Clach Toll Broch, Assynt
Conservation Management Plan

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AOC Archaeology Group

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Clach Toll Broch, Assynt, Sutherland

Conservation Management Plan

On Behalf of:	**Historic Assynt** c/o Robin Noble Glenleraig Drumbeg By Lairg Sutherland IV27 4NJ
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This document has been prepared in accordance with AOC standard operating procedures.

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Executive Summary

AOC Archaeology were commissioned to carry out a conservation appraisal of the broch site at Clach Toll, Assynt, Sutherland by the Historic Assynt Group, and produce a management plan for the future management of the monument. This document constitutes the results of survey work and engineering appraisal based on non-intrusive analysis of the structure in its current condition. A full descriptive and analytical survey is provided from both archaeological and engineering perspectives, and the threats to the monument are identified. After the definition of our conservation principles, a risk assessment is supplied and a range of mitigation proposals are put forward that address the short, medium and long term requirements of the monument. Finally, a series of management and presentation solutions are offered as possibilities that address the desired use of the monument as a heritage asset and tourist attraction.

SECTION A

Site Survey and Appraisal

Part One: The Archaeological significance of Clach Toll broch

The brochs of Sutherland

1. Although the northern mainland counties (Caithness, Sutherland, Ross-shire and Inverness-shire) contain about 300 definite, probable and possible brochs and although some of them are well preserved, few are well known or excavated. Modern explorations are rare with only a handful undertaken in Caithness (e.g. Calder 1945; Crosskirk 1984; Heald & Jackson 2002) and only one in Sutherland, at Durcha on the east coast of the county (Dunwell 1999). This latter excavation was on a very small scale and provided no material evidence from which the broch and associated remains could be accurately dated. Other excavations of Sutherland brochs are largely concentrated on the east of the county, the majority excavated in the 19th century, for example Carrol and Carn Liath (Joass 1873), Kintradwell (Joas 1865, 1873) and Backies (Stuart 1870).

2. Our present understanding of Sutherland brochs is based on survey (see location map, Fig. 1). It is a reflection of our current knowledge that discussions still largely rest on the report of the Royal Commission on the Ancient and Historical Monuments of Scotland (1911) undertaken almost a hundred years ago and on the work of earlier scholars such as Joseph Anderson (1878). The RCAHMS Inventory of Sutherland presented descriptions of the 67 Sutherland sites recorded at that time as brochs. These lists were subsequently updated by Graham (1949, 94-6), Hamilton (1968, 175-9) and MacKie (1965; 2007). In 1996 the National Monuments Record of Scotland recorded 84 sites in Sutherland as 'brochs' with numerous further roundhouses described as duns. Our understanding of the architectural details of Sutherland brochs has been greatly enhanced by the work of Euan MacKie (2002; 2007) which has made the available data far more accessible, but the overwhelming majority of our knowledge is still derived from surface-survey.

3. Irrespective of number the distribution of brochs in Sutherland is weighted heavily to the northern and eastern areas of the county (Anderson 1878; Rivet 1966, foldout; Gourlay 1996, 12, 69; Cowley 1999, 70; fig 2B). There are very few known brochs from the west coast area of the county with only three specifically mentioned by Mackie (2007, 614-7): Clachtoll, Loch Ardbhair and Kylestrome. To the south in Loch Broom, Ross Cromarty lies Achiltibuie or Loch Poll An Dunain which may be a dun or a broch and from here there are very few examples until one reaches the area around Skye (Henderson 2007, fig 5.1).

Sutherland, Atlantic Scotland and frontier zones

4. The origin, development, use and abandonment of Sutherland brochs is one of the least understood aspects of Iron Age societies in northern Scotland (Dunwell 1999, 283). This is, of course, due to the lack of excavation of said monuments. Fairhurst (1984, 183) regarded the Sutherland brochs as representing a secondary spread from an Orkney/Caithness core area, and drew a distinction between the distribution of sites along the coastal edge, often attended by extra-mural settlements, and the mostly isolated structures occupying the more rugged inland areas (see also Young 1962, 173-5, 184-9).

5. More recent writing has emphasized that although brochs and their variants were built and used across Atlantic Scotland it is probable that there were different zones of interaction and development within different areas. Such discussions have been based largely on analysis of artefacts and, secondarily, architecture. For example Mackie has recently suggested (2000, 2005, 2007) that the flat plain of Caithness and the eastern coastal zone of Sutherland represents a transitional zone, indicated not by the architecture but by the suggestion that as one moves through Caithness to the south there is a gradual transition in material culture. He argues that there is a

movement from 'typical' Atlantic assemblages found in the north (with abundant fine pottery and masses of bone implements) to more impoverished assemblages in the south which are more closely aligned to non-Atlantic mainland cultures. Importantly for our present study MacKie (2005, 24) also suggests that the north-west coast may be a similar transitional or frontier zone. He suggests again that, within this zone, although brochs were used by groups, individuals used different material culture than that found in other areas, particularly in the Hebrides. As MacKie would himself admit, the foundations for discussing frontier zones are sparse; from point of view of material culture the database is very small and heavily predicated on 19th century excavation on the east coast, but this does not mean these hypotheses are without merit.

6. The depiction of the north-west as some form of transitional zone between and within Atlantic areas is emphasized by other recent scholars. For example, Henderson (2007, 151; fig 5.1) draws a clear distinction between the 'Northern Settlement Sequence' – that is northern and eastern Sutherland, Caithness, Orkney and Shetland - and the 'Western Isles and Skye Settlement Sequence'. Although the few west-coast mainland brochs, including Clachtoll, are viewed as part of this latter group, Clachtoll lies more-or-less on the boundary between the two, suggesting again that, at least geographically, the west-coast of mainland Scotland may be a form of frontier zone.

7. This suggestion may be lent credence by analysis of architectural form. At least according to MacKie (2000, 101) there are two distinct forms of broch, with a few transitional examples. In the *ground-galleried* form the hollow wall is constructed directly on the ground, the wall base tends to be slimmer and the central court larger; these are concentrated heavily in the Western Isles but are also a minority in the north, especially in Orkney. In the *solid-based brochs* the galleried wall sits on a massive base which is solid stone except for the entrance passage and one or more intra-mural cells. This type, overwhelmingly dominant in the northern islands and the north-east mainland, tends to have thicker wall bases and smaller central courts (see also MacKie 1971, fig 1). Clachtoll broch is a ground-galleried broch, more closely aligned with the Western Isles type.

Archaeological overview of Clachtoll

8. The broch site at Clach Toll has never been excavated. It was recorded in the RCAHMS Inventory for Sutherland and has been surveyed in modern times by AOC Archaeology Group, the RCAHMS, and the local community's survey team. A steatite cup or lamp was found in a recess in the wall of the guard cell to the right of the entrance by the Rev J M Joass of Golspie who still had it in his possession in 1909; it is now in Dunrobin Museum. In 2005 Euan MacKie found the lower stone of a discoid rotary quern among the rubble on the wallhead on the southern side.

9. Discussions of the Scottish Iron Age seldom focus on remains from Sutherland. Where they do they generally are focused on the few east coast brochs excavated in the 19th century. It is, therefore, of little surprise that Clachtoll does not feature in the overwhelming majority of standard texts. In discussions and general guides to Scottish archaeology, aimed primarily at keen visitors and amateurs, again very few Sutherland brochs are mentioned. When they are included discussions again generally focus on the east coast examples excavated in the 19th century. However, within many of these more popular publications Clachtoll does appear and, more often, Clach Toll is mentioned as the only site from the west coast fringes (e.g. Feacham 1963, 174; Close-Brooks 1995, 145-6, esp Gourlay 1996, 69). Clachtoll undoubtedly draws attention due to the sheer impressive nature of the remains. The site has been described as the '…most visitable broch on the west coast of Sutherland' (Gourlay 1996, 74).

Part Two: Clach Toll Broch, map regression

10. The first map of the Clachtoll Broch vicinity dates from 1654 and was compiled by Jean Blaeu and Robert Gordon (Fig. 2). The map does not show the area in great detail and only shows the major settlements in the vicinity. The settlement of Clachtoll is depicted as Clawhoill.

11. Herman Moll's map of the area which dates from 1745 is very similar to Blaeu's and Gordon's map and does not show any new developments in the vicinity of the broch (Fig 3.).

12. The first detailed map of the area is Roy's military survey of Scotland which dates from 1747-1755. It shows a settlement of Ballclachinhole immediately south of the broch and Stoir immediately northwest of it. It also indicates the presence of cultivated fields to the north and south of the site (Fig. 4).

13. John Home's survey of Assynt from 1774 is the first map which depicts the Clachtoll broch, which is shown as an 'Old Castle' (Fig. 5). His survey shows that the vicinity was a fully developed rural settlement during the latter half of the eighteenth century. Cornfields are shown north, east and south and settlements both north and southeast of the broch. Three shielings are also depicted in the vicinity.

14. John Thomson's map *Sutherland Shire* of 1832 is of a similar large scale to Blaeu's and Gordon's map of 1654 and therefore only the settlements of Stoir, Ballchackinhole and Clachtoll are depicted in the vicinity (Fig. 6).

15. The first edition Ordnance Survey map (1:10,560) dates from 1878. It shows the Clachtoll Broch '*An Dun (Pictish)*' and its surroundings in detail (Fig. 7). It also depicts tumuli immediately south of the broch, and the findspots of a silver coin of the reign of Charles II and a stone cup SSE of it. *'An Dun*' is shown northeast of the Clachtoll Broch, where according to the map a stone coffin was found in 1871.

16. The second edition Ordnance Survey map (1:10,560) dates from 1907. It indicates that no major developments had occurred between the first and second editions (Fig. 8).

17. The third edition Ordnance Survey map (1:10,000) dates from 1971 (Fig. 9). The map indicates that the landscape surrounding the Clachtoll Broch remained largely the same since the beginning of the twentieth century. The map depicts the broch without its southwest side which indicates collapse of the structure. As the 1907 edition depicts the broch as a circle, it is possible that the collapse of occurred between 1907 and 1971. However, it is more probable that the difference is due to an increase in detail in the 1971 edition.

Cartographic References

1654 Blaeu, Joan/Gordon, Robert. *Extima Scotiae septentrionalis ora, ubi Provinciae sunt Rossia, Sutherlandia, Cathenesia, Strath-Naverniae, cum vicinis regiunculis quae eis subsunt, etiamque Moravia / R. Gordonius à Strath-loch collegit et descripsit.*
1745 Moll, Herman. *The Shires of Ross, and Cromartie*
1747-55 Roy. *Roy's Military Survey of Scotland*
1774 Home, John. *John Home's Survey of Assynt in 1774. No. 3 - A Plan of the Farms of Storie [Stoer], Clachtoll, and Auchmelvich [Achmelvich]*
1832 Thomson, John. *Sutherland Shire*
1878 Ordnance Survey. *Sutherland* LVIII 1:10,560
1907 Ordnance Survey. *Sutherland* LVIII 1:10,560
1971 Ordnance Survey. *Sutherland* NC02 NW

Part Three: Clach Toll Broch, Condition Survey

General description

18. Clach Toll broch is situated on a rocky knoll, close to the shoreline at NC 0366 2784 (Fig 1). The surviving remains of the broch are generally in good condition, with much of its original structure at ground level is interpretable, albeit that is somewhat obscured by the rubble from its collapse. While the broch wall has been better preserved to the landward side, where it stands over 3.2m above the bedrock, the shoreward side of the site has been very badly damaged, and approximately one third of the circuit of the wall has been lost to collapse. The interior of the site is almost full with rubble and none of the anticipated internal features of the broch can be seen (site plans, Fig. 10-13).

19. Clach Toll broch is similar in style to those found in the Western Isles, but external constructions seem to be present around the broch, a feature that is more reminiscent of the northern mainland and Orkney brochs. The broch roundhouse measures 16.96m externally, at the level of the current wallhead, while the internal diameter at the level of the rubble surface is 8.46m. Four intra-mural galleries, or chambers within the wall thickness are present, at least three of which are at original ground level, and while the evidence of a staircase within the composite wall cannot now be observed on site, this is likely to have been located in cell 4 (Figs. 10-12). Like many of the Western Isles brochs, the Clach Toll roundhouse makes use of a rocky knoll, very close to the coastline. However, at Clach Toll this provides uneven footings that had to be compensated for using infills of stone coursing in order to provide a level base. It may also have required a rather spectacular engineering achievement on the landward side where the ground level falls away steeply.

20. The broch constitutes a spectacular example of a north mainland Atlantic Roundhouse, and despite being one of the lesser known brochs receives a large number of visitors, particularly during the summer months.

The Survey

21. In January 2008 a laser scan and topographic survey of the broch remains was carried out by AOC Archaeology group. A Trimble GS101 laser scanner was used to scan the monument and produce a three-dimensional point cloud model, from which the survey plan, elevation and sectional drawings were extracted. A Trimble S6 total station was used to survey interpreted detail and the survey was controlled in Ordnance Survey coordinates, established using a Trimble R6 differential GPS.

Numbering system used in this document

22. The following sections comprise the results of a systematic survey of the monument as it currently survives. The descriptions make use of the site sector divisions (A, B, C and D) identified on the survey plan (Fig. 10**).** The numbering system used to describe the features of the monument is cross referenced to Fig. 19 and reflects the location of each feature described. Features of the main broch wall are denoted by numbers beginning with 100 and have suffixes denoting the sector where they are located, while features outside the broch are denoted by numbers beginning with 200. For example, the northern part of the broken outer wall of the broch on the seaward side is given the feature number 108/A, denoting feature 8 of the broch wall, located in sector A.

The Broch Wall: exterior areas

23. The wall of the broch is for the most part well preserved, standing to over 3m in height in places. The upper courses of the structure, however, are unstable in some areas, and in several places the wall appears to have been repaired or rebuilt in relatively recent times: the exposed faces of individual stones bear no or little lichen, unlike the *in situ* material.. The level of modification of the broch wall in antiquity is unclear, and little can be established with certainty from the areas currently exposed, but some rebuilding may have occurred around the entrance to the broch. The broch wall stands to 2m in around eight visible courses at the entrance (Plate 1), but at section 100/B the exterior wall face is lose and disturbed, pinning stones[1] are missing and the build quality of the walling is relatively poor. This is suggestive of a reconstruction of the broch wall, probably post abandonment; this area is relatively unstable and in need of consolidation. It is possible that the remodelling of the broch wall involved some movement or perhaps even reinstatement of the entrance lintel, as this is not in alignment with the outer face of the broch wall and may even have been reinstated with the original base of the stone in now in the top right position (Plate 2). The lower courses of the broch wall, however, are undisturbed original construction and apparently in good condition. The danger of applying simple drystone wall-building techniques on reconstructive building is clearly revealed here because the entire outer skin of the rebuilt or refashioned entrance area is in imminent danger of falling outwards because it is not keyed into the structure.

24. Adjacent to area 100/B, at 101/B the broch wall is ruinous and has tumbled into the surrounding rubble slope, exposing the wall core to a level that is close to the capping stones of cell 2. In this area of collapse, deposits of red mineral soil and brash (crushed stone and soil); these deposits are being eroded both by exposure to the elements but also due to rabbit burrowing (Plate 4). Several large rectangular stones displaced from some original position now lie in this area. They measure on average 0.8 by 0.2 by 0.2m. and may be lintels of a now lost upper gallery, or tie stones knitting together the outer and inner walls of the broch; or prop stones keeping them apart. These stones are no longer *in situ* and having fallen partially out of the broch wall (Plate 5) are in danger of being lost.

25. The outer wall face is much better preserved to the south, in area 102/B, where the original wall face stands to c.1.5m above the current rubble level in eight visible courses composed of blocks measuring 0.3 by 0.2m on average but also incorporating large square blocks up to 0.5 by 0.5m and smaller pinning stones averaging 0.1 by 0.1m (Plate 6). In a few places, particularly in the lower course of 102/B, the pinning stones have fallen from the broch wall, probably due to the collapse of area 101/B and the stonework is loose and less stable.

26. South of 102/B, the broch wall is again much denuded, and stands only to a level close to the current rubble surface in 103/D, with only two or three courses visible (plate 7). The construction style of the wall in this area is very similar to 102/B, using large blocks and smaller pinning stones. Further south, in area 104/D more of the exterior wall face is visible, standing to 1.1m above the current rubble surface in c.5 visible course (plate 8). Pinning stones are missing from this stonework and several of the large blocks are cracked vertically. It is probable that the altered stress distribution in this area is a result of the partial collapse of the exterior wall in area 105/D, where the inner wall core and inorganic soil deposits are exposed (Plate 9).

[1] Pinning stones or pinnings are small stones used to infill gaps between the larger stones of the built wall face. Their presence is a characteristic of broch walls and in our current understanding of the engineering of these walls, they are essential to the wall's stability and ability to resist deformation and damage.

27. The outer wall is visible to its greatest extent in the southern areas of the broch, and in area 106/D it stands to over 2.5m where it fills a large V-shaped cleft in the bedrock, making use of large blocks up to 1.0 by 0.5m and smaller pinning stones averaging between 0.1 and 0.3m across (see plate 10). The lower course of the wall at this point are loose and eroding due to several factors, including the loss of pinning stones and the erosion of soil deposits from beneath the wall. It is probable that these insecure footings are the reason for the complete collapse of the outer wall at area 107/C, where many of the large blocks of the original wall face have fallen, leaving the surviving walling battered back from this breach at an angle of c.70-80 degrees. The rubble and brash of the wall core is exposed in this area (Plate 11) and is actively eroding due to its exposure to the sea and prevailing weather direction.

