The Wonderboom Acheulean Site:

2021 – 2022 Field Report

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Executive Summary

The Wonderboom Acheulean site (Gauteng Province) was recently permitted by Drs. Matthew V. Caruana and Matt G. Lotter of the University of Johannesburg to conduct archaeological excavations. The South African Heritage Resource Agency awarded an excavation permit (ID: 3263) for a three year period in May, 2021. Here, we report on our first year of archaeological research at the site, which included sampling for cosmogenic nuclide burial dating and excavations to collect stone tools. We recovered >1000 stone tool artefacts, which are now housed at the Palaeo-Research Institute in the University of Johannesburg (South Africa) for study. Below, we provide a brief history of the site and detail our research interests and field operations.

Introduction

The Wonderboom Acheulean site is situated within the eastern extent of the Magaliesberg (Gauteng Province) and is part of the UNESCO Magaliesberg Biosphere World Heritage Site (Fig. 1). It is further located in the 'Friends of Magalies' Mountain Bike Trails Park, which is ~6.6 km northeast of the Tshwane Metro city center (Fig. 1B). Wonderboom was first identified as a stone tool site by Edwin Hanish (a local school teacher) in 1955, after a road was cut into a colluvial accumulation within the Wonderboom Valley. Sometime after, the Archaeological Society of South Africa (a group of amateur enthusiasts) began excavating the colluvium, and they eventually alerted Revil Mason (Archaeological Survey, University of the Witwatersrand) to their activities. Mason (1957, 1958) visited Wonderboom and the deposit as a quartzite rubble (i.e., colluvium), rich in ESA tools and lithic debris, constrained to the southern slopes of the valley covering >650 m^2 (9 × 76 m) with an average depth of 3 m or more (Mason, 1957, 1958).

In 1960, Mason (assisted by Beaumont) excavated a test trench of 1.8 × 2.7 m (6 ft by 9 ft), proceeding in arbitrary 7.6 cm (3 inch) spits to bedrock at approximately 3 m and recovered ~15,000 artefacts (see Mason, 1962). He identified three samples from arbitrary levels within the lower, middle and upper portions of the colluvium for comparison to identify any 'cultural change'. Mason (1962) concluded that there was no such change from 'Early' to 'Late/later' Acheulean technology, and that typologically speaking, the Wonderboom tools were similar to the Bed III assemblage form the Cave of Hearths, which was the 'type site' for the later Acheulean period in South Africa. Mason's stone tools collections from the site were housed at the University of the Witwatersrand and eventually stored in the Origins Center. However, there remain no radiometric ages for Wonderboom and thus the scientific value of the artefacts is lessened and the site has largely been ignored in archaeological literature focused on the African Earlier Stone Age.

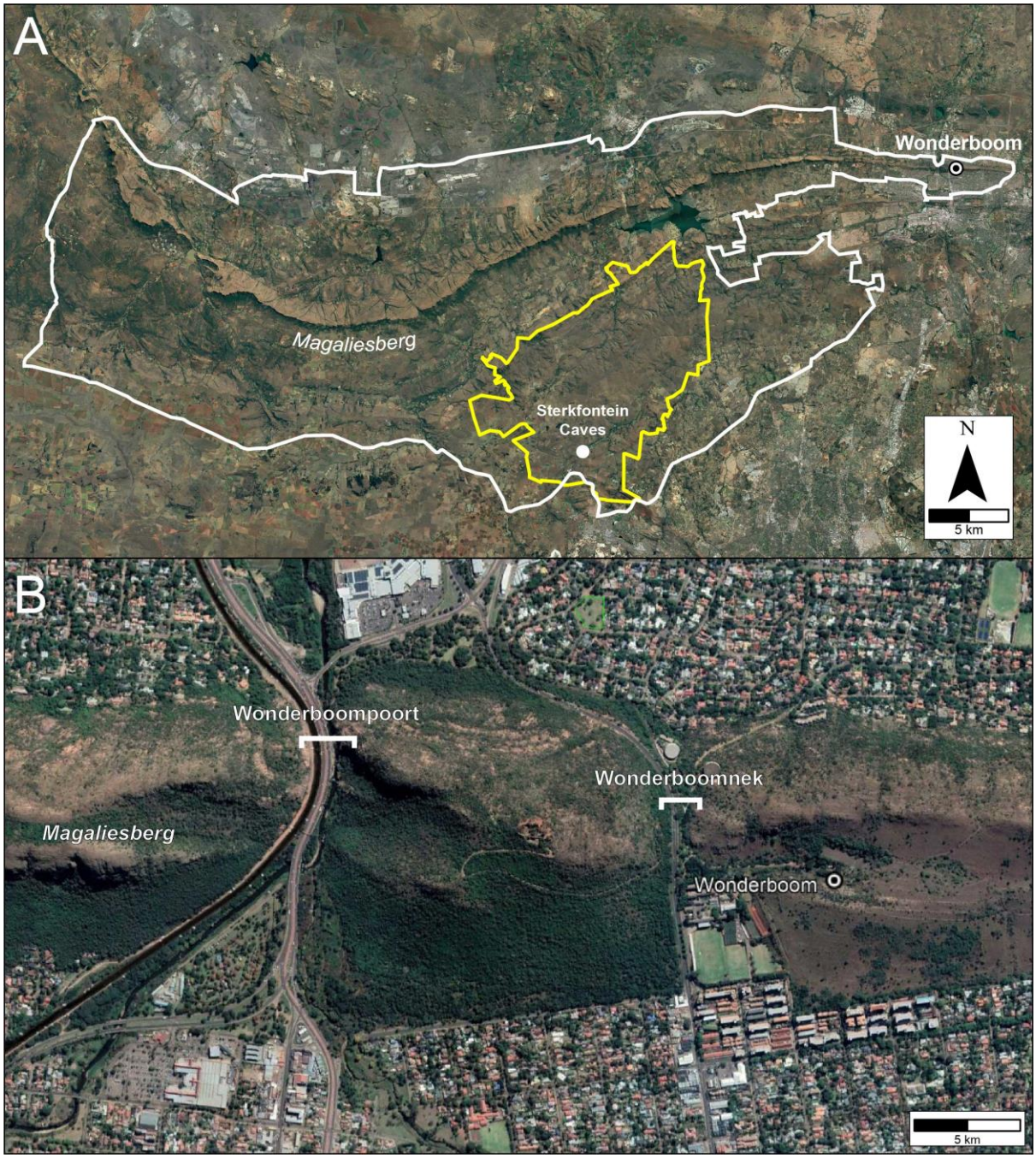

Figure 1. Context map. A) The location of Wonderboom within the Magaliesberg Biosphere (white) and relative to the 'Cradle of Humankind' boundary (yellow). B) An orthographic photo of the Wonderboom Valley, showing the site in relation to the 'nek' and 'poort'.

In 2019, Drs. Matthew V. Caruana, Matt G. Lotter and Timothy R. Forssman, in collaboration with Prof. Marlize Lombard, contacted Prof. Anton van Vollenhoven to locate the Wonderboom site. They found Mason's excavation square and discovered a concrete plaque with handaxes and cleavers embedded into it, which was likely created by the Archaeological Society of South Africa or Mason himself (Fig. 2). Later in 2020, MVC, MGL and TRF sorted and borrowed the Large Cutting Tool (LCT; i.e., handaxes, cleavers, picks and knives) assemblage

Figure 2. Wonderboom site. Photo showing the cement plaque that identified Mason's excavation square. MGL is standing in Mason's excavation square. The datum 'WBMD2' is depicted for reference (see maps below).

from Wonderboom for analysis. MGL led a publication on these artefacts and it was decided that a formal project would be created to increase the scientific relevance of the site (Lotter et al., 2022). Despite there being over 30 known Acheulean localities in South Africa, few of them are radiometrically dated (see Kuman, 2007). Thus, efforts to increase chronological resolution of the Acheulean industry in the southern African region are important for understanding the timing of early hominin occupation and technological evolution.

Site Context

Geology, Geography and Stratigraphy

The Wonderboom site is located within the Pretoria Group, comprised of quartzites, shales, dolerites that were deposited on top of the Kaapvaal Craton (Archean Basement Complex) (Caruthers, 2012). Within the Wonderboom valley, two quartzite ridges (situated to the north and south) sit on top of an eroded diabase sheet (Fig. S1) (Mason 1957, 1958; Lotter et al., 2022).

The stone tool deposit is then comprised of a colluvial 'rubble' that accumulated on the valley floor, although the dates of this event(s) remains unknown. As stated above, the colluvium is >650 m^2 (9 × 76 m) with an average depth of 3 m and is comprised of a poorly-sorted, clast-supported matrix (Fig. 3). Clasts range from boulder to pebble in size, which were exfoliated from the ridges above. The colluvium extends across the valley, although only the southern side of the deposit contains large amounts of stone tools. Surveys of the surrounding area found no concentrations of stone tools in any direction.

Figure 3. Wonderboom colluvium. Tape measure extended to 30 cm.

Mason's excavation site is approximately 480 m east of the Wonderboomnek, which is a saddle in the mountain range and 1.64 km from the Wonderboompoort, which is an erosional gap bisected by the Apies River. Mason (1958, 1962) hypothesized that the poort may have functioned as a funnel for passing ungulate herds, and early hominins ambushed passing animals to acquire meat on a seasonal basis (see Lombard et al., 2021). This may explain the restriction of the stone tool accumulation in the surrounding area, although the 'hunting hypothesis' requires further investigation and some form of tangible evidence to prove.

Research Summary

After our initial exploration of the Wonderboom collections housed at the University of the Witwatersrand, we decided to form a research project focused on dating the colluvial deposit and excavating a new sample of stone tools. Our primary questions are:

1) Did the colluvium accumulate rapidly and represent a debris-flow event, or gradually and represent an earth-flow event?

2) What is the age of the accumulation and can this produce minimum age constraints for the production and/or discard of the archaeology?

3) Is there a transition in Earlier to Middle Stone Age technocomplexes preserved at the site?

To address questions regarding the timing and nature of the colluvial accumulation, we decided that cosmogenic nuclide burial dating would be best suited to produce reliable dates for the deposit given its clast-rich structure. We contacted Dr. Tebogo Makhubela (University of Johannesburg) to collaborate with us and carry out this dating work. Sampling from the top to bottom of the colluvium would help us understand the timing of the accumulation. If the returned dates that were close in mean value and error margins, this would suggest a rapid accumulation event (i.e., debris-flow). If the samples returned dates that were disparate in mean value and error ranges, this would suggest a gradual accumulation (i.e., earth-flow).

Once ages for the deposit were attained, we could then provide context for the archaeology. Primarily, age ranges would provide some chronological constraint, albeit a minimum age for the deposition of the archaeology. However, the weathering patterns of a newly excavated sample of artefacts would provide perspective on the timing of their incorporation into the colluvium. Fresh to slightly weathered artefacts would suggest that the time between discard and incorporation into the colluvium was relatively short. Moreover, Mason (1957, 1958, 1962) suggested that only Acheulean lithic materials were found at Wonderboom. Controlled excavations and new ages could be used to test this hypothesis and to see if perhaps a Middle Stone Age component is also present within the colluvium.

In 2021, we applied for an excavation and destructive sampling permit from the South African Heritage Resource Agency (permit ID: 3263). Shortly after, MVC was awarded an African Origins Platform grant (#: 136509) from the National Research Foundation, South Africa to fund our studies of Wonderboom. In June 2021, we then travelled to the Wonderboom site and agreed that exposing Mason's excavation area was the best approach to sample for cosmogenic dating and for excavation. However, this area was filled in with sediment slump and over October 2021, we hired workers from the Ngomo Game Reserve, near Krugersdorp, to clear it and re-expose Mason's excavation squares.

The Digital Coordinate Grid

We set up a digital grid using a Leica differential geographic positioning system (DGPS) and Nikon Nivo 5.C total station (TS) (Fig. 4). To create permanent datums, we used a Hilti drill to sink holes into four places surrounding Mason's excavation area, we then filled these holes with rockset and set in steel nails (Fig. S2). These datums were labelled 'Wonderboom Mason Datum' (WBMD1, WBMD2, etc.), and georectified onto the Universal Transverse Mercator (UTM) coordinate system (Zone 35 South). To achieve this, we first set up the DGPS over WBMD1 and WBMD2, and let this machine collect data from satellites for approximately 2 to 3 hours.

Figure 4. DGPS. A Leica Differential Geographic Positioning System set up over the WBMD1 datum.

We then recorded the Cartesian coordinate (X,Y,Z) in the TS and set up over a known point. We used the following setting to establish our grind in the TS: 1) north-facing azimuth; 2) grid increases north and east; 3) meters as units of distance; and 4) degrees as units of angles. We established our grid according to True North (a stable cardinal direction) rather than Magnetic North, which changes with the Earth's electromagnetic field. The magnetic declination in this area is -18°39' (compass bearing 341.61°) so to correct for this, we used a compass to orientate the face of the TS to 341.61° and shot to a temporary back-site, which oriented the grid towards True North. We used a 1 cm chit on the ground to act as our back-site, which was removed afterwards and thus it is not a permanent fixture. We then shot in all remaining datums at UTM coordinates (Fig. 5).

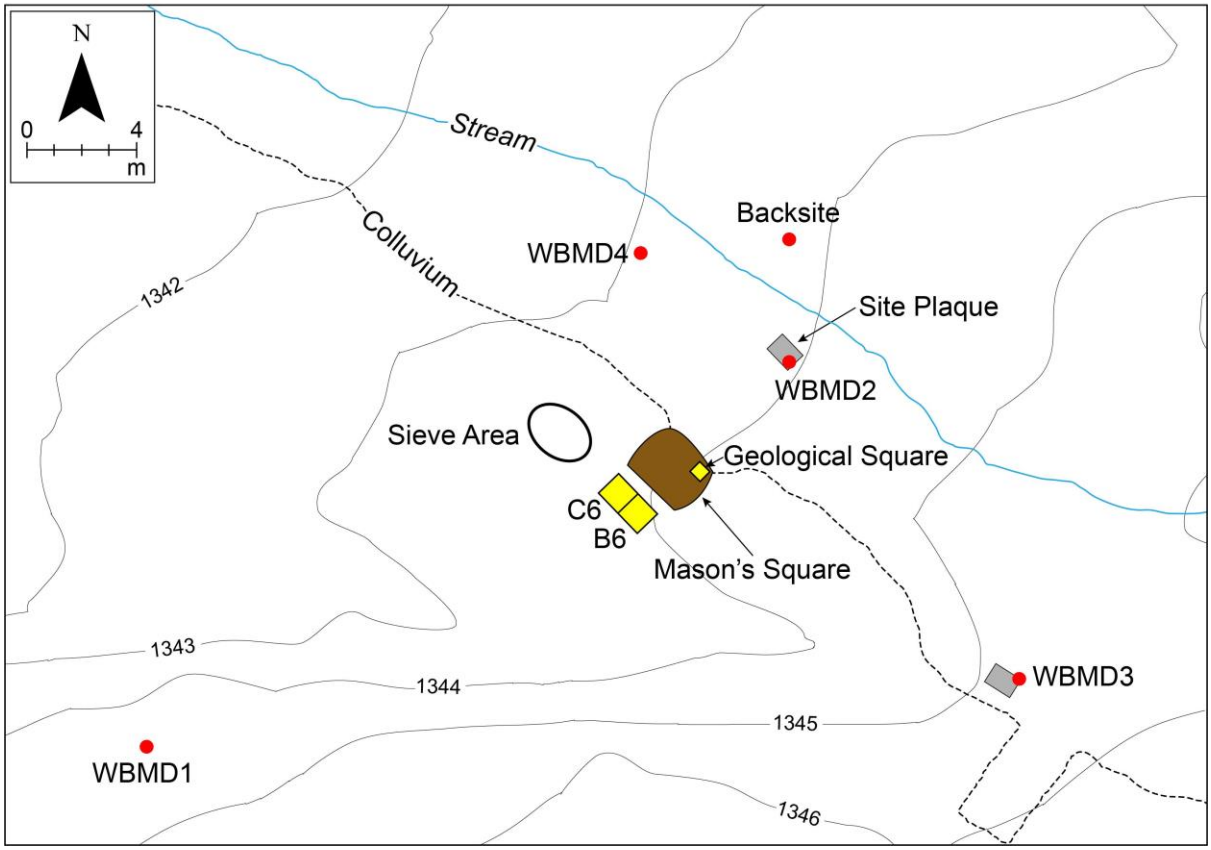

Figure 5. Site Plan. Planview map of the excavation area, including datums (WBMD#). Elevation measured in meters above sea level.

Destructive Sampling for Dating

In November 2021, MVC and MGL accompanied Dr. Makhubela to Wonderboom, and he extracted both sediment and clast samples from six places, ~50 cm apart, beginning from 2.8 m in depth (Fig. S3). Six sediment and six clast samples were collected, resulting in 12 cosmogenic dating samples. While generating ages for the Wonderboom deposit, Dr. Makhubela is also testing differences in the reliability of these types of samples (i.e., sediment versus clasts) in cosmogenic nuclide dating techniques. These samples have since been cleaned in Dr. Makhubela's lab, and they have since been shipped to Dr. Stephan Winkler (Helmholtz-Zentrum Dresden-Rossendorf Institute, Germany) to perform accelerated mass spectrometry in effort to isolate and measure aluminium and beryllium isotopes.

Excavation Protocols

Over July 4th to the 31st, we initiated excavations at Wonderboom, on the top of the south profile of Mason's excavation square. We set in a 2x1 m square and used a 'local' labelled convention, where each square was assigned a number and letter (Fig. 6). To do this, we created an arbitrary grid coordinate, 6 m to the northeast of the surface targeted for

excavation. This local grid increases south and west to potentially include excavation areas in future. Our two squares were labelled B6 and C6, respectively, which were further divided into four 50x50 cm quadrants (Fig. 7).

We set the grid ~3 cm south of the edge of Mason's excavation profile, because of undercutting below within the profile due to heavy rains. After the excavation grid was

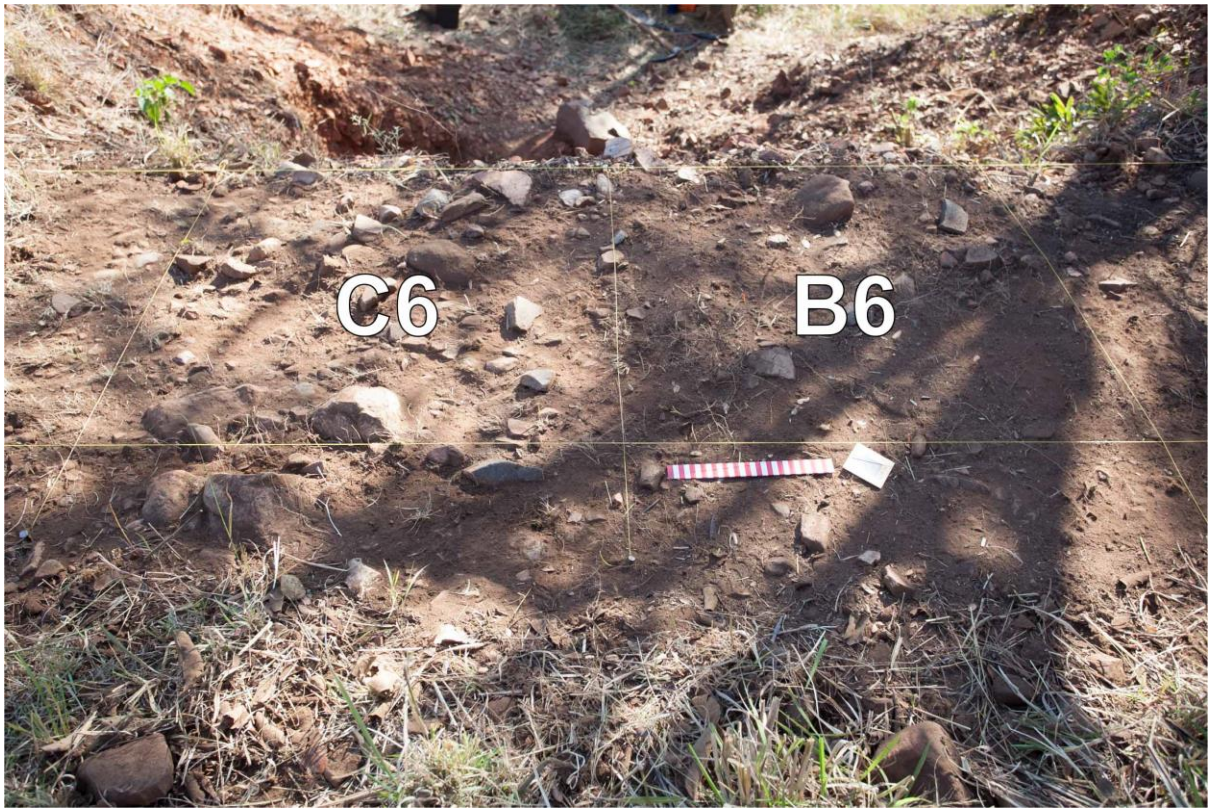

Figure 6. Excavation squares.

constructed, we then mapped in our square corners, nails heads and lines to georectify them onto our digital UTM grid (Fig. S4). Our sieve station was located approximately 5 m to the west of the excavation grid to limit carrying buckets of excavated sediments over long distances (Fig. 8). We used a 3 mm sieve screen to capture any small flaking debris, although due to the nature of the quarzitic substrate, we did not anticipate being able to identify flaking debris small than 1-2 mm.

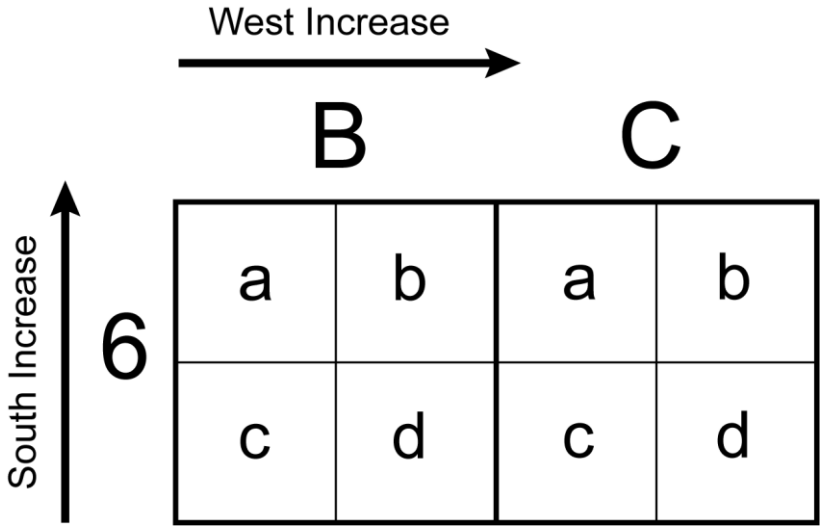

Figure 7. Local grid plan. Square naming convention based on a local grid (using numbers and letters) that increases south and west. Squares labelled by capital letter and corresponding number, and quadrants labelled by lower-case letter.

We excavated each square one quadrant at a time, and given the lack of any stratigraphic integrity within the deposit, we decided to excavate in arbitrary 10 cm spit depths. Each spit surface from the ground going down was mapped in with the TS. After each spit surface was reached, we then removed the adjacent portion of profile wall, ~2-3 cm in width, which was labelled as 'wall collapse'. All artefacts over 2 cm were mapped, along with 'buckets' of excavated sediments that were taken to the sieve station. Each plotted artefact received a unique 'WB#' point number, which was recorded with its provenance information (square and quad #s) on an excavation tag (Fig. 9). Every time a bucket was filled with sediment, a point in the middle of the quadrant was mapped with the TS, and assigned a 'bucket number' (WBBK#) to record a general coordinate for all corresponding sieve finds (Fig. 9). We then boxed all artefacts by their square number and spit depth to preserve their 'stratigraphic' positing for analysis.

***Figure 8**. Sieve station.*

To better understand site formation, MGL collected data relating to fabric analysis and sediment samples for testing grain size, shape and chemical composition. The fabric data was collected through piece plotting tabular or flat-ellipsoidal, clasts or artefacts (>2 cm in length) that were either 'elongated' (length is twice the width) or 'flat' (thickness if less than half of width). Each piece that it these criteria was plotted at either end to digitally record its dip and orientation, along with cardinal orientation taken with a compass. Three sediment sample bags were collected from each spit level to run future tests.

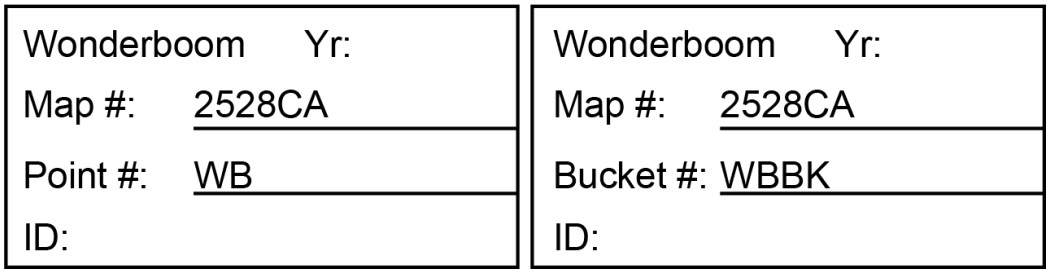

Figure 9. Tags. Example of excavation tag for plotted finds (left) and a bucket tag for sieve remains (right).

We excavated 50 cm (5 spits) in B6 and 40 cm (4 spits) in C6 and recovered 1046 piece plotted artefacts that were mapped with the TS, as well as shot in 103 buckets (Fig. 10). We also collected 18 sediment samples from our excavated spits across the two squares. All recovered artefacts and sediment samples were taken to our laboratory at the Palaeo-Research Institute, University of Johannesