the nature and distribution of recorded archaeological monuments in eastern central Scotland.
2. To quantify and analyse monument condition change in eastern central Scotland since 1850.
3. To identify and evaluate the processes responsible for observed changes in monument condition.
4. To assess the implications of the results in ongoing and future archaeological resource management.

A number of more specific objectives stemming from objectives 1, 2 and 3 above were outlined in chapter 2, relating to the identification of relationships between trends in monument distribution and loss and environmental variables such as elevation, land use and land use change. In this chapter, the fourth of the general research objectives is addressed, through the presentation and discussion of conclusions arising from each of the first three research objectives. In assessing the implications of the results of this research in ongoing and future archaeological resource management, however, it is important to note, that most of the patterns and trends observed in this research are likely never to be repeated. For example, forestry policy is unrecognisable today compared with even 20 years ago, making the widespread damage to and loss of monuments observed during the 1960s, 70s and 80s unlikely to be continued or restarted in the future. Similarly, the National Planning Policy Guidelines have come into being only within the last decade, but are thought to have greatly reduced the impact of development on the archaeological resource (Swanson 2001, 5). Agricultural legislation, too, is evolving to include environmental benefits, although with farming operations still falling outwith planning control, the potential for monument loss is likely to continue for the foreseeable future. Because of these recent and ongoing changes to planning, farming and forestry legislation, no attempts are made here to project future levels of loss through extrapolation from the conclusions presented. Instead, the results obtained through this research are discussed firstly with reference to the findings of other studies, and secondly, to illustrate how they might contribute to the future general understanding, recording and management of the archaeological resource. Section 7.1 entails a review of the methodology and results of the desk-based study and accuracy assessment, followed by discussion. A similar procedure is followed in section 7.2, where the methods used to identify loss among cropmark monuments are reviewed briefly before the results and potential applications of the techniques are discussed. Finally, drawing on the review of methodology, wider conclusions and discussion, recommendations for future professional and academic work are presented in section 7.3.

7.1 Monument distribution and loss

7.1.1 Review of methodology

In the desk-based study, several methods have been used to extract, interpret and analyse data pertaining to the distribution, condition and surrounding environment of a large number of archaeological monuments. Not all have proved adequate as a means of addressing the research objectives. As chapters 3, 4 and 5 have made clear, the use of NMRS data as the main source of information on monument condition change has created a number of problems in quantifying loss among cropmark and non-cropmark buried monuments. However, the calibrated results of the desk-based study have enabled a thorough analysis of monument distribution (though the census) and an indication of minimum levels of loss among extant monuments.

Because the desk-based study was intended to be as inclusive as possible in its treatment of the archaeological resource, it has been necessary to include monuments in the population from which the sample was extracted for which there is no written information or baseline data. This has had ramifications for the interpretation and analysis of data later in the research. Ideally, monuments without baseline condition data would have been excluded from the research, to enable a more accurate representation of monument loss to be obtained through the desk-based study before calibration. However, this would have left a sample consisting almost entirely of prehistoric, Roman and medieval extant monuments, with very few MoLRS or cropmarks. Although the generality of the sample used has enabled the drawing of conclusions on a wide variety of themes, this generality has ensured that analysis has, by necessity, lacked detail.

Two types of data have been assembled for use in the desk-based study and accuracy assessment. First, data pertaining to the archaeological characteristics and condition of sample monuments, and second, environmental data such as land use and elevation. With both groups of data, simplification has been necessary and assumptions have been made. Although data interpretation has been as objective as possible, it is inevitable that small biases will have occurred through subjectivity of interpretation. In creating monument condition histories, the key assumption made is that if no damage has been recorded in an NMRS record, then no damage has occurred to the monument in question. The accuracy assessment has shown this assumption to be incorrect in a number of cases. Furthermore, by using NMRS data to create monument condition histories, it has often been impossible to determine precise causes or dates of damage, and in some cases, monument loss may have occurred at any time in a 140-year period. In determining monument condition, aerial photographs have not been particularly useful, and it has been found that field survey is the only truly accurate means of determining the condition of a monument.

Data pertaining to the environmental setting of sample monuments have mostly been collected using Arcview GIS. Although this has proved useful for recording variables such as elevation and local authority area, determining land use at monuments during the desk-based study has been most accurately achieved where the NMRS record refers directly to the land use type. The use of maps and the LCS88 has proved misleading at times, partly because of the lack of accurate grid coordinates for many of the sample monuments but primarily because the Ordnance Survey 1:10000 mapping can be difficult to interpret and because the resolution of the LCS88 data is too crude to recognise small land use parcels. The accuracy assessment has shown that land use can be determined fairly accurately using aerial photographs, but that as with recording monument condition, the only truly reliable method of recording land use is through field survey. This, along with the use of Monument Warden reports, has proved far more successful as means of determining current monument condition and land cover than the use of maps, digital datasets and aerial photographs.

Because of the difficulties encountered in retrieving and interpreting data on each of the sample monuments, it has been necessary to restrict analysis to the use of descriptive statistics, cross tabulations and occasional distribution maps. Despite the basic nature of the analyses used, it is possible to be reasonably confident in the results produced in examining monument distribution patterns through the census. Results relating to condition change among sample monuments are less reliable, particularly those for cropmarks and buried features such as cists and souterrains. Among extant monuments, it has not been possible to produce definitive totals of those undamaged, reduced and destroyed, but the use of the results of the accuracy assessment to calibrate the findings of the desk-based study has ensured that indicative totals have been produced, outlining best- and worst- case scenarios of monument loss since 1850. Although these may not provide precise quantitative statistics on monument loss, these scenario outputs illustrate minimum levels of loss and enable qualitative comparison between groups of monuments according to rates of loss and environmental variables.

The majority of problems encountered during the desk-based study have been attributable to a lack of consistent baseline data. Although it has been possible to use a number of available documentary and digital data sources, there are dangers attached to an over-reliance on second-hand data. While sources of this type are useful as complementary tools in a larger project, it must be concluded that the best way to obtain data on monument condition and land use is through direct observation, and any future research of this type would benefit from less reliance on documentary sources and greater emphasis on field survey. Despite the problems outlined, however, a number of conclusions can be drawn from the desk-based study. These are now presented and discussed, beginning with the results of the census.

7.1.2 Monument distribution: conclusions and discussion

The census outlined in chapter 3 has characterised the nature and distribution of recorded archaeological monuments in eastern central Scotland with specific regard to monument period, land use, material construction, status as cropmarks or non-cropmarks, LCA classification, elevation, monument period, and scheduling. Many of these variables are interrelated, and some of the patterns identified in monument distribution are not unexpected. For example, distribution of extant monuments is skewed towards upland locations, while cropmarks are generally found at low altitudes. Variations in monument distribution according to period of construction are evident also. Roman monuments are concentrated along the line of the Agricolan campaign of the late 1st century AD and the Gask Ridge. Demonstrably medieval monuments, most of which are high-status sites, are concentrated at low altitudes, while many of the MoLRS that make up the bulk of the medieval or later monuments in the sample are found at higher altitudes. However, the most significant variables identified in relation to monument distribution are elevation, LCA and land use, although again, these are closely related. By examining monument distribution according to elevation, it has been possible to identify a number of zones within which the characteristics of monument distribution show distinct relationships with the environmental variables examined. These zones are shown in table 7.1.

Zone	Elevation (m OD)	Dominant land uses according to the LCS88	Dominant LCA classifications	Recorded monuments per 100 sq km
Positive information lowland	0m-100m	Arable / improved pasture (75%) Developed (8.1%)	2 (25%) 3 (59%)	24.4
Negative information lowland	100m-200m	Arable / improved pasture (71.9%) Non-intensive (8.8%)	3 (59%) 4 (17%)	11.1
Marginal	200m-250m	Arable / improved pasture (43.8%) Non-intensive (36.1%) Forestry (13.8%)	4 (39%) 5 (34%)	17.0
Positive information upland	250m-400m	Non-intensive (66.6%) Forestry (19.5%)	5 (57%) 6 (32%)	21.0
Negative information upland	> 400m	Non-intensive (90.5%) Forestry (8.3%)	5 (6%) 6 (89%)	3.4

Table 7.1. Summary information relating to each of the monument zones identified in which recorded monument distributions relate to environmental variables.

As table 7.1 shows, the first zone identified can be loosely (if slightly awkwardly) defined as a positive information lowland zone, where the land falls between 0m and about 100m OD. Within this zone, the majority of land is suitable for intensive agriculture, with over 80% of land having an LCA classification of 2 (25%) or 3 (59%). Correspondingly, about 75% of land in this zone is arable or improved pasture, with the second largest land use class being developed land (8.1%). Nearly half of all sample monuments are found here, but the destructive nature of agricultural practices in this zone has ensured that only about 35% of monuments here are recorded as upstanding features. However, this lack of extant monuments is offset by a high density of recorded cropmark monuments, particularly below 50m OD. The concentration of sample monuments in this zone is due to a combination of factors. It is certain that this zone will have attracted settlement and farming in prehistory, just as it does today, and large numbers of monuments are perhaps to be expected here. More importantly, the abundance of archaeological remains recorded in this zone is due in no small part to the long history of archaeological recording here (57% of all monuments recorded before 1950 fall within this zone) and the high density of levelled monuments in this zone which have been recorded as cropmarks in the last 50 years. Figure 7.1 shows the distribution of all monuments making up the population from which the desk-based study sample was extracted in relation to arable and improved land within the positive information lowland zone, and demonstrates clearly the concentration of cropmark monuments in land situated below 100m OD.

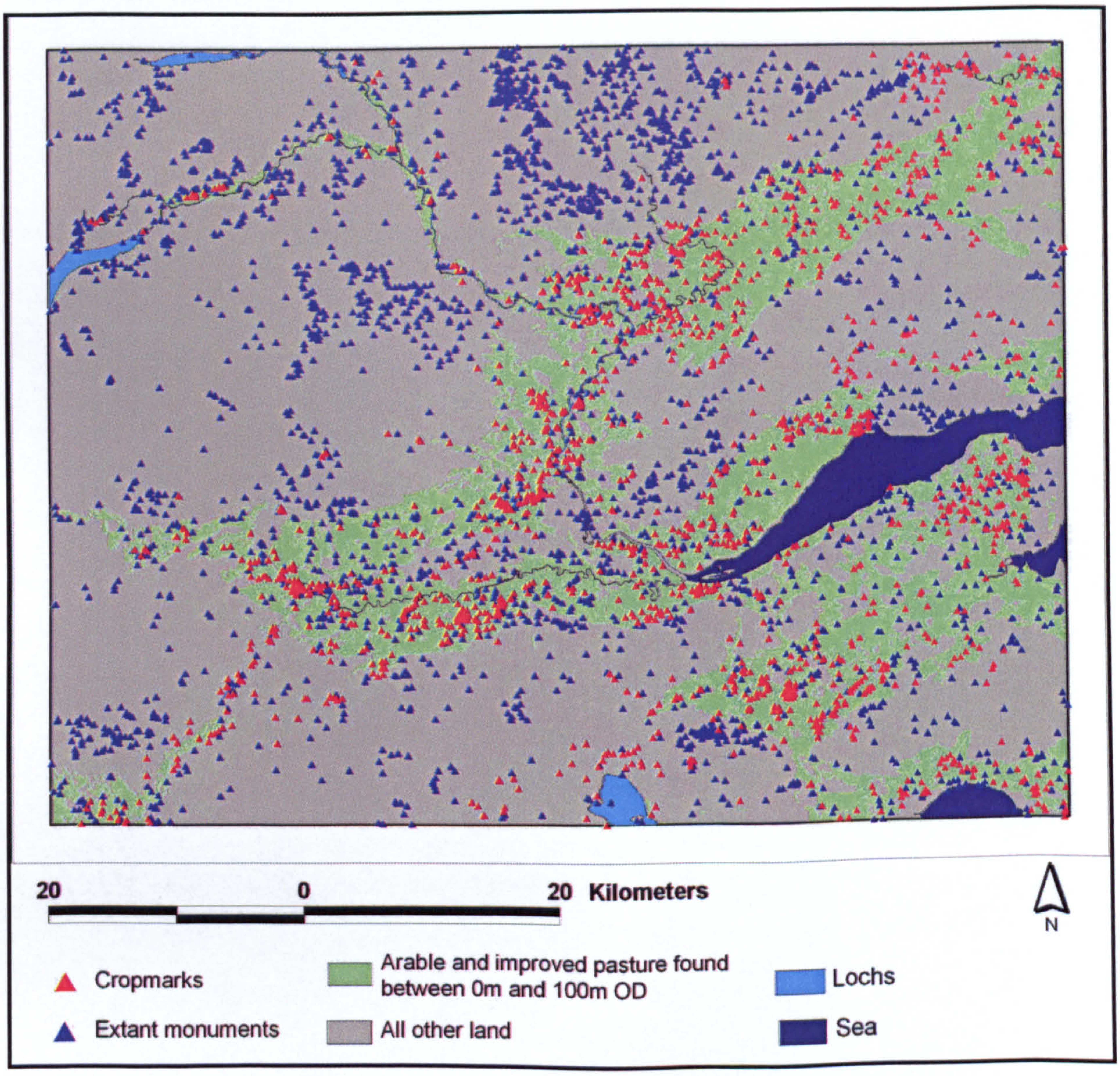

Figure 7.1. Map showing distribution of monuments in the study area and arable / improved land between 0m and 100m OD.

The second zone identified and shown in table 7.1 can be defined as the negative information lowland zone, where the land falls between about 100m and 200m OD. Land in this zone is generally of lower agricultural capability than land between 0m and 100m OD, with the majority of land being classified as LCA Class 3 (59%) and 4 (17%). In this zone, the density of recorded monuments is less than half of that among monuments found between 0m and 100m OD. The reasons for this paucity of monuments are twofold: firstly, there is a slightly lower density of recorded extant monuments than in the positive information lowland zone. More significantly, however, there is a paucity of recorded cropmarks in this zone, particularly above 150m OD, despite over 70% of the land area being under arable or improved pasture. Consequently, it seems likely that either aerial survey has been scarce in this zone, or that buried archaeological remains, which might form cropmarks at lower altitudes, remain undetected. Figure 7.2 shows the distribution of all monuments making up the population from which the desk-based study sample was extracted in relation to arable and improved land within this negative information lowland zone. As figure 7.2 demonstrates, large areas of arable and improved land can be found in the study area in which few if any cropmarks have been recorded. Furthermore, figure 7.2 illustrates the relative paucity of extant monuments recorded in this zone.

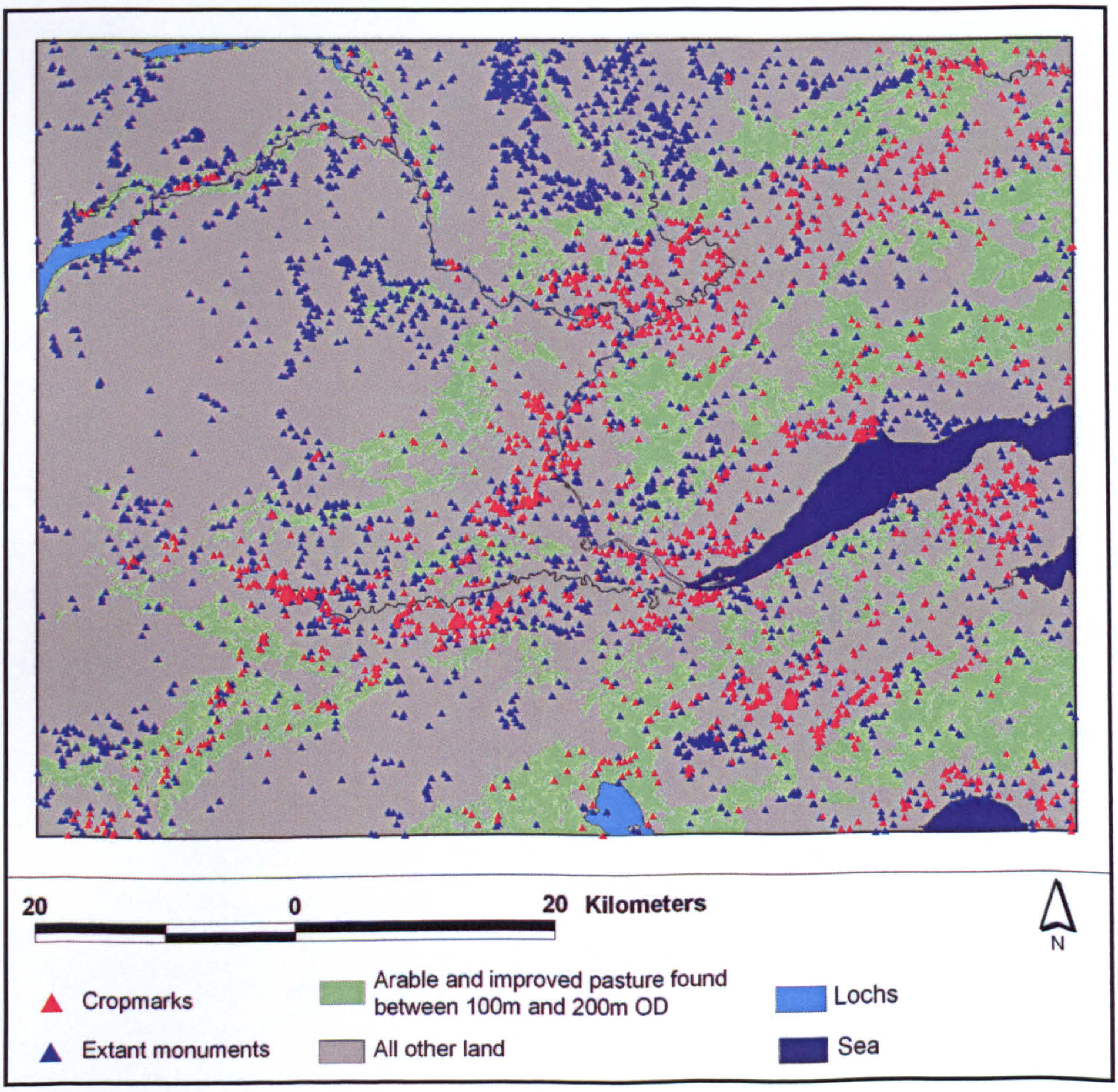

Figure 7.2. Map showing distribution of monuments in the study area and arable / improved land between 100m and 200m OD.

The third zone identified can be defined as the positive information upland zone, where land falls between about 250m and 400m OD. Within this zone, non-intensive land uses such as heather moor and rough grazing dominate, making up about 66% of land cover. These land uses reflect the agricultural capability of the land, nearly 90% of which has an LCA classification of 5 or 6. There is a relatively high density of recorded monuments here, although this density is less pronounced above 350m OD. Nearly all recorded monuments here survive as above-ground features, and with arable and improved land accounting for less than 10% of land area in this zone, it is reasonable to assume that buried features which have been masked by land improvements will be scarce. However, about 20% of land here is under forestry, a land cover type in which the recording of previously undiscovered monuments appears to be rare. Figure 7.3 shows the distribution of extant monuments in unimproved parts of this upland positive information zone, and demonstrates that although clusters of monuments can be found in this zone in some parts of the study area (most notably in North East Perthshire, where systematic RCAHMS survey was conducted in advance of the 1990 inventory), other parts of this positive information zone contain very few recorded monuments.

The fourth zone identified and shown in table 7.1 can be defined as the negative information upland zone, and all land within this zone is found at 400m OD or higher. Over 90% of land here is under non-intensive uses, with forestry making up another 8.3% of the total land area, and nearly all land here is of low agricultural capability. Despite these trends in land use within the zone, however, there is a very low density of recorded monuments. While this can probably be attributed partly to a lack of archaeological survey at these altitudes, the paucity of recorded monuments here can also be attributed to human preference for settlement in low-lying areas.

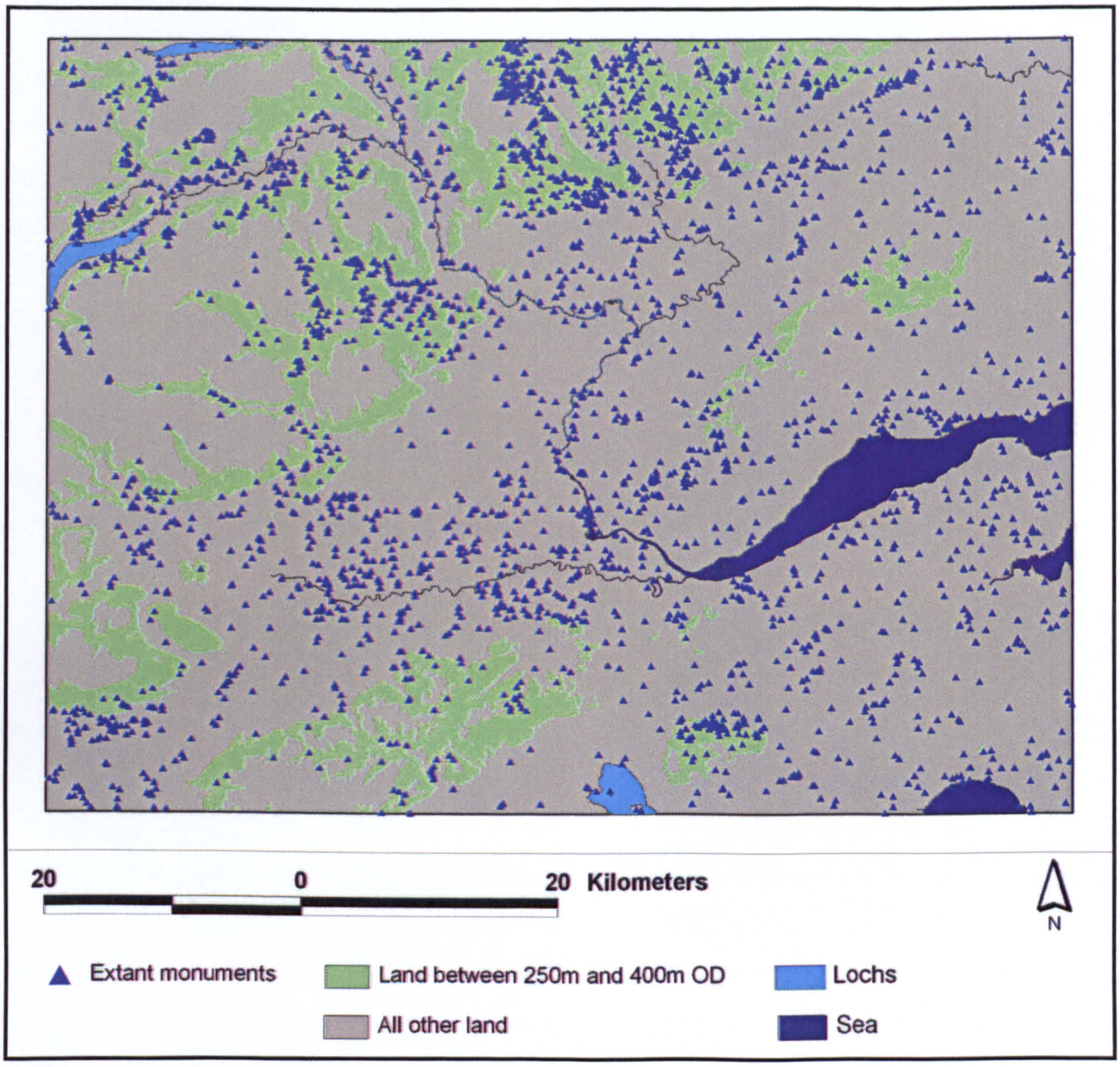

Figure 7.3. Map showing distribution of extant monuments in the study area and non-intensive land uses between 250m and 400m OD.

The final zone identified and shown in table 7.1 can be loosely defined as the marginal zone, where the land falls between about 200m and 250m OD. Although this zone occupies only a narrow altitude band (50m), it is treated here as separate from both the negative information lowland zone below it and positive information upland zone above it, for two reasons. Firstly, the character of the land in this zone is unlike any other 50m elevation band within the study area. In all other 50m elevation bands, one land use type dominates, accounting for over 50% of land cover. In the lowlands (0m – 200m OD), arable and improved pasture account for over 70% of land, while in the uplands (land over 250m OD), non-intensive land uses such as heather moor and unimproved grazing account for about 67% of land up to about 400m OD, and about 90% of land over 400m OD. In the marginal zone between 200m and 250m, however, no single land use type constitutes over 50% of land cover. The two largest land use types are arable and improved pasture (about 44%) and non-intensive uses (about 36%), and a significant proportion (14%) of the land is under forestry. Similarly, land capability for agriculture (LCA) is split in this marginal zone, unlike the lowlands (where LCA Class 3 land dominates) and the uplands (where LCA Classes 5 and 6 dominate). In the marginal zone, LCA classification is split between Class 4 (39%), 5 (34%), 3 (16%) and 6 (7%), so that no single LCA classification dominates. Thus, land between 200m and 250m OD cannot be defined as either lowland or upland. The final reason for treating land in this zone as distinct from land above and below it is that the largest constituent LCA classification in this zone is Class 4. No other elevation band in the study area is dominated by Class 4 land, and as discussed in section 3.7, archaeological monuments in Class 4 land are scarce by comparison with Class 2, 3 and 5 land.

As table 7.1 shows, monument density in the marginal zone is significantly higher than in the negative information lowland zone, but lower than in the positive information upland zone. As might be expected, recorded cropmarks are rare in this zone, despite arable and improved land making up over 40% of the land area. However, this low incidence of cropmarks is offset by a density of extant monuments more than double of that found among extant monuments in the negative information lowland zone. This high density of extant monuments can be at least partially attributed to non-intensive land uses which cover about 36% of land here. Thus the distribution of sample monuments in this marginal zone can be seen as a 'halfway house' between the negative information lowlands and positive information uplands, where the low incidence of cropmark monuments in improved areas is offset by a higher incidence of extant monuments in unimproved areas. The marginal zone is illustrated in figure 7.4, which demonstrates the limited spatial extent of the zone.

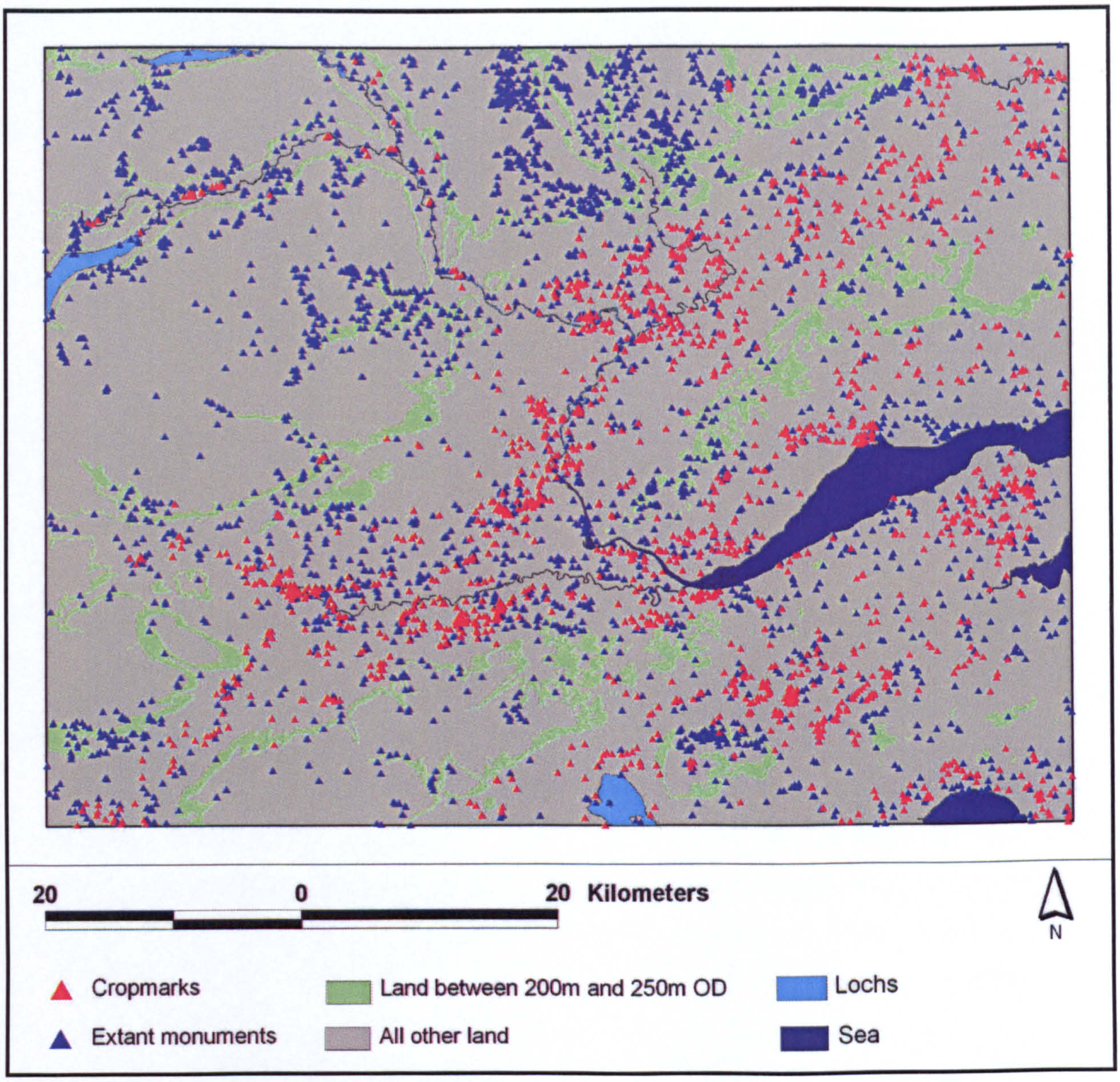

Figure 7.4. Map showing distribution of monuments within the study area and the marginal zone identified through the desk-based study.

While the zones defined above are based largely on elevation, it is also worth reiterating the variations in densities of recorded monuments according to land use, as shown in table 7.2.

Land Use	Extant monuments per 100 sq km	Cropmarks per 100 sq km	Non-cropmark buried features per 100 sq km	Total monuments per 100 sq km
Arable / Improved	4.5	11.5	0.6	16.6
Non-intensive	13.8	0	0.1	13.9
Semi-natural woodland	17.2	0	0	17.2
Forestry	9.7	0	0.2	9.9
Developed	5.3	0.7	8.0	14.0

Table 7.2. Densities of sample monuments according to calibrated land use.

As table 7.2 demonstrates, the highest density of recorded monuments within the study area is in semi-natural woodland, and although arable and improved land contains almost the same density of monuments, most of these are cropmarks. Table 7.2 also demonstrates the role of invasive land uses in the recording of buried archaeological features, with the majority of monuments found in developed land comprising non-cropmark buried features. Proportions of sample monuments are generally commensurate with overall percentages of land cover within the study area. For example, about 50% of sample monuments are found in arable or improved land, which make up about 50% of study area land. The only notable exceptions to this are forestry, which makes up about 9% of land area but where only about 5% of sample monuments are found (as reflected in the low density of monuments shown in table 7.2) and monuments found in enclosures, verges and field margins, which make up over 10% of the sample. Although the total proportion of study area land made up of small enclosures, field margins and verges cannot be calculated, it is unlikely to be as high as 10%. The significance of these enclosures and field margins is particularly notable in the positive information lowland zone of the study area, where about 30% of extant monuments are located in enclosures and field boundaries. It is likely that this high figure for numbers of monuments recorded in enclosures and field margins can be attributed at least in part to their protected location.

Before going on to discuss the findings of the desk-based study in relation to rates and causes of monuments loss, it is worth considering how the results of the census might contribute to the future recording and management of archaeological remains. As densities of recorded monuments have been noted according to land use and elevation, it might be possible to target areas for survey where a high return of monuments might be expected, such as unimproved land and semi-natural woodland below 400m OD. Alternatively, survey might target areas in which a relative paucity of monuments has been recorded, (such as marginal arable land and improved pasture) with a view to partially redressing the imbalance in monuments recorded. Figure 7.5 shows the distribution of recorded extant monuments in the study area in relation to the potential for the further recording of extant monuments.

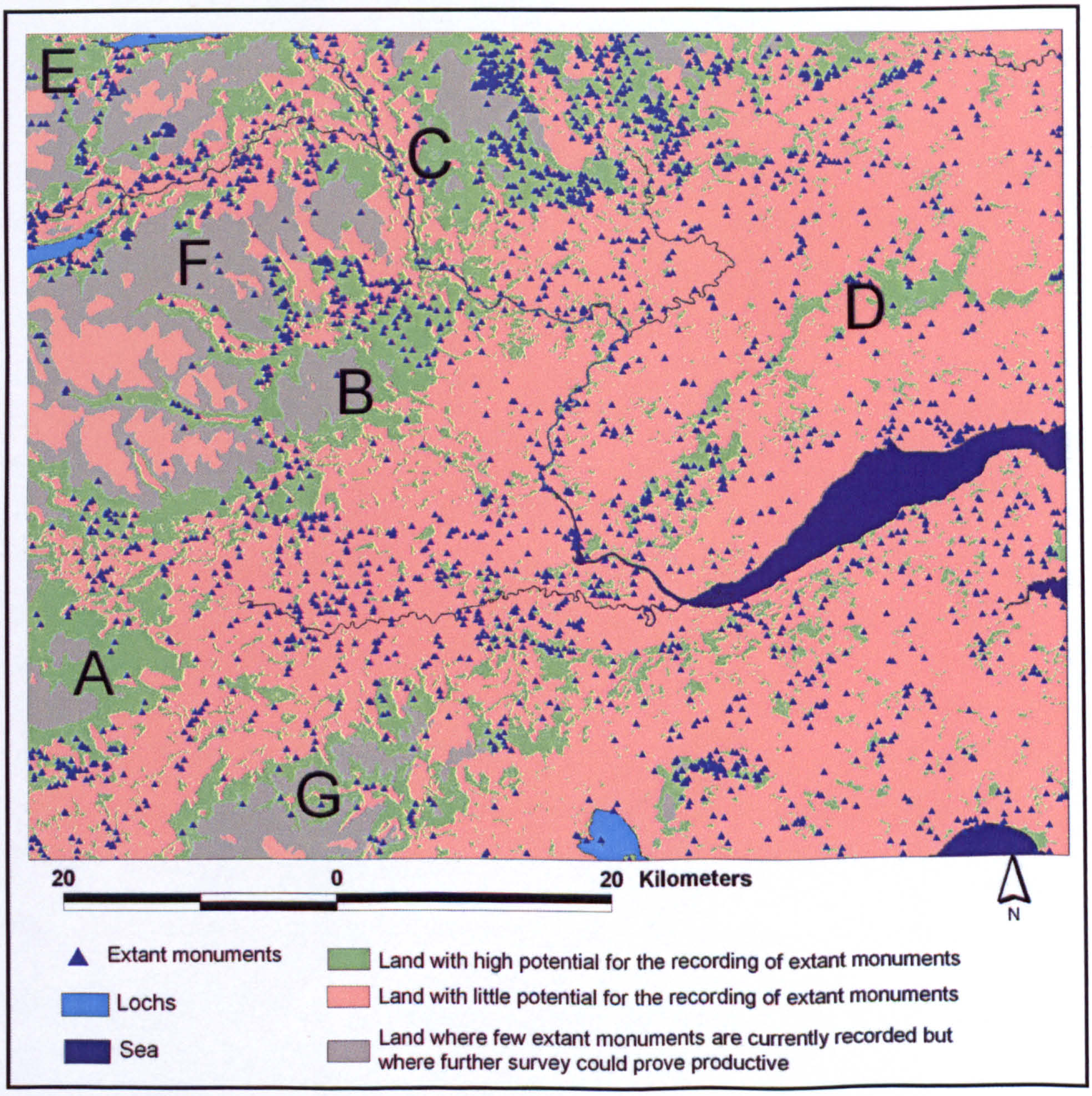

Figure 7.5. Map showing extant monuments in the study area and areas of high and low potential for the further recording of extant monuments.

In figure 7.5, green areas represent non-intensive land uses and semi-natural woodland below 400m OD, where densities of recorded monuments are high and the potential for the recording of further numbers of extant monuments is high also. Pink areas represent all land above 600m OD and all land classed by the LCS88 as arable / pasture, forestry, developed, semi-developed and coastal land. Densities of recorded extant monuments are low in these land uses, and consequently, so is the potential for the recording of further extant monuments. Grey areas in figure 7.5 denote areas of non-intensive land uses and semi-natural woodland found between 400m and 600m OD, where although density of recorded monuments is low, there is reasonable potential for the discovery of further monuments such as shieling groups.

Locations A, B, C, D and E in figure 7.5 identify points at which numbers of recorded monuments are low but the potential for the recording of further monuments is high. These are: (A) The area between Strathallan and Glenartney (centred around grid squares NN71SE, NN71NW and NN71SE). (B) The area between Logiealmond, Glenshee and Strathbraan (centred on NN93SE and NN93NE). (C) The area between Forest of Clunie and Strathtay (centred around NO04NW and NO05SW), which lies immediately to the west of the area covered by the RCAHMS inventory for north-east Perth (RCAHMS 1990). (D) The area of the Sidlaw Hills to the south of Glamis, Angus (centred on NO34SE). (E) The Braes of Kynachan between the River Tummel on the north and Schiehallion on the south (centred on NN75NW and NN75NE). Locations F and G denote two examples of areas which lie between 400m and 600m OD but which might prove productive. They are: (F) The area between Glen Quaich and Glen Cochill, Perth and Kinross (centred around NN84SW and NN84SE). (G) The northern slopes of the Ochils (centred on NN80SE and NN90SW). To the current writer's knowledge, none of the locations shown in figure 7.5 has been subject to systematic survey, although this has not been verified. The assertion that these locations (the latter two in particular) might prove productive in field survey is speculation, but given the evidence of elsewhere in the study area, it is reasonable to suggest that these areas have greater potential for the recording of extant monuments than elsewhere in the study area.

Similarly, figure 7.6 shows the distribution of recorded cropmark monuments in the study area in relation to areas where the potential for continued discovery of cropmarks is high or low. Green areas represent arable and improved land below 100m OD, where densities of recorded cropmarks are high and the potential for the recording of further numbers of extant monuments is generally high also. Pink areas represent all land classed by the LCS88 as non-arable or non-improved and all land situated above 250m OD. Incidences of recorded cropmarks in these areas are very low, as is the potential for the recording of further cropmarks. Grey areas in figure 7.6 denote arable and improved areas between 100m and 250m OD, where numbers of recorded cropmarks are low. It is within these areas that large quantities of archaeological remains are likely to survive undetected, either through a lack of cropmark formation or through a lack of aerial survey at these altitudes.

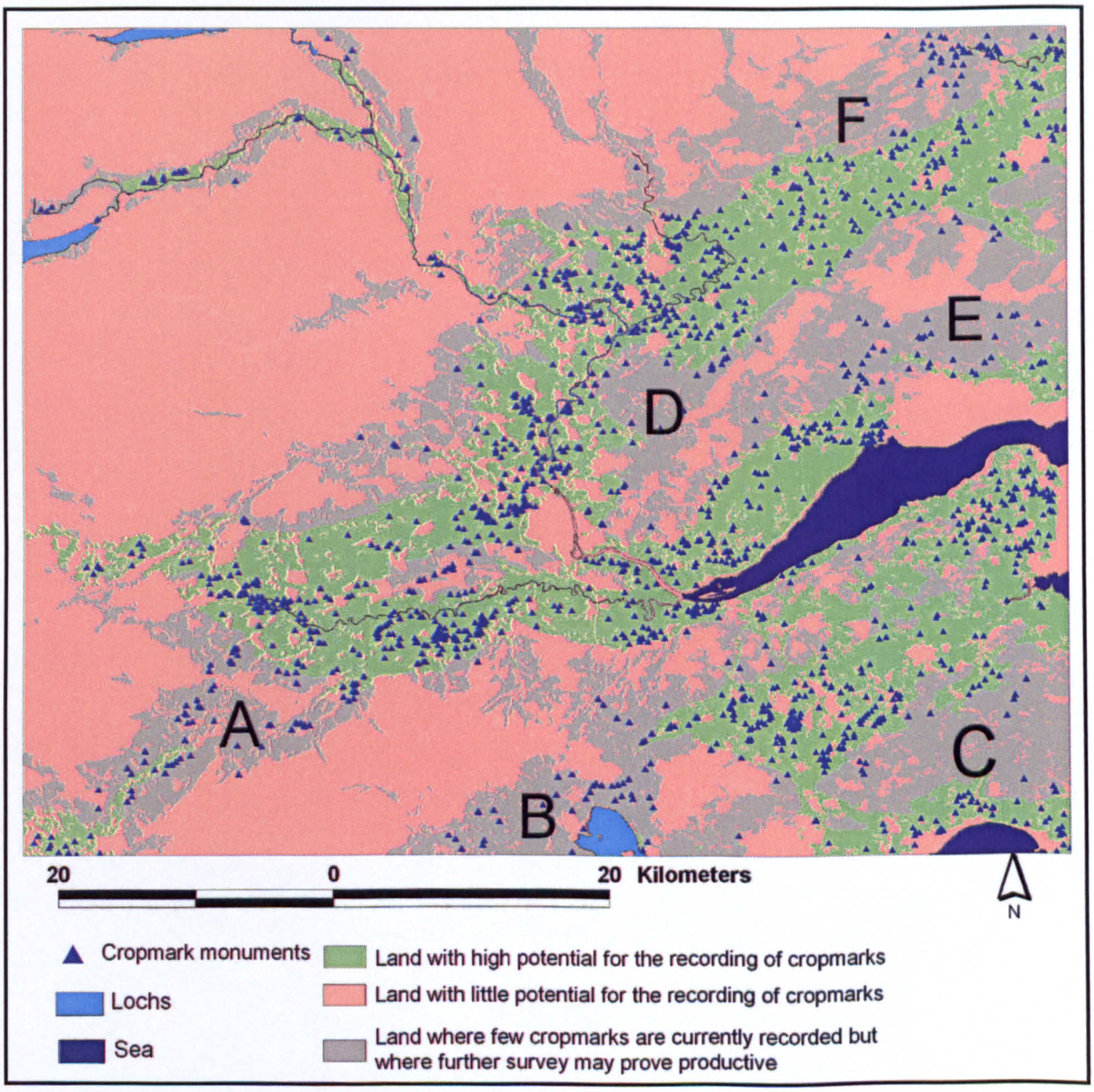

Figure 7.6. Map showing cropmark monuments in the study area and areas of high and low potential for the further recording of cropmarks.

The five locations identified in figure 7.6 that might warrant more intensive investigation are: (A) The area around Braco and Blackford, Strathallan (centred around NN80NE and NN81SE). (B) The area to the west of Loch Leven (centred on

NO00SE). (C) A large area to the south west of St Andrews incorporating most of NO30NE, NO40NW, NO40NE, NO41SW and NO41SE. (D) The area around Wolfhill, Guildtown and Balbeggie (centred on NO12NE and NO13SE). (E) The area north of Dundee around Tealing and Wellbank (centred around NO33NE, NO43NW and NO43NE). (F) The area to the south west of Kirriemuir, south of Kirkton of Kingoldrum and south of Bridgend of Lintrathen (centred around NO25SE, NO35SW and NO35SE). While it is acknowledged that the method by which the identification of these areas has been achieved is crude (using only land use and elevation data but taking no account of soil type, cropping regimes or previous survey patterns), these are areas which the desk-based study has identified as warranting closer examination. In addition to informing future survey and research patterns, the results of the census might also help in the conservation and management of the archaeological resource. For example, the census has shown that extant monuments (particularly earthworks) are rare in lowland areas, and that a disproportionately high number are found in semi-natural woodland and marginal locations such as field boundaries and verges. This information might be used in the identification of monuments that would be particularly vulnerable to ongoing pressures of land use or in the prioritising of conservation and management needs among monuments depending on their location.

7.1.3 Monument loss: conclusions and discussion

The desk-based study has addressed the second and third overarching research objectives by quantifying and analysing monument condition change in eastern central Scotland since 1850, identifying and evaluating the processes responsible for observed loss. In the following two sections of this chapter, general rates and causes of monument loss are quantified and discussed (section 7.1.3.1) before conclusions and discussion pertaining to the environmental setting of the sample are presented in section 7.1.3.2.

7.1.3.1 General rates and causes of monument loss

The calibrated results of the desk-based study suggest that among monuments extant in 1850, a minimum of 38% have been reduced in extent, with at least 5% destroyed, giving a maximum of 57% of extant monuments in the study area undamaged since 1850. It is likely that actual proportions of monuments damaged and destroyed will be significantly higher, but given the data sources used, actual rates of loss are impossible to quantify accurately. Among cropmark monuments, visible damage has been considerably less. According to the calibrated results of the desk-based study, at least 5% have been reduced in extent since 1850, although only about 1% have been destroyed. Again, this is certain to be a significant under-representation of actual loss rates at cropmark monuments within the study area, but given the invisible nature of agricultural damage at cropmark monuments, actual loss cannot be quantified. Finally, among non-cropmark buried features such as cists and souterrains, recorded loss has been high, with about 75% destroyed and about 18% reduced. This high level of loss is attributable to the mechanisms of discovery of such monuments, as few are recorded unless disturbed. It is likely, therefore, that these figures are an over-representation of actual rates of loss at non-cropmark buried monuments.

The desk-based study has identified archaeological excavation, farming, development and forestry as the four largest known causes of monument loss since 1850, though due to the lack of information in some NMRS records, a substantial quantity of damage has occurred for which a cause cannot be ascertained. Archaeological excavation has caused about 32% of the damage noted, while about 27% of damage has occurred through unknown causes. Farming, development and forestry have accounted for 11%, 8% and 7% of recorded damage respectively. Monument destruction recorded through the desk-based study is dominated by unknown causes (31%), farming (27%), development (20%), mineral extraction (9%) and forestry (7%), though it is worth reiterating that about 30% of destruction through unknown causes can probably be attributed to farming. Damage attributable to natural causes such as tree growth and natural collapse account for a very small proportion of the loss recorded, underlining the fact that most damage to archaeological monuments can be attributed to human activity. The accuracy assessment has emphasised the negative impacts of forestry, farming, and development on the archaeological resource, with 32% of damage identified attributable to forestry, and farming and development accounting for 26% and 12% of monument damage respectively. Other notable damage causes identified include re-utilisation (7%), tree growth (7%) and unknown causes (4%). By contrast, only one case of damage attributable to archaeological excavation has been identified through the accuracy assessment.

The levels of loss recorded to sample monuments through this research are markedly lower than those recorded by MARS, which recorded the destruction of 16% of monuments and piecemeal loss at all but 5% of the surviving monuments examined during field survey (Darvill and Fulton 1998, 122). By comparison, this research suggests that a minimum of 5% of monuments within the study area extant in 1850 have been destroyed, with at least 37% reduced in extent. Direct comparisons between the two projects are difficult because of differences in sampling and methodology employed between the respective projects. However, some of the results produced are so disparate that it is necessary to explore possible reasons why levels of loss identified through this research should be so much lower than those identified by MARS.

Firstly, the samples of monuments used in the two programmes of research are markedly different in character. For example, in producing the sample for the current research, most monuments in urban settings were excluded, creating a sample heavily biased towards the rural setting. In the sample of 779 monuments used in the current research, 2.7% are located in developed land, with about 50% found in arable and pasture and about 25% found in non-intensive land use areas. By contrast, about 44% of MARS monuments under single land use regimes in 1995 were in built-up land, with about 21% in pasture and 17.5% in arable. These variations in the setting of the samples used in each programme of research are reflected in the results produced. For example, MARS found that 68% of destruction and about 31% of piecemeal loss recorded could be attributed to development and urbanisation, demolition and building alteration, mineral extraction and industry and road building. The current research has found the impact of development to be much less, with development, mineral extraction, renovation, re-utilisation and demolition accounting for about 31% of destruction and about 17% of damage recorded through the desk-based study, and 21% of damage recorded through the accuracy assessment.

While the comparatively high level of development-related loss recorded through MARS is likely to be at least partially attributable to the sample of monuments used, it is also likely that the data sources used in the current research and MARS have also contributed to the disparity in the levels of development-related loss recorded between the two programmes of research. MARS made use of SMRs, and as these are designed to aid with the curation of the archaeological resource, it is likely that these would contain far greater detail of development-related loss than the NMRS would. The contrast between the datasets used is also emphasised through an examination of the levels of loss recorded in the two projects that are attributable to archaeological excavation. In the current research, this has accounted for 32% of damage recorded through the desk-based study. By contrast, only 4% of piecemeal loss recorded by MARS was attributable to archaeological excavation (Darvill and Fulton 1998, 122), although it should be noted that about 17% of monuments recorded as destroyed by MARS had been excavated in advance under rescue conditions (ibid, 126).

It should be noted also that in calibrating the results of the desk-based study, burrowing animals, scrub, bracken and other natural processes noted by Monument Wardens and through field survey were seldom classed as damage (even though their presence was noted at over half of the 61 monuments surveyed). Damage was recorded only where there was no doubt whatsoever that the physical integrity of the monument had been compromised either since 1850 or since the last dated record of the monument described in the NMRS. MARS did record natural processes (including water, waves, wind, visitor erosion and animal activity) and identified them as the cause of about 5% of monument destruction noted and about 24% of piecemeal loss (Darvill and Fulton 1998, 137). In the current research, it was felt that the inclusion of all indicators of natural damage would have lead to the calibrated totals identifying almost the entire sample as reduced, making comparisons between monument groups according to environmental variables meaningless. Had all natural indicators been included, however, it is possible that the quantity of damage identified through the current research would not have been dissimilar to the rate of piecemeal loss identified by MARS.

Ultimately, it must be acknowledged that the datasets used in this research have not proved adequate. As noted in chapters 3 and 4, the records contained in the NMRS reflect archaeological interest and research over the past century or so, and the database was never designed to reflect changes in the condition of the archaeological resource. This is reflected in the high number of cases of monument loss identified to which no precise date or cause have been attributed. Given the lack of an alternative core dataset, however, the use of the NMRS has been unavoidable. Although the accuracy assessment has been used to calibrate the results produced through the desk-based study, condition survey data (either through specific field survey or through the use of Historic Scotland Monument Warden reports) has been used for only 111 of the 258 monuments examined. Consequently, the calibrated results produced can be treated as indicative of best-case scenarios only, and as stated in section 7.1.1, it must be concluded that any future research of this type would benefit from less reliance on documentary sources and greater emphasis on field survey.

7.1.3.2 Monument loss in relation to environmental variables

Although the results produced through the desk-based study and accuracy assessment can be treated only as indicative and should not be regarded as precise indicators of rates of monument loss, they do enable comparisons between rates of monument loss according to a number of environmental variables. The single variable identified through this research with the greatest bearing on monument condition change is land use. Farming and forestry account for at least a fifth of all damage noted through the desk-based study and about 59% of damage noted through the accuracy assessment. Of extant monuments situated in arable and improved pasture, only about 34% remain undamaged since 1850, with about 39% reduced and 27% destroyed, though it should be remembered that not all loss identified here can be directly attributed to farming operations. The severity of loss among sample monuments in arable areas is further attested to by the fact that among sample monuments situated in arable and improved land, fewer than 8% are extant and undamaged since 1850, with the remainder having been reduced, destroyed or only ever recorded as cropmarks. Furthermore, examination of the LCS88 suggests that the majority of these undamaged extant monuments are likely to be located in permanent pasture rather than in rotational pasture or arable. Among extant monuments situated in forestry, only about 12% remain undamaged, with about 79% reduced and 9% destroyed. Levels of damage and destruction are higher still among extant monuments situated in developed land, where none of those recorded remain undamaged. By contrast, monuments situated in low intensity land uses such as permanent pasture (91% undamaged), rough grazing (85% undamaged) and semi-natural woodland (75% undamaged) appear to have been subjected to considerably less pressure over the last 150 years. Levels of loss among monuments located in enclosures, verges and field margins are higher than might have been expected, with about 50% undamaged in verges and field margins and about 36% undamaged in enclosures. However, rates of loss among these monuments have been markedly lower than among those monuments situated in the more intensively utilised surrounding areas, and many of the enclosed monuments are standing buildings which will deteriorate naturally if not maintained.

By examining land use change at sample monuments, the desk-based study and accuracy assessment have identified those trends in land use change which have had a negative impact on the archaeological resource. Urbanisation and the expansion of forestry over the last 50 years have accounted for about a fifth of noted monument loss. Given the huge increase in forestry in Scotland since the 1940s, its identification as a major factor in monument loss is not unexpected. More surprising, however, is the failure of this research to identify a marked increase in monument loss since the 1940s that might be attributed to farming. Both the National Countryside Monitoring Scheme (Mackey *et al.* 1998) and Agricultural and Horticultural Census (SEERAD 1939-99) show an increase in cultivated area from the 1940s until the late 1980s in the study area. Evidence from elsewhere in the UK (e.g. Hinchcliffe and Schadla-Hall 1980; Oxford Archaeology 2002; English Heritage 2003) suggests that arable expansion has caused widespread monument loss, particularly over the past six decades. However, only one such case has been identified through this research.

The reasons for this lack of monument loss attributable to arable expansion in the second half of the 20th century are difficult to ascertain. It is possible that widespread loss did occur, but that it was never recorded. However, a more probable answer is that widespread loss did not occur during this period because the majority of monuments in these more marginal arable areas had been destroyed during the agricultural Improvements of the 18th and 19th centuries. This argument is supported by a number of observations. Firstly, the Ordnance Survey 1st Edition maps and present maps show that the area currently enclosed within the study area remains largely unchanged since the 1860s, suggesting that the majority of land currently enclosed was already improved by the time of the 1st Edition mapping. Furthermore, during the examination of vertical aerial photographs as part of the accuracy assessment, very little evidence of agricultural expansion into previously unimproved areas was noted. Secondly, agricultural statistics (MAFF 1968, 95; SEERAD 1939-99) show that the total area of tillage in Scotland at the peak of the late 1980s was only 80% of the tillage area of the 1940s which, in turn, was slightly less than the area of tillage recorded in Scotland during the late 1860s and 1870s. This would suggest that most arable expansion in the second half of the 20th century would have been into previously enclosed and cultivated areas. Thirdly, as described in chapter 1, the destruction of monuments in the study area through agriculture was already being noted in the 18th century. It is worth reiterating that even in the 1750s, detection of earthworks was necessarily directed towards uncultivated ground (Stuart 1870, 29), and many of Roy's maps show only partial earthwork survival at this early date (Roy 1793). It seems likely, therefore, that the majority of destruction of monuments in arable parts of the study area occurred before and during the agricultural Improvements of the 18th and 19th centuries, long before the Ordnance Survey 1st Edition mapping took place.

While the expected rash of monument destruction attributable to agricultural expansion in the 20th century has not been identified in this research, arable intensification has accounted for some monument loss, with the bringing into cultivation of marginal tracts of land at the edges of arable fields and the removal of monuments from arable areas to increase the land area available for cultivation. This loss has been largely confined to monuments already situated within arable land, and appears to have been particularly prevalent among post-medieval structures. Figure 7.7 (overleaf) shows extracts from the Ordnance Survey 1st Edition (1867) and current map sheets for part of the Gask area of Perthshire (NN91NW & NN91NE), and shows that within a small geographic area, at least five structures or enclosures have been removed since the mid-19th century. Much of this removal of earlier remains from arable land appears to have occurred between the 1st and 2nd Edition mapping, although the examination of aerial photographs during the accuracy assessment showed that the intensification of lowland agriculture at the expense of uncultivated pockets of land, doocots, MoLRS and other 'unproductive' features had continued into at least the 1980s. That this loss should have occurred predominantly to post-medieval structures is likely to reflect the probability that the majority of earlier monuments in lowland arable areas had been removed before the Ordnance Survey 1st Edition mapping.

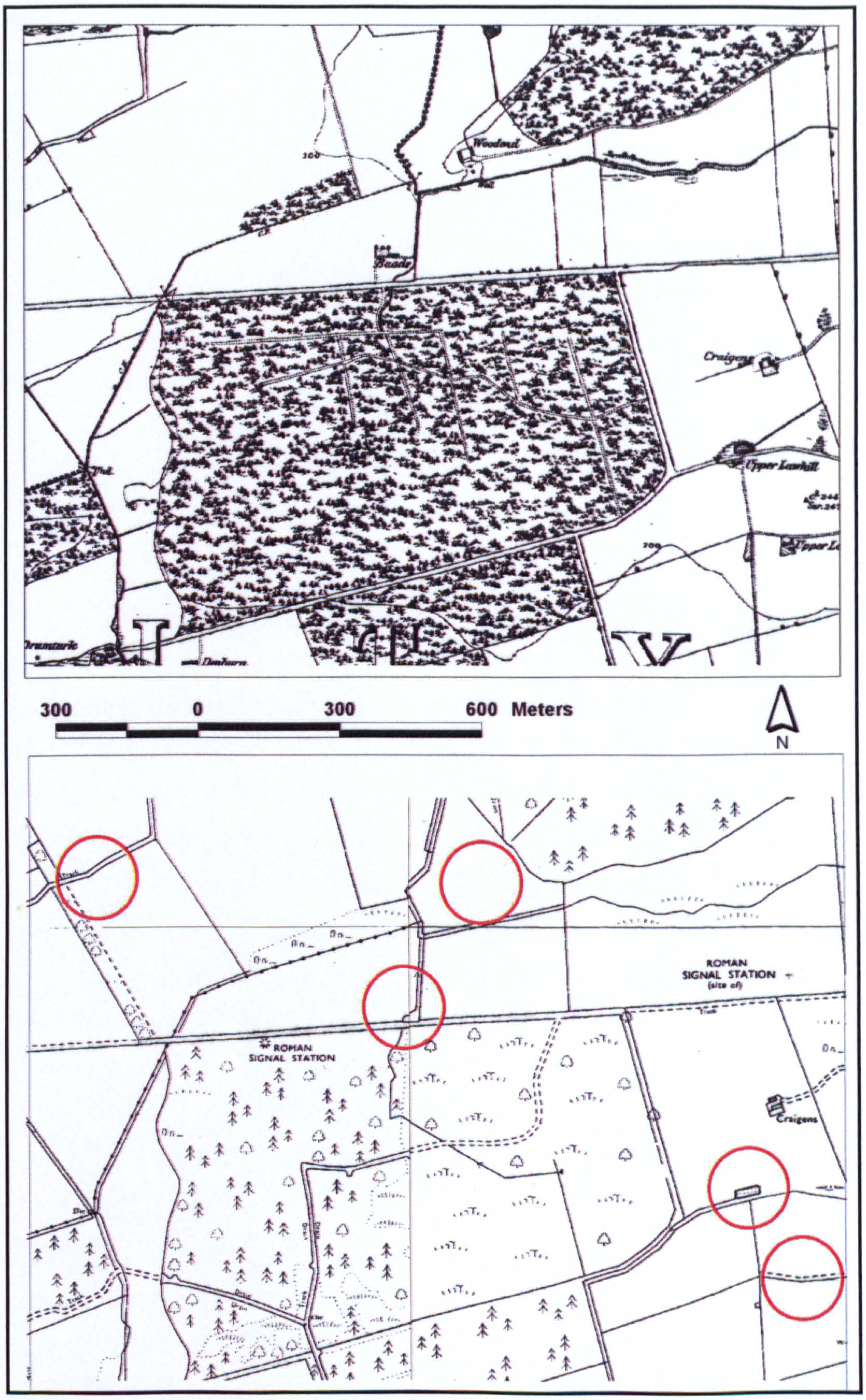

Figure 7.7. First Edition map (1867) and current map of part of the Gask area to the west of Perth, showing the removal of several post-medieval features from the landscape. Current base map © Crown copyright. All rights reserved. Historic Scotland License No. 100017509 [2004]. First Edition map © Crown copyright and Landmark Information Group Ltd.

Land Capability for Agriculture (LCA) and altitude at sample monuments have also been examined to provide an indication of how general environmental conditions relate to monument survival. The calibrated results of the desk-based study have shown it is those monuments situated at low altitudes and in land with high agricultural capability that have suffered greatest loss, though again, it should be remembered that much of this loss cannot be attributed to agriculture. As noted in chapter 2, loss of agricultural land to development is primarily in areas where agricultural land value is highest (Davidson 1992). This trend appears to have affected the archaeological resource in the same manner. In lowland areas, where LCA classification is usually 2 or 3, the major recorded causes of monument loss are archaeological excavation, development (including mineral extraction) and farming. Other known causes of loss in these lowland areas include building renovation, demolition and re-utilisation.

In upland areas, where LCA classification is usually 5 or 6, recorded damage to monuments is dominated by forestry, although the accuracy assessment has shown that non-arable farming activities in these upland areas have also contributed to monument loss. The recording of forestry-related damage has been considerable in this research, primarily through the accuracy assessment, where 32% of damage to extant monuments noted has been attributable to forestry operations. Although the level of forestry-related damage noted through this research has not been entirely unexpected, it is interesting to note that MARS did not record forestry as a major contributing factor in monument loss in England, attributing less than 1% of monument destruction and just over 1% of piecemeal loss to forestry (Darvill and Fulton 1998, 118, 123). Why the results of MARS and this research should differ so widely with regard to forestry-related monument loss is unclear. It is worth noting that among those monuments in forestry surveyed as part of the accuracy assessment, those found in Forestry Commission plantations (although invariably with management problems) were found to be in better condition than those in areas of private forestry. This observation may be misleading, as only eight monuments in forestry (four in Forestry Commission land, four in private forestry) were surveyed. However, it is notable that of those monuments visited in Forestry Commission land, only one had been ploughed and planted with the remainder being left in clearings. By contrast, in areas of private forestry, all four monuments visited had been partially destroyed by ploughing and planting.

Although the environmental variables discussed above have all contributed to monument loss, either directly or indirectly, the desk-based study has also examined non-environmental variables in relation to monument condition change. An examination of the relationship between monument condition change and material construction has been achieved with some success among extant monuments, but the accurate quantification of loss among buried monuments and cropmarks has been impossible. Calibrated results suggest that among extant monuments, earthworks (58% undamaged) are more susceptible to damage than stone-built monuments (64% undamaged), particularly within areas where a change in land use has occurred.

The results produced through an examination of monument condition change and local authority area have proved inconclusive. Although variations exist in monument loss rates between local authority areas, it is impossible to demonstrate any variations that can be attributed to the varying degrees of archaeological input within each of the study area local authority area planning departments. The attempt to identify variations in rates of loss between monument period groups has proved more successful, but has been complicated by disparities in the levels of information held within the NMRS for each of the period groups. For example, the desk-based study has recorded abundant damage to prehistoric and medieval sites because the NMRS generally records such sites in some detail. By contrast, very little damage is recorded through the desk-based study at monuments of post-medieval or unknown date because they are mostly cropmarks or monuments with very little NMRS description. These data biases notwithstanding, examination of survival rates in relation to monument period has shown some variations in monument condition change between groups. Firstly, archaeological excavation has occurred mostly at Roman, prehistoric and medieval monuments, primarily because it is monuments dating to these periods which have held archaeological interest for longest. Secondly, several of the sample monuments of medieval and post-medieval date have been damaged through renovation, re-utilisation or natural building decay. This damage to monuments of medieval and post-medieval date can be attributed to their relatively good state of preservation when compared with monuments of prehistoric date, however, and so is related more to their date of abandonment than date of construction.

Finally, this research has examined differences in rates of loss between scheduled and unscheduled monuments. This has again produced inconclusive results, but for different reasons. The uncalibrated results of the desk-based study show that no scheduled sample monuments have been destroyed and that half of the damage to scheduled monuments identified through the desk-based study has been through archaeological excavation. The calibrated results, however, have been produced using the results of the accuracy assessment. As the accuracy assessment has used Historic Scotland Monument Warden reports to determine condition change among scheduled monuments, significant biases have occurred in the calibrated results, which suggest that only about 35% of extant scheduled monuments remain undamaged, compared with about 75% of extant unscheduled monuments.

Although any comparison between condition change between scheduled and unscheduled monuments must be discounted due to data biases, the calibrated results produced for the group of 95 scheduled sample monuments are of significant value in themselves. It is likely that these calibrated figures are among the most accurate results produced by this research, owing to the quality of the data on which they are based. Most are monuments with a long history of recording, and the Monument Warden data enables a relatively detailed record of changes in their condition in the last 15 years. No other group of monuments examined during this research has this degree of condition information available, and so it could be argued that the calibrated results for these monuments could be applied to all extant sample monuments, suggesting that of the extant sample monuments, at least 66% will have been reduced in extent since 1850. The obvious weakness in extrapolating from these results, however, is that no scheduled sample monuments are recorded as destroyed. Consequently, although the results for scheduled extant monuments can be regarded as illustrative of weaknesses in the calibrated figures produced for *damage* among unscheduled monuments, these results cannot be extrapolated to quantify rates of destruction.

7.2 Identifying loss at cropmark monuments

Because the desk-based study and accuracy assessment have only enabled the identification of visible damage to cropmark monuments, and the damage caused by ploughing and other agricultural practices leave no visible trace, it has been necessary to employ alternative means by which to assess damage (and risk) to cropmark monuments (chapter 6). Specifically, this study of cropmarks and the arable landscape has sought to

1. Identify relationships between the condition of a cropmark monument and its management history, topography and topsoil depth characteristics through the collection of field data from a number of locations.

2. Identify the parts of a cropmark monument likely to have been subject to the greatest levels of damage through ploughing and other agricultural practices.

3. Extrapolate from the results of 1 and 2 to identify cropmark monuments (and parts of cropmark monuments) at greatest risk from ongoing and future agricultural damage.

As described in section 6.13, the first of these objectives has been achieved with some success, with excavations showing that damage to upper levels of subsoil is closely linked to topsoil depth and management history. Furthermore, statistical analysis has shown that at some locations, there are significant relationships between topsoil depth and land surface curvature. Using these observations, it has been possible to address the second objective above by mapping topsoil depth across each of the locations at which excavations were undertaken, thus identifying those areas likely to have been subject to greatest levels of damage through ploughing and other agricultural practices. This mapping of topsoil depth has been developed further to assess ongoing and future risk to cropmark monuments imposed either by a change in management regime or through the effective deepening of cultivation as a result of topsoil erosion. As discussed in section 6.17, in addressing the third objective listed above, extrapolation of the excavation results to the regional scale has been hindered by problems in the reliability of the DTM on which the regional scale analysis and mapping have been based. It has been possible to identify those scheduled cropmark monuments which, on the basis of surface topography, are likely to have been subject to greatest agricultural damage in the past, and, consequently, are likely to be at greatest risk from ongoing and future agricultural damage.

As discussed in chapter 6, scheduling is currently ineffective as a means of protecting cropmark monuments from routine agricultural practices. Consequently, it is necessary to explore alternatives as to how the cropmark resource might be better protected in future. Three options are considered below.

1. **Removal from cultivation.**

A number of writers have argued for the revocation of agricultural class consents (e.g. Renfrew 1980; Plouviez 2003; CSA 2001). According to the LCS88, approximately 1850 km² of the study area is arable, while the total area of scheduled cropmarks in the study area is about 7.43 km². Their permanent removal from cultivation either through a revocation of agricultural class consents or through cross-compliances linked to agricultural payments would therefore see an automatic reduction in arable area of about 0.4%. However, the actual area removed from cultivation would be higher as some fields would become unviable for cropping following the prohibition of cultivation over part or the majority of their area. If all arable fields in the study area containing scheduled cropmarks or parts of scheduled cropmarks were removed from cultivation, and area of about 53 km² would be affected, reducing the arable area by about 3.4%. Such a move would meet with considerable opposition, and even attempting to introduce such legislation would probably do irreversible damage to relations between archaeologists and the farming community. Furthermore, those areas removed from cultivation would need to be carefully managed. Many arable farms have no livestock, and so the removal of cropmarks from cultivation might precipitate a new set of management problems as the areas removed from cultivation reverted to scrubland.

2. **Retention in cultivation but with improved and targeted management.**

If one accepts that an enforced revocation of agricultural class consents would be unrealistic and probably unmanageable, it is necessary to look to alternative means by which to secure the long-term conservation of cropmark archaeology. At a site-specific scale, topsoil depth mapping of the type outlined in this research may prove a valuable tool in the management of cropmark monuments, as it would allow the identification of the parts of monuments at greatest risk from ongoing agriculture or a change in agricultural practice (from cereals to root crops, for example). More importantly, through the hypothetical predictive mapping described briefly in chapter 6, there would be potential for mapping of this type to be used to assess the likely benefit to a monument brought about by sensitive management such as a change to minimum tillage cultivation. It is generally accepted that the ideal management option for a cropmark monument is its removal from cultivation entirely, preferably through conversion to permanent pasture or set-aside, or through an agri-environment scheme. Where this is not feasible, however, the ability to map topsoil depth across fields containing cropmarks would enable the targeting of areas within fields where plough depth could be raised and subsoiling avoided. Advances in farming technology could be adapted to help with this targeted management. For example, GPS units in tractors linked to computers can be used to monitor cereal yields during harvest, and quantities of fertilizers dispensed in subsequent years in different parts of fields can be adjusted automatically using the data collected during harvest. Given the existence of this technology, it is not outwith the realms of possibility to suggest that the same GPS technology could be used to automatically adjust plough depth at various parts of a field, in order to minimise disturbance to underlying archaeological deposits.

While soil depth mapping might have potential for use at individual sites, it would have little value at a regional scale. Regional risk mapping is probably the most logical method by which the rapid assessment and targeting of cropmark monuments for management might be achieved. In the present research, regional scale risk mapping has been limited by the availability of accurate data on topography, and has been based on a single variable. Better regional scale mapping of risk could be achieved by incorporating further parameters such as soil type, climate and rates of erosion. More importantly, however, such mapping would need to be based upon a more refined DTM. The horizontal and vertical accuracy of data obtained using Light Detection and Ranging (LIDAR) instruments can be as low as 15cm (Campbell 2002, 237), enabling the creation of detailed DTMs. Although costly, such LIDAR-derived data would form an easily obtainable foundation on which any digital terrain modelling could be based, thus eliminating the inaccuracies experienced in this research imposed by the use of a DTM with a cell size of 25m. Furthermore, the use of LIDAR data would remove the need for time-consuming contour surveying. Any assessment of damage or risk to cropmark monuments based upon computer modelling would of course need to be tested using trial trenching or excavation, but there is surely great potential for computer modelling based on an accurate DTM being used to rapidly identify management needs and priorities at the regional scale.

3. Targeted rescue excavation.

If a more pessimistic (but perhaps realistic) view is taken, it could be argued that any attempt to secure the widespread in situ preservation of cropmark monuments would be doomed to failure. Legislative changes could take decades to introduce and enforce, by which time the resource they would be designed to protect may already have been destroyed. In addition to the problems surrounding the management of cropmark monuments, it should also be remembered that the archaeological remains that create cropmarks are often poorly understood. Countless excavations of cropmark monuments have shown their initial interpretation or classification to be incorrect. Because cropmarks are poorly understood, they perhaps have greater potential to offer the future understanding of the archaeological resource than some of their better understood extant counterparts. It could be argued, therefore, that in addition to attempting to secure the preservation of cropmark monuments, archaeologists should be attempting to retrieve archaeological data from cropmark monuments before the data is destroyed without record. Such a programme of rescue excavation would need to be devised carefully, and given the restrictions of financial resources in archaeology, it would be unrealistic to expect more than a fraction of cropmark monuments to be excavated in such a programme. In order to maximise the use of monetary resources and ensure that retrieved data could be used in academic research, such a programme would need to be guided by academic objectives as well as management needs. Alternatively, it might be argued that given the probable lack of finances to resource such a scheme, resource managers should consider the option of embracing opportunities for the excavation of a diminishing resource through developer funding. This is not to suggest that attempts to preserve cropmark monuments in situ should be abandoned. However, given the current lack of knowledge about the cropmark resource, the lack of funds to protect this resource, and the likelihood that much of this resource is destroyed annually, it is reasonable to suggest that all eventualities (including developer funding) should be explored to ensure the recovery of archaeological data from cropmark monuments.

7.3 Suggestions for future work

Over the course of this research, a number of topics have been identified that might benefit from further academic or professional study. Some (such as suggestions for cropmark management strategies) have been discussed in the previous section. Others are outlined here.

Visible indicators of damage to monuments such as trees, scrub growth and rabbit burrows were ignored during the desk-based study and accuracy assessment unless damage was visible. As a result, it is likely that natural causes of damage have been under-represented in analysis. A systematic study of natural damage to field monuments within any geographic area would be an enormous project, and given the seasonal variations in bracken growth and rabbit activity, would be restricted in the detail of analysis that might be achieved. Nevertheless, such a project would be desirable to further understanding of the nature and extent of the threat posed to the archaeological resource through natural processes. During the accuracy assessment, the data extracted from Historic Scotland Monument Warden reports has been invaluable in identifying monument condition change. As many of the Monument Warden reports (particularly those from the last 6-7 years) contain detailed information on monument condition, these would be a logical starting point for research of this type. Indeed, much of the information contained in the Monument Warden reports would merit analysis, synthesis and publication in its own right.

Tree growth has not been treated as an automatic indicator of damage in this research, primarily because the precise effects of tree root growth on archaeological deposits remain poorly understood and so the presence of trees on a monument does not necessarily equate to damage of the monument. As Fojut (2002, 203) has pointed out, archaeological deposits containing tree roots are seldom targeted for excavations. However, in order to understand fully the effects of tree roots on archaeology, a programme of systematic research should be undertaken, as advocated by Fojut (2002) and Crow (2001). While such a programme might be achievable through the excavation of monuments which already have tree cover on them, the possibility that it may be necessary to plant monuments with trees and scrubby plants in order to observe the root effects at various time intervals through excavation should not be ruled out.

In addition to research into the effects of tree roots on archaeology, it is recommended that research should be conducted exploring the feasibility of using tree cover as a long-term management option for earthworks. This is not necessarily to advocate the new planting of trees onto earthworks, but to assess the potential of woodland as a land use relatively benign to archaeological earthworks and requiring minimal management. The census has recorded a high density of monuments in semi-natural woodland. Although only about 75% of these have been recorded as undamaged through the desk-based study, this rate of survival is significantly higher than among extant monuments in surrounding agricultural land uses where numbers of recorded extant monuments are lower anyway.

As chapter 6 has shown, the impact of arable cultivation on the buried archaeological resource is significant. However, study of arable cultivation in relation to archaeology is hampered by the inability to observe its effects except through excavation. Even where excavation is undertaken, there is seldom any baseline data with which to compare the observed condition of deposits exposed, and so rates of attrition cannot be quantified. This lack of baseline condition data and inability to identify rates of change in condition has prompted the development of non-invasive methods of assessing damage and risk. However, the use of invasive methods in identifying and quantifying condition change at levelled monuments in arable cultivation should not be ruled out. A number of potential approaches can be proposed.

Firstly, the majority of the modern field boundaries within the study area were laid out during the agricultural improvements of the 18th and 19th centuries. It is likely, therefore, that preserved beneath many of these field boundaries are archaeological deposits that have not been subject to ploughing for 150 years or more. By identifying cropmark monuments which straddle field boundaries, it should be possible to identify locations at which these archaeological deposits might exist. Excavation would enable a comparison of preservation rates between those archaeological deposits found adjacent to and beneath the field boundaries, such as at Shanzie souterrain (Coleman and Hunter 2002). Furthermore, assuming that the field boundaries could be dated (if only approximately) using documentary sources, a chronological baseline could be established, enabling basic quantification or estimates of levels of truncation and information loss. Given the potential for variations in topsoil depth and feature preservation over short distances, such quantification would come with provisos, but systematic research of this type would significantly enhance understanding of rates of loss that might be attributed to modern and historical agricultural practices.

A second approach to measuring rates of truncation at cropmark monuments might involve repeated excavations of a cropmark monument over a number of years with detailed recording of agricultural operations undertaken between excavation seasons. Such a programme would need to rely on hand de-turfing to minimise the damage that machine excavation would cause, and again, the potential for variations in topsoil depth and feature preservation over short distances would need to be taken into account. Taken a step further, a research programme of this type could examine the precise effects of a range of agricultural operations such as deep ploughing and potato seedbed preparation, de-stoning, subsoiling and pan busting by specifically ensuring that these operations took place over the archaeological remains between excavation seasons. This would, unfortunately, necessitate damaging (if not destroying) the archaeological remains. If the controlled and recorded destruction of a monument in this way could not be justified, an alternative approach might be to 'create' an experimental cropmark site consisting of ditches, pits and other features within which markers could be placed and stratigraphies constructed. An experimental site of this type could not hope to replicate exactly the nature of a genuine archaeological site, but would enable the recording of the effects of agricultural practices without the deliberate destruction of part of the archaeological resource.

An alternative to the repeated excavation of an archaeological monument might be the insertion of coloured markers into pits in the subsoil with periodic field walking to locate any markers that had been brought to the surface. The use of coloured glass chips as markers has been used successfully by McAvoy (2002), who found that by placing coloured glass chips at set depths within pits in a cultivated field and fieldwalking after potato cropping, it was possible to identify disturbance to set depths. The use of field walking and coloured markers to identify subsoil disturbance would be less expensive than repeated excavation, and would cause less inconvenience to any farmer willing to participate in such a programme. If markers could be inserted within an existing cropmark site, their removal to the surface would indicate ongoing disturbance to the adjacent archaeological deposits. Furthermore, if the markers could be inserted to known depths (red markers to 30cm and blue markers to 40cm, for example), then the colours of the markers being found during field walking would provide an indication of the depth of fresh disturbance. Equally informative would be the insertion of different coloured markers to different depths in pits cut into the subsoil at various topographic locations within a field. With subsequent field walking (for 20 – 30 years if necessary), it would be possible to identify the depth to which fresh disturbance had occurred, enabling an assessment of rates of truncation at various topographic locations over a number of years.

The mapping of risk to cropmark monuments used in this research has been crude, based on a low-resolution DTM and a single variable (land surface curvature). However, if refined, a rapid risk assessment method of this type may prove invaluable in the development of management and research agendas for cropmarks. It is recommended that serious consideration should be given to the development of a rapid risk assessment technique of this type, ideally using a larger number of variables and based on a LIDAR-derived DTM.

This research has failed to identify a widespread loss of monuments that might be attributable to the expansion of arable farming in the second half of the 20th century. It is worth noting also that the majority of literature pertaining to the loss of monuments through agricultural expansion is from the south of England, where current and recent land use patterns have been different from Perthshire, Fife and Angus. However, it is possible that the impact of arable expansion in eastern central Scotland has been more pronounced than this research has suggested, but because this research has been general in its approach to quantifying monument loss, this pattern has not been identified. Furthermore, it is equally possible that arable expansion has had a greater impact in other parts of Scotland. Further research, ideally targeted at marginal agricultural areas, is required in order to clarify the extent of loss.

No Historic Land use Assessment (HLA) has been used in this research, primarily because none of the areas of Scotland covered by HLA coincides with the study area used in this research. However, a study of monument distribution incorporating an HLA might enable the refinement of identification of zones of survival and destruction, which might in turn aid targeting and decision making in future conservation and management agendas. Coverage of HLA currently extends to about 41% of Scotland (Govan, pers. comm.), and its increased incorporation into archaeological study and management would add a further dimension to any future audit of Scotland's archaeological resource.

Carter (2002, 212) has argued that the assumption still exists that archaeological remains in upland areas are predominantly visible. The threat to archaeology from forestry is currently significantly diminished, but two recently published targets illustrate that pressure on the upland resource may increase in coming years. First, The recent

Forests for Scotland – The Scottish Forestry Strategy (Scottish Executive 2000) has set a target of increasing woodland and forestry cover in Scotland from its current 17% to around 25% in the next 50 years. Secondly, the recent Scottish Executive publication *A Partnership for a Better Scotland: Partnership Agreement* set a target for 40% of Scottish electricity generation to come from renewable sources by 2020 (Scottish Executive 2003b), a commitment carried forward from the previous administration. The bulk of electricity generated from renewable sources will come from windfarms, the majority of which are likely to be located in upland areas. With this increasing pressure on the uplands through windfarm proposals and the likely increase in tree planting, perhaps now is the time for further research into the nature of visibility and survival of monuments in upland settings.

While pressure upon the upland archaeological resource may increase through renewed tree planting in years to come, it is worth remembering that tree planting will not be confined to upland areas, but will occur at lower altitudes also (Yarnell 2003). The threat to the buried archaeological resource in improved areas caused by a move of forestry 'down the hill' has been acknowledged for some 15 years (e.g. Proudfoot 1989; Barclay 1992b). The significance of this threat is strengthened by the findings of this research, which show that recorded monuments are relatively sparse between about 100m and 250m OD, reinforcing Cowley's (2002) argument for the systematic aerial survey of improved pasture to redress the balance in recorded cropmarks and parchmarks. The potential for the discovery of buried archaeological remains in this part of the landscape may be removed entirely by tree planting, and so priority should be given to aerial survey in marginal arable areas and improved pasture to improve the possibility of recording sites here or at least to enable an assessment of the potential of marginal arable and improved pasture in the recording of new sites.

The census has demonstrated a high incidence of recorded monuments in areas of semi-natural woodland. Field survey for the forthcoming RCAHMS inventory for Strathdon has included the systematic survey of shelter belts and other areas of woodland, predominantly recording post-medieval cultivation remains but also some prehistoric monuments (Halliday, pers. comm.). Consideration should be given to extending this type of targeted survey of shelter belts and other woodland areas to other areas of Scotland.

One of the main problems encountered in this research has been a lack of baseline data against which current and recent monument condition can be compared. During this research, use of data created by the First Edition Survey Project (FESP) has been confined only to those few monuments also surveyed in the field. Although some analysis of loss among FESP sites has been undertaken (RCAHMS / Historic Scotland 2002), this has been confined to a small number of case study areas. However, FESP provides a baseline dataset which could easily be utilised in future research of this type. Analysis of the FESP dataset combined with field verification would produce reliable statistics on resource loss, and should be made a priority in the study of Medieval or Later Rural Settlement in Scotland.

The census has demonstrated a lack of extant monuments (particularly earthworks) in lowland areas. Consideration should be given to a programme of targeted scheduling of such monuments. While this might not solve ongoing management problems at many of the monuments, it would ensure that they were regularly monitored, would make landowners aware of archaeological remains on their land, thus lessening the chances of their being damaged inadvertently. The importance of this final point should not be underestimated, and it could be argued that a programme to increase awareness of unscheduled archaeological remains would be desirable also. Of the 61 monuments surveyed as part of the programme of field survey undertaken for the accuracy assessment, in twelve cases, the landowner or land manager was completely unaware of the monument's presence. In a further eleven cases, the landowner or manager was only partially aware of the extent of the remains. In one further case, although the farmer was aware of the presence of a monument on his land (rig and furrow), he did not consider it important enough to be classed as being of archaeological importance. In addition, during the programme of field survey, scheduled monuments were found during field survey to be in consistently better condition than unscheduled monuments. Based on discussions held with landowners and land managers, it is possible to suggest that this variation in condition is due at least in past to the fact that owners are more aware of scheduled archaeological monuments. A programme of providing information to landowners and land managers on the nature and extent of recorded but unscheduled archaeological remains on their land would be costly, but such a scheme might prove invaluable as a means of increasing awareness of the archaeological resource and potentially securing its sympathetic management through agri-environment schemes.

Finally, it is worth noting that archaeological resource management continues to develop slowly in Scotland. Several Scottish local authorities still have no archaeologist or SMR, while only two Scottish universities (Edinburgh and Glasgow) have an archaeology department, neither of which offers courses in archaeological resource management beyond modules as part of wider honours degrees. Furthermore, published academic material relating to resource management in Scotland is scarce, with the bulk of publication coming from Historic Scotland and RCAHMS. While it is accepted that archaeological resource management falls primarily within the professional sphere rather than the academic sphere and that Scotland is a small country both in terms of population and infrastructure, there is surely potential for increased Scottish academic involvement in resource management. This might be achieved either through the two existing Scottish archaeology departments or through the creation of a new or subsidiary department within another of the Scottish universities. As recently as 1993, the key archaeological text *Archaeological Resource Management in the UK: An Introduction* was created to try to bring all the disparate threads of archaeological resource management into a single volume. Prior to this, most material relating to the subject was found in "... journals, pamphlets, leaflets, government circulars and advice notes, unreadable statutes and newspaper cuttings, ... mostly inaccessible or obscure and almost invariably out of print." (Hunter and Ralston 1993, vii). It has been found during the course of this research that ten years after the publication of Hunter and Ralston's observations, this situation is largely unchanged but now encompasses a new raft of legislation. Although the internet now makes access to some material easier, many elements of modern archaeological resource management remain confined to the professional sphere, and to research such material for academic purposes is a daunting process. With the planned revision and re-publication of Hunter and Ralston's volume in the near future, this is perhaps an appropriate juncture at which academic involvement in Scottish archaeological resource management might be increased, adding a further (yet invaluable) facet to the understanding, conservation and management of Scotland's archaeological resource.

8. Appendices

Appendix A. List of sample monuments used in the desk-based study.

Name	Classification	NMRS no.		NGR East	NGR North	Local Authority	Parish
Cromlix	hut-circle	NN70NE 12 (2)	NN	7670	0713	Stirling	Dunblane and Lecropt
Cromlix	enclosure	NN70NE 15	NN	7756	0683	Stirling	Dunblane and Lecropt
Crocket Burn	shieling-huts; shieling-mounds; rig	NN70NE 17 (1)	NN	7795	0821	Perth and Kinross	Ardoch
Cromlix	shielings	NN70NE 24	NN	778	070	Stirling	Dunblane and Lecropt
Crocket Burn	enclosure	NN70NE 27	NN	780	085	Perth and Kinross	Ardoch
Allt Na Criche	cairn	NN70NW 14	NN	7275	0802	Stirling	Kilmadock
Garvald Burn	building; shieling-hut	NN70NW 15	NN	7137	0778	Stirling	Kilmadock
Wester Bows	shieling-huts	NN70NW 23	NN	730	066	Stirling	Dunblane and Lecropt
Wester Bows	homestead; small cairns; banks	NN70NW 27	NN	7331	0760	Stirling	Dunblane and Lecropt
Hillside, Dunblane	Roman temporary camps	NN70SE 11	NN	775	005	Stirling	Dunblane and Lecropt
Hillside, Dunblane	enclosure	NN70SE 38	NN	7782	0050	Stirling	Dunblane and Lecropt
Lady's Mount	bank	NN70SE 75	NN	7902	0333	Stirling	Dunblane and Lecropt
Upper Auchinlay	cultivation remains; vegetation marks	NN70SE 76	NN	775	030	Stirling	Dunblane and Lecropt
Inveardoch	mausoleum; chapel	NN70SW 13	NN	7344	0036	Stirling	Kilmadock
Doune Lodge	earthwork	NN70SW 16	NN	7101	0334	Stirling	Kilmadock
Doune	Roman fort; annexe (possible)	NN70SW 36	NN	7273	0130	Stirling	Kilmadock
Tulloch Knowe	cairn	NN70SW 4	NN	7177	0119	Stirling	Kilmadock
Shrubhill	enclosure (possible); cropmarks	NN70SW 50	NN	745	006	Stirling	Kilmadock
Doune - Dunblane	Roman road (possible); old road	NN70SW 54	NN	728	012	Stirling	Kilmadock
Mailermore	fort	NN71NE 16	NN	752	185	Perth and Kinross	Comrie
Bishopsfauld	trackway	NN71NE 17	NN	7844	1744	Perth and Kinross	Muthill
Tullichettle, Old Parish Church	church; graveyard	NN71NE 7	NN	7671	1975	Perth and Kinross	Comrie
Pairc Mhor	township	NN71NW 1	NN	703	167	Perth and Kinross	Comrie
Meall Na Gaisge	enclosures; turf house	NN71NW 2	NN	726	180	Perth and Kinross	Comrie
Mailer Fuar	cup-markings	NN71NW 6	NN	7290	1725	Perth and	Comrie

						Kinross	
Mailermore	building; kiln	NN71NW 7	NN	749	181	Perth and Kinross	Comrie
Langside	trackway	NN71SE 2	NN	7920	1342	Perth and Kinross	Ardoch
Balmuick	cairns; field banks	NN72NE 5	NN	777	251	Perth and Kinross	Monzievaird and Strowan
Fintulich Farm	farmstead	NN72NE 8	NN	753	263	Perth and Kinross	Comrie
Cultybraggan	enclosure	NN72SE 32	NN	7701	2044	Perth and Kinross	Comrie
Dalginross, 'Court Knoll'	barrow; cist	NN72SE 4	NN	7771	2105	Perth and Kinross	Comrie
Silver Hollow	farmstead; field banks; cultivation remains	NN72SE 51	NN	778	239	Perth and Kinross	Monzievaird and Strowan
'Dunmoid', Dalginross	stone circle: four poster; cist	NN72SE 6	NN	7802	2125	Perth and Kinross	Comrie
Wester Tullybannocher	stone circle; cup-markings	NN72SE 7	NN	7548	2247	Perth and Kinross	Comrie
St Fillans Chapel	chapel; burial-ground; cross-incised stone	NN72SW 2	NN	7038	2357	Perth and Kinross	Comrie
Gleann A' Chilleine	farmstead; shieling-huts; kiln (possible)	NN73NW 13	NN	729	379	Perth and Kinross	Kenmore (Perth and Kinross)
Seana Mhoine	enclosure; buildings; cultivation remains	NN73NW 7 (1)	NN	712	370	Perth and Kinross	Kenmore (Perth and Kinross)
Seana Mhoine	shieling-hut (possible)	NN73NW 7 (6)	NN	715	364	Perth and Kinross	Kenmore (Perth and Kinross)
Glen Turret	shieling-huts; bloomery (possible)	NN73SE 3	NN	793	302	Perth and Kinross	Monzievaird and Strowan
Inchadney, Church, Well and Manse	well	NN74NE 11	NN	788	468	Perth and Kinross	Kenmore (Perth and Kinross)
Loch Tay, Isle of Spar	crannog	NN74NE 21	NN	7730	4511	Perth and Kinross	Kenmore (Perth and Kinross)
Comrie Castle	tower-house	NN74NE 29	NN	7867	4860	Perth and Kinross	Dull
Kinigallin	cup-markings	NN74NE 43	NN	7585	4709	Perth and Kinross	Fortingall
Litigan	fort: ring	NN74NE 6	NN	7666	4966	Perth and Kinross	Fortingall
Tombuie Cottage	cup-markings	NN74NE 80	NN	7965	4512	Perth and Kinross	Kenmore (Perth and Kinross)
Fortingall	homestead moat	NN74NW 1	NN	7340	4665	Perth and Kinross	Fortingall
Easter Achtar (Near)	township	NN74NW 38	NN	724	460	Perth and Kinross	Fortingall
Fortingall Churchyard	stones: cross-incised	NN74NW 41	NN	742	470	Perth and Kinross	Fortingall
Acharn Falls	stone circle	NN74SE 1	NN	7678	4249	Perth and Kinross	Kenmore (Perth and Kinross)
Hermitage	folly (possible)	NN74SE 13	NN	7567	4319	Perth and Kinross	Kenmore (Perth and Kinross)

Achianich	homestead (possible)	NN74SW 10	NN	7314	4258	Perth and Kinross	Kenmore (Perth and Kinross)
Clach An Tuirg, Fearnan	cup-markings	NN74SW 13	NN	7251	4477	Perth and Kinross	Kenmore (Perth and Kinross)
Beinn Bhreac	buildings	NN74SW 24	NN	718	410	Perth and Kinross	Kenmore (Perth and Kinross)
Lagfern, Fearnan	cross-slab: incised	NN74SW 9	NN	7017	4279	Perth and Kinross	Kenmore (Perth and Kinross)
Braes of Foss	homestead; building	NN75NE 1	NN	7534	5592	Perth and Kinross	Dull
Tom Chaiseil	homestead	NN75NE 11	NN	7856	5801	Perth and Kinross	Dull
Braes of Foss	homestead (possible)	NN75NE 38	NN	7559	5633	Perth and Kinross	Dull
Tummel Bridge	bloomery	NN75NE 65	NN	7611	5876	Perth and Kinross	Dull
Caisteal Choise	homestead	NN75NE 7	NN	7856	5738	Perth and Kinross	Dull
Dalreoch Farm	hut-circle; field-system	NN75NW 1	NN	7435	5943	Perth and Kinross	Blair Atholl
Dunalastair	homestead	NN75NW 11	NN	7118	5922	Perth and Kinross	Fortingall
Lochan An Daim	cairns; hut-circle(possible)	NN75NW 13	NN	718	575	Perth and Kinross	Fortingall
Garth Lodge	cup and ring-markings	NN75SE 1	NN	7574	5074	Perth and Kinross	Fortingall
Tom Liath	hut-circle; field-system	NN75SE 11	NN	7611	5133	Perth and Kinross	Fortingall
Tom Liath	hut-circle	NN75SE 13	NN	7588	5156	Perth and Kinross	Fortingall
Garth Cottage	field clearance cairns	NN75SE 20	NN	757	507	Perth and Kinross	Fortingall
Ruighe Nan Eachraidh	shieling-huts	NN75SW 5	NN	745	535	Perth and Kinross	Fortingall
Topfauld	enclosure	NN80NE 10	NN	8752	0825	Perth and Kinross	Blackford
Ardoch Bridge	bridge	NN80NW 7	NN	8378	0990	Perth and Kinross	Ardoch
Danny Burn	shieling-huts; enclosure	NN80SE 1	NN	8762	0424	Perth and Kinross	Blackford
Dornock	Roman temporary camp	NN81NE 14	NN	8782	1901	Perth and Kinross	Crieff
Dalpatrick	enclosure; timber hall (possible)	NN81NE 18	NN	893	188	Perth and Kinross	Crieff
Strageath	Roman fort	NN81NE 2	NN	898	180	Perth and Kinross	Muthill
Redhills	enclosure	NN81NE 58	NN	886	197	Perth and Kinross	Crieff
Dornock Cottage	enclosure (possible); linear cropmarks	NN81NE 62	NN	8860	1876	Perth and Kinross	Crieff
Concraig	enclosure (possible)	NN81NE 77	NN	856	190	Perth and Kinross	Muthill
Strageath	Roman road	NN81NE 8889	NN	8734	1500	Perth and Kinross	Muthill
Westerton	pit-circle (possible)	NN81SE 15	NN	8713	1404	Perth and Kinross	Muthill
Aldonie Cottage	enclosure (possible)	NN81SE 9	NN	855	135	Perth and Kinross	Muthill

Nether Braco	Roman temporary camp (possible)	NN81SW 10	NN	832	102	Perth and Kinross	Ardoch
Connachan	cairn	NN82NE 12	NN	8805	2746	Perth and Kinross	Fowlis Wester
Knock Durroch	fort; road	NN82NE 3	NN	8774	2551	Perth and Kinross	Crieff
Connachan	cup-markings	NN82NE 8	NN	8840	2705	Perth and Kinross	Fowlis Wester
King Kenneth's Cairn	cairn	NN82NW 1	NN	8204	2871	Perth and Kinross	Monzievaird and Strowan
Milquhanzie Hill	fort: flint flake	NN82SE 37	NN	8944	2494	Perth and Kinross	Fowlis Wester
North Forr	ring-ditch	NN82SE 75	NN	870	203	Perth and Kinross	Crieff
Monzie	henge (possible)	NN82SE 78 (1)	NN	8798	2418	Perth and Kinross	Crieff
Monzie	barrow (possible)	NN82SE 78 (2)	NN	8813	2407	Perth and Kinross	Crieff
Castle Cluggy	castle	NN82SW 1	NN	8397	2340	Perth and Kinross	Monzievaird and Strowan
Loch Monzievaird	cairn	NN82SW 20	NN	8353	2325	Perth and Kinross	Monzievaird and Strowan
Carse of Lennoch	barrows	NN82SW 32	NN	8038	2256	Perth and Kinross	Monzievaird and Strowan
Clathick House	stone setting	NN82SW 6	NN	8121	2315	Perth and Kinross	Monzievaird and Strowan
Lawers	standing stone	NN82SW 7	NN	8010	2267	Perth and Kinross	Monzievaird and Strowan
Corrymuckloch	building	NN83NE 40	NN	8925	3545	Perth and Kinross	Fowlis Wester
Glenquaich	hut-circles; field-system	NN83NE 9	NN	854	368	Perth and Kinross	Dull
Creag Na Meine	farmstead; corn-drying kiln	NN83SE 19	NN	8905	3445	Perth and Kinross	Fowlis Wester
Sma' Glen	cairn	NN83SE 2	NN	8899	3018	Perth and Kinross	Fowlis Wester
Clach Na Tiompan	stone circle: four poster	NN83SW 2	NN	8301	3281	Perth and Kinross	Monzievaird and Strowan
Pittiely Burn	cup-markings	NN84NE 1	NN	8770	4822	Perth and Kinross	Logierait
Crieff - Dalnacardoch	military road	NN84NE 46	NN	8862	4500	Perth and Kinross	Dull
Moness	farmstead; field-system	NN84NE 53 (1)	NN	8678	4795	Perth and Kinross	Dull
Moness	hut-circle	NN84NE 53 (2)	NN	8671	4765	Perth and Kinross	Dull
Moness	hut-circles; small cairns	NN84NE 70	NN	8691	4727	Perth and Kinross	Dull
Brae of Cultullich	cup and ring-markings	NN84NE 9	NN	8811	4902	Perth and Kinross	Logierait
Drumdewan	hut platform (possible)	NN84NW 37	NN	8127	4903	Perth and Kinross	Dull
Urlar Burn	cup-markings	NN84NW 39	NN	8499	4657	Perth and Kinross	Dull
Castle Menzies	enclosures: palisaded; souterrains; round houses	NN84NW 46	NN	835	493	Perth and Kinross	Weem
Weem	settlement: unenclosed (possible)	NN84NW 51	NN	839	496	Perth and Kinross	Weem
Dalrawer	homestead:	NN84NW 64	NN	815	486	Perth and	Dull

	palisaded (possible)					Kinross	
Witches Cairn	cairn	NN84SE 1	NN	8607	4236	Perth and Kinross	Dull
Glen Cochill	whisky still (possible)	NN84SE 3	NN	8935	4312	Perth and Kinross	Little Dunkeld
Glen Cochill	shieling-huts	NN84SE 5	NN	898	426	Perth and Kinross	Little Dunkeld
Glen Quaich	enclosure	NN84SW 4	NN	817	406	Perth and Kinross	Dull
Urlar Burn	enclosures	NN84SW 7	NN	812	446	Perth and Kinross	Dull
Duntanlich	graveyard; church (possible); buildings; corn-drying kiln	NN85NE 2	NN	8603	5952	Perth and Kinross	Dull
Ceann Na Coille	ring fort	NN85NW 3	NN	8074	5859	Perth and Kinross	Dull
Cultullich Burn	cup-markings	NN85SE 11	NN	8763	5018	Perth and Kinross	Logierait
Lundin	cup-markings	NN85SE 19	NN	8781	5026	Perth and Kinross	Logierait
Tobairandonaich	cup-marked stone	NN85SE 29	NN	8866	5320	Perth and Kinross	Weem
Edradynate Castle	motte (possible) ; buildings	NN85SE 33	NN	8808	5215	Perth and Kinross	Weem
Tombuie	chambered cairn; cairn; field clearance cairns; field wall	NN85SE 34	NN	8729	5114	Perth and Kinross	Weem
Grandtully, Saint Mary's Church	church	NN85SE 6	NN	8869	5062	Perth and Kinross	Logierait
Meall Rawer	hut-circle	NN85SW 14	NN	8316	5067	Perth and Kinross	Dull
Creag Brollachain	shieling-huts	NN85SW 17	NN	821	529	Perth and Kinross	Dull
Creag Brollachain	shieling-hut	NN85SW 20	NN	824	529	Perth and Kinross	Dull
Lurgan	hut-circles- (possible)	NN85SW 38	NN	814	508	Perth and Kinross	Dull
Rawer	cup-marking (possible)	NN85SW 4	NN	8379	5039	Perth and Kinross	Dull
Loch Farleyer	shieling-huts (possible)	NN85SW 48	NN	807	521	Perth and Kinross	Dull
Coul Burn	enclosure; cultivation remains	NN90NE 5	NN	982	090	Perth and Kinross	Auchterarder
Gleneagles Castle	tower-house	NN90NW 12	NN	9289	0924	Perth and Kinross	Blackford
Millhill	enclosure	NN90NW 16	NN	928	097	Perth and Kinross	Blackford
Craigentaggart Hill	farmstead; cultivation remains; sheepfold	NN90NW 23	NN	903	067	Perth and Kinross	Blackford
Garchel Burn	hut platform	NN90SE 3	NN	9697	0183	Perth and Kinross	Glendevon
Glensherup Reservoir	field banks; cultivation remains	NN90SE 7	NN	960	040	Perth and Kinross	Glendevon
Corim Burn	enclosures; cultivation remains	NN90SW 2	NN	934	042	Perth and Kinross	Glendevon

New Backhill	rig-and-furrow cultivation	NN90SW 4	NN	912	035	Clackmannan	Tillicoultry
Upper Lawhill	building	NN91NE 116	NN	9581	1825	Perth and Kinross	Trinity Gask
Broadslap	enclosures; cropmarks	NN91NE 23	NN	993	158	Perth and Kinross	Auchterarder
Mailingknowe	enclosures (possible)	NN91NE 28	NN	9936	1529	Perth and Kinross	Dunning
Gascon Hall	enclosure	NN91NE 31	NN	9865	1742	Perth and Kinross	Trinity Gask
Belhie	enclosed cremation cemetery	NN91NE 37	NN	9772	1605	Perth and Kinross	Auchterarder
Kirkhill	Roman watch tower	NN91NE 4	NN	9676	1883	Perth and Kinross	Trinity Gask
Laigh of Rossie	settlement	NN91NE 48	NN	987	151	Perth and Kinross	Auchterarder
Loanhead, Waulk Mill	waulk mill	NN91NE 54	NN	9767	1589	Perth and Kinross	Auchterarder
Ruthven Water	lade	NN91NE 77	NN	9701	1427	Perth and Kinross	Auchterarder
Woodend	farmstead	NN91NE 80	NN	9514	1905	Perth and Kinross	Trinity Gask
Lawhill	farmstead; kiln (possible); quarries	NN91NE 93	NN	9585	1778	Perth and Kinross	Trinity Gask
Borestone Cottage	cottage	NN91NE 97	NN	9728	1798	Perth and Kinross	Trinity Gask
Milton of Machany, Water Meadow	water meadow	NN91NW 104	NN	9100	1590	Perth and Kinross	Blackford
Bogotree	farmstead	NN91NW 118	NN	9282	1890	Perth and Kinross	Trinity Gask
Muirmouth	building	NN91NW 120	NN	9371	1936	Perth and Kinross	Madderty
Ardunie	building; farmsteading (possible)	NN91NW 125	NN	9432	1910	Perth and Kinross	Madderty
Kinkell Bridge	enclosure (possible)	NN91NW 145	NN	982	167	Perth and Kinross	Trinity Gask
Parkneuk Wood	Roman road; archaeological excavations	NN91NW 146	NN	914	185	Perth and Kinross	Crieff
South Mains, Innerpeffray	enclosure (possible)	NN91NW 34	NN	909	179	Perth and Kinross	Crieff
Shearerston	pits	NN91NW 42	NN	920	186	Perth and Kinross	Trinity Gask
Raith	pits	NN91NW 52	NN	931	185	Perth and Kinross	Trinity Gask
Hillhead	farmstead	NN91NW 70	NN	9094	1530	Perth and Kinross	Blackford
Bernie Wood	buildings	NN91NW 77	NN	929	153	Perth and Kinross	Trinity Gask
Parkneuk Wood	Roman road	NN91NW 8888	NN	915	185	Perth and Kinross	Crieff
Rossie Law	fort	NN91SE 1	NN	997	124	Perth and Kinross	Dunning
Kay Craig	enclosure	NN91SE 17	NN	9744	1275	Perth and Kinross	Auchterarder
Ogle Hill	fort	NN91SE 3	NN	9694	1148	Perth and Kinross	Auchterarder
Upper Beldhill	farmstead	NN91SE 30	NN	9831	1059	Perth and Kinross	Auchterarder

Kirklands of Damside	enclosure; cropmarks; field boundary	NN91SE 32	NN	9634	1465	Perth and Kinross	Auchterarder
Westerton	pit-enclosure	NN91SE 36	NN	982	144	Perth and Kinross	Auchterarder
Lochie	enclosure; pits; linear cropmarks	NN91SE 42	NN	956	114	Perth and Kinross	Auchterarder
Thorn	fort	NN91SE 7	NN	9616	1207	Perth and Kinross	Auchterarder
Kirkton, St Mackessog's Church	church	NN91SW 4	NN	9482	1407	Perth and Kinross	Auchterarder
Easthill	stone circle : four poster	NN91SW 7	NN	9292	1246	Perth and Kinross	Blackford
Wester Campsie	cists	NN92NE 2	NN	9831	2886	Perth and Kinross	Methven
Sma' Glen	Roman watch tower	NN92NW 1	NN	9089	2848	Perth and Kinross	Fowlis Wester
Little Dunie	house; outbuildings	NN92NW 11	NN	9166	2953	Perth and Kinross	Fowlis Wester
Buchanty Hill	cup and ring-markings	NN92NW 18	NN	9112	2597	Perth and Kinross	Fowlis Wester
Fendoch	Roman fort	NN92NW 2	NN	9196	2830	Perth and Kinross	Fowlis Wester
Isle	souterrain (possible)	NN92SE 10	NN	956	237	Perth and Kinross	Fowlis Wester
Williamston	settlement: palisaded	NN92SE 2	NN	9726	2248	Perth and Kinross	Madderty
Ross	rig	NN92SE 49	NN	987	217	Perth and Kinross	Findo Gask
Fowlis Wester	stone circles; cairn; standing stone	NN92SW 1	NN	924	249	Perth and Kinross	Fowlis Wester
Pitmonie Knowe	rig	NN92SW 101	NN	9298	2493	Perth and Kinross	Fowlis Wester
Crofthead Farm	standing stones	NN92SW 4	NN	9203	2404	Perth and Kinross	Fowlis Wester
Inchbrakie Castle	moat; castle (possible)	NN92SW 6	NN	9031	2174	Perth and Kinross	Crieff
Westhill	cottage	NN92SW 84	NN	9367	2075	Perth and Kinross	Madderty
Allt Coire A' Mhor-Fhir	farmstead; field-system; mill (possible); rig	NN93NE 11	NN	982	394	Perth and Kinross	Little Dunkeld
Cairn Na Liath	cairn; enclosure	NN93NE 2	NN	9952	3674	Perth and Kinross	Auchtergaven
Dancy Burn	hut-circles; small cairns	NN93NE 22	NN	9998	3919	Perth and Kinross	Little Dunkeld
Airlich	building; cultivation remains	NN93NE 35	NN	967	382	Perth and Kinross	Little Dunkeld
Deanshaugh	township; retting ponds	NN93NW 1	NN	925	385	Perth and Kinross	Little Dunkeld
Tomnagrew	township	NN93NW 11	NN	944	393	Perth and Kinross	Little Dunkeld
Tomnagairn	cup-markings	NN93NW 12	NN	9466	3496	Perth and Kinross	Little Dunkeld
Ballinreigh	hut-circles	NN93NW 13 (8)	NN	90	37	Perth and Kinross	Little Dunkeld
Dullator	small cairns; enclosure	NN93NW 18	NN	937	371	Perth and Kinross	Little Dunkeld
Glen Cochill	hut-circle (possible)	NN93NW 20	NN	9173	3930	Perth and Kinross	Little Dunkeld

Girron	shieling-hut; enclosure; cultivation terraces; township (possible)	NN93NW 4	NN	9072	3575	Perth and Kinross	Little Dunkeld
Creag A' Chuallaich	hut; pen	NN93NW 9	NN	9259	3928	Perth and Kinross	Little Dunkeld
Car Stone	standing stone	NN93SE 1	NN	9733	3004	Perth and Kinross	Logiealmond
Shannoch	cairns	NN93SE 2	NN	9977	3169	Perth and Kinross	Logiealmond
Elrick More	cairn	NN94NE 2	NN	9648	4659	Perth and Kinross	Little Dunkeld
Tobar Louris	well	NN94NE 5	NN	9830	4969	Perth and Kinross	Little Dunkeld
Kindallachan	cist	NN94NE 6	NN	9948	4973	Perth and Kinross	Dunkeld and Dowally
Meall Reamhar	hut-circles	NN94NW 2	NN	9310	4656	Perth and Kinross	Little Dunkeld
Allt Na Moine Buidhe	hut-circles; field-system	NN94NW 5	NN	9170	4937	Perth and Kinross	Logierait
Meall Uaine	hut-circles; field-system	NN94NW 9	NN	9306	4878	Perth and Kinross	Little Dunkeld
Torr Beag	farmstead	NN94SE 11	NN	968	401	Perth and Kinross	Little Dunkeld
Parktown	farmstead; mill	NN94SE 17	NN	972	414	Perth and Kinross	Little Dunkeld
Logie Burn	small cairns; trackways; rig	NN94SE 26	NN	9830	4150	Perth and Kinross	Little Dunkeld
Salachill	hut-circle; small cairns	NN94SE 28	NN	9568	4286	Perth and Kinross	Little Dunkeld
Little Trochrie	cairn (possible)	NN94SE 4	NN	9855	4031	Perth and Kinross	Little Dunkeld
Cochill Burn	shieling-huts	NN94SW 15	NN	9006	4257	Perth and Kinross	Little Dunkeld
Cochill Burn	cairn	NN94SW 16	NN	9030	4252	Perth and Kinross	Little Dunkeld
Ballinloan Burn	enclosure	NN94SW 19 (1)	NN	9367	4319	Perth and Kinross	Little Dunkeld
Ballinloan Burn	building	NN94SW 27	NN	9496	4213	Perth and Kinross	Little Dunkeld
Creag Na Tairnge	trackway	NN94SW 29	NN	9377	4191	Perth and Kinross	Little Dunkeld
Ballinloan Burn	shieling-huts	NN94SW 5	NN	926	474	Perth and Kinross	Little Dunkeld
Scotston	hut-circles; field-system	NN94SW 7	NN	904	432	Perth and Kinross	Little Dunkeld
Pitcastle Burn	huts; small cairns; enclosures	NN95NE 14	NN	983	570	Perth and Kinross	Logierait
Tom Dubh	farmstead; field banks; cultivation remains	NN95NE 20	NN	984	557	Perth and Kinross	Logierait
Balnacree	buildings; enclosure	NN95NE 46	NN	9645	5710	Perth and Kinross	Logierait
Baile A' Bhruthaich Path	hut-circle; small cairns; shieling-huts	NN95NE 6	NN	9839	5929	Perth and Kinross	Moulin
Caisteal Dubh	castle	NN95NW 1	NN	9470	5892	Perth and Kinross	Moulin
Balnakeilly	standing stone	NN95NW 11	NN	9463	5943	Perth and Kinross	Moulin
Dun Beag	chapel	NN95NW 13	NN	9155	5924	Perth and Kinross	Moulin

Fonab	limekiln	NN95NW 41	NN	9055	5595	Perth and Kinross	Logierait
Clachan An Diridh	stone circle: four poster	NN95NW 5	NN	9251	5574	Perth and Kinross	Logierait
Eastertyre	homestead	NN95SE 12	NN	9510	5260	Perth and Kinross	Logierait
Mill-Lands of Dalcapon	enclosure	NN95SE 31	NN	9714	5439	Perth and Kinross	Logierait
Dalcapon Wood	bridge	NN95SE 43	NN	9751	5414	Perth and Kinross	Logierait
Balnaguard	barrow; stone axe	NN95SW 1	NN	9450	5184	Perth and Kinross	Little Dunkeld
Tullypowrie Burn	cross-slab; church; farmstead; corn-drying kiln; mill	NN95SW 15	NN	9128	5448	Perth and Kinross	Logierait
Clochfoldich	homestead moat	NN95SW 16	NN	9001	5278	Perth and Kinross	Logierait
Balnaguard	cup-markings	NN95SW 20	NN	9374	5145	Perth and Kinross	Little Dunkeld
Balnaguard Burn	hut cirles; enclosure	NN95SW 26	NN	9315	5004	Perth and Kinross	Little Dunkeld
Castle Dow	field clearance cairns	NN95SW 27	NN	929	508	Perth and Kinross	Little Dunkeld
Clach Na Croiche, Balnaguard	standing stone: cup-markings; cist; cremation	NN95SW 3	NN	9462	5211	Perth and Kinross	Little Dunkeld
Tulloch of Pitnacree	enclosure (possible)	NN95SW 32	NN	928	536	Perth and Kinross	Logierait
Haugh of Grandtully	pits; pottery; cremation cemetery	NN95SW 44	NN	922	533	Perth and Kinross	Little Dunkeld
Haugh of Grandtully Farm	barrows	NN95SW 45	NN	9191	5319	Perth and Kinross	Little Dunkeld
North Hill	building; enclosures; trackways	NO00NE 18	NO	0579	0854	Perth and Kinross	Forteviot
Corb	field-system	NO00NW 5	NO	011	090	Perth and Kinross	Dunning
Gelvan	enclosure	NO00SE 18	NO	054	014	Perth and Kinross	Fossoway
Wood of Coldrain	enclosure	NO00SE 5	NO	0837	0076	Perth and Kinross	Fossoway
Crook of Devon	enclosure (possible)	NO00SW 18	NO	0378	0080	Perth and Kinross	Fossoway
Fossoway Church	church; graveyard	NO00SW 6	NO	0158	0192	Perth and Kinross	Fossoway
Down Hill	fort	NO00SW 8	NO	0007	0364	Perth and Kinross	Glendevon
Home Farm, Invermay	rig	NO01NE 102	NO	063	155	Perth and Kinross	Forteviot
Craighall	cultivation remains	NO01NE 27	NO	0814	1748	Perth and Kinross	Forgandenny
Kildinny	pits; enclosures (possible)	NO01NE 37	NO	0630	1774	Perth and Kinross	Forteviot
Green of Invermay	pits	NO01NE 73	NO	050	160	Perth and Kinross	Forteviot
Forteviot	pit-alignment	NO01NE 83	NO	055	171	Perth and Kinross	Forteviot
Netherholm	rig	NO01NE 89	NO	0650	1698	Perth and Kinross	Forteviot
Mains of Duncrub	ring-ditch	NO01NW 34	NO	0064	1547	Perth and Kinross	Dunning

Mains of Duncrub	enclosure	NO01NW 35	NO	0043	1545	Perth and Kinross	Dunning
Upper Cairnie	enclosure	NO01NW 4	NO	038	192	Perth and Kinross	Forteviot
Leadketty	enclosure: pit-defined	NO01NW 40	NO	020	159	Perth and Kinross	Dunning
Blaeberry	settlement: unenclosed; souterrain	NO01NW 51	NO	011	153	Perth and Kinross	Dunning
Leadketty	enclosure; pits	NO01NW 58	NO	019	156	Perth and Kinross	Dunning
Drum of Garvock	ring-ditch; pits	NO01NW 70	NO	0324	1588	Perth and Kinross	Dunning
Hennhill	rig	NO01NW 94	NO	048	174	Perth and Kinross	Forteviot
Garvock Burn	rig	NO01NW 95	NO	0385	1710	Perth and Kinross	Dunning
Duncrub	enclosure	NO01SW 27	NO	0096	1471	Perth and Kinross	Dunning
Baadhead	farmstead; enclosures; cultivation remains	NO01SW 29	NO	002	116	Perth and Kinross	Dunning
Balquhandy	enclosures; cultivation remains	NO01SW 33	NO	039	115	Perth and Kinross	Dunning
Ha' Tower	earthworks	NO01SW 8	NO	0429	1454	Perth and Kinross	Dunning
Moneydie House	pit-alignment	NO02NE 102	NO	063	292	Perth and Kinross	Moneydie
Broxy Kennels	fort	NO02NE 28	NO	0911	2788	Perth and Kinross	Redgorton
Loanleven	enclosure	NO02NE 32	NO	058	252	Perth and Kinross	Methven
Coldrochie	henge (possible); cropmarks; cultivation remains	NO02NE 42	NO	0779	2925	Perth and Kinross	Moneydie
Tulloch	enclosure (possible); cropmarks	NO02NE 49	NO	0925	2520	Perth and Kinross	Perth
Broxy Kennels	enclosure (possible)	NO02NE 67	NO	091	275	Perth and Kinross	Redgorton
Loanleven	pit-alignment	NO02NE 90 (1)	NO	0542	2589	Perth and Kinross	Methven
Chapelhill, Old Parish Church	church; burial-ground	NO02NW 10	NO	0096	2990	Perth and Kinross	Methven
Burn Brae	burial	NO02NW 6	NO	0283	2881	Perth and Kinross	Methven
Callarfountain	cairn	NO02SE 105	NO	0975	2058	Perth and Kinross	Forgandenny
Cotton	rig	NO02SE 124	NO	0706	2107	Perth and Kinross	Aberdalgie
Dupplin Castle Policies, Backhill Wood	rig	NO02SE 126	NO	0590	2080	Perth and Kinross	Aberdalgie
Letham	cist; bronze dagger; bone objects	NO02SE 16	NO	0842	2384	Perth and Kinross	Tibbermore
Peel	ring-ditch	NO02SE 38	NO	0604	2322	Perth and Kinross	Tibbermore
Blackruthven Cottages	ring-ditches; enclosure: pit-	NO02SE 59	NO	061	241	Perth and Kinross	Tibbermore

	alignment						
Kinnon Park	enclosure	NO02SW 14	NO	038	248	Perth and Kinross	Methven
Mains of Tippermallo	pits; cultivation remains; settlement: unenclosed (possible); cropmarks	NO02SW 30	NO	034	244	Perth and Kinross	Methven
Cultmalundie Woods	rig	NO02SW 54	NO	0321	2121	Perth and Kinross	Tibbermore
Mains of Cultmalundie, Mill Pond	mill pond	NO02SW 57 (1)	NO	0401	2342	Perth and Kinross	Tibbermore
Merriness, Laigh of Cultmalundie	cottage	NO02SW 59 (4)	NO	0315	2381	Perth and Kinross	Tibbermore
Westmuir	Roman watch tower	NO02SW 8	NO	0287	2078	Perth and Kinross	Tibbermore
Murthly Castle	standing stone	NO03NE 5	NO	0705	3956	Perth and Kinross	Little Dunkeld
Balhomish	field banks; cultivation remains; small cairns; shielings (possible)	NO03NW 19	NO	020	395	Perth and Kinross	Little Dunkeld
Horse Wells	farmstead; cultivation remains	NO03NW 30	NO	002	367	Perth and Kinross	Auchtergaven
Kinvaid	enclosure	NO03SE 22	NO	069	300	Perth and Kinross	Moneydie
Luncarty	linear cropmarks; enclosure	NO03SE 24	NO	098	303	Perth and Kinross	Redgorton
Luncarty, Old Parish Church	burial ground	NO03SE 31	NO	094	300	Perth and Kinross	Redgorton
Tophead	pits	NO03SE 41	NO	082	319	Perth and Kinross	Moneydie
Benchil Burn	souterrain (possible)	NO03SE 42	NO	0946	3134	Perth and Kinross	Redgorton
Cowford	standing stone	NO03SE 5	NO	0563	3205	Perth and Kinross	Auchtergaven
Logiebride	church; burial-ground	NO03SW 4	NO	0492	3418	Perth and Kinross	Auchtergaven
Laighwood	earthwork	NO04NE 1	NO	077	456	Perth and Kinross	Clunie
Leduckie	small cairns	NO04NE 26	NO	066	465	Perth and Kinross	Clunie
Riemore	building; enclosure	NO04NE 27	NO	0520	4950	Perth and Kinross	Dunkeld and Dowally
Leduckie	farmstead	NO04NE 29	NO	0705	4667	Perth and Kinross	Clunie
Arlick	cup-markings	NO04NE 36	NO	0833	4668	Perth and Kinross	Clunie
Easter Riemore	hut-circles	NO04NE 42	NO	0529	4902	Perth and Kinross	Dunkeld and Dowally
Sheriffmuir	building	NO04NE 45	NO	0899	4944	Perth and Kinross	Clunie
Craigend	hut-circles; field-system; shieling-hut (possible)	NO04NE 6	NO	078	484	Perth and Kinross	Clunie
Dunkeld - Dalnacardoch - Ruthven - Aviemore - Inverness Militarv	military road	NO04NW 21	NO	0025	4700	Perth and Kinross	Dunkeld and Dowally

Road							
Culthill	enclosure (possible)	NO04SE 35	NO	0993	4217	Perth and Kinross	Caputh
Coupar Angus - Dunkeld - Amulree	military road	NO04SE 41	NO	0500	4100	Perth and Kinross	Dunkeld and Dowally
Kincairney	chapel (possible)	NO04SE 6	NO	0834	4398	Perth and Kinross	Caputh
Dunkeld, Bishop's Hill, New Palace	country house	NO04SW 29	NO	0204	4264	Perth and Kinross	Dunkeld and Dowally
Balhomish	enclosure	NO04SW 69	NO	0227	4006	Perth and Kinross	Little Dunkeld
Pitcarmick	buildings	NO05NE 106	NO	060	575	Perth and Kinross	Kirkmichael (Perth and Kinross)
Pitcarmick Burn	building; enclosure	NO05NE 115	NO	0734	5662	Perth and Kinross	Kirkmichael (Perth and Kinross)
Pitcarmick	small cairns	NO05NE 135	NO	0830	5668	Perth and Kinross	Kirkmichael (Perth and Kinross)
Balnakilly	small cairns	NO05NE 144	NO	0693	5997	Perth and Kinross	Kirkmichael (Perth and Kinross)
Pitcarmick Burn	small cairns	NO05NE 30	NO	052	560	Perth and Kinross	Kirkmichael (Perth and Kinross)
Cultalonie	hut-circles; small cairns	NO05NE 32	NO	076	583	Perth and Kinross	Kirkmichael (Perth and Kinross)
Pitcarmick Burn	small cairns	NO05NE 49	NO	0675	5648	Perth and Kinross	Kirkmichael (Perth and Kinross)
Pitcarmick Burn	hut-circle (possible); small cairns	NO05NE 56	NO	0631	5573	Perth and Kinross	Kirkmichael (Perth and Kinross)
Pitcarmick Loch	small cairns; cord rig	NO05NE 62	NO	0541	5618	Perth and Kinross	Kirkmichael (Perth and Kinross)
Pitcarmick Burn	buildings; shieling-huts	NO05NE 77	NO	0674	5596	Perth and Kinross	Kirkmichael (Perth and Kinross)
Balnabroich	standing stone	NO05NE 79	NO	0917	5675	Perth and Kinross	Kirkmichael (Perth and Kinross)
Creag Mholach	building	NO05NE 91	NO	0771	5767	Perth and Kinross	Kirkmichael (Perth and Kinross)
Croft of Cultalonie	building	NO05NE 97	NO	0703	5926	Perth and Kinross	Kirkmichael (Perth and Kinross)
Tulliemet Wood	hut-circles; field-system; shieling-huts	NO05NW 1	NO	0066	5512	Perth and Kinross	Logierait
Loch Broom	buildings; small cairns; rig-and-furrow cultivation	NO05NW 3	NO	012	564	Perth and Kinross	Logierait
Loch Broom	hut-circle(possible); enclosure; shieling-huts	NO05NW 4	NO	0082	5860	Perth and Kinross	Moulin
Moine An Tuim Bhealaidh	hut-circle(possible); enclosure: small	NO05NW 5	NO	0101	5892	Perth and Kinross	Moulin

	cairns; field-wall						
Craigsheal Burn	hut-circle	NO05SE 13	NO	0603	5220	Perth and Kinross	Clunie
Craigsheal Burn	hut-circles; field-system; building: Pitcarmick-type	NO05SE 16	NO	070	515	Perth and Kinross	Clunie
Craigsheal Burn	hut-circles	NO05SE 17	NO	0675	5132	Perth and Kinross	Clunie
Creag Nam Mial	building	NO05SE 29	NO	0575	5444	Perth and Kinross	Kirkmichael (Perth and Kinross)
Buckinhill	enclosure	NO05SE 30	NO	0839	5099	Perth and Kinross	Clunie
Lochan A'chait	cultivation remains	NO05SE 34	NO	0532	5178	Perth and Kinross	Clunie
Baden Burn	building	NO05SE 42	NO	0835	5238	Perth and Kinross	Clunie
Meall Dubh	hut-circle	NO05SE 47	NO	0756	5354	Perth and Kinross	Clunie
Buckinhill	small cairns	NO05SE 56	NO	0845	5099	Perth and Kinross	Clunie
Loch Charles	burnt mound	NO05SE 60	NO	0880	5437	Perth and Kinross	Kirkmichael (Perth and Kinross)
Woodhill	burnt mound	NO05SE 61	NO	0936	5398	Perth and Kinross	Kirkmichael (Perth and Kinross)
Cragganfearn	fermtoun; kiln	NO05SW 10	NO	0053	5352	Perth and Kinross	Logierait
Cragganfearn	small cairns (possible); structures; cultivation remains	NO05SW 8	NO	008	534	Perth and Kinross	Logierait
West Lomond	structures	NO10NE 50	NO	198	057	Fife	Strathmiglo
Balcanquhal, Dovecot	dovecot	NO10NE 6	NO	1637	0999	Fife	Strathmiglo
Westfield of Pitlochie	old roads	NO10NE 67	NO	169	085	Fife	Strathmiglo
Arlary	ring-ditch	NO10NW 19	NO	1353	0556	Perth and Kinross	Orwell
Grahamstone	ring-ditch (possible)	NO10SE 12	NO	1725	0141	Perth and Kinross	Portmoak
Balnethill Farm	enclosure	NO10SE 2	NO	1768	0390	Perth and Kinross	Portmoak
Loch Leven, St Serf's Island, St Serf's Priory Church	priory	NO10SE 3	NO	1615	0026	Perth and Kinross	Portmoak
Abernethy Hill	rig	NO11NE 123	NO	1911	1569	Perth and Kinross	Abernethy (Perth and Kinross)
Muirhead	rig	NO11NE 139	NO	1757	1917	Perth and Kinross	Rhynd
Aberargie	enclosure: rectilinear; pits; ring-ditch (possible); rig	NO11NE 30	NO	1673	1580	Perth and Kinross	Abernethy (Perth and Kinross)
Ferryfield of Carpow, Old Road	track	NO11NE 66	NO	194	180	Perth and Kinross	Abernethy (Perth and Kinross)
Dunmore	enclosure	NO11NE 71	NO	178	162	Perth and Kinross	Abernethy (Perth and Kinross)
Law of Dumbuils	fort	NO11NW 19	NO	1015	1695	Perth and	Forgandenny

						Kinross	
Dunbarney Quarry	ring-ditches; pits; rig	NO11NW 53	NO	110	181	Perth and Kinross	Dunbarney
Moncreiffe Hill	fort	NO11NW 7	NO	1313	1988	Perth and Kinross	Dunbarney
Pittuncarty	enclosure	NO11SE 49	NO	1865	1107	Perth and Kinross	Abernethy (Perth and Kinross)
Muirfield	barrows: square (possible)	NO11SE 50	NO	1508	1017	Perth and Kinross	Arngask
Devil's Well	well; stone	NO11SE 7	NO	1936	1477	Perth and Kinross	Abernethy (Perth and Kinross)
Edmund's Grave	cairn	NO11SW 1	NO	1469	1450	Perth and Kinross	Dron
Glenfarg Reservoir	cultivation remains	NO11SW 26	NO	1015	1138	Perth and Kinross	Arngask
Cairn Geddes	cairn; cist	NO11SW 3	NO	1196	1304	Perth and Kinross	Arngask
Paris Cottage	trackway; rig	NO11SW 45	NO	136	116	Perth and Kinross	Arngask
Arnbathie	rig	NO12NE 17	NO	174	264	Perth and Kinross	Kilspindie
Murrayshall Hill	plantation bank	NO12NE 25	NO	1633	2545	Perth and Kinross	Kinnoull
Pole Hill	buildings; shieling-huts	NO12NE 35	NO	195	258	Perth and Kinross	Kilspindie
Shanry	buildings; huts	NO12NE 40	NO	196	271	Perth and Kinross	Kilspindie
Law Hill, Arnbathie	cairn	NO12NE 43	NO	1703	2586	Perth and Kinross	Kilspindie
Pole Wood	building	NO12NE 46	NO	1879	2663	Perth and Kinross	Kilspindie
Scone Park	Roman temporary camp	NO12NW 14	NO	1044	2715	Perth and Kinross	Scone
Ardgilzean Cottage	'motte'; cairn	NO12NW 3	NO	1264	2951	Perth and Kinross	Scone
Ardgilzean	enclosure	NO12NW 40	NO	1244	2941	Perth and Kinross	Scone
Blairhall	cursus; ring-ditches; linear cropmarks; pits	NO12NW 43	NO	116	280	Perth and Kinross	Scone
Locheye	enclosure: rectilinear; pits; cropmarks; cultivation remains	NO12NW 61	NO	114	278	Perth and Kinross	Scone
Innerbuist Mill	watermill	NO12NW 70	NO	1064	2938	Perth and Kinross	Scone
Ardgilzean	enclosures; cropmarks; pits; rig	NO12NW 72	NO	1119	2908	Perth and Kinross	Scone
Elcho Castle	tower-house	NO12SE 11	NO	1643	2107	Perth and Kinross	Rhynd
Inchyra House, 'Witch Knowe'	barrow; burial; urns	NO12SE 14	NO	1894	2118	Perth and Kinross	St Madoes
Balthayock Castle	tower-house	NO12SE 4	NO	1741	2295	Perth and Kinross	Kinnoull
Coates of Fingask	enclosure; rig	NO12SE 62	NO	1590	2104	Perth and Kinross	Rhynd
Coates of Fingask	souterrain (possible)	NO12SE 75	NO	157	207	Perth and Kinross	Rhynd

Mount Tabor	rig	NO12SW 110	NO	130	238	Perth and Kinross	Kinnoull
Bridgend	well; iron implement	NO12SW 112	NO	122	237	Perth and Kinross	Kinnoull
Upper Muirhall	cist	NO12SW 114	NO	1454	2405	Perth and Kinross	Kinnoull
Upper Muirhall	enclosure	NO12SW 187	NO	1414	2391	Perth and Kinross	Kinnoull
Gannochy	road	NO12SW 190	NO	1307	2491	Perth and Kinross	Scone
Gannochy	enclosures; cropmark	NO12SW 191	NO	1306	2496	Perth and Kinross	Scone
Perth, Blackfriars Street	burial-ground	NO12SW 213	NO	1173	2383	Perth and Kinross	Perth
Kinnoull Hill	well	NO12SW 246	NO	141	228	Perth and Kinross	Kinfauns
Hangie's Stone	standing stone	NO13NE 14	NO	1575	3557	Perth and Kinross	Cargill
Brunty	bridges	NO13NE 25	NO	1971	3819	Perth and Kinross	Cargill
Meikleour	enclosure	NO13NE 33	NO	1618	3980	Perth and Kinross	Caputh
Gallowhill	road	NO13NE 78	NO	1595	3568	Perth and Kinross	Cargill
Hatton	settlement: unenclosed; souterrain	NO13NE 79	NO	1714	3777	Perth and Kinross	Cargill
Isla Cottage	pits; cropmarks; enclosure	NO13NE 80	NO	1663	3760	Perth and Kinross	Cargill
Leyston	settlement: unenclosed; souterrains	NO13NE 82	NO	1900	3855	Perth and Kinross	Cargill
Meikleour	motte	NO13NE 87	NO	1536	3869	Perth and Kinross	Cargill
Hallhole	round house; enclosure; pits; cultivation remains; souterrain (possible)	NO13NE 97	NO	183	397	Perth and Kinross	Caputh
Kercock	settlement	NO13NW 16	NO	1357	3884	Perth and Kinross	Kinclaven
Kercock	enclosure	NO13NW 19	NO	1388	3892	Perth and Kinross	Kinclaven
Kercock	enclosure; cropmarks	NO13NW 23	NO	1280	3870	Perth and Kinross	Kinclaven
Inchtuthil	building	NO13NW 24	NO	1214	3947	Perth and Kinross	Caputh
Inchtuthil	linear cropmark	NO13NW 5 (10)	NO	1253	3926	Perth and Kinross	Caputh
Inchtuthil	Roman temporary camp	NO13NW 5 (2)	NO	1165	3934	Perth and Kinross	Caputh
Inchtuthil	Roman temporary compound	NO13NW 5 (7)	NO	1271	3937	Perth and Kinross	Caputh
Ballathie	settlement: unenclosed	NO13NW 57	NO	145	370	Perth and Kinross	Kinclaven
Inchtuthil, The Women's Knowe	barrow; plantation bank	NO13NW 7 (1)	NO	1279	3968	Perth and Kinross	Caputh
Bandirran House, Dovecot	dovecot	NO13SE 23 (3)	NO	1976	3034	Perth and Kinross	Collace
St Martins	standing stones	NO13SE 9	NO	1595	3122	Perth and Kinross	St Martins

Blackfaulds	stone circle	NO13SW 15	NO	1413	3167	Perth and Kinross	St Martins
Colen	stone circle; cup-markings	NO13SW 19	NO	1106	3116	Perth and Kinross	St Martins
Inchbervis Castle	castle	NO13SW 27	NO	1226	3291	Perth and Kinross	Auchtergaven
Taymount	cropmarks	NO13SW 29	NO	1182	3465	Perth and Kinross	Kinclaven
Byres	enclosure (possible)	NO13SW 49	NO	1327	3310	Perth and Kinross	St Martins
Pleasance	enclosure	NO13SW 68	NO	1352	3389	Perth and Kinross	Cargill
Berryhill	ring-ditch	NO13SW 75	NO	117	321	Perth and Kinross	St Martins
Gowrie	cropmarks; cultivation remains	NO13SW 82	NO	104	316	Perth and Kinross	Redgorton
Berryhill	enclosure	NO13SW 84	NO	117	318	Perth and Kinross	St Martins
Berryhill	pit-enclosure (possible)	NO13SW 85	NO	116	321	Perth and Kinross	St Martins
Stobhall	enclosure (possible)	NO13SW 86	NO	1334	3469	Perth and Kinross	Cargill
Hilltown of Mause	cairn; small cairns	NO14NE 21	NO	1581	4813	Perth and Kinross	Blairgowrie
Mains of Mause	small cairns	NO14NE 69	NO	1529	4929	Perth and Kinross	Blairgowrie
Welton of Creuchies	hut platforms	NO14NE 80	NO	1943	4976	Perth and Kinross	Bendochy
Coupar Angus - Braemar - Corgarff - Fort George	military road	NO14NE 86	NO	1642	4783	Perth and Kinross	Blairgowrie
Drumend	souterrain	NO14NE 96	NO	197	460	Perth and Kinross	Rattray
Kirklands	souterrain (possible)	NO14NE 99	NO	189	460	Perth and Kinross	Rattray
Middleton Muir	hut-circle (possible); bank	NO14NW 16	NO	1338	4800	Perth and Kinross	Kinloch
Middleton Muir	hut-circles	NO14NW 18	NO	1210	4825	Perth and Kinross	Kinloch
Middleton Muir	hut-circle; small cairns	NO14NW 19	NO	1250	4807	Perth and Kinross	Kinloch
Muir of Gormack	cup and ring-markings	NO14NW 28	NO	1253	4721	Perth and Kinross	Kinloch
Middleton Muir	hut-circle	NO14NW 31	NO	1169	4775	Perth and Kinross	Kinloch
Wester Tullyneddie	ring-ditch (possible)	NO14NW 39	NO	1158	4543	Perth and Kinross	Clunie
Carnashach Wood	cup-markings	NO14NW 43	NO	1449	4819	Perth and Kinross	Kinloch
Ranageig	building: Pitcarmick-type	NO14NW 54	NO	1025	4947	Perth and Kinross	Blairgowrie
Ranageig	field-system	NO14NW 55	NO	1015	4965	Perth and Kinross	Blairgowrie
Gormack Muir	hut-circles; field-system; cairn	NO14NW 6	NO	124	474	Perth and Kinross	Kinloch
Gormack Muir	hut-circle (possible); enclosure	NO14NW 60	NO	1197	4741	Perth and Kinross	Kinloch
Gormack Muir	hut-circles	NO14NW 68	NO	132	470	Perth and Kinross	Kinloch
Cairns	hut-circles; small	NO14NW 74	NO	111	471	Perth and	Clunie

	cairn					Kinross	
Cairns	building	NO14NW 75	NO	1114	4716	Perth and Kinross	Clunie
Lornty Burn	building; enclosure	NO14NW 77	NO	1116	4796	Perth and Kinross	Kinloch
Mains of Pittendriech	cairn	NO14SE 19	NO	1557	4186	Perth and Kinross	Lethendy
Burnside	enclosure	NO14SE 22	NO	1522	4346	Perth and Kinross	Kinloch
Easter Essendy	cist; food vessel; jet necklace	NO14SE 23	NO	1557	4277	Perth and Kinross	Clunie
Blairgowrie, Greenbank Cottage	souterrain	NO14SE 3	NO	1741	4484	Perth and Kinross	Blairgowrie
The Welton	enclosure; pits	NO14SE 34	NO	1977	4396	Perth and Kinross	Blairgowrie
The Welton	fort	NO14SE 35	NO	1963	4397	Perth and Kinross	Blairgowrie
Easter Essendy	settlement: unenclosed; linear cropmarks; souterrain	NO14SE 67	NO	1501	4253	Perth and Kinross	Clunie
The Welton	settlement: unenclosed	NO14SE 75	NO	1910	4404	Perth and Kinross	Blairgowrie
Carsie Mains	pit-enclosure	NO14SE 94	NO	171	420	Perth and Kinross	Blairgowrie
Loch of Clunie	crannog	NO14SW 26	NO	1142	4445	Perth and Kinross	Clunie
Middle Gourdie	settlement: unenclosed; souterrain	NO14SW 38	NO	1182	4187	Perth and Kinross	Caputh
Kirkton of Lethendy	church; burial-ground	NO14SW 40	NO	1300	4180	Perth and Kinross	Lethendy
Knockali	hut-circles	NO15NE 13	NO	1531	5920	Perth and Kinross	Alyth
Corrie Burn	hut-circles; field-system	NO15NE 3	NO	171	582	Perth and Kinross	Alyth
Drumderg	building	NO15NE 37	NO	1808	5644	Perth and Kinross	Alyth
Badkeirie	enclosure; building	NO15NE 6	NO	1753	5748	Perth and Kinross	Alyth
Mains of Persie	hut-circles	NO15NW 3	NO	132	558	Perth and Kinross	Kirkmichael (Perth and Kinross)
Craigton	cup-markings	NO15NW 30	NO	1237	5863	Perth and Kinross	Kirkmichael (Perth and Kinross)
Bleaton Hallet	township; corn mill; smithy; kiln	NO15NW 35	NO	137	571	Perth and Kinross	Kirkmichael (Perth and Kinross)
Drumfork	chapel	NO15NW 4	NO	1488	5953	Perth and Kinross	Alyth
Balnabroich	cairn	NO15NW 45	NO	1049	5707	Perth and Kinross	Kirkmichael (Perth and Kinross)
Balnabroich	building: Pitcarmick-type	NO15NW 47	NO	1079	5702	Perth and Kinross	Kirkmichael (Perth and Kinross)
Hill of Easter Bleaton	hut-circles	NO15NW 7	NO	148	569	Perth and Kinross	Kirkmichael (Perth and Kinross)
Wester Bleaton	farmstead; kiln	NO15NW 70	NO	1118	5972	Perth and Kinross	Kirkmichael (Perth and Kinross)

Lochan Na Clodaich	cultivation remains	NO15NW 71	NO	105	587	Perth and Kinross	Kirkmichael (Perth and Kinross)
Hill of Kingseat	fermtoun; kiln	NO15SE 30	NO	1523	5477	Perth and Kinross	Alyth
Heatheryhaugh	buildings	NO15SE 41	NO	1862	5090	Perth and Kinross	Bendochy
Rannagulzion Farm	farmstead; kiln	NO15SE 47	NO	1815	5360	Perth and Kinross	Alyth
Heatheryhaugh	cairn	NO15SE 52	NO	1891	5115	Perth and Kinross	Bendochy
Smyrna	hut-circle	NO15SE 81	NO	1912	5301	Perth and Kinross	Alyth
Rannagulzion	enclosure	NO15SE 83	NO	1791	5415	Perth and Kinross	Alyth
Drumderg	cairn	NO15SE 86	NO	1756	5469	Perth and Kinross	Alyth
Old Milton of Drimmie	mill	NO15SE 87	NO	1599	5123	Perth and Kinross	Blairgowrie
Hill of Cally	hut-circles	NO15SW 20	NO	1214	5280	Perth and Kinross	Kirkmichael (Perth and Kinross)
Hill of Cally	buildings	NO15SW 28	NO	1308	5169	Perth and Kinross	Kirkmichael (Perth and Kinross)
Rochallie	burnt mound	NO15SW 29	NO	1423	5065	Perth and Kinross	Blairgowrie
Hill of Cally	buildings	NO15SW 31	NO	1215	5280	Perth and Kinross	Kirkmichael (Perth and Kinross)
Ardlebank	building	NO15SW 32	NO	1178	5485	Perth and Kinross	Kirkmichael (Perth and Kinross)
Hill of Ashmore	building; platform; structure; small cairns; field-banks	NO15SW 36	NO	149	533	Perth and Kinross	Blairgowrie
Heatherhall Wood	banks; old roads; rig	NO20NE 102	NO	291	097	Fife	Collessie
Falkland Castle	tower	NO20NE 18	NO	2536	0757	Fife	Falkland
Maryfield	cropmark; rig	NO20NE 232	NO	267	089	Fife	Kettle
Mill Burn	plantation bank	NO20NW 101	NO	2370	0703	Fife	Falkland
Kilgour	settlement (possible)	NO20NW 103	NO	2190	0795	Fife	Falkland
House of Falkland	building	NO20NW 111	NO	2435	0709	Fife	Falkland
West Lomond	hut platforms; enclosures	NO20NW 31	NO	200	058	Fife	Strathmiglo
West Lomond, Laird's Faulds	enclosures	NO20NW 37	NO	218	069	Fife	Falkland
West Lomond	enclosures	NO20NW 40	NO	219	067	Fife	Falkland
West Lomond	enclosure	NO20NW 43	NO	222	068	Fife	Falkland
West Lomond, Bracks	rig; field clearance cairns	NO20NW 48	NO	226	066	Fife	Falkland
Harperleas Reservoir	field system; enclosures	NO20NW 54	NO	202	060	Fife	Falkland
Coalpit Burn	rig-and-furrow cultivation	NO20NW 55	NO	229	063	Fife	Falkland
East Lomond, Hume's Head	structure	NO20NW 58	NO	238	063	Fife	Falkland
East Lomond	cup-markings	NO20NW 59	NO	244	062	Fife	Falkland
Balharvie Moss	mound	NO20NW 67	NO	2043	0692	Fife	Strathmiglo

Balharvie Moss	trackway	NO20NW 69	NO	2088	0687	Fife	Falkland
West Lomond	rig-and-furrow cultivation	NO20NW 72	NO	219	068	Fife	Falkland
Woodmill	linear soilmark; ring-ditch (possible)	NO20NW 75	NO	247	094	Fife	Falkland
Bracks	hut-circle	NO20NW 93	NO	2241	0659	Fife	Falkland
Bandon Tower	tower	NO20SE 3	NO	2768	0424	Fife	Markinch
Harperleas	enclosure	NO20SW 17	NO	203	048	Fife	Leslie (Kirkcaldy)
Harperleas	enclosure	NO20SW 19	NO	201	049	Fife	Leslie (Kirkcaldy)
Meikle Balquhomrie	cultivation remains	NO20SW 25	NO	228	033	Fife	Leslie (Kirkcaldy)
Strathendry	standing stone	NO20SW 5	NO	2306	0152	Fife	Leslie (Kirkcaldy)
Arnot Tower	tower	NO20SW 8	NO	2060	0167	Perth and Kinross	Portmoak
Dunbog House	house; preceptory	NO21NE 1	NO	2852	1805	Fife	Dunbog
Dunbog	church	NO21NE 15	NO	2851	1803	Fife	Dunbog
Balmeadie	chapel; burial ground	NO21NE 22	NO	2998	1838	Fife	Dunbog
Cairnie Hill	barrow; cist	NO21NE 26	NO	2792	1549	Fife	Abdie
Braeside of Lindores	enclosure	NO21NE 29	NO	2569	1746	Fife	Abdie
Glenduckie Hill	fort; homestead	NO21NE 5	NO	2813	1931	Fife	Flisk
Carpow	unenclosed settlement; cultivation remains; cropmarks	NO21NW 42	NO	203	178	Perth and Kinross	Abernethy (Perth and Kinross)
Easter Clunie	settlement: unenclosed	NO21NW 86	NO	216	178	Perth and Kinross	Abernethy (Perth and Kinross)
Rossie Drain	timber structure; mortuary enclosure (possible); pits	NO21SE 113	NO	276	101	Fife	Collessie
Monimail Tower and Melville House Garden Walls	tower; palace: Episcopal	NO21SE 13	NO	2984	1409	Fife	Monimail
Melville Home Farm	enclosure; enclosures (possible)	NO21SE 27	NO	2923	1329	Fife	Collessie
Kinloch	settlement: unenclosed	NO21SE 33	NO	2795	1154	Fife	Collessie
Rossie House	settlement: unenclosed; cultivation remains; cropmarks	NO21SE 40	NO	267	124	Fife	Collessie
Kinloch	pit-alignment	NO21SE 75	NO	2825	1176	Fife	Collessie
Woodhead	souterrain	NO21SE 76	NO	2627	1404	Fife	Collessie
Heatherhall Wood	ring-ditch (possible); enclosure(possibl e)	NO21SE 84	NO	280	102	Fife	Collessie
Gaddon Plantation, Kinloch	souterrain (possible); cropmarks	NO21SE 88	NO	2876	1252	Fife	Collessie
Orchardfield	settlement:	NO21SW 127	NO	2355	1005	Fife	Strathmiglo

	unenclosed; souterrain (possible)						
Craigowerhouse	enclosure (possible)	NO21SW 134	NO	239	126	Fife	Auchtermuchty
Easter Colzie	ring-ditch (possible)	NO21SW 146	NO	232	141	Fife	Abdie
Myres Castle	enclosure	NO21SW 26	NO	2330	1087	Fife	Auchtermuchty
Reedieleys	enclosure (possible)	NO21SW 29	NO	2359	1043	Fife	Auchtermuchty
Strathmiglo	ring-ditch	NO21SW 34	NO	2094	1022	Fife	Strathmiglo
Rossie Priory	enclosure; cultivation remains	NO22NE 13	NO	2915	2982	Perth and Kinross	Longforgan
Middlebank	settlements: unenclosed; souterrains	NO22NE 14	NO	2588	2747	Perth and Kinross	Errol
Middlebank Holdings	ring-ditch; pits; cropmarks	NO22NE 25	NO	2562	2661	Perth and Kinross	Errol
Middlebank	enclosure; settlement: unenclosed (possible); souterrain	NO22NE 35	NO	2545	2750	Perth and Kinross	Errol
Powgavie	enclosure: rectilinear; cropmarks	NO22NE 42	NO	287	257	Perth and Kinross	Errol
Westown	church; burial-ground	NO22NW 21	NO	2493	2746	Perth and Kinross	Errol
Over Fingask	field-system; enclosures; rig	NO22NW 37	NO	221	289	Perth and Kinross	Kinnaird
Franklyden	farmstead; kiln	NO22NW 48	NO	2187	2982	Perth and Kinross	Kinnaird
Whitemyre	hut-circle; hut-circle (possible)	NO22NW 50	NO	2022	2839	Perth and Kinross	Kilspindie
Rait	fort	NO22NW 6	NO	2299	2675	Perth and Kinross	Kilspindie
Gasconhall	cropmarks; souterrain (possible)	NO22NW 67	NO	219	262	Perth and Kinross	Kilspindie
Ballinbreich Castle	enclosures; flints; pottery; cultivation remains; metal	NO22SE 12	NO	271	203	Fife	Flisk
Ballinbreich	enclosure (possible)	NO22SE 13	NO	2786	2054	Fife	Flisk
Tay Lodge	cropmark	NO22SE 17	NO	2571	2242	Perth and Kinross	Errol
Hill of Errol	souterrain (possible)	NO22SW 17	NO	2364	2105	Perth and Kinross	Errol
Silvermuir Ovals	plantation boundaries	NO22SW 35	NO	2488	2176	Perth and Kinross	Errol
Sandyhall	settlement: unenclosed; cropmarks; enclosure: rectilinear	NO22SW 37	NO	2180	2328	Perth and Kinross	Errol
Hillview	pits	NO22SW 59	NO	2102	2275	Perth and Kinross	Errol
Clashbenny	settlement: unenclosed; souterrain; pits	NO22SW 63	NO	218	214	Perth and Kinross	Errol
Hill of Errol	building:	NO22SW 65	NO	2326	2163	Perth and	Errol

	rectangular; building: rectangular (possible)					Kinross	
Myreside	souterrains; pits; cultivation remains	NO22SW 68	NO	218	245	Perth and Kinross	Kilspindie
Pitcur	souterrain; stones: cup and ring-markings; cup-markings	NO23NE 1	NO	2529	3738	Perth and Kinross	Kettins
Woodside	souterrain; cropmarks	NO23NW 46	NO	212	375	Perth and Kinross	Kettins
Peattie	enclosure	NO23NW 50	NO	2293	3646	Perth and Kinross	Kettins
Lintrose House	settlement: unenclosed	NO23NW 58	NO	2277	3812	Perth and Kinross	Kettins
Peattie	souterrain (possible); cropmarks	NO23NW 64	NO	232	358	Perth and Kinross	Kettins
Kettins	souterrain (possible); cropmarks	NO23NW 75	NO	238	385	Perth and Kinross	Kettins
Flatfield	enclosure (possible); cropmarks	NO23NW 77	NO	241	399	Perth and Kinross	Kettins
Balgove	souterrain (possible)	NO23NW 80	NO	2382	3745	Perth and Kinross	Kettins
Dron Parish Church	church	NO23SE 1	NO	2955	3240	Perth and Kinross	Longforgan
Rossie	barrow cemetery	NO23SE 21	NO	294	308	Perth and Kinross	Inchture
Rossie Priory	settlement: unenclosed; souterrains	NO23SE 30	NO	277	304	Perth and Kinross	Inchture
Rossie Priory	barrows; building	NO23SE 31	NO	277	303	Perth and Kinross	Inchture
Baledgarno	settlement: unenclosed; enclosure; cropmarks	NO23SE 41	NO	2831	3007	Perth and Kinross	Inchture
Rossie	cropmarks; trackway; building; enclosures: rectilinear	NO23SE 48	NO	292	307	Perth and Kinross	Inchture
Gallows Knowe	cists	NO23SE 9	NO	2517	3373	Perth and Kinross	Longforgan
Kirkton of Collace	enclosure	NO23SW 31	NO	2001	3203	Perth and Kinross	Collace
Over Buttergask	settlement: unenclosed (possible)	NO23SW 32	NO	220	349	Perth and Kinross	Cargill
Macbeth's Law	barrow	NO23SW 6	NO	2015	3446	Perth and Kinross	Cargill
Cardean	Roman temporary camp	NO24NE 15	NO	299	463	Angus	Airlie
Wester Cardean	barrow (possible)	NO24NE 29	NO	2972	4629	Angus	Airlie
Law of Brigton	souterrain	NO24NE 43	NO	285	483	Angus	Ruthven
Selvie Wood	enclosure (possible)	NO24NE 77	NO	2805	4823	Angus	Ruthven
Grangemount	settlement: unenclosed; souterrain	NO24NW 40	NO	239	452	Perth and Kinross	Bendochy

Blackbird Inn	ring-ditch	NO24NW 45	NO	2450	4763	Perth and Kinross	Alyth
Old Mains of Rattray	laird's house; architectural fragments	NO24NW 48	NO	2065	4525	Perth and Kinross	Rattray
Welton of Creuchies	burnt mound	NO24NW 59	NO	2020	4943	Perth and Kinross	Alyth
Lochlands	ring-ditches	NO24NW 60	NO	2138	4536	Perth and Kinross	Bendochy
Cattylinns	souterrain (possible)	NO24NW 68	NO	2274	4660	Perth and Kinross	Bendochy
Belliduff, Belmont Castle	cairn; cist	NO24SE 15	NO	2890	4421	Perth and Kinross	Meigle
Duff's Knowe	cairn	NO24SE 24	NO	2776	4329	Perth and Kinross	Meigle
Keillor, Dovecot	dovecot	NO24SE 28 (1)	NO	2683	4021	Perth and Kinross	Kettins
Knowehead	enclosure	NO24SW 44	NO	2158	4183	Perth and Kinross	Bendochy
Princeland	ring-ditches	NO24SW 58	NO	2241	4072	Perth and Kinross	Coupar Angus
Easter Denhead	souterrain (possible)	NO24SW 71	NO	2391	4161	Perth and Kinross	Coupar Angus
Easter Coul	building; structures; enclosures	NO25NE 13	NO	284	582	Angus	Lintrathen
Pitewan	farmstead	NO25NE 16	NO	254	565	Angus	Lintrathen
Strone Hill	township; field system	NO25NE 18	NO	288	566	Angus	Lintrathen
Creigh Hill, Cairn Motherie	cairn	NO25NE 3	NO	2711	5935	Angus	Lintrathen
Strone Hill	cairn:ring	NO25NE 31	NO	289	567	Angus	Lintrathen
Strone Hill	cairn:ring (possible)	NO25NE 33	NO	291	567	Angus	Lintrathen
Wester Peathaugh	cairn	NO25NW 13	NO	2279	5803	Angus	Glenisla
Redlatches	enclosure	NO25NW 17	NO	206	590	Angus	Glenisla
Whitesheal	building: round-ended; rig	NO25NW 32	NO	2261	5673	Angus	Glenisla
Broom Hill	shooting-butt (possible); mounds	NO25NW 35	NO	2234	5679	Angus	Glenisla
Easter Peathaugh	enclosures (possible)	NO25NW 37	NO	2368	5766	Angus	Glenisla
Easter Peathaugh	stone circle (possible)	NO25NW 38	NO	2354	5730	Angus	Glenisla
Forest of Alyth	hut-circles; field-system	NO25NW 5	NO	205	583	Angus	Glenisla
Bruceton	cist	NO25SE 19	NO	2875	5029	Perth and Kinross	Alyth
Barry Hill	enclosure	NO25SE 26	NO	2654	5027	Perth and Kinross	Alyth
Lintrathen	mound	NO25SE 37	NO	2855	5457	Angus	Lintrathen
Peel of Lintrathen	moat	NO25SE 4	NO	2634	5392	Angus	Lintrathen
Bruceton	cist	NO25SE 43	NO	2905	5083	Perth and Kinross	Alyth
East Campsie	cist; burial; flint flake	NO25SE 45	NO	2883	5271	Angus	Lintrathen
Hill of Alyth	burnt mound	NO25SW 21	NO	2298	5024	Perth and Kinross	Alyth
Hilton Hill	cairn	NO25SW 23	NO	2175	5267	Perth and Kinross	Alyth

Shealwalls	stone setting	NO25SW 26	NO	2396	5150	Perth and Kinross	Alyth
Tullymurdoch	building: Pitcarmick-type	NO25SW 27	NO	2034	5334	Perth and Kinross	Alyth
Kinkeadly	small cairns	NO25SW 28	NO	2082	5261	Perth and Kinross	Alyth
Craighead	shieling-huts; rig; enclosures	NO25SW 31	NO	2076	5431	Perth and Kinross	Alyth
Bamff	earthwork	NO25SW 33	NO	2275	5169	Perth and Kinross	Alyth
Montrave House, Home Farm Dovecot	dovecot	NO30NE 8 (1)	NO	3782	0668	Fife	Scoonie (North East Fife)
Cults Hill Limestone Quarry	clamp-kilns; kiln (possible)	NO30NW 113 (2)	NO	3377	0835	Fife	Cults
Downfield, The Vault	manor house	NO30NW 20	NO	3424	0758	Fife	Kettle
Lawfield	ring-ditch	NO30NW 24	NO	327	099	Fife	Collessie
Rameldry	enclosure (possible); cropmarks	NO30NW 74	NO	3286	0648	Fife	Kettle
Blacketyside	settlement	NO30SE 27	NO	3861	0228	Fife	Scoonie (Kirkcaldy)
Balgrummo	standing stone	NO30SE 4	NO	3754	0297	Fife	Scoonie (Kirkcaldy)
Durie Home Farm, Dovecot	dovecot	NO30SE 8	NO	3708	0239	Fife	Scoonie (Kirkcaldy)
Pilmuir	ring-ditches (possible)	NO30SE 91	NO	397	034	Fife	Largo
Balfour	enclosure	NO30SW 10	NO	318	003	Fife	Markinch
Carriston Doocot	dovecot	NO30SW 2	NO	3246	0401	Fife	Markinch
Law Head	cairn; cist	NO30SW 6	NO	3023	0121	Fife	Markinch
Lochmalony House	dovecot	NO31NE 11	NO	3654	1999	Fife	Kilmany
Foodie Hill	enclosure	NO31NE 14	NO	3843	1736	Fife	Dairsie
Myrecairnie	enclosure	NO31NE 26	NO	365	179	Fife	Kilmany
Pitbladdo	well	NO31NE 30	NO	367	173	Fife	Cupar
East Hall	settlement: unenclosed; souterrains	NO31NW 35	NO	342	157	Fife	Monimail
Collairnie Castle	castle; farmsteading	NO31NW 7	NO	3060	1713	Fife	Dunbog
Asylum Farm	enclosure (possible)	NO31SE 117	NO	3502	1209	Fife	Cupar
Craigrothie, Dovecot	dovecot	NO31SE 30	NO	3815	1101	Fife	Ceres
Edenwood	Roman temporary camp	NO31SE 39	NO	3570	1170	Fife	Ceres
Tarvit Mill, Mileplate	milestone	NO31SE 82	NO	3648	1250	Fife	Ceres
Annsmuir	barrows	NO31SW 10	NO	3017	1115	Fife	Collessie
Rankeilour House	ring-ditch	NO31SW 16	NO	332	116	Fife	Monimail
Melville Muir	pit-alignment	NO31SW 74	NO	305	122	Fife	Collessie
Annsmuir	ring-ditches	NO31SW 79	NO	318	112	Fife	Collessie
Scurr Hill	terraces	NO32NE 12	NO	368	250	Fife	Balmerino
Dundee, Westfield Avenue	structure	NO32NE 24	NO	3935	2974	Dundee	Dundee
Kirkton	enclosures (possible)	NO32NE 9	NO	361	253	Fife	Balmerino
Mylnefield	settlement: unenclosed	NO32NW 24	NO	337	299	Perth and Kinross	Longforgan
Kilmany	ring-ditch; cursus	NO32SE 49	NO	3973	2265	Fife	Kilmany

	(possible)						
Grange Dovecot	dovecot	NO32SE 6	NO	3596	2290	Fife	Balmerino
Wester Kilmany	enclosure	NO32SE 69	NO	386	225	Fife	Kilmany
Starr	dovecot	NO32SW 30	NO	3472	2005	Fife	Kilmany
Balluderon, 'St Martins Stone'	Pictish cross-slab	NO33NE 2	NO	3748	3758	Angus	Tealing
Wynton Wood	ring-ditch	NO33NE 23	NO	3810	3744	Angus	Tealing
Auchterhouse	fort; cairn (possible)	NO33NE 3	NO	3543	3975	Angus	Auchterhouse
Strathmartine Castle	souterrains; cropmarks	NO33NE 31	NO	371	359	Angus	Mains and Strathmartine
East Adamston	settlement: unenclosed; souterrain	NO33NW 16	NO	3345	3591	Angus	Auchterhouse
Dronley Burn	enclosure	NO33NW 21	NO	3383	3607	Angus	Auchterhouse
Keithhall	souterrain (possible)	NO33NW 25	NO	3165	3525	Angus	Fowlis Easter
West Mains Hill	plantation bank	NO33NW 6	NO	314	377	Angus	Auchterhouse
Dundee, Beauly Avenue	cist	NO33SE 37	NO	397	334	Dundee	Dundee
Camperdown House	enclosure (possible)	NO33SE 56	NO	3623	3263	Dundee	Dundee
Invergowrie	souterrains; settlement (possible)	NO33SW 29	NO	344	304	Angus	Liff and Benvie
Carmichael Cottages	ring-ditch; cropmarks	NO33SW 39	NO	306	310	Perth and Kinross	Longforgan
Bullionfield	souterrain	NO33SW 46	NO	3438	3045	Perth and Kinross	Liff and Benvie
Benvie Church	church; burial-ground; font; sundial	NO33SW 6	NO	3283	3145	Angus	Liff and Benvie
Mains of Gray	souterrains	NO33SW 63	NO	337	324	Dundee	Liff and Benvie
Invergowrie	enclosures; settlement (possible); cropmarks; rig	NO33SW 82	NO	3437	3031	Dundee	Liff and Benvie
Cossans	castle	NO34NE 13	NO	3919	4982	Angus	Glamis
Mains of Rochelhill	house; dovecot	NO34NE 21	NO	3750	4516	Angus	Glamis
Glamis Castle	icehouse	NO34NE 22	NO	3889	4761	Angus	Glamis
Mossend	enclosure; road	NO34NE 40	NO	365	498	Angus	Airlie
Eassie Mill	barrow (possible); ring-ditches; linear cropmarks; cropmarks	NO34NE 44	NO	358	469	Angus	Eassie and Nevay
Balkeerie	settlement: unenclosed	NO34NW 20	NO	324	451	Angus	Eassie and Nevay
Castle of Ruthven	tower-house	NO34NW 3	NO	3020	4791	Angus	Ruthven
Baitland	enclosure (possible)	NO34NW 33	NO	3236	4995	Angus	Airlie
Nether Handwick	buildings	NO34SE 14	NO	366	414	Angus	Glamis
Broom Hill	small cairns	NO34SE 5	NO	384	417	Angus	Glamis
Knockenny	cists; cairns	NO34SE 7	NO	3925	4485	Angus	Glamis
Wester Denoon	sheepfold	NO34SW 10	NO	339	430	Angus	Glamis
Castleward	cairn	NO34SW 12	NO	343	438	Angus	Glamis
Kirkton of Nevay	ring-ditch (possible)	NO34SW 23	NO	321	435	Angus	Newtyle

Castle Hill	rig	NO35NE 28	NO	364	566	Angus	Kirriemuir
Prosen Bridge	settlement: unenclosed; souterrain; pits; cropmarks	NO35NE 46	NO	392	590	Angus	Cortachy and Clova
Castle Hill	cairn	NO35NE 51	NO	362	564	Angus	Kirriemuir
Caddam	souterrain (possible); cropmarks	NO35NE 57	NO	382	566	Angus	Kirriemuir
Kintyrie	ring-ditches; cultivation remains	NO35NE 63	NO	384	579	Angus	Kirriemuir
West Kinwhirrie	settlement: unenclosed; souterrains (possible)	NO35NE 66	NO	3755	5865	Angus	Kirriemuir
Nether Balgray	souterrain	NO35NE 69	NO	350	592	Angus	Kirriemuir
Brankam Hill	hut-circles	NO35NW 13	NO	3004	5567	Angus	Lintrathen
Kinclune Hill	rig	NO35NW 29	NO	320	570	Angus	Kingoldrum
Kingoldrum	Pictish cross-slab	NO35NW 3 (1)	NO	334	550	Angus	Kingoldrum
Brankam Hill	small cairns	NO35NW 33	NO	300	561	Angus	Lintrathen
Brankam Hill	stone circle: 'four poster'.	NO35NW 41	NO	301	557	Angus	Lintrathen
Wester Logie	enclosures; pit-alignment; cultivation remains	NO35SE 47	NO	382	515	Angus	Kirriemuir
Nether Migvie	ring-ditch	NO35SE 57	NO	3996	5480	Angus	Kirriemuir
Burnside	field-system; enclosures; cropmarks	NO35SE 63	NO	383	502	Angus	Kirriemuir
Den of Reedie	Roman road	NO35SE 69	NO	362	522	Angus	Airlie
Meikle Kenny, Baldovie	stone settings	NO35SW 1	NO	3180	5417	Angus	Kingoldrum
Meikle Kenny	cist	NO35SW 10	NO	3074	5317	Angus	Kingoldrum
Cairnwell	standing stone	NO35SW 22	NO	3208	5025	Angus	Airlie
Philpie	cairns; cists	NO35SW 23	NO	3116	5017	Angus	Airlie
Lingo Den	enclosures; rig	NO40NE 30	NO	4950	0940	Fife	
Teasses Quarry	rig	NO40NW 39 (1)	NO	4042	0774	Fife	Ceres
Dunnicher Law	fort (possible)	NO40NW 40	NO	449	082	Fife	Kilconquhar
Kilconquhar	ring-ditches	NO40SE 100	NO	4815	0214	Fife	Kilconquhar
Muircambus	barrow: square (possible)	NO40SE 112	NO	475	018	Fife	Kilconquhar
Muircambus	ring-ditches	NO40SE 116	NO	473	019	Fife	Kilconquhar
Balchrystie	enclosure (possible); cropmarks	NO40SE 117	NO	4622	0265	Fife	Newburn
Muircambus	fermtoun	NO40SE 123	NO	466	025	Fife	Newburn
Barnyards	enclosures; cropmarks	NO40SE 126	NO	485	026	Fife	Kilconquhar
Sprattyhall	ring-ditch	NO40SE 127	NO	469	048	Fife	Kilconquhar
Charleton House	enclosure	NO40SE 128	NO	459	036	Fife	Kilconquhar
Elie House	ring-ditch; cropmarks	NO40SE 130	NO	495	011	Fife	Elie
Largo Station	cists	NO40SW 10	NO	4181	0264	Fife	Largo
Dumbarnie	cropmark	NO40SW 20	NO	449	025	Fife	Newburn

	complex; cultivation remains						
Viewforth	deserted farmstead	NO40SW 202	NO	431	025	Fife	Largo
Hatton	ring-ditches; enclosure: rectilinear; cropmarks	NO40SW 217	NO	409	044	Fife	Largo
Thomsford	enclosure (possible)	NO40SW 326	NO	400	045	Fife	Largo
Strathtyrum, Dovecot	dovecot	NO41NE 16	NO	4915	1724	Fife	St andrews and St Leonards
Kincaple	settlement: unenclosed	NO41NE 21	NO	459	180	Fife	St andrews and St Leonards
Nydie Mains, Dovecot	dovecot	NO41NW 13	NO	4380	1743	Fife	St andrews and St Leonards
Kemback, Old Parish Church	church	NO41NW 7	NO	4172	1510	Fife	Kemback
Mount Melville, Dovecot	dovecot	NO41SE 1	NO	4818	1452	Fife	Cameron
Denork Craig	fort	NO41SE 5	NO	4561	1370	Fife	Cameron
Ceres Burn	settlement: unenclosed (possible)	NO41SW 16	NO	410	122	Fife	Ceres
Rumgally Park	cist	NO41SW 3	NO	4104	1476	Fife	Kemback
Tayport Castle	castle	NO42NE 1	NO	4566	2909	Fife	Ferry-Port-On-Craig
Tentsmuir	buildings	NO42NE 110	NO	486	263	Fife	Ferry-Port-On-Craig
Vicarsford	shell midden	NO42NE 15	NO	4505	2550	Fife	Leuchars
Kirktonbarns	enclosures; ring-ditch; linear cropmarks	NO42NE 37	NO	457	260	Fife	Forgan
Spears Hill	enclosure	NO42NE 40	NO	4524	2876	Fife	Ferry-Port-On-Craig
Burnside	settlement: unenclosed	NO42NE 45	NO	451	275	Fife	Forgan
Shanwell	settlement: unenclosed; cropmarks	NO42NE 63	NO	470	272	Fife	Ferry-Port-On-Craig
Comerton Home	souterrain	NO42NW 107	NO	4388	2538	Fife	Forgan
Danes' Camp, Links Wood	fort	NO42NW 11	NO	4132	2508	Fife	Forgan
Inverdovat	ring-ditch	NO42NW 45	NO	4300	2671	Fife	Forgan
Poachers' Clump	settlement: unenclosed	NO42NW 56	NO	4182	2536	Fife	Forgan
South Friarton	settlement: unenclosed	NO42NW 68	NO	432	253	Fife	Forgan
Kirktonbarns	enclosure	NO42NW 69	NO	4418	2626	Fife	Forgan
Cowbakie Hill	ring-ditch; pits; linear cropmarks	NO42NW 76	NO	4415	2543	Fife	Forgan
Kirktonbarns	settlement: unenclosed (possible); linear cropmarks	NO42NW 93	NO	443	262	Fife	Forgan
Leuchars, St Bonach's Chapel	long cist cemetery	NO42SE 2	NO	4546	2138	Fife	Leuchars

Tentsmuir, Wards	rig	NO42SE 37	NO	472	219	Fife	Leuchars
Rhynd	enclosure	NO42SE 44	NO	4667	2466	Fife	Leuchars
Heathery Knowe	building	NO42SE 72	NO	477	238	Fife	Leuchars
Brackmont Mill	cremation cemetery	NO42SW 10	NO	436	223	Fife	Leuchars
Crawley Hill	ring-ditch; linear cropmarks	NO42SW 23	NO	4294	2394	Fife	Leuchars
Easter Kinnear	enclosure	NO42SW 26	NO	4072	2353	Fife	Kilmany
North Straiton	settlement: unenclosed	NO42SW 37	NO	4221	2327	Fife	Logie (North East Fife)
Easter Kinnear Tower	tower-house	NO42SW 5	NO	4035	2301	Fife	Kilmany
Strathburn	linear cropmarks; cultivation remains	NO42SW 54	NO	4375	2324	Fife	Leuchars
Hawkhill	settlement: unenclosed; linear cropmarks	NO42SW 57	NO	4065	2381	Fife	Kilmany
Murroes	cropmarks; cultivation remains	NO43NE 35	NO	460	351	Angus	Murroes
Murroes	enclosure: rectilinear; cultivation remains	NO43NE 48	NO	4615	3525	Angus	Murroes
Westhall	souterrain	NO43NE 8	NO	4563	3542	Angus	Murroes
Wedderburn Castle	dovecot	NO43NW 16	NO	4352	3528	Angus	Murroes
Tealing House	souterrain; stone lamp; axe; vessel	NO43NW 19	NO	4119	3801	Angus	Tealing
Craig Hill	fort; broch	NO43NW 22	NO	432	358	Angus	Murroes
Barnhill, 'Eglismonichty'	chapel; burial ground	NO43SE 11	NO	477	325	Dundee	Dundee
Ethiebeaton	enclosure (possible); cultivation remains	NO43SE 41	NO	476	343	Angus	Monifieth
Ardownie	souterrain (possible); cropmarks	NO43SE 60	NO	496	342	Angus	Monifieth
Ardownie	souterrains	NO43SE 61	NO	4948	3379	Angus	Monifieth
Mains Castle	castle	NO43SW 18	NO	4109	3300	Dundee	Dundee
Barns of Claverhouse	souterrain (possible)	NO43SW 65	NO	4142	3441	Dundee	Mains and Strathmartine
Meathie	church; burial-ground	NO44NE 10	NO	4654	4624	Angus	Inverarity
Westfield	enclosure	NO44NW 15	NO	447	497	Angus	Forfar
South Leckaway	dovecot	NO44NW 28	NO	4400	4828	Angus	Kinnettles
Hatton Cairn	cairn	NO44SE 9	NO	4715	4158	Angus	Inverarity
Battledykes	enclosure	NO45NE 14	NO	4587	5530	Angus	Oathlaw
Battledykes	cairn	NO45NE 15	NO	4602	5510	Angus	Oathlaw
Finavon Castle	tower-house	NO45NE 18	NO	4968	5648	Angus	Oathlaw
East Mains of Whitewell	barrow (possible); ring-ditch; pits	NO45NE 25	NO	474	576	Angus	Tannadice
East Murthill, Tannadice	pits; ditches	NO45NE 30	NO	466	578	Angus	Tannadice
Baldoukie	souterrains; cropmarks	NO45NE 34	NO	468	589	Angus	Tannadice
Easter Oathlaw	Roman road (possible)	NO45NE 62	NO	483	565	Angus	Oathlaw

Turfachie	ring-ditch	NO45NW 16	NO	4166	5825	Angus	Tannadice
Shielhill	pit-alignments	NO45NW 19	NO	427	575	Angus	Kirriemuir
Shielhill Bridge	souterrains (possible)	NO45NW 33	NO	4237	5810	Angus	Kirriemuir
Turfachie	pit-enclosure (possible); pits	NO45NW 38	NO	4185	5842	Angus	Tannadice
Castle Hill	motte	NO45NW 6	NO	4421	5715	Angus	Tannadice
Lunanhead	burial ground	NO45SE 12	NO	4774	5237	Angus	Forfar
Lunanhead	earthwork	NO45SE 16	NO	473	521	Angus	Forfar
Murton Farm	cists	NO45SE 33	NO	4931	5119	Angus	Forfar
Loch Fithie	cist; stone axe	NO45SE 34	NO	4833	5125	Angus	Forfar
Mirestone	cists	NO45SE 7	NO	4905	5362	Angus	Aberlemno
Murton	souterrain (possible)	NO45SE 91	NO	494	515	Angus	Forfar
Fletcherfield	enclosure; querns	NO45SW 15	NO	4052	5218	Angus	Kirriemuir
Barnsdale	enclosure	NO45SW 16	NO	4256	5350	Angus	Kirriemuir
Balmuckety	standing stones	NO45SW 6	NO	4003	5251	Angus	Kirriemuir

Appendix B. List of land cover summary types used in research

Land cover summary type used in desk-based study and accuracy assessment	Types of landuse included in land cover summary type	Land Cover of Scotland 1988 land cover codes included in land cover summary type	Land Cover of Scotland 1988 land cover categories included in land cover summary type
Arable / Improved	Arable Improved pasture	100 101 102 104 - 90 91 94 -	Arable: no rock no farms no trees Arable: no rock no farms trees Arable: no rock farms no trees Arable: rock no farms no trees All mosaic categories in which the above are the predominant classes Imp. pasture: no rock no farms no trees Imp. pasture: no rock no farms trees Imp. pasture: rock no farms no trees All mosaic categories in which the above are the predominant classes
Non-arable improved	Parkland Permanent improved pasture	NA	NA
Non-intensive land use	Unimproved pasture Heather moor Bog / mire	110 111 112 113 114 115 116 120 121 122 124 130 131 132 134 136 140 141 142 143 150 151	Dry heather moor: no rock no burning no trees Dry heather moor: no rock no burning trees Dry heather moor: no rock burning no trees Dry heather moor: no rock burning trees Dry heather moor: rock no burning no trees Dry heather moor: rock no burning trees Dry heather moor: rock burning no trees Wet heather moor: no rock no burning no trees Wet heather moor: no rock no burning trees Wet heather moor: no rock burning no trees Wet heather moor: rock no burning no trees Undif. heather moor: no rock no burning no trees Undif. heather moor: no rock no burning trees Undif. heather moor: no rock burning no trees Undif. heather moor: rock no burning no trees Undif. heather moor: rock burning no trees Undif. Nardus/Molinia: no rock no trees Undif. Nardus/Molinia: no rock trees Undif. Nardus/Molinia: rock no trees Undif. Nardus/Molinia: rock trees Smooth grass/rushes: no rock no trees Smooth grass/rushes: no rock trees

		152 153 155 156 157 158 160 161 162 163 180 181 182 183 185 186 190 200 201 202 203 222 223 -	Smooth grass/rushes: rock no trees Smooth grass/rushes: rock trees Smooth grass/low scrub: no rock no trees Smooth grass/low scrub: no rock trees Smooth grass/low scrub: rock no trees Smooth grass/low scrub: rock trees Undiff. smooth grass.: no rock no trees Undiff. smooth grass.: no rock trees Undiff. smooth grass.: rock no trees Undiff. smooth grass.: rock trees Blanket bog/peatland veg.: erosion no trees Blanket bog/peatland veg.: erosion trees Blanket bog/peatland veg.: no erosion no trees Blanket bog/peatland veg.: no erosion trees Blanket bog/peatland veg.: industrial peat workings Blanket bog/peatland veg.: other peat workings Undiff. salt marsh: no trees Wetlands: no drains no trees Wetlands: drains no trees Wetlands: no drains trees Wetlands: drains trees Montane veg.: undiff. montane rocky Montane veg.: undiff. montane non-rocky All mosaic categories in which the above are the predominant classes
Semi-natural woodland	Semi-natural woodland (coniferous, broadleaved, mixed) In a clearing within any of the above Plantation marked on OS 1st Edition maps	73 76 79 82 -	Coniferous (semi-natural - area) Undiff. broadleaf (area) Undiff. mixed woodland (area) Undiff. low scrub All mosaic categories in which the above are the predominant classes
Forestry	Commercial plantation (young – mature) In forestry clearing	70 83 84 85 -	Coniferous (plantation - area) Recent ploughing Recent felling Open canopy (young plantation) All mosaic categories in which the above are the predominant classes
Developed	Urban Transport corridor Quarry / extraction Bings	3 6 12 14 20 21	Factory Cemeteries Quarries (area) Bings (area) Built-up (area) Road
Semi-developed	Airfield Golf course Caravan park Race course Cemetery Old mine	4 5 7 -	Airfield Golf course Caravan parks All mosaic categories in which the above are the predominant classes

	workings		
Enclosed	Enclosed In a yard or garden	NA	NA
Verge / field margin	Within field boundary Within uncultivated field margins Roadside verge Miscellaneous linear feature such as stream or shelter belt Within MoLRS	NA	NA
Water	Loch Reservoir	18	Water (area)
Estuarine (not used)	Estuary	24	Estuary

Appendix C. List of damage cause summary codes used in desk-based study and accuracy assessment

Damage category	Causes of damage making up category and recorded during desk-based study or accuracy assessment
Farming	Ploughing, pasture improvement, conversion to arable, agricultural drainage, demolition / removal to increase cropping area, creation of tracks / vehicle damage, stock erosion / poaching, stone dumping.
Development	Housing / urbanisation, road-building, WW2 development, drainage operations connected with development, pipeline construction, reservoir creation, telecommunication masts / ancillary buildings.
Extraction	Large scale quarrying and mineral extraction, small scale extraction by individuals.
Forestry	Forestry ploughing, mounding, planting, tracks, drainage, windthrow, burning, felling.
Excavation	Research excavation, rescue excavation, excavation in advance of development, excavation in advance of agricultural operations, excavation in advance of consolidation works.
Building decay	Building decay.
Building renovation	Building renovation for conservation.
Building re-utilisation	Building renovation to re-use.
Demolition	Demolition (non-agricultural).
Stone removal	Stone removal.
Landscaping	Landscaping (non-development, non-agricultural).
Tree growth	Tree growth causing visible damage.
Windthrow	Windthrow (non-forestry).
Vandalism	Vandalism.
Earth Tremor	Earth tremor.
Unknown	Unknown, but probable cause of damage established wherever possible.

Appendix D. Field survey pro-forma

FIELD SURVEY RECORDING SHEET

Name: Class:

NMRS No: NGR: Numlink:

Date: Conditions:

DESK-BASED STUDY CONTROL

Land use 1: % Land use 2: % Land use 3: %

Surrounding LU 1: % Surrounding LU 2: % Surrounding LU 3: %

Site condition: Damage Agent 1: Damage Agent 2: Damage Agent 3:

FIELD SURVEY DATA

Dimensions

Length 1: Length 2: Length 3:

Width 1: Width 2: Width 3:

Height:

Plan sketch with dimensions: Profile sketch with dimensions:

SITE CONDITION DATA

Trees

Present / Absent: Approx. number: Approx. density:

% monument with trees: Location on monument:

Age: Species:

Scrub

Present / Absent: Approx. density: % monument with scrub:

Bracken

Present / Absent: Approx. density: % mon. with bracken:

Burrowing animals:

Scrapes: None;	1-5;	6-10;		11-15;	16+
Burrows: None;	1-5;	6-10;		11-15;	16+
Burrow Spacing:	Dispersed		or	<1m	
Recent Spoil:	Yes	or	No		

Agriculture:

% of site under plough: DA 1: DA 2: DA 3:

Forestry:

% of site under forestry: DA 1: DA 2: DA 3:

NOTES

Historic Scotland Monument Warden damage categories

Note: These categories have been typed out here as the original sheets used could not be reproduced for the thesis due to poor print quality. Under each category, damage was noted as either marginal damage, damage, or serious damage.

Development / Human Intervention

Erosion – recreation (e.g. bikes, 4-wheel drive, etc)
Erosion – visitor
Stone erosion (carved stone) – human activities
Controlled burning e.g. of vegetation
Fences / walls
Drains
Excavation / development / quarrying
Dumping
Removal
Stone robbing or rearrangement
Metal detecting
Vandalism / graffiti
Previous repairs
Linear / services / access tracks / forest tracks
Traffic – impact
Traffic – soiling / fumes
Previous archaeological exploration
Other

'Nature'

Erosion – marine
Erosion – wind
Erosion – water
Trees (>10cm in diameter)
Regeneration, shrubs and scrub (excl. rhododendron) (<10cm in diameter)
Bracken
Other harmful vegetation (such as rhododendron)
Wind-thrown trees
Rabbits and other burrowing animals
Masonry decay
Stone erosion (non-carved stones) – general
Stone decay (carved stones) – acid deposition (pollution)
Stone decay (carved stones) – frost
Stone decay (carved stones) – rain / water
Stone decay (carved stones) – salt crystallisation
Stone decay (carved stones) – (biological)
Metal decay
Fire (uncontrolled / unintentional)
Flooding

Farming

Animal feeding
Erosion – animal
Erosion – ploughing

Forestry

Forestry plantation
Forestry ploughing

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