28. The collapsed segment of the broch, to the W, comprises boulders of varying sizes but averaging 0.5 by 0.5 by 0.2m. There is little trace of the wall in this area, but one or two large stones may represent the footings of the internal wall. Similarly to area 107/C, the outer wall at 108/A comprises massive blocks up to 0.5 by 0.5 by 0.5m stepped back from the area of collapse. The basal courses of this area have slipped out of alignment with the original coursing, causing some further collapse of the courses above (Plate 12). In this area, the wall core is exposed, to such an extent that the corbelling of cell 1 can be detected under one or two overlying stones.

29. On the north face of the broch in area 109/A the outer wall is well preserved, standing to a height of 1.2m above the current rubble surface in 4-6 courses of large rectangular blocks, averaging 0.5 by 0.3m, but incorporating some up to 1.0 by 0.4m. The upper three courses of this area of the wall are somewhat smaller stones, and the build quality is poorer, suggesting that parts of the upper areas have been rebuilt. These upper courses are loose and unstable, and in places are very close to collapse (see Plate 13). One of the blocks in this area is split vertically, though this does not appear to be causing structural problems for the wall in its current condition.

The Broch Wall: interior areas

30. On the interior of the broch, the internal wall is preserved to varying degrees, though some has clearly been subject to rebuilding in relatively recent times. In area 110/A the interior wall face stands to a maximum of c.1.1m above the rubble level, and is composed of blocks averaging 0.5 by 0.2m in relatively good condition (plate 14). In area 111/B, however, the wall face is far less well preserved, and is in danger of collapse. The wall stands to 1.0m above the rubble level in blocks averaging 0.6 by 0.2m, with pinnings around 0.1-0.15cm across. Several of the blocks are cracked vertically (Plate 15), most probably due to slumping caused by the lack of support for the wall on the W side, where the excavation of the entrance has removed the support for the masonry block above (Plate 16). This area is extremely unstable, and at risk of imminent collapse. It is a clear health and safety hazard and requires immediate remediation.

31. In area 112/D the wall face stands to c.1.2m above the current rubble level in a maximum of seven visible courses in blocks averaging 0.4 by 0.2m, but using some up to 0.6 by 0.2m (Plate 17). The upper courses are loose and unstable, and are suggestive of a rebuild in relatively recent times. To the W, in area 113/C the wall stands to 0.5m above the rubble level in three visible courses. Both sides of the interior wall are visible at this point, with the facing stones of what must have been the interior of an upper gallery visible on the S side (Plate 18). The interior wall is 0.85m thick at this point, with two closely bonded faces. The wall slopes somewhat to the S, and does not appear to respect the alignment of what has been proposed as the remains of a scarecement below (Plate 19); it is unclear whether this is due to slipping of the interior wall or that the supposed 'scarecement' is not genuine.

The rubble interior

32. The interior of the broch is completely filled with rubble, the majority presumably derived from the putative broch tower. No internal or secondary features are evident, though some recent disturbance has apparently taken place, with several depressions in the rubble mound suggesting attempted superficial excavation.

The entrance passage

33. The entrance passage is the only area of the broch to have been subjected to excavation. As such, the entrance passage is clear, though some loose rubble debris still lies around and access is not easy. The passage is 0.9m across at the exterior end, but widens to 1.2m across inside two offset door jambs on either side of the passage. Cells 1 and 2 open N and S from the entrance passage, though the lintels of the entrances are less than 0.5m above the current rubble ground surface. Previous surveyors have noted the presence of bar holes in the entrance passage, but none of the visible holes are convincing in this role, and although these may have been used as bar holes, appear rather to be gaps in the surviving stonework rather than part of an original entrance furniture design.

34. The entrance passage is capped by six lintels prior to the entrances to cells 1 and 2, including the large triangular entrance lintel. The fourth of these, counting in from the entrance threshold, is cracked and has been supported with steel straps (Plate 19), and the fifth is supported at the east side by a marble pillar surmounted with lead wedges (Plate 20). South of the entrances to the guard cells, a further two lintels are visible. The first of these (the seventh lintel in from the entrance) is cracked at the point where it bonds with the broch wall, and is extremely unstable (see plate 21). Given its position supporting the masonry block of the broch wall to the E, this area is a major cause for concern.

The intra-mural galleries

35. Cells 1 and 2 form guard cells in the broch wall, accessed from the entrance passage. Cell 1 is 3.8m long by 1.2m across at ground level, and is corbelled to a height of 1.6m above the current ground surface. The chamber attains its height in a series of stepped corbel stones from the entrance, and makes use of very large slabs to create the corbelled chamber (Plate 22). The cap stone of the chamber is now missing, allowing access from the wall head; this is a hazard to both human and animal visitors- a dead sheep lay inside the cell at the time of survey. Cell 1 was also accessed from the interior space within the broch, and a massive lintel caps an entrance 0.6m across. The floor of the cell is filled with rubble, presumably mainly from the collapse of the capping of the cell.

36. Cell 2 is accessed from the north of the entrance passage, through a narrow passage 0.65m across that curves to the N before opening into the cell itself. The cell is similar to cell1, although the corbelling is complete, and measures 2.49m in length by 1.1m across, standing to 1.5m in height above the rubble floor. The source of the rubble that covers the cell floor is not obvious, since the walls seem to be intact and the cell capping is complete. This could only be explored through excavation. While the cell is apparently very well preserved, the entrance lintel, at its south end, does not bond securely to the broch wall, and is, or will soon become, unstable (Plate 23).

37. Cell 3 is the tallest surviving gallery, standing to a height of 3.1m and appears virtually intact (plate 24); the cap stones have been moved in recent times to provide access to the cell but the cell interior seems undisturbed. The cell is cut into the bedrock at its base, with stone coursing compensating for the step down from the interior of the broch to the lower level of the cell. There are no connections to cells 2 or 4 from this cell, though the stonework between the adjacent galleries is relatively thin. The floor of cell 3 is clear of rubble, unlike the other galleries, and appears to be undisturbed. Cell 3 is generally in good condition, and there is no evidence that the structural integrity has been compromised. However, the lintel of the entrance to the broch interior is cracked vertically (Plate 25), and several of the uppermost corbel stones are also split and potentially unstable.

38. Cell 4 is the longest intramural gallery, possibly containing a staircase, although direct evidence for this has not been observed. The base of the cell is covered by rubble collapse, and the space between the cell cap stones and the rubble surface is only 0.7m (Plate 26). Cell 4 was accessed from the central area of the broch, through an entrance 1.05m wide. The lintel capping this entrance is now split and is only supported by a square block of stone (Plate 27); MacKie (2007:615) has speculated that this stone may be the top of a pillar built to support the cracked lintel in antiquity, but while probable, this is not demonstrable without excavation.

39. To the W, cell 4 is ruinous in the area where the broch wall has collapsed towards the sea, though the internal wall face curves into the wall core, eccentrically to the interior curvature (Plate 28), so that the cell seems likely to have continued at least as far as the collapse zone. There are several lintels or tie-stones in this area (Plate 29), which may either have capped the upper gallery or provided its floor.

Other internal features

40. MacKie has considered the broch to have a scarcement ledge, evidenced by a projecting ledge visible at the two broken ends of the broch wall to the W (MacKie 2007:614). This evidence is equivocal, however, and unless significantly less of the scarcement is visible now than when MacKie inspected the site, this assertion should not be considered conclusive. Analysis of the laser scan survey carried out on the broch shows that this putative scarecement ledge is only c.0.2m above the entrance passage (not over 1m as shown in MacKie's schematic cross section (2007:655)), which, while not impossibly low, is somewhat lower than most other broch scarcements.

External features

41. Although much of the area surrounding the broch is covered in rubble presumably derived from the monument, several structures are visible outside of the broch itself. Some of these are demonstrably secondary to the broch, such as 200, which is a curving wall face to the NE of the entrance, composed of sub-angular to rounded blocks averaging c.0.4- 0.5m across (Plate 30). The walling terminates in long thin lintel [201] over the passage leading to the broch entrance, which appears to be a reused lintel or tie-stone, most probably derived from area 101/B of the broch wall and therefore relating to post-collapse activity on the site and probably to a relatively recent period (Plate 31). This lintel is cracked vertically, and may be unstable.

42. In alignment with the walling 200, 202 continues on the opposite side of the passage, so that the two structures form an annexe to the broch entrance (Plate 32), reminiscent of those found on many of the north mainland and Northern Isles brochs. Feature 202 with only one or two courses

visible above the rubble surface is less visible than 200 but the similarity in construction style and alignment leaves little doubt that 200 and 202 functioned together.

43. To the north, 203 is a curvilinear stretch of walling curving gently away from the broch entrance, to form an approach passage but perhaps also the apsidal end of a structure located to the NE of the broch entrance (Plate 33); this could only be tested by excavation. The walling is variable in character, standing to 1.3m in six courses, with the lower areas probably original but the upper courses clearly having been rebuilt in relatively recent times. The batter on this walling, angled towards the SE, increases the impression that this wall may be related to a structure located to the SE of 203.

44. Opposite 203, to the NW, 204 is a similar low wall forming the other side of the approach passage to the broch, standing to 0.5m in three visible courses, and composed of rounded beach boulders (Plate 34). The wall is ruinous, and its northern extent is lost in rubble debris, but it seems probable that the primary function of this wall was to form an approach passage into the broch entrance.

45. The entire broch and its immediate surroundings are enclosed by a massive enclosure wall, which at various points in its circuit appears to function both as a wall and a revetment. To the NE of the broch, a wide entrance is formed by two massive boulders, each c. 1.0 by 1.0 by 1.0m. The northern section of walling, 205, continues northward to the cliff edge for c.8m, but is ruinous and has collapsed (Plate 35). The wall is massive, composed of blocks over 1m across. To the south, the wall 206 is similarly massive, again using blocks over a metre across. This section of wall continues around the broch to the S, where it is largely buried by rubble debris (Plate 36). It is uncertain whether the wall was originally intended as an enclosure to the broch, or as a revetment wall designed to retain construction on the bedrock knoll. The most likely scenario is that it was intended as both; in the areas to the S, at 207, the walling stands to almost 2m in height and retains a mass of rubble debris above. In the southern areas, there is a considerable mass of stone debris between the broch and the perimeter wall, and it is possible that there are structures within this debris. No surface evidence is visible, however, and this could only be tested by excavation.

Later features

46. Several later walls have been constructed abutting the rubble debris from the broch site (208, 209; Plate 35 & 36). These are generally of poor quality build, and appear to be considerably later than the original broch constructions. It is probable that these walls are related to agricultural activity around the broch.

Condition: General observations

47. The surviving remains of Clach Toll broch are generally in a stable condition, and beneath the rubble debris the original wall may survive to over three meters in height in places. Nonetheless, there are several areas where elements of the structure are very unsafe, and at risk of collapse. Aside from unstable masonry there are also several areas where continuing erosion acts to the detriment of the monument and will contribute over time to further instability in the structure.

48. Several areas of the structure give cause for immediate concern. In area 101/B, for example, rabbits are burrowing into the wall core, removing the brash and inorganic soils of the wall around cell 2 and serving to destabilize areas of masonry above. Just as importantly, weathering of the mineral soils around the foundation courses of the broch is potentially undermining the stonework supporting the surviving broch wall. This process is illustrated particularly clearly by photographs

taken by the authors during a survey in January 2008 and a second survey in January 2009 (Plates 41 and 42), which shows that soil is being rapidly eroded, and pinning stones are also falling from the wall face in area 106/D.

49. The erosion of the site is being further accelerated by damage caused by visitors accessing the monument over the damaged parts on the seaward side. Several pathways have formed leading into the site over the rubble mound and over the walls, and these correlate with areas of unstable stonework, clearly disturbed recently. Management of visitor access and its restriction to routes safe enough to accommodate safe access.

Part Four: Analysis of the broch structure

Processes of destruction

50. The processes of destruction and taphonomy of a broch site are complex and variable between sites. Some general principles, however, do apply to all circular drystone and corbelled structures, and the results of recent experimental research can inform our understanding of the condition of the broch.

51. In general, while brochs retain the full circumference of their wall, they are structurally very strong, with no predisposition to collapse and no inherent instabilities. Destruction of their upper structures requires substantial undermining, quarrying or significant foundation failure. When the circularity of the structure is breached, however, the stress of the considerable weight of masonry of the broch wall may not be distributed evenly or in the ways intended by the builders, leading to critical failures in the structure. It is these points that are of most urgent concern at the remains of Clach Toll broch; the collapse of the W segment of the broch wall and the unhelpful intervention and removal of material from around the entrance passage are two major sources of immediate threat to its integrity

52. Corbelled structures have been shown by theoretical studies and experimental building to rely on an internal balancing of forces for their structural stability (Fig. 22). They are very strong in compression, and the addition of material on and over them actually increases their strength. However, removal of quite modest volumes of the counterbalancing mass destabilises them and leads inevitably to collapse. At the Clach Toll broch remains, several distinct factors are working to remove material from the wall enclosing corbelled intramural galleries threatening their stability.

Structural and conservation issues

53. This conservation project should aim to fully appraise the structural integrity of the broch tower, the main building on the site, from an engineering and archaeological perspective and contribute to the understanding of the design of key phases of the site. Structural considerations directly affect the remedial measures and presentation strategies to be recommended, which should be structurally sound, compatible with the existing fabric and allow the monument to function as a document of its history. These aims focus on five main areas:

- Understanding of the original design of the broch
- Appraisal of its current condition
- Risk assessment and identification of areas of immediate remedial attention
- Temporary stability of the fabric during archaeological investigation and conservation works
- Conservation and presentation of the site

The following sections will discuss observations in the critical areas identified during the site survey in January 2009 and subsequent detailed structural investigations.

The structural character of the broch

54. The definition of the structural behaviour and construction technology of the original configuration provides an extra source of documentation for the archaeological investigation. The study of the original form permits the formation of hypotheses of the collapse or gradual destruction of the broch that can be tested. This appraisal contributes to the interpretation of later phases and the identification of key load-bearing areas of the fabric for the restoration of the monument.

55. In the absence of archaeological investigation of the development of the site this discussion will focus on the ideal configuration of the broch and gauge it with widespread definitions of key features (dimensions and proportions, entrance configuration, construction of wall, role of scarcement etc). The measured survey indicates a quite regular circular footprint, with an average internal diameter ID=9.7 m and external diameter ED=16.2 m, resulting in a wall-base ratio PWB = 40.1. When compared to the statistical data compiled by MacKie (Martlew 1982) for Sutherland (48.5 to 49.4) Clachtoll is a relatively thin broch, but with an internal diameter above the average for the area (8.75 to 9.18 m). It should be noted, however, that a survey of the basal levels of the broch is not possible due to the rubble coverage, and as such these figures may be slightly misleading.

56. The SE talus is the deeper external face but due to the fallen stonework is difficult to assess the springing angle of the external wall which, where visible, appears to be close to vertical. A characteristic of brochs is the tapered profile of the outer wall and a springing angle of 70 to 73 degrees. This form in modern engineering terms could be viewed as exerting a uniform pressure all around the internal wall, with beneficial stabilising effects.

57. The broch lies on an uneven plateau of the coastal bedrock which may have been levelled on the NW area. Trenches for foundations have not been identified but they seem unlikely or they are very shallow. Solid based brochs are usually considered as more stable than brochs with a substantial gallery at their basal level, but the floor of the chambers where this diagnosis could be verified is covered with debris. Cell 3, however, is rock cut at its base and as such Clach Toll can be classed as ground-galleried. However, with such an unusual foundation configuration, to mathc the underlying geology, the application of essentially typological classification is probably unwarranted.

58. Apart from its form, the structural behaviour of the monument is equally affected by the construction style of the walls. If full uninterrupted galleries and staircases are considered as the pinnacle of the broch architectural achievement (Mousa, Dun Telve), the design here is somewhat more simplistic, if little less impressive. There is no clear distinction in character between outer and inner wall and the thickness of the wall (3.5 to 3.8m) contains chambers (Fig. 12) that are separated with sufficient masonry lengths to avoid the need to reinforce the wall with longitudinal through ties. This is not the case however in the areas where the chambers have to be roofed and it is from these areas that most of the long blocks (lintels) observed in the debris may derive, indicating the presence of further chambers in the missing upper wall (see Plate 5). The chambers have a corbelled profile that reduces the opening to be roofed and their blocks are well embedded in the masonry, enhancing the restrain of their thrusts by the friction between the blocks (see Plate 22). The building stone used throughout is Torridonian sandstone, mainly quarried from a local source although some beach boulders seem also to have been used.

59. The foundation/basal courses can be clearly seen in the S side where they lie directly on the bedrock. Larger blocks of all dimensions seem to have been used in these zones with lighter and flatter blocks towards the upper parts. There is no specific pattern in the layout of the blocks, though attempts have been made to locate the longer ones on top of a joint underneath. Layers are

roughly kept horizontal but the stonework quality is irregular as relatively very thin blocks are piled next to very large ones, a practice that does not guarantee a good bond in the hoop sense, despite the use of pinnings throughout.

60. The only entrance to the broch is on the N side which is protected from the prevailing SW wind. A triangular block on top functions as a lintel relieving the opening from upper structure loads but its current position is precariously supported and it seems it has been rearranged in this location. The entrance passage is flanked by intramural openings which spread into cells 1 and 2. The other two cells, 3 and 4, provided internal openings into the interior; these are currently blocked by fallen masonry. Layers of stone coursing lie on top of their lintels so it is probable the stacked effect of openings, designed to relieve stress on the lintels observed in Mousa and the Glenelg brochs was not repeated here.

61. Observations about possible arrangements of internal furnishings and the roof structure will be possible only when archaeological excavation has revealed the interior of the broch. As noted above, if the revetment in area 110/A does indeed turn out to be genuine, this may be taken as an indication of a support for a gallery or floor between levels. This feature can only be confirmed by further investigation, but may give information about the gradual reduction of the wall in upper levels.

Understanding the monument: recommended avenues for research

62. Further hypotheses on the design, construction and destruction of the broch will be formulated during any archaeological works, and validated by more detailed structural analysis. Testing of the ideal configuration of the monument against the current ruinous situation may help clarify origins of failure and distinguish between natural causes (weather, settlement) or inherent problems (inefficiency of form or changes) and later human actions, such as incoherent repairs, re-use or vandalism.

63. The following avenues of research are recommended as concomitant programme to the conservation works:

- An extensive literature survey and study of proportions (case studies in Sutherland and Hebrides)
- An identification of function of key stone elements during archaeological works, distinguishing between broch structure and revetment, and evaluation of original volume
- Assessment of the durability and strength of the local sandstone material
- Physical modelling in scale (at 1/5 or 1/10) and application of reasonable structural actions (eccentric loads due to irregular interior decking, excessive vertical load, gradual long-term loss of upper curvature, differential settlement, freeze/ thaw).
- Reproduction of the construction process with a scale model and the development of an understanding of the role of key structural elements during construction
- Testing of a wall quadrant at a larger scale under dead load, in order to relate efficiency of form with stone bonding and the distribution of pinnings
- A simulation of entire structure with discrete blocks via numerical modelling; a 2D study of wall sections using advanced simulation of friction contact; identification of thrust line and stability
- The development of flexible modelling strategies that can allow testing of remedial techniques

Structural condition appraisal

64. Most of the conservation problems of the broch are due to the slow degradation of the fabric, while structural instability is a concern in certain areas that may trigger further failure.

65. The remaining upper courses are built of blocks loosely held together. In some areas blocks have been replaced irregularly and, although they apply some load to keep the blocks underneath in place, any dislocation or drop may damage more delicate stonework such as the lintels over chambers. At the edges of the collapsed W section in area 107/C and 113/C or areas where a massive failure probably occurred (e.g. area 100/B or 105/D), stone has been crushed forming a lithosol mix, which may act as a protecting layer for the stonework underneath. For the most part, no significant vegetation is present apart from lichens. The lithosol layers however are also an indication of the constant erosion of the fabric, which has been further accelerated by uncontrolled access from visitors.

66. As a result of the current fragmented configuration, the efficiency of the overall design of the broch tower cannot be clearly assessed. The compression of the inner ring due to the almost domical behaviour of the external ring may never have existed and in combination with the uneven supports and the irregularity of the masonry have probably resulted in local failures, which in turn have accumulated and contributed to the destruction of the entire fabric. The collapse process may have started from the W side where the foundations have slipped on the bedrock and the fact that the fragile S side (Plate 10) is still in place probably indicates that the next areas of failure was in the E side.

67. Most of the stone blocks in the outer (visible) faces of the broch wall do not appear to have sufficient contact areas between them, reducing significantly the cohesion of the dry-stone masonry due to friction. In these conditions, the pinnings may prevent some local dislocation but do not seem to improve the integrity of the works in the hoop sense.

68. The entrance is still partially filled with debris and deposits which may be beneficial for maintaining the integrity of the entrance passage frame. The triangular threshold lintel, however, is supported on very narrow ledges and may be toppled by disturbance of the weight behind. The stone blocks in areas 100/B and 109/A are heavily cracked, apparently not long ago, indicating they have carried high or asymmetrical loads of a more intact part of the broch.

69. The intramural chambers survive in various degrees of preservation. Cells 1 and 2 are linked with the entrance passage through a narrow path (filled with debris) and access depends on the integrity of the orthostats that frame the entrance opening. Their walls appear to be geometrically undistorted, though several of the capping lintels in Cell 1 are missing. Cell 3 is in a very good condition but the opening giving access to the interior is filled with debris, and although its lintel still functions it is cracked vertically. Cell 4 is almost completely filled with debris and many of its lintels are out of place. The lintel over the internal opening has cracked and only a supporting block takes the weight of the remaining upper structure.

70. There is no visible dislocation of stones inside the chambers, which although apparently stable, are under varying conditions created by the debris surrounding their walls. The E side of the broch wall is contained between the talus of the broch debris, but Cell 1 receives asymmetric thrusts as the exterior face is free of debris. Cell 4 however receives pressure from the interior debris while it sits precariously on the fissured bedrock. This chamber is also filled with debris (Plate 27) which may stiffen the section by balancing the pressures from the interior and it is probable there is a complex interaction with the rest of the fill which has shifted the line of thrust away from the edge of the bedrock, acting to improve the stability of the section. The stability of this area needs to be studied

further in parallel to that in sector A as part of the preparations for any archaeological excavation within the intramural area.

Understanding the structural stability of the site: recommended action

71. As part of the works required to understand more fully the dynamics of the broch remains as they currently survive, the following actions are proposed:

- Establish models of collapse as part of the structural analysis stage.
- Update the analysis with data from the experimental programme conducted in Spittal Quarry and research on collapse hypotheses of broch sections
- Investigation of the composition of the infill in the S area and the depth of fill in the rest of the chambers
- Monitoring of movement in critical areas: entrance surrounds, S walling in area 106/D, cell 2
- Focussed engineering analysis on the behaviour of these areas using detailed models

Risk assessment and immediate priorities

72. Based on our initial structural analysis, the following areas of imminent danger for the integrity of the fabric have been identified:

- The triangular cap stone of the entrance has been repositioned in the past and is currently insecure. The basal masonry in areas 108/A and 109/A has moved forward on its foundations.
- Lintels above intramural passage at the W end of cell 4 have been exposed and if fractured could destabilise precarious equilibrium of the stonework above.
- The entire SW quadrant may be in danger of collapse if any of the basal blocks on the fissured bedrock in area 106/D moves or deforms
- Material accumulated on both sides of the wall may perform a buttressing function but the angle of repose of stones from collapsed masonry in the SE area is still above the natural value and therefore unstable.
- The masonry block above the stonework, in area 111/B, are heavily cracked and in danger of collapse, particularly if the unstable lintels in the entrance passage are further destabilised.
- All capping stones of the chambers need to be secured to avoid further cracking and accidents to visitors or animals

Archaeological and strengthening works

73. The structural integrity of the fabric of the monument depends significantly on the stability of the talus slope of the debris accumulated around the walls, especially at the E side. An archaeological investigation at the interior and intramural spaces would eventually remove most of the rubble and fill and the effect on the stability of the monument during this delicate phase will need to be assessed carefully in order to guarantee the safety of the archaeological team. This concern may require temporary works or strengthening strategies which will be beneficial if they can be integrated in the final conservation works.

74. It will also be important to consider the limited accessibility of the site and the wet conditions of the soil when the transport of materials and staff, plant and storage are planned.

75. The following concerns are of direct importance to the archaeological and consolidation works on the site:

- It will be essential to ensure the security of chambers, where intact archaeology may be present. The walls may collapse after soil or the rubble in the interior are removed and the equilibrium of the chamber is disturbed. A possible solution is to design a lightweight and demountable, yet strong cage which could adapt in the geometry of the chamber. This cage can shield the investigator from any dislodged block but should provide reasonably comfortable conditions for the archaeological work.

- It will be essential to carefully plan the sequence of removal of debris. It is probable that pressure exerted by the interior rubble debris is higher than that exerted by the exterior and the collapse of the broch simply accumulated material at the floor of the broch without disturbing the interior face. The wall is thick enough to have withstood this differential pressure in its current arrangement but care must be taken if the stress distribution profile of the wall has fused with the fallen debris and now depends on its stability.

- Archaeological works could proceed in deep and narrow trenches that can be stabilised with sheet piles or superficial buttresses before the adjacent trench is opened, but these measures will have to be carefully tailored to the area they are required

- The revetment/enclosure wall 206 may still function as a retaining wall for the E side of the broch but the condition of the deposits in this area is not known as it is currently buried by collapse debris. This area therefore requires thorough examination. A similar temporary and phased strengthening with profiled sheeting may be planned for the investigation and consolidation of this area.

- The stabilisation of the entrance is an urgent priority. This will involve an excavation down to original ground level to provide safe access to the chambers. During the consolidation works, if the interior rubble is cleared then posts could be placed at either end of the entrance, holding beams that support the lintels. In order to make sure load is transferred equally on the beams, the posts height would be controlled with jacks

Part Five: Archaeological Potential of the Broch

76. The archaeological potential of the monument subsists in two elements, the structure itself and the deposits it contains. The former has been assessed above and it is necessary to carry out an assessment of the archaeological deposits of the broch and, to a lesser extent, of the surrounding area prior to undertaking any modifications to the existing site.

Depth of deposits

77. Although the height of the bedrock underlying the broch is not easy to establish reliably across the site, from levels measured wherever the bedrock is visible (including in the floor of cell 3) it is probable that there is over 3m of rubble deposits within the roundhouse interior (Fig. 18). Equally, outside the broch, the rubble abutting the broch wall stands to a height of almost 2m above the enclosure/revetment wall 206, so that external structures may lie outside the roundhouse, from the entrance westwards to the south side.

78. Given the similarity of Clach Toll to the Hebridean brochs, and the presence of some external secondary structures in the area around the entrance, it is possible that significant secondary, late Iron Age and Early Historic structures relating to use of the broch, internally and externally may survive in situ.

Current social and cultural importance of the site

79. The broch has real social meaning and value in the present day. The sparse population of Assynt parish is nowadays mainly concentrated on the coast and, despite the history of clearance and depopulation, has still a real affinity with the land, and particularly with natural and cultural heritage. The process of Land Reform, which has done much to transform the Highlands and Islands in recent years, began here, with the buy-out of the North Assynt Estate by the Assynt Crofters' Trust in 1992. In recent years Historic Assynt has been responsible for the preservation of Ardvreck Castle, Calda House and the Inchnadamph Church, (which has highlighted the lives of the MacLeod and Mackenzie Lairds), while Comun Eachdraidh Asainte has concentrated on genealogy, a photo archive, the Altnabradhan Mill and the Stoer radar station. This heightened interest in the human history of the area is beginning to bring the lives historically lived in the Assynt landscape into the light of day.

80. Aside from the academic value that can be drawn out of any future work at Clach Toll there is a wish to preserve, use and develop the broch as an iconic centrepiece within the heritage landscape of Assynt. In a real sense, the local community wish to use the monument to draw people, both local and visitors, into their landscape. They also wish to use the broch as a way to increase enjoyment of the area with programmes of exploration, consolidation, interpretation, training, and education which would ultimately add to our knowledge of the past. Just as with current and past projects Historic Assynt wish to marry preservation of their monuments with programmes of education and community involvement, and in doing so unite past and present in underpinning a culturally healthy and confident future.

SECTION B

Conservation Management

Part Six: Conservation Recommendations

81. Our engagement in this project is predicated upon the local community's interest in having this broch preserved and made accessible to the public. This would form part of their larger ambition to develop cultural tourism as an economic strategy for the Assynt area. They have previously completed conservation projects at Ardvreck Castle, Calda House and the Inchnadamph Church to a high standard. In what follows, we are conscious of the high standards set and of the integrity of the community's aspirations for their heritage and their sensitivity to its real needs.

Conservation planning

Philosophy and terminology

82. Our approach to the conservation of the Clach Toll broch follows the principles set out in the Burra Charter (1999) and the terminology used here is that specified by the charter. These are not fully rehearsed here- the reader is referred to the Burra Charter documentation[2]- but the following critical terms, principles and their precise meanings should be noted at this stage:

- In accordance with article 2.2 of the charter, *conservation* should always seek to retain the cultural significance of the site, and all acts of conservation should be designed with this aim in mind
- *Conservation* means all of the ways in which a the site should be cared for in order to retain its cultural significance
- *Maintenance* means the continuous protective care of the fabric and setting of a site, and is to be distinguished from *repair,* which involves *restoration* or *reconstruction.*
- *Preservation* means the maintenance of the fabric of the site in its existing location

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- *Restoration* means the return of the existing fabric of the site into a known earlier state, without the introduction of new material
- *Reconstruction* means the reinstatement of the site to a known earlier state, and may involve the introduction of new material
- *Adaptation* means the modification of the site to suit existing conditions or proposed use.

83. In advancing our recommendations for the conservation of this monument we shall consider the conservation of the monument itself as a pure exercise in conservation in the first instance. Taking into account the community's aspirations, we will then measure the compatibility of their developmental proposals with the conservation of the monument's cultural value and attempt to make explicitly clear the compromises that this would force on the conservation of the original and authentic elements of the monument.

[2] http://www.icomos.org/australia/burra.html

Priorities for conservation

84. Our priorities for conservation as set out below deal firstly with some areas of major concern that require immediate remediation for the safety of the broch remains. These works are also essential under health and safety legislation, for the safety of the visiting public. The Clach Toll broch remains, therefore, require both:

- The stabilisation of unsafe stonework that might be a threat to the health and safety of visitors to the site
- The stabilisation of unsafe stonework that may be a threat to the survival of the monument

The Threats to the monument

85. The following distinct vectors of threat and damage have been observed or deduced at Clach Toll:

The sea

86. The loss of the entire broch wall on the seaward side of the monument may with safety be attributed to the action of the sea. It is probable that the foundations of the broch at this side lay on a thin soil overlying the steeply shelving bedrock (see early maps; above). Rising sea levels brought the highest annual storm waves just into range of this soil cover and in consequence the soil pinning the founds on this side was washed away. This would have loosened the founds and the overlying masonry which would progressively have fallen away, or being loose, been preferentially removed as a raw material for buildings elsewhere.

87. It seems at least possible that salt spray and occasional overwashing by salt waves is killing off the vegetation formed on the broch remains themselves and on the soils around its footings. The loss of soil in area 106/D is typical of this type of damage, exacerbated no doubt by animal and human traffic.

88. The predicted continuing rise in sea level due to global warming will continue to endanger the monument, albeit that it is only the most severe storm waves that can actually reach it at their maximum extension.

Stone robbing

89. Without doubt, stone robbing has been a major source of loss of historic fabric for this site. This is no longer a major concern, however, and the involvement of the local community in the future management of the monument should ensure that this threat will not arise again.

Natural decay

90. The stone of which the broch has been made is predominantly Torridonian sandstone. However, soil and brash (waste from quarrying or stone working) has been used in levelling courses and this is actively decaying on the site. In consequence the overlying masonry is destabilised, and is lost or removed.

Erosion due to human activity

91. The increased numbers of summer visitors poses a substantial threat to the monument. It is clear that stones, including capstones to the chambers have been lifted and, in some cases, replaced and

that holes have been excavated into the rubble infill of the centre of the broch (though it is not clear when this took place). In addition, stones on the wall heads have been loosened and some thrown down while some spurious rebuilding has taken place. There is no direct evidence of outright vandalism and given the levels of local interest this is probably a remote threat, but not an absent one. Grazing animals no longer have free access to the monument and this, once a factor, seems under control now.

Scale of threat and damage

92. The erosion profile of the broch remains on the seaward side (in sectors A and C) continues the slope of the underlying, sea-scoured bedrock. We can have some confidence that the significance of this threat is now greatly reduced: it has done the greater part of the damage that it can do and erosion from that source will be slight and can be managed for the short term future. However, global warming may raise the current sea level. Estimates range from decimetres to meters. Perhaps more pressingly, increased energy in the climate system is likely to result in more frequent, stronger gales. Thus, in the medium to long term, the impact of the sea may re-emerge as a potent erosional factor, possibly as a destructive factor.

93. It is clear from our survey that the remains now visible once had at least one further gallery level above that which now survives. By analogy with other comparable sites, it would not be unreasonable to estimate that two or three levels existed originally above that which survives. Thus, there has been major reduction of the monument and major removal of material from the site. Scheduling will have helped by preventing large scale removal of material and in any event, the social context of the area has changed considerable over the last century and the large scale quarrying of this broch has now ended.

94. The observable natural decay on the site is a consequence of the salt spray of the maritime environment. Loss of the little vegetation cover continues and with the loss of its root-mat the underlying soils are exposed to aeolian and other natural erosional forces. This is slow and insidious and cumulatively, potentially very harmful indeed. It must be countered, especially where it affects foundations and soft, intra-mural deposits.

95. The scale of individual interventions on the site by visitors is probably small, but their cumulative impact has clearly wrought some considerable damage. Apart from direct interference with the historic fabric, even the movement of people onto and over the site is causing a slow but continuous erosion of fabric and a resorting of loose material.

96. The entrance area has been identified as wholly unsafe but is clearly in more or less frequent use by visitors. This holds the possibility of sudden and potentially catastrophic loss of historic fabric, not to mention the risk of injury or death. The progressive loss of material from the current wall heads threatens the destabilisation of the intra-mural chambers and consequent catastrophic collapse, again with attendant risks to health and safety. The tipping point is close for Cells 2 and 4, has been passed for Cell 1 and is less immediately imminent for Compartment 3, albeit that the latter, which is over 3m deep from the wall head poses other risks for visitors to the site.

97. In conclusion, dramatic collapse of the broch remains is not imminent but areas of the structure are undergoing slow, continuous erosion whose cumulative effects will lead in time to great damage to the site. The risk from the sea is perhaps past its maximum harmful capacity for the time being but remains real. Human and animal access to the site are the most persistent and prevalent threat to its security.

Conservation principles

98. Our conservation priorities are predicated on a sequence of actions necessary to secure the historic fabric of the monument. As a separate issue, the proposed use, i.e. presentation of the monument to the public, will be considered and its implications for the monument will be detailed. Finally, an explicit assessment of the compatibility of the proposed use with the conservation of the monument's cultural value will be presented.

99. In pursuing these priorities, the following conservation principles must be strictly adhered to.

100. CP1: Maximise the retention in situ of historic fabric. Corollary: only remove loose or endangered masonry and deposits.

101. CP2: Minimise the adaptation of the historic fabric so as only to improve the visitor's ability to understand the monument, or to address issues of health and safety.

102. CP3: Maximise the use of original fabric in the reconstruction of parts of the monument wherever possible.

103. CP4: Wherever possible, restoration of historic fabric is preferred to reconstruction.

104. CP5: Restoration will only be undertaken where the original configuration is demonstrable based on archaeological evidence derived from the site itself.

Phase 1: Emergency works of stabilisation and site management

105. Our survey and analysis of the monument have identified some areas and some problems that require immediate remediation on health and safety grounds in addition to the threat they pose to the monument. This raises issues of principle because we have to propose some interim works that have negative aesthetic impacts, albeit for a short period, and introduce alien materials onto the site. Planning for a worst case scenario, we should allow for the possibility that these interim measures could become long term fixes or permanent arrangements. It is imperative therefore to ensure that future scholars will be able to distinguish between original or authentic fabric and materials introduced for temporary shoring. These matters would be detailed in the Scheduled Monument Consent application to Historic Scotland which would necessarily precede even these temporary works.

The entrance area

106. The entrance area was excavated by stonemasons under the direction of Historic Scotland. The remedial works undertaken at that time were, no doubt, adequate in the short term but continuing erosion from all causes have now created a dangerous instability in this area.

Proposal

107. We propose the infilling of the entrance area in the short term both to exclude visitors and to provide some support and shoring for the masonry above and on either side. Ideally, this should be done with bags of sand or shingle, rather than drystone masonry which would have the potential to create confusion in the future if no further works were undertaken on the site.

108. We further propose to use wooden props to shore up the block of masonry over the inner left hand side of the entrance passage (looking into the monument) that is in imminent danger of collapse. We would construct a wooden frame to hold the masonry and prop this with heavy wooden baulks bedded in the rubble of the interior. This sheeting and propping structure can be prepared in advance with dimensions taken from the laser scan survey.

The Wall Head

109. Continuing loss of stone from the wall head endangers the corbelled chambers beneath. Loss of the courses stepping down to the seaward breach in the wall continues to erode the historic fabric, facilitates access to the wall heads and provides an axis of erosion into the heart of the monument.

Proposal

110. We propose the overlaying of the wall heads with terram and the deposition of further stone onto the wall head to secure the exposed and endangered features and to inhibit visitor access to the wall head. The emplaced stone could be contained in gabions which would be easily built on site, are clearly distinguishable from the built monument and which can be easily removed when the main phase of conservation proceeds.

Prevention of burrowing by rabbits and other animals

111. The damage from this source, to date, is only superficial but with the increasing exposure of soft deposits, has the potential to become a major problem in a short timescale.

Proposal

112. We propose to safeguard the softer deposits in the short term by burial under temporary gabions and by the use of appropriate geotextiles, under introduced stone or under lifted and replaced rubble on the wallhead, where gabions cannot be used.

Control and management of visitor access

113. Visitors scrambling up onto the monument and onto the wall head in particular, provide a continuous, if low grade erosion vector.

Proposal

114. The temporary use of gabions with associated fencing and information display would channel visitors onto safe areas of the site, inform them about the monument and about the risks associated with it as well as describing the works proposed and underway.

Phase 2: Exploratory and interim works

115. Once funding has been secured, the temporary securing works will be replaced with permanent arrangements, designed to secure the monument for the longer term. This will be approached in a two step process, Phase 2 comprising exploratory and preparatory works whilst Phase 3 comprises the main conservation effort directed to preserving the historic fabric of the monument.

Research and conservation

116. As we have stated, it is impossible to undertake appropriate conservation of a historic monument in the absence of a detailed investigation of the site, designed to inform our understanding of how the monument functions, as a structure. Our structural and archaeological analysis, thus far, has identified a range of issues that will need to be addressed prior to and during archaeological and conservation works at Clach Toll broch. These agendas for research are closely integrated with our proposals for conservation measures and are described here concurrently with the ways that they will be approached.

Understanding the masonry fabric of the monument

117. We have identified several uncertainties in the form and function of the monument that must be addressed so that we can understand its current structural behaviour. In the first place, what was the original form of the built structure and how does it relate to the irregular bedrock surface onto which it has been built?

118. We hypothesise that the broch was circular in ground plan, despite the variation in levels from which it springs. This must mean that the wall on the landward site either extends downwards through what is now a rubble spread or that the latter covers the remains of a built plinth from which the broch wall was built upwards. The nature of the arrangements at this side has clear implications for our ability to secure the stability of the structure.

Testing

119. We have observed on site a sloping glacis of debris down which we argue stone from the broch may have been toppled for removal from the site. A possible revetment wall can be seen on either side of it but no structured masonry can be seen within it. If we explore the underpinning of the broch in a trial trench at this point we will not disturb *in situ* structural remains. Rather, by revealing such remains we will clarify the nature of the structure on this side, which in turn will allow us to develop the most appropriate plan for stabilising the wall and the intra-mural chamber.

Accommodation to variation in foundation levels

120. The plans of the broch presented here necessarily contain some distortions, foremost amongst which are those arising from the anticipated difference in wall thickness at the base and higher up the structure. Thus, for example, the intra-mural chambers are surveyed at ground level but the wall lines are surveyed at the level of the wallhead. Hence the thickness of the walls separating the compartments from the interior and exterior broch environments is not correctly represented in our survey drawings and cannot be properly represented by any survey until we can access the wall footings directly. This raises an important question in respect of the accommodation of a vertically tapering form to a variable base. If, in a simple approach, the thickness of the wall is set at, say 4 m everywhere that the masonry rests on the bedrock. The composite broch wall then thins out as it rises. Once built above the level of the highest foundation level, the thickness of the wall will now

vary significantly when viewed in any horizontal level, potentially creating a hazardous imbalance in the ability of the structure to resist deformation, for example, under wind pressure.

121. A more sophisticated response by the builders may have been to build up a level plinth until the unevenness of the bedrock foundations are covered and then to build the classic broch shape from that level upwards. Even more sophisticated would have been to build the tapering shape from the uneven base allowing for the horizontal variance required to achieve a symmetrical monument all the way up.

122. Each of these approaches implies a certain level of cognitive interaction with the geometry of the monument. The first might be more consistent with a level of articulation that could be described as vernacular architecture, writ larger than usual. The second implies a functional engineering awareness above the purely vernacular whilst the third suggests a cognitive engagement with the construction form and process that implies a specialised knowledge base and a level of control over the development that is not consistent with 'consensus' or 'committee building'.

Proposal

123. It will be essential to take advantage of every opportunity to observe directly the intercalation of the broch masonry with the underlying bedrock or sediment base. These observations will be either laser scanned directly or built into the overall laser scanned model of the site. We would use a 'goodness-of-fit' test to distinguish which of the three approaches is most descriptive of Clach Toll broch remains and most indicative of its original design concept.

Securing the seaward erosional edges of the broch wall

124. The breach in the seaward side of the monument allows easy access onto the wallhead and facilitates further erosion of the wall with stones slipping down from the wallhead and being lost. The following measures aim to prevent further erosion of original fabric at these points.

Proposal

125. We propose to reduce the wallhead at these points following a laser scan re-survey of its then current condition. We would then pin stones from the lowest course of *in situ* masonry directly into the bedrock and pin the next course or two into the foundation stones as required. These works would involve the insertion of a marker layer to show the maximum extent of our disturbance. Finally, we would reinstate the removed stones, guided by the laser scan survey, and undertake a final survey of the conserved ends. Any soft deposits encountered in this exercise would be archaeologically excavated and removed because their continuing survival could not be ensured.

Stabilising Cells 1 and 4

126. Cells 1 and 4 are threatened by the reduction of the wall head with erosion potentially spreading from the seaward breach. In stripping the loose material from the wall head to secure the exposed wall ends (see above) we would continue the strip of the wall head as far as the *in situ* cappings of the two adjacent compartments. This would require precautionary propping inside the corbelled cells because the reduction of the overburden could destabilise the corbelling. In turn, this would endanger the floor deposits, if any survive within the compartments.

127. The order of execution of works in Cells 1 and 4 would therefore be, i) the excavation of the compartment floors, ii) propping of the chambers and iii) removal of sufficient of the loose

overburden to establish the condition and structural needs of the surviving historic fabric. It is anticipated that some form of reinforcing collar may be required to support the top of cell 1, whilst the needs of Cell 4 cannot be assessed without the exploratory works described here. It is not unlikely that a stair leads upwards to the seaward end of Compartment 4 and if so, its condition and conservation requirements could only be established once the overburden had been lifted and the loose rubble within the compartment removed.

128. Cell 4 is currently filled to within 70cm or so of its roof and its original entrance from the interior of the broch has a fractured lintel supported by a pillar stone. The viability of the broch wall in this area is critical to the survival of the monument and whilst there is some hazard associated with removing the rubble from the compartment, the hazard associated with the do-nothing option is at least as great and ultimately, greater since its current condition facilitates further subsidence in the inner broch wall. It would be necessary to prop the side walls of the compartment as the rubble infill is reduced to reveal the conservation needs of the inner broch wall over the entrance passage to the compartment.

129. In order to relieve the pressure on the inner broch wall from the interior of the broch, the loose rubble inside the broch abutting the arc of wall containing Cell 4 would have to be reduced, in line with the reduction in levels within the compartment. Similarly, the level of loose rubble abutting the outer wall face along this arc would also need to be reduced. The aim throughout would be to prevent the development of an unbalanced force by uneven reduction of pressure on either side of any structural element.

130. At some point between the accessible floor of Cell 4 and the seaward breach in the broch wall, the change in heights of the underlying bedrock must have forced a commensurate change in the nature of the underpinnings and foundation of the broch wall. It will be necessary to observe this as a research priority for its bearing on the engineering and architectural abilities of the broch builders and as a conservation priority, to ensure that our conservation programme does not endanger this zone of potential weakness.

Stabilisation of the Entrance area

131. This is likely to prove the most technically challenging area for conservation. The immediate remedial works will have infilled the entrance passage to prevent collapse and the upper masonry mass will have been stabilised by wooden shuttering.

132. It seems inescapable that the entrance pend will have to be stripped down to the level of the lintels of the passage and side compartments and that some of the existing lintels may have to be reinforced and missing lintels be replaced. The pend structure will then have to be replaced, stone by stone. Extra stones may need to be added to key the vulnerable corner of the masonry back into the bulk of the wall. Alternatively, a horizontal anchor may be required to supply the necessary pinning. These choices depend on the state of the wall masonry revealed by stripping. Use of laser scanning throughout will ensure that the final product will look as close to the original as is possible. Specifically, the structure will be laser scanned at the following stages:

- Pre-remedial works,
- Pre masonry strip out
- With replacement and reinforcement of lintels complete
- With membrane and disturbance markers in place
- With masonry replaced

133. Clear demarcation, which identifies the date of the disturbance, will be made between undisturbed and disturbed masonry.

Broch wall between the entrance and Cell 1

134. The stretch of broch wall from the entrance to Cell 1 will be at least partly stripped down to solid *in situ* masonry during the works at the entrance area.

135. This will reveal the rear of the head of the corbelled cell on this side and facilitate the insertion of a retaining collar at the head of the corbelling if this work coincided with the strip down from the seaward side (see above). Once the remedial works are completed the wall head in this area would be built back up with masonry selected from the loose debris on the wall, again clearly demarcated from *in situ* historic fabric.

Observation of the internal structural detail of the built wall

136. The drystone building in the area of the entrance which includes the triangular stone over the entrance passage is visibly moving outwards, away from the core of the wall. Modern drystone wall building creates wall faces that are pinned into the built wall with 'stretchers', stone running through the thickness of the wall. Even well built, a broch wall constructed in this way would probably be unstable and the loss of wall faces would have been a far commoner occurrence that is currently observed. It is probable that this problem was overcome by the dense stacking of stones throughout the thickness of the wall with no built plane of weakness separating core from face. This hypothesis requires detailed testing and the removal of loose material from on top of the wallhead would allow compilation of a detailed study of the nature of the stone placement throughout the wall thickness.

137. The details of the wall structure will be recorded by photography and laser scanning so that estimates of the standard bulk density of the wall structure can be measured. At least one intact layer of stone will be lifted to reveal the layer beneath and then will be replaced using the laser scan to guide the process. Particular attention will be paid to the interdigitation of the corbels of the intra mural compartments with the mass of the stone building in the wall because this is crucial to the stability of the corbelled compartments and will guide our treatment of the exposed heads of the compartments.

Broch wall between the entrance and Cell 2

138. Stripping out of the entrance area (see above) will require some stripping down onto the head of Cell 2. Although in better condition than Cell 1, the former should also be reinforced by means of a collar around the head of the corbelling. This would resist the removal of counterbalancing material over the cell. The compartment would need to be reinforced whilst the overburden is removed and as a precondition here also, the compartment floor deposits should be excavated under temporary shoring before the props are inserted. The same sequence of operations as that indicated for Cells 1 to 4 is indicated here also.

Broch wall at Cell 3

139. Cell 3 is the most complete of the intra-mural chambers but is now vulnerable to removal of material from the wall head. Given its shape, a reinforcing collar could not be achieved without large scale disturbance of original fabric. It would be preferable, as well as feasible to strip off the loose overburden on the wall head here and insert a sealing cap of durable material over the compartment, reburying it under replaced masonry. As elsewhere, new or displaced and replaced material would

be clearly demarcated from *in situ* historic fabric. It would not be necessary to excavate out the floor deposits of Compartment 3 to facilitate the remedial works on the broch wall. However, see our proposals below on the excavation of the interior.

140. The broch wall in this area is pressed upon by masses of loose stone inside and outside the broch wall. These stresses should be reduced in matching stages by the reduction of the material inside and out.

Excavation of soft deposits within and outwith the broch

141. We have indicated above the need to excavate the soft deposits from within Cells 1, 2 and 4. However, the works on the broch wall will undoubtedly endanger any soft deposits within the broch and possible structures and deposits outwith it. Furthermore, removal of debris from inside the broch would necessarily disturb the depositional environment of soft sediments on the floor of the broch or scattered throughout the enclosed deposits.

142. Quite apart from the needs of the conservation programme, there is one excellent reason for reducing the level of debris inside and outside the broch and that is that it would restrict access to the wall head and discourage visitors from scrambling over and across the walls. Of course, easy access to the wall head could still be secured from the seaward breach where the surviving masonry reaches ground level. This matter is addressed below in terms of the preparation of the monument for presentation to visitors and for visitor-proofing.

143. For these various and good reasons, removal of the loose debris within the broch and reduction of the loose debris abutting the walls are the obvious way forward. Therefore the excavation of the whole of the interior as well as the interiors of the intra mural compartments can be considered a basic requirement. There are independent research questions and criteria for the excavation of the soft deposits that must be considered as part of the project design for any excavation proposed on the site. These will not be fully rehearsed here, but must be designed prior to intrusive works in order to address research issues pertinent to broch studies more widely, so that the full archaeological value of intrusive works on the site is maximised. These works will go some way to establishing our understanding of the significance of the site in its geographical and cultural context (see Part One, above).

Part Seven: Compatibility of the proposed reuse of the broch as a heritage asset with the conservation of the monuments cultural value

144. Historic Assynt propose to develop the Clach Toll broch remains as a visitor attraction. To this end, it would be necessary to bring the monument to a state in which it was safe for visitors and safe from visitors. The Venice Charter sets out the ethical policies within which the compatibility of modifications to the monument for the purpose of its new function can be evaluated.

145. Enhanced visitor access to the monument would require a means of safe access to the monument's features that was compatible with the conservation plan for the site. The following notes sketch out some possibilities for approaching this problem, based on our current understanding of the monument and its requirements. They should necessarily be taken at this stage as tentative suggestions, and any solution will require a careful design to approach the challenges and requirements set by the site. The purpose of drawing attention to these solutions here is to highlight the need for forward planning throughout the conservation process, in order to ensure that all works are designed with the intended ultimate use of the monument in mind whilst the end use remains conditional on the requirement to conserve the cultural value of the monument.

Wallhead walkway

146. One suitable solution would be the creation of an access trackway onto and over the broch wall head, supported by the reinforcement collars and covering pads for the cells. The walkway would run from approximately the midpoint of Cell 4, across the seaward breach and onto the wallhead north of the breach, as far as the entrance. Access to the walkway would be via a ramp rising up the east side of the structure.

147. The access walkway would be widened over the area of the breach to mimic the original broch wall. The footings of the broch wall in the breach could be represented by aesthetically suitable material or some other, more inventive solution that respects the context in a sympathetic way, such as glass blocks cast in the form of typical stones. These would both demarcate the footprint of the broch and, pinned into the bedrock, would assist in offering resistance to further erosion in this vulnerable area.

Access to the interior

148. Once the interior of the broch has been excavated an extension of the walkway down into the broch would be designed and installed.

Disabled access

149. Every effort will be made to ensure that access to the broch is provided for disabled visitors. We should be able to guarantee disabled access to the exterior but it would be necessary to undertake a full design exercise to attempt to accommodate the gentler slopes needed for disabled access down into the interior of the monument.

Interpretation and presentation

150. The interpretation and presentation of the broch at Clach Toll will form part of the larger cultural tourism route planned by the local community. Three levels of information presentation will be made available in a range of media. On site presentation will be minimised and will focus on directing the visitors attention to the monument and the structural, architectural and archaeological challenges to

understanding with which it provides and provokes us. Whilst not avoiding the low level what-when-and-why level of interpretation we would attempt to induce the visitor to take part in the ongoing debate on the nature of these iconic monuments.

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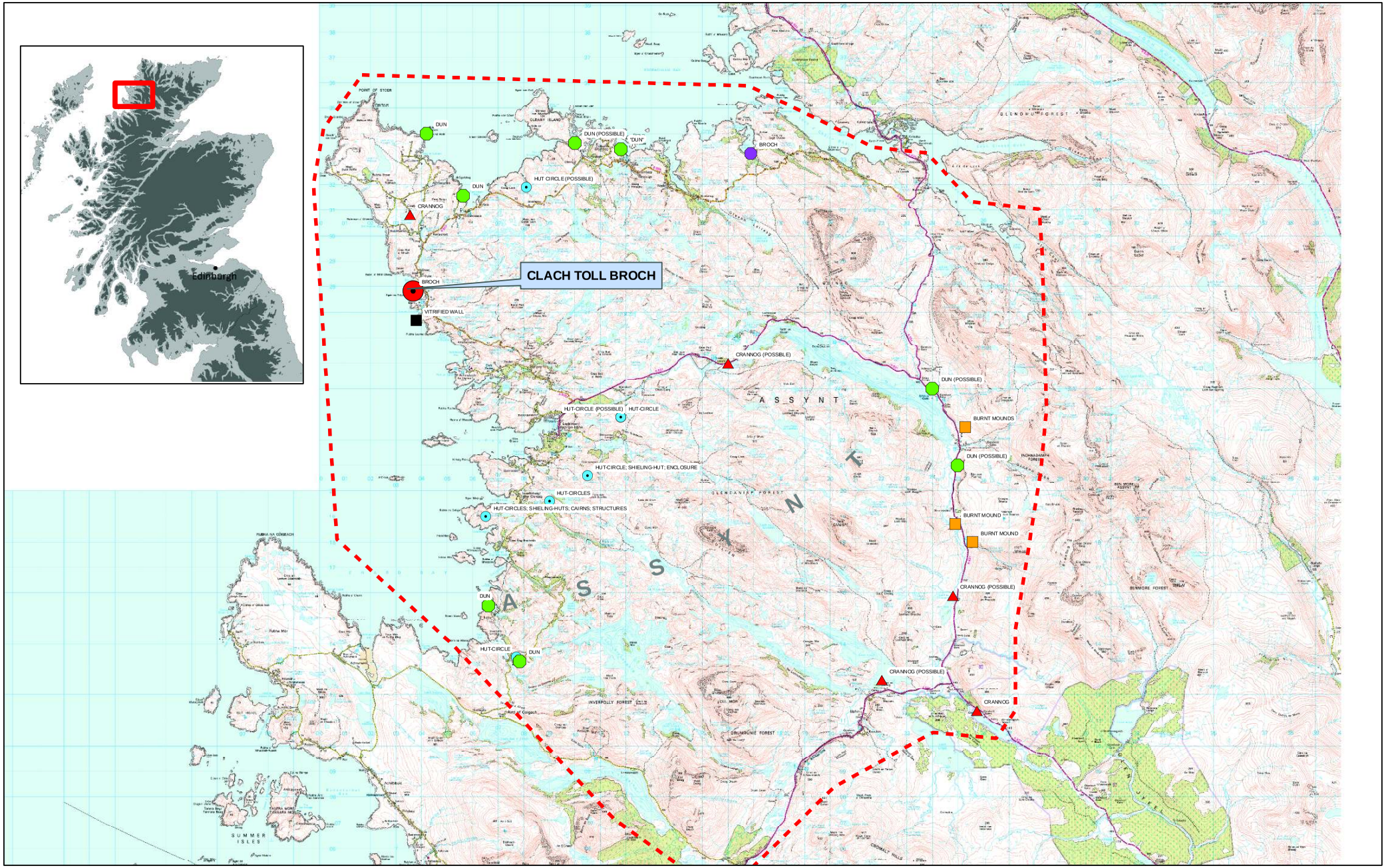

0 1.25 2.5 5 7.5 10 Kilometers

FIGURE 1:
Assynt: later prehistoric sites listed in the NMRS

Legend

Clach Toll Broch

Later Prehistoric Sites

CLASS

- Duns
- Brochs
- Burnt Mound
- Crannogs
- Hut Circles and related features
- Vitrified Wall

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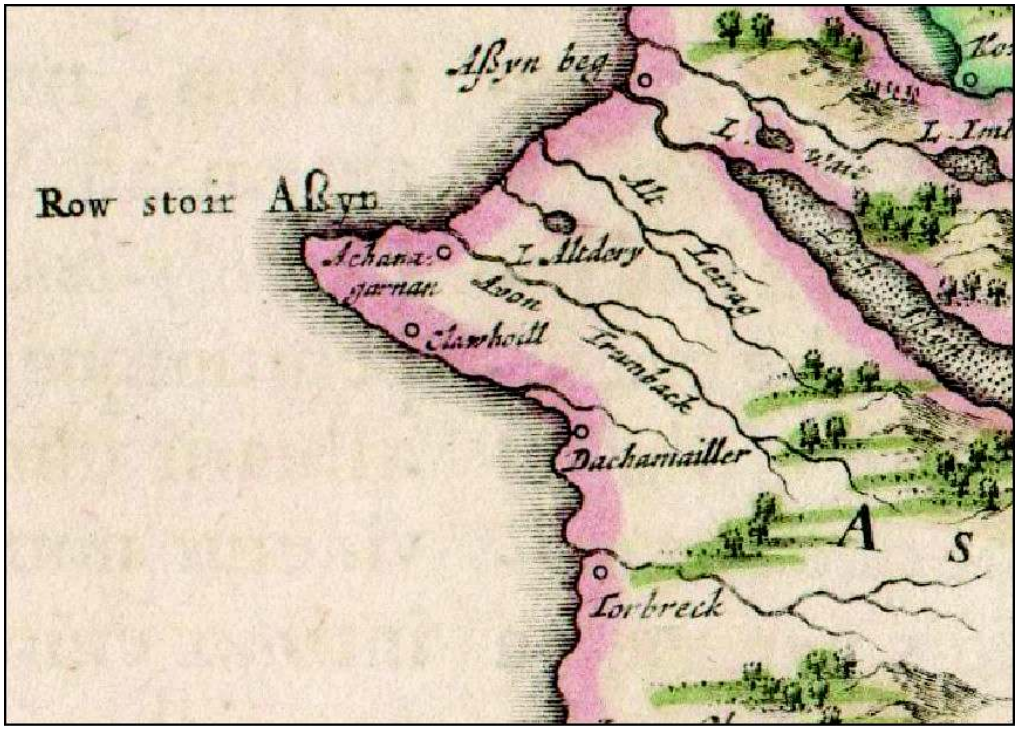


Figure 2: Map 1, Blaeu, Joan/Gordon, Robert, 1654

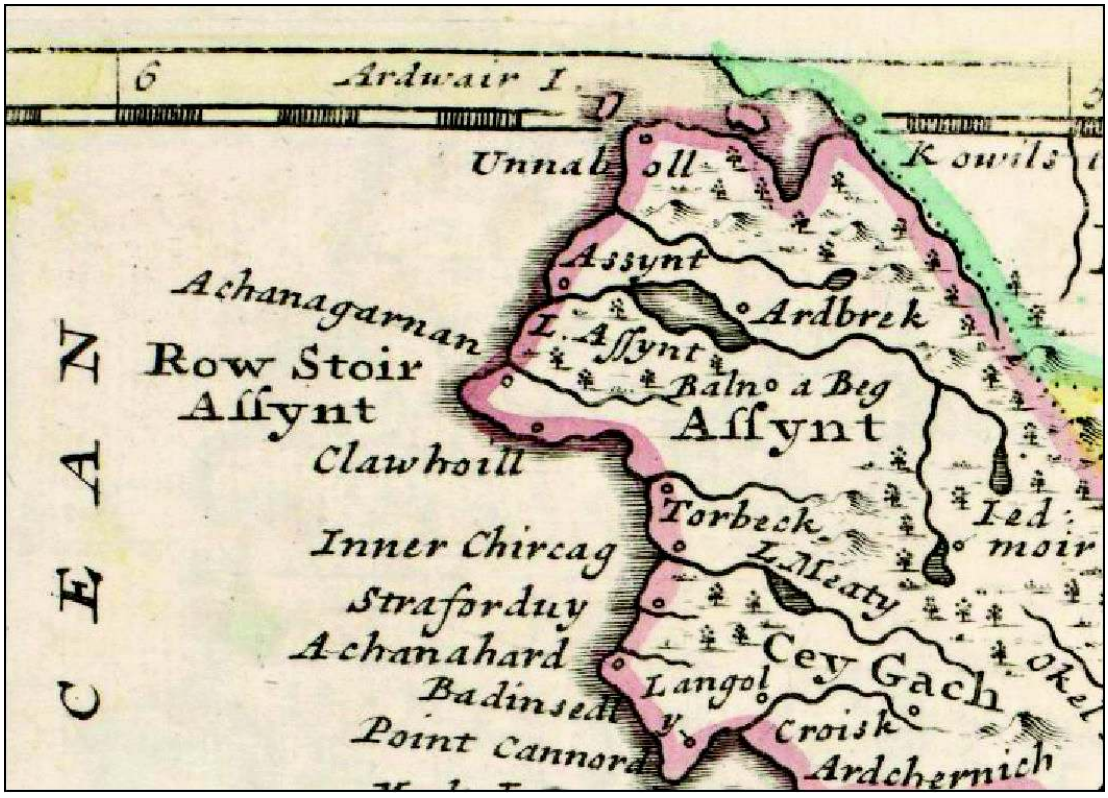


Figure 3: Map 2, Moll, Herman 1745, The Shires of Ross and Cromartie

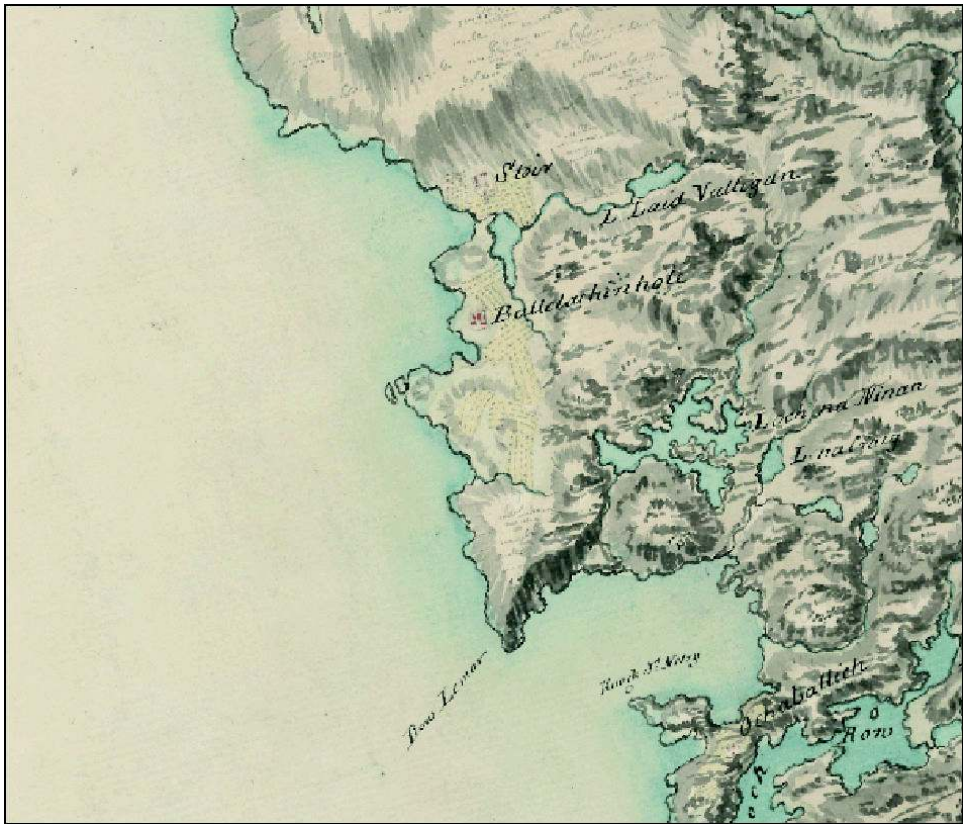


Figure 4: Map 3, Roy 1747-55, Roy's Military Survey of Scotland

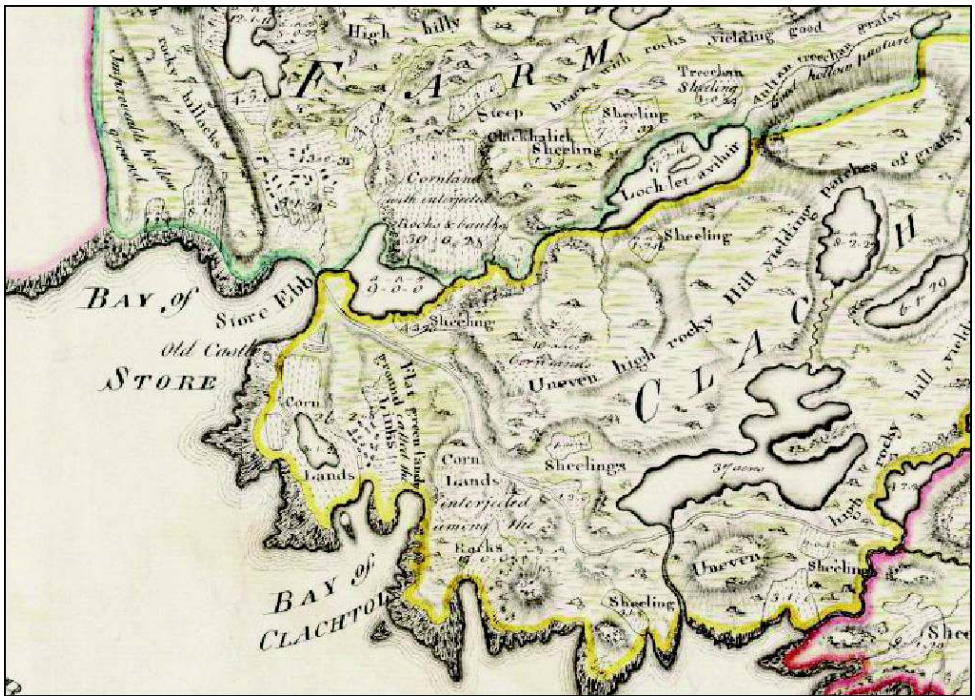


Figure 5: Map 4, Home, John 1774, John Home's Survey of Assynt in 1774. No. 3 - A Plan of the Farms of Storie [Stoer], Clachtoll, and Auchmelvich [Achmelvich]

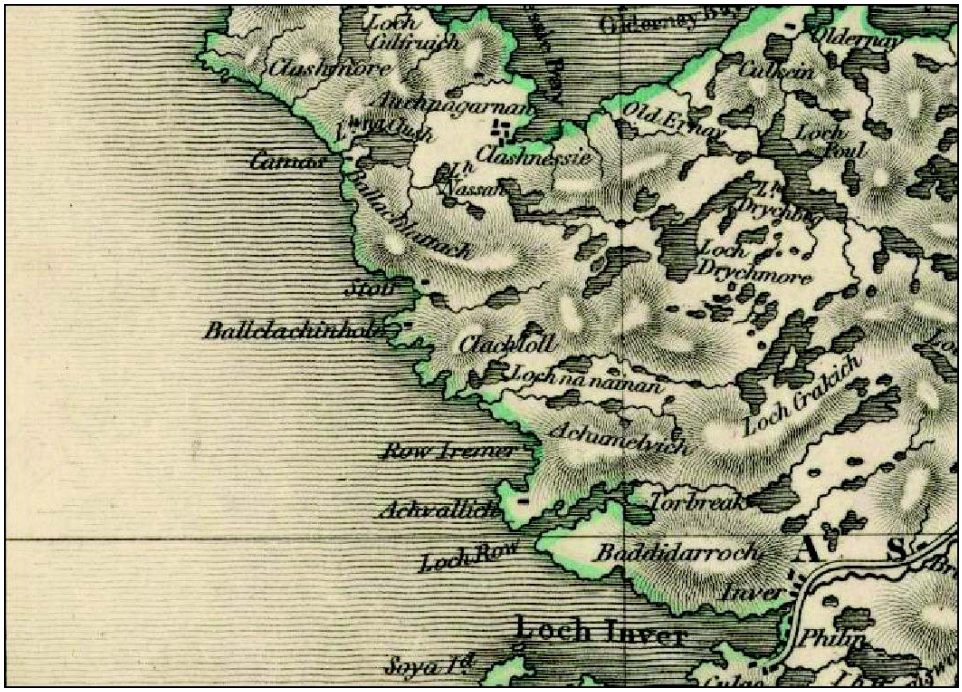


Figure 6: Map 5, Thomson, John 1832, Sutherland Shire

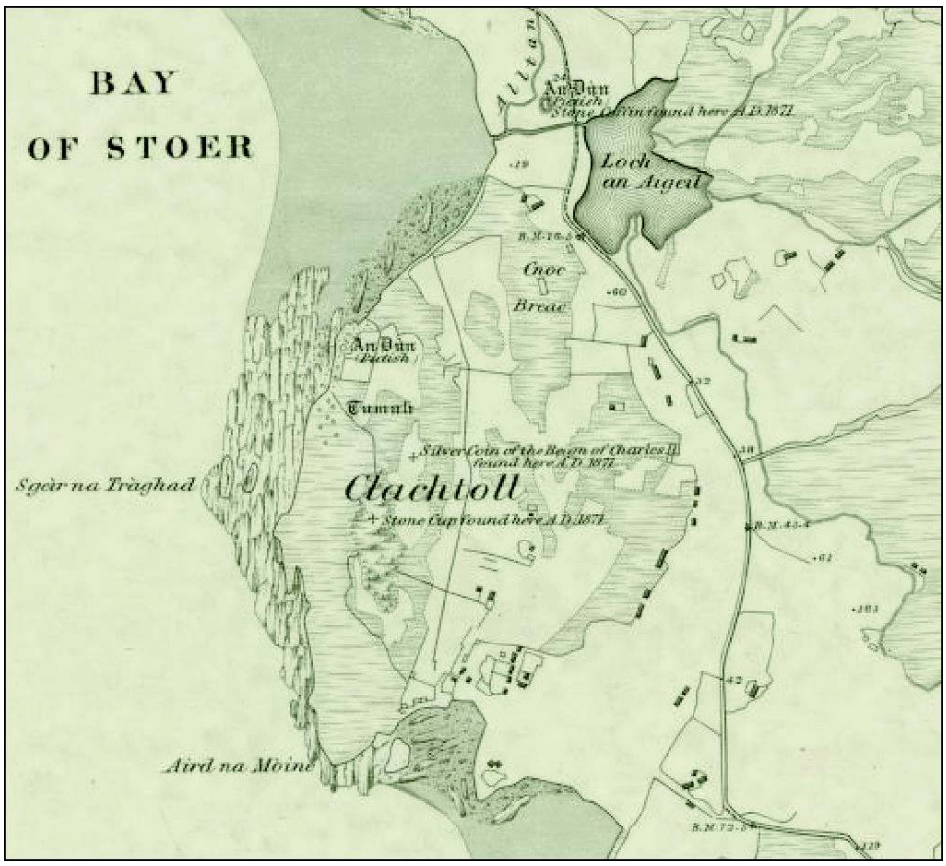


Figure 7: Map 6, Ordnance Survey 1878, Sutherland LVIII 1:10,560

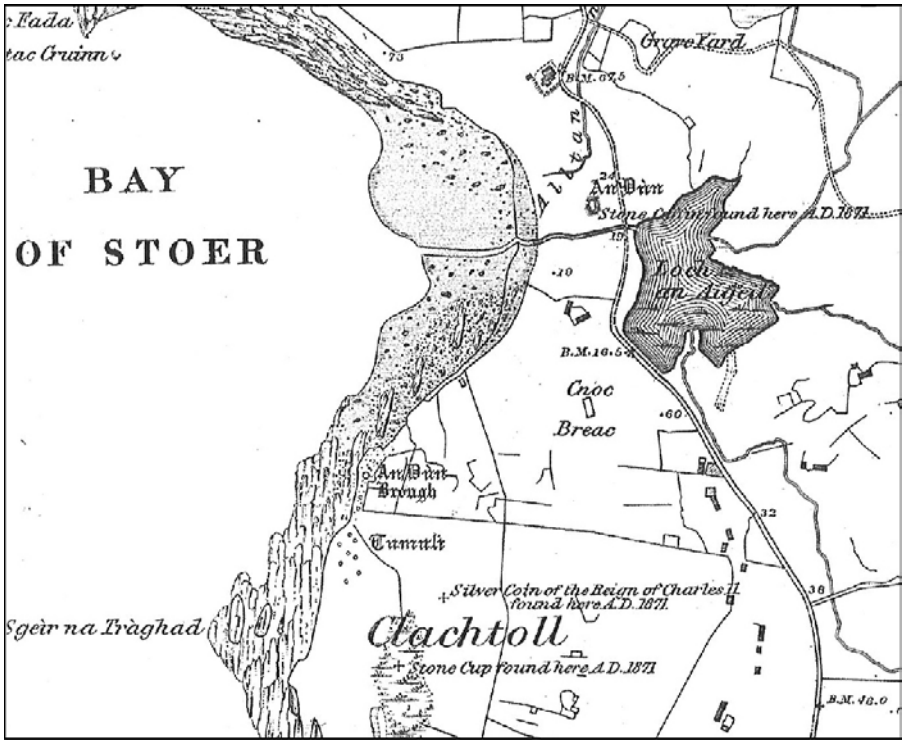


Figure 8: Map 7, Ordnance Survey 1907, Sutherland LVIII 1:10,560

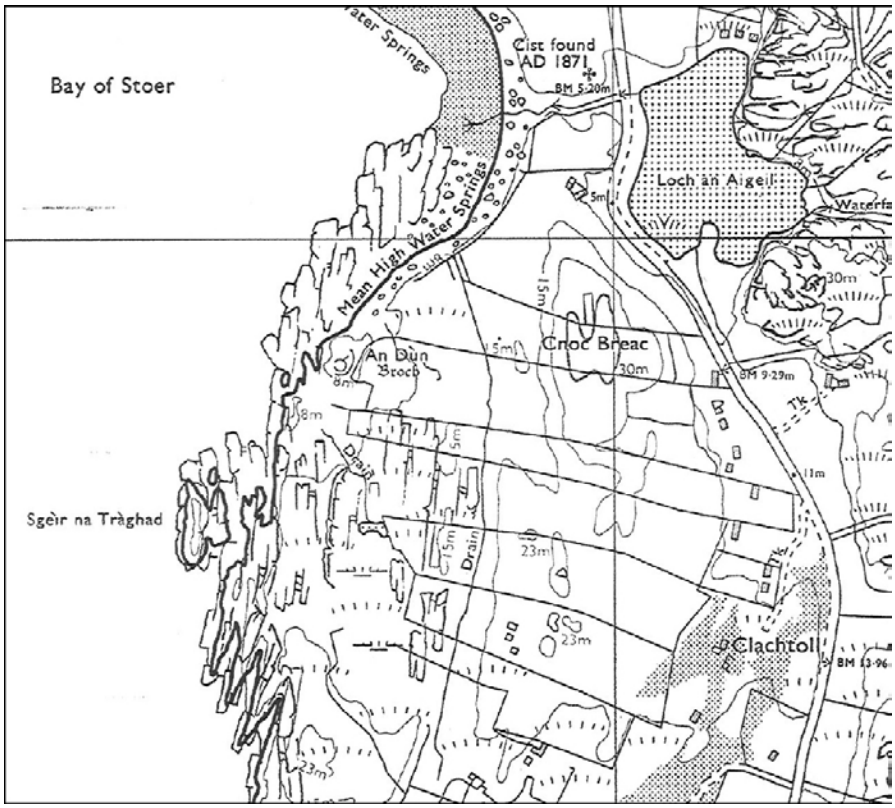
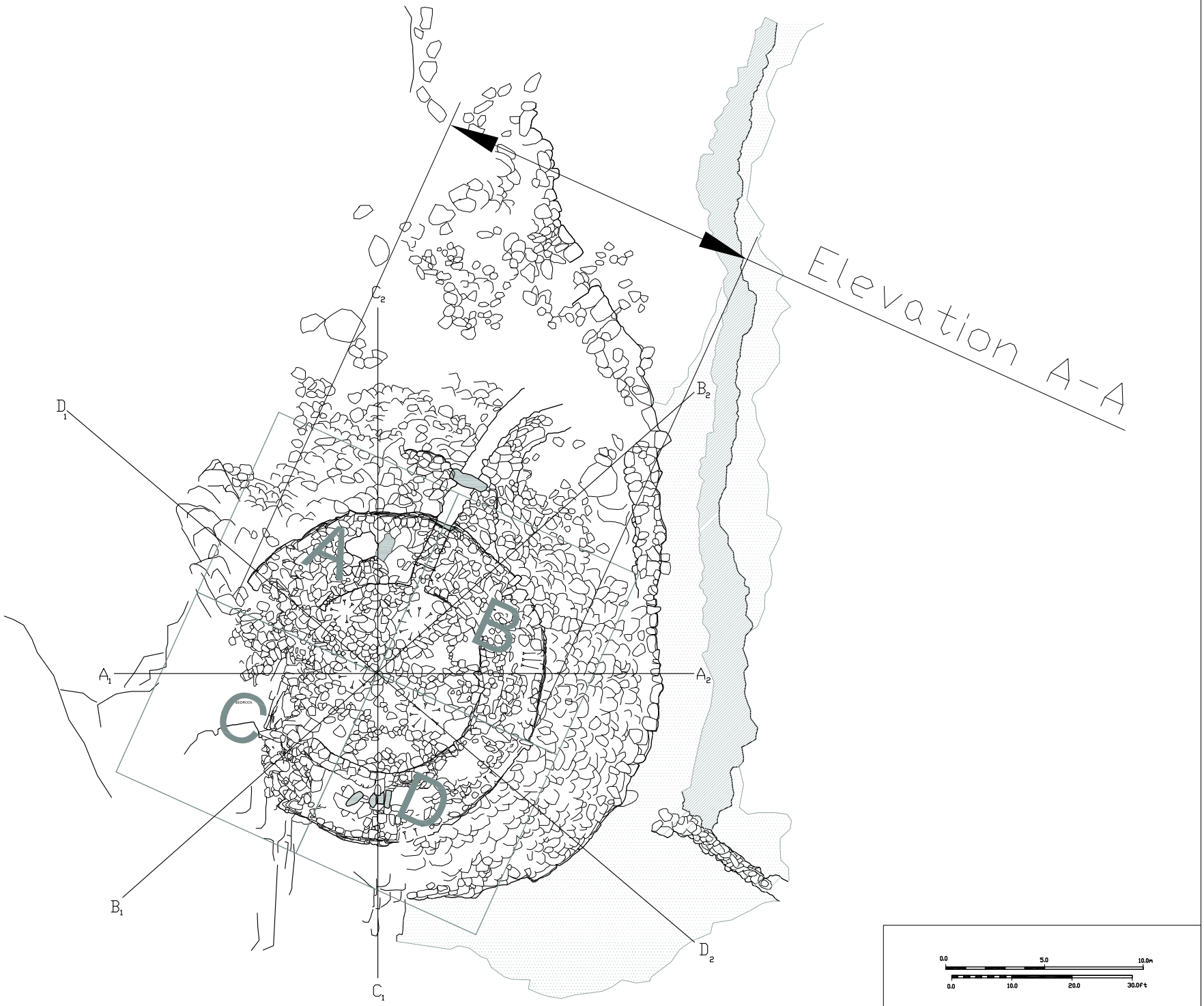


Figure 9: Map 8, Ordnance Survey 1971, Sutherland NC02 NW 1971

General Notes

An Dunan broch, Clachtoll

FIGURE 10: Site plan



Survey & Drawing:
G. Cavers & G.Hudson

No.	Revision/Issue	Date
	0/1	12/08

Firm Name and Address

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Edgefield Road,
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EH20 9SY.

Project Name and Address

An Dunan, Clachtoll

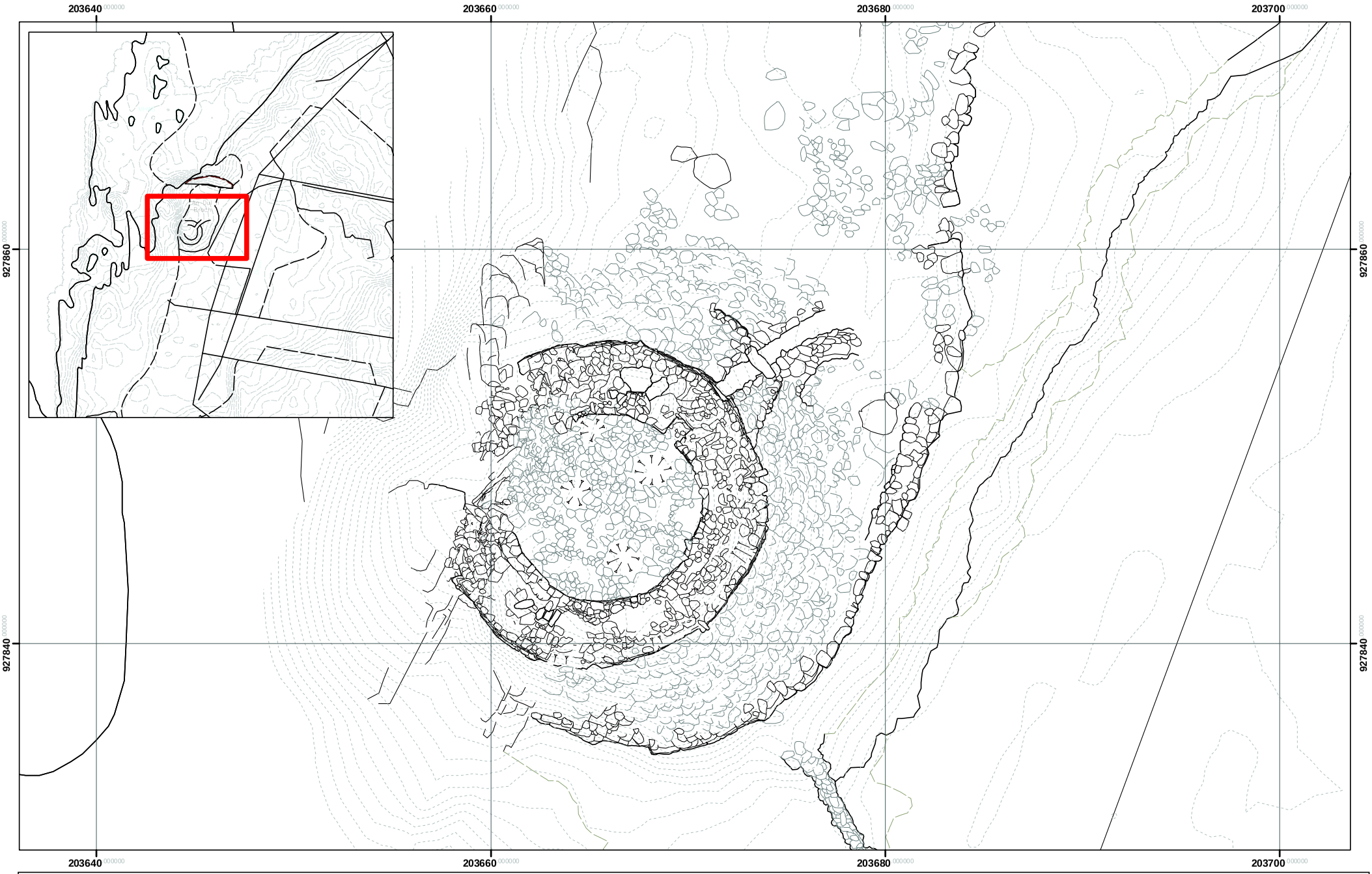

Figure 11: Clach Toll, georeferenced survey plan

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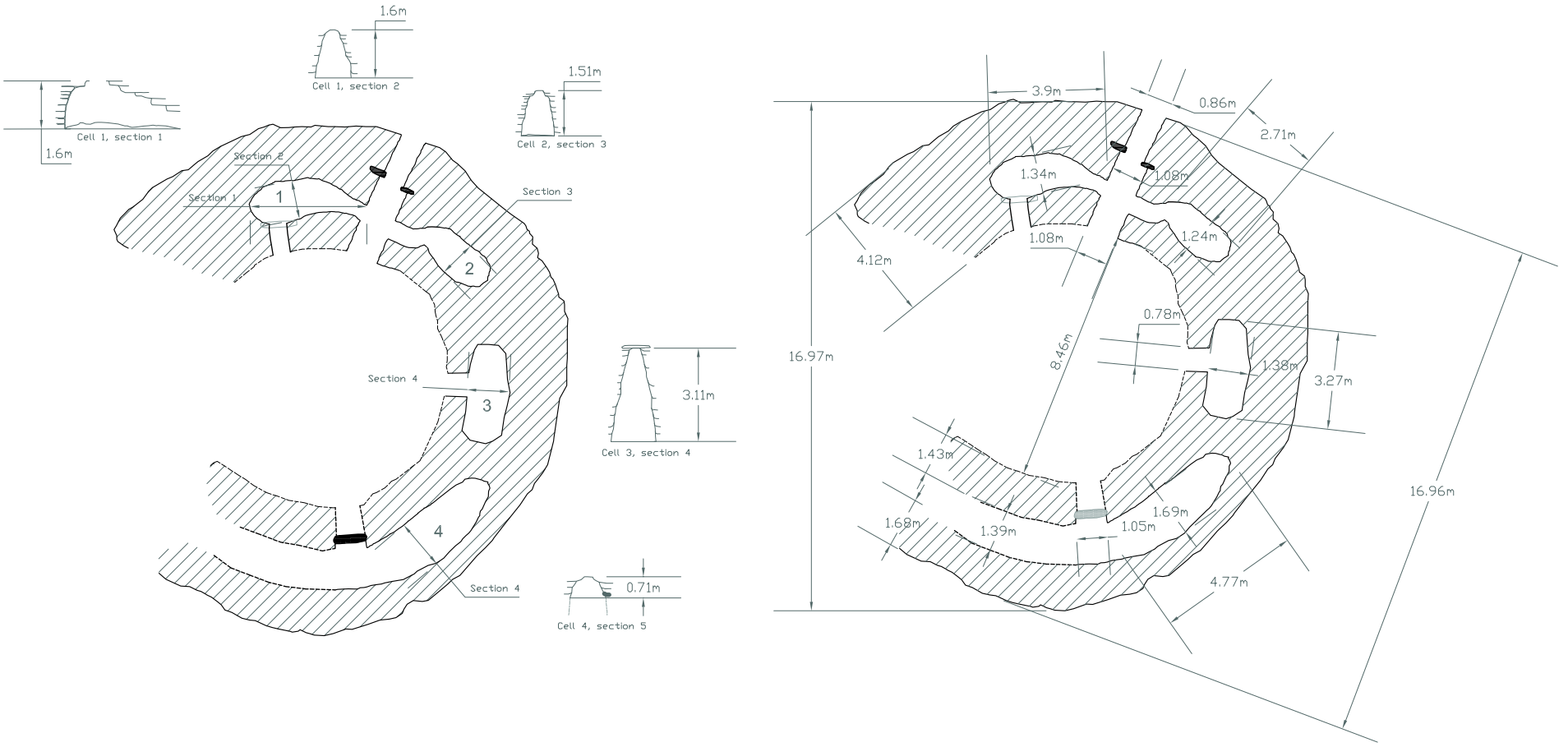

General Notes

An Dunan broch, Clach Toll
Assynt

FIGURE 12:
Cell profiles & lower level plan

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	0/1	

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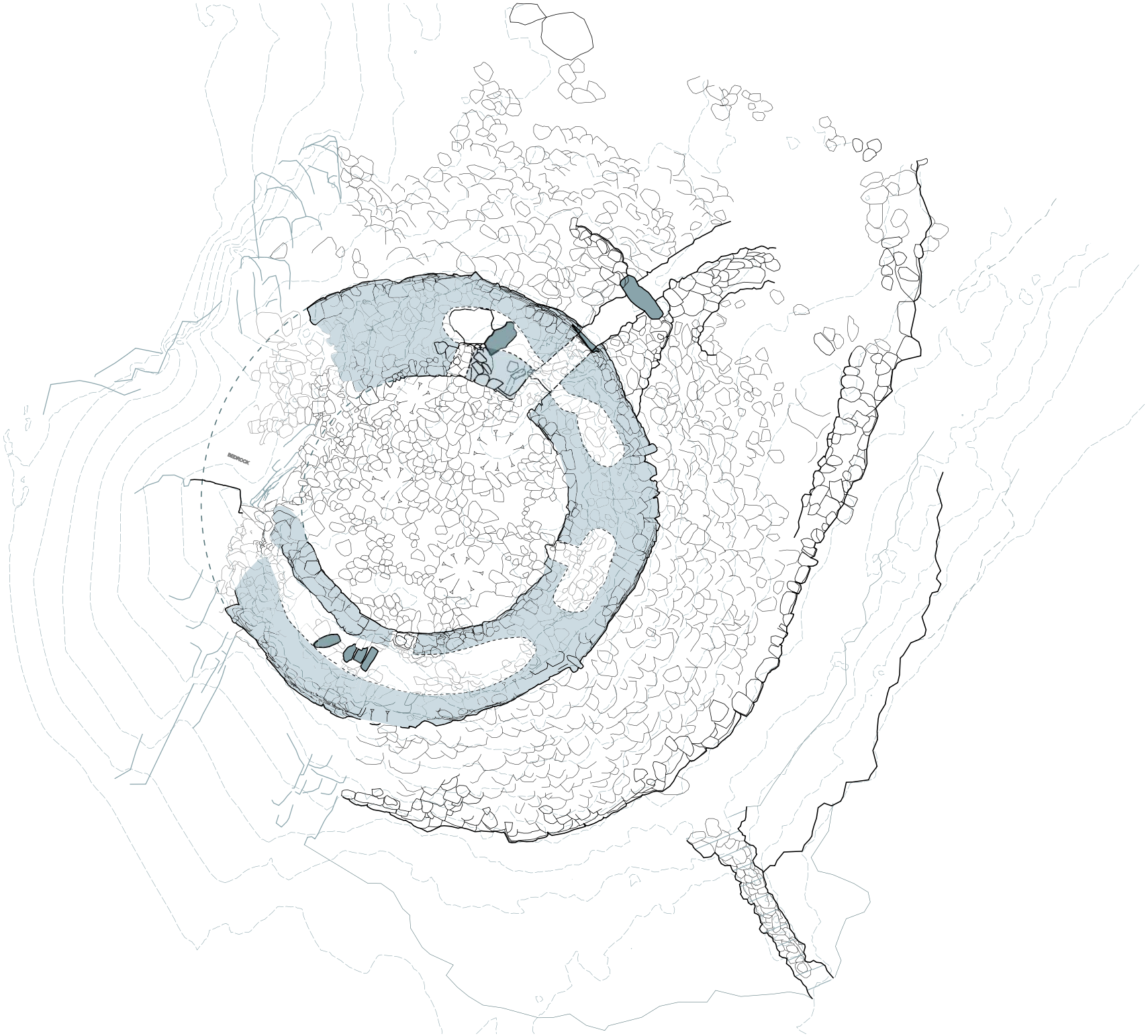
Project Name and Address
Clach Toll Broch

Project	Sheet
AOC 20867	
Date: January 2009	
Scale	



General Notes

An Dunan broch, Clach Toll
Assynt

Ground plan with cell positions

0.0 3.0m

0.0 10.0ft

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No	Revision/Issue	Date
	0/1	

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Clach Toll Broch

AOC 20867

January 2009

Figure 14: Clach Toll, laser scanned model of the entrance façade.

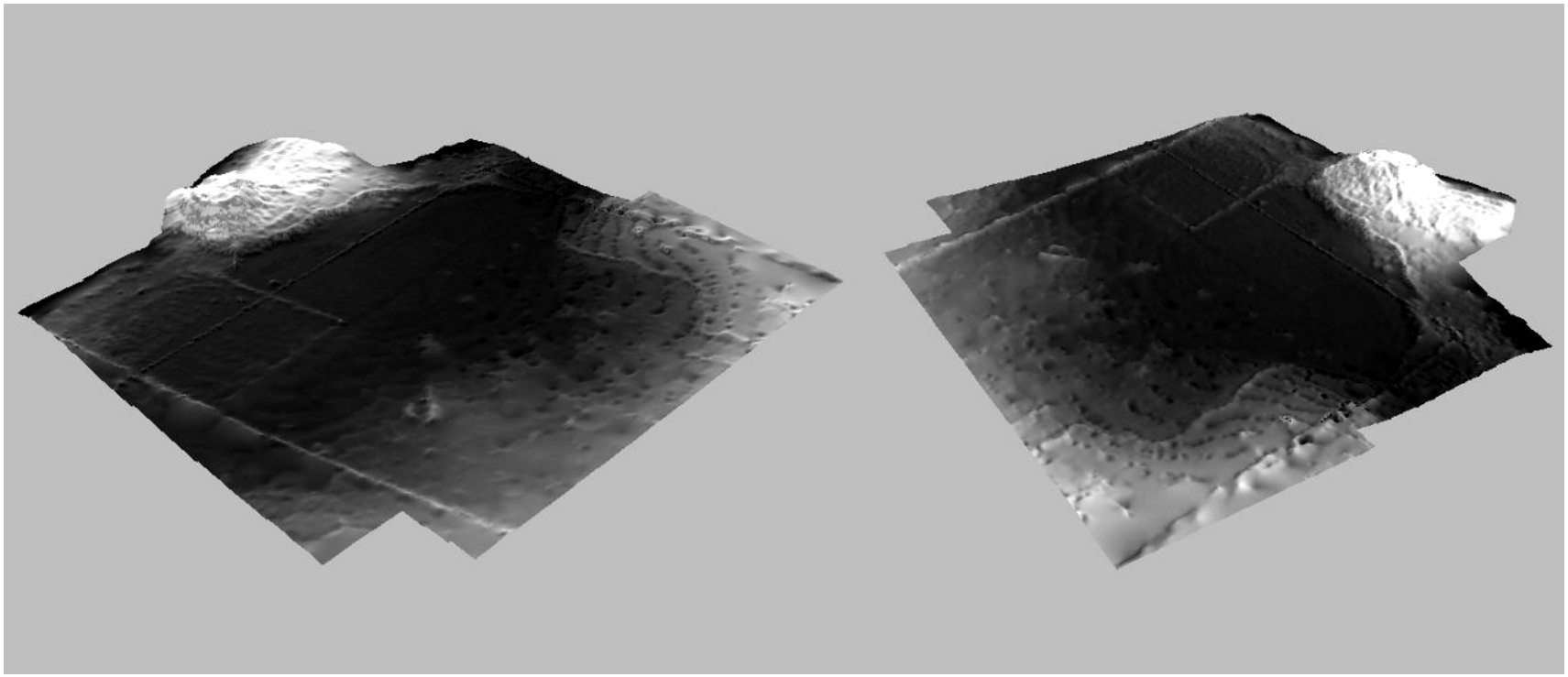
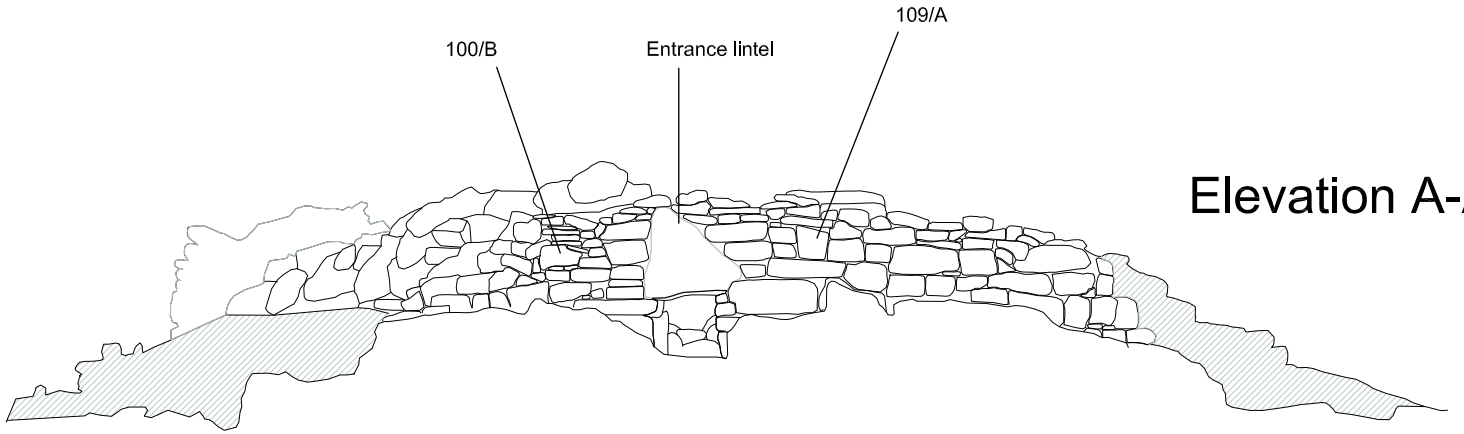


Figure 15: Clach Toll, digital elevation model (DEM) of the site and its immediate environs.



Elevation A-A

General Notes

An Dunan broch, Clach Toll
Assynt

FIGURE 16:
Entrance elevation AA

0.0 3.0m

0.0 10.0ft

AOC Archaeology Group

Survey & Drawing:
G. Cavers & G.Hudson

No.	Revision/Issue	Date
	0/1	

Firm Name and Address

AOC Archaeology
Edgefield Industrial Estate,
Edgefield Road,
Loanhead,
Midlothian,
EH20 9SY.

Project Name and Address

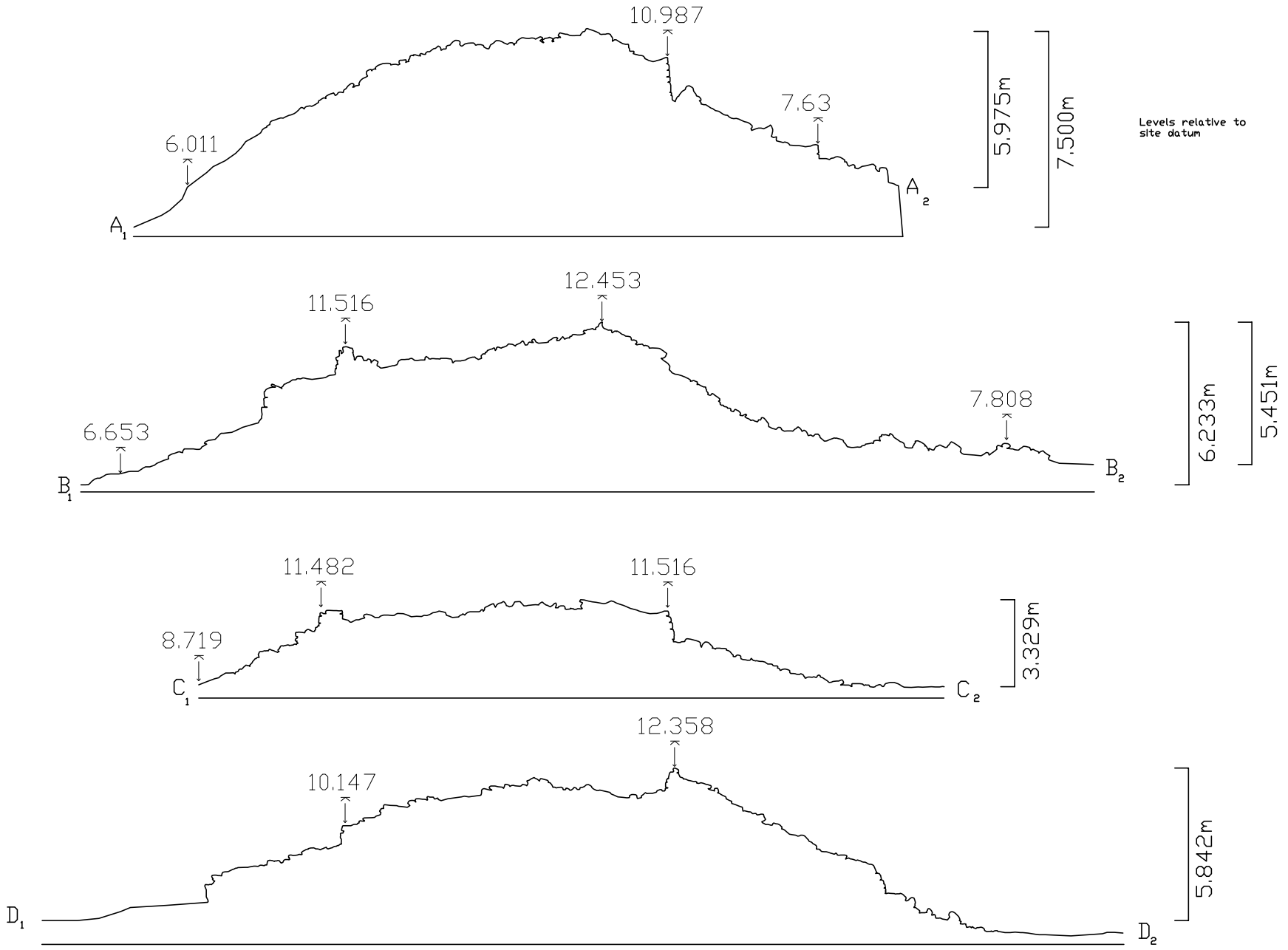
Clach Toll Broch

Project
AOC 20867

Date
January 2009

Scale

Sheet



General Notes

An Dunan broch, Clach Toll
Assynt

FIGURE 17:

Cross sections through broch (see Fig.2 for locations)

Levels in m OD

0.0 3.0m

0.0 10.0ft

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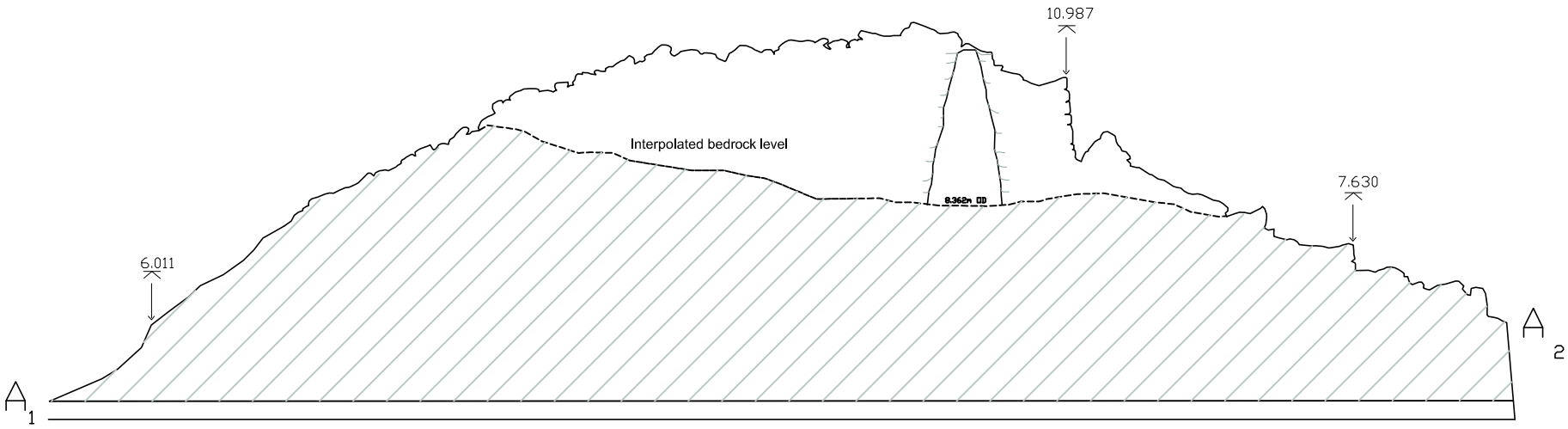

General Notes

An Dunan broch, Clasch Tuil
Assynt.

Cell profiles & lower level plan

0.0 3.0m

0.0 10.0ft

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Project	Sheet
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Date	
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Scale	

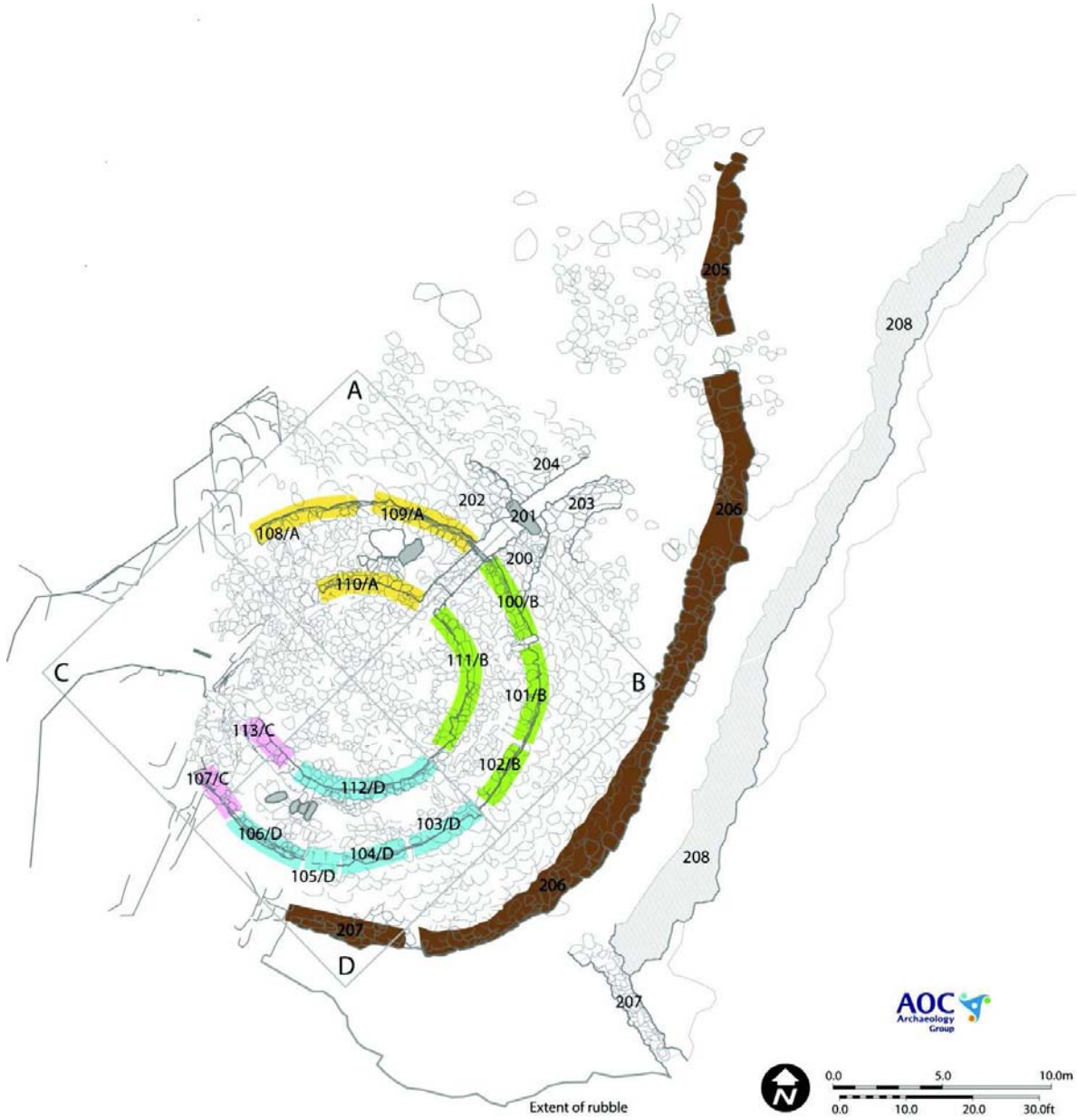


Figure 19: Plan of broch with labels applied during the survey.

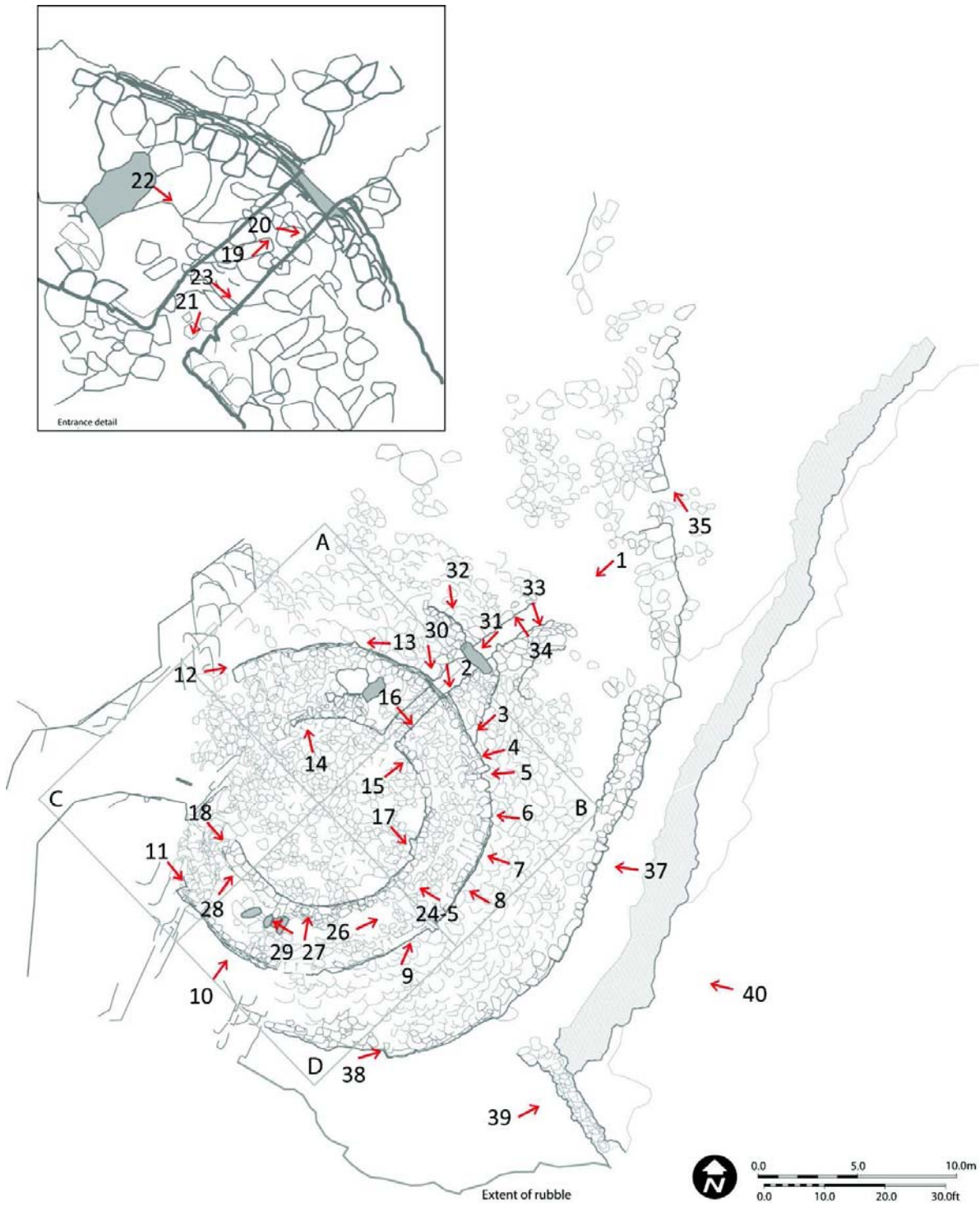


Figure 20: Locations and orientations of plates.

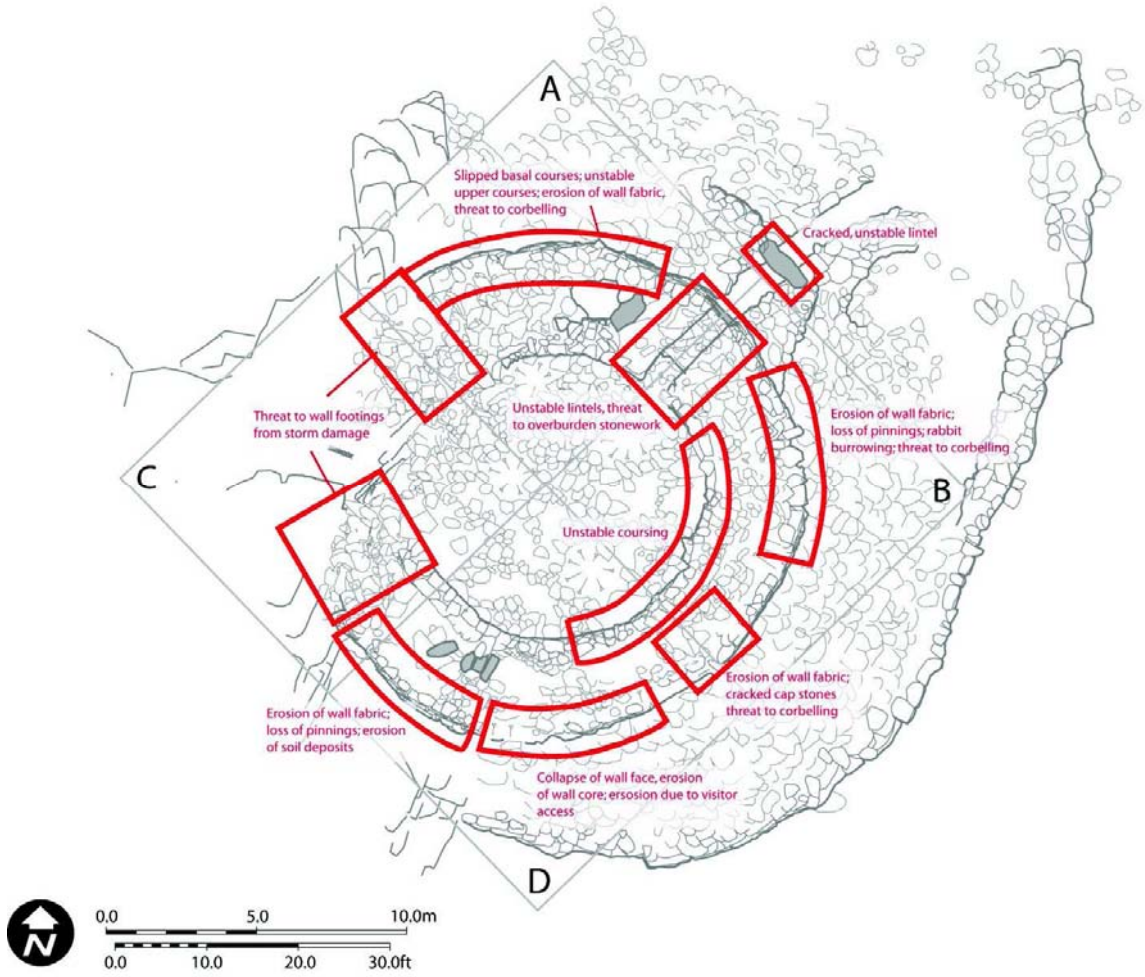


Figure 21: Summary of the treats to the monument identified and their locations

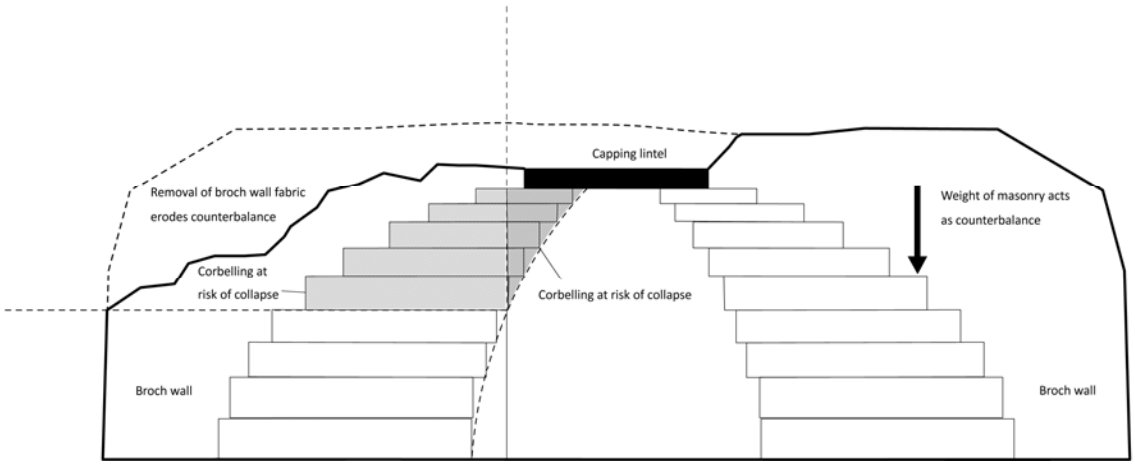
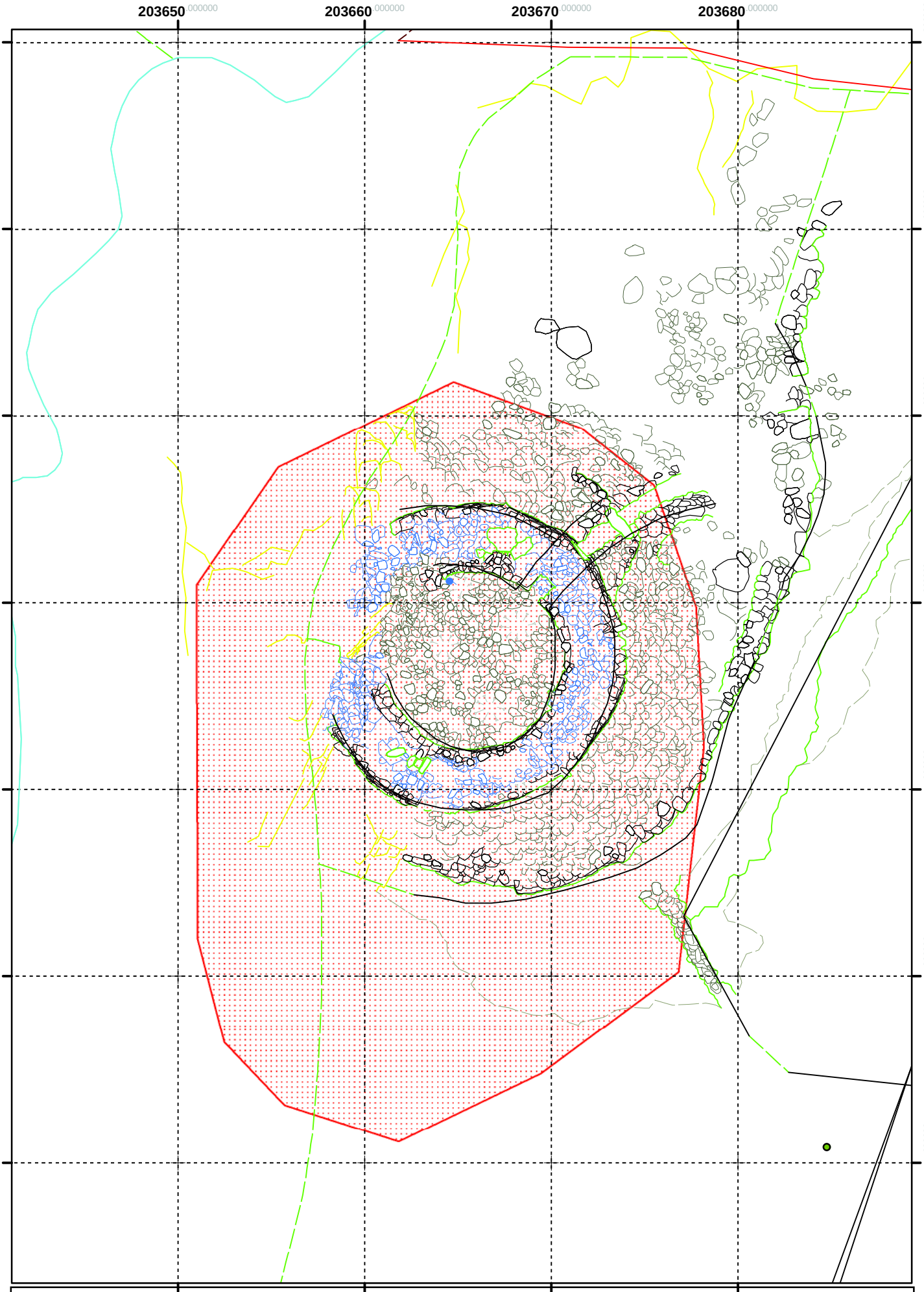


Figure 22: Schematic representation of intramural corbelling and its destabilisation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203660.000000
203670.000000
203680.000000
927880.000000
927870.000000
927860.000000
927850.000000
927840.000000
927830.000000
927820.000000
0
10
Meters
Figure 23: Clach Toll broch: Scheduled Area
Scheduled
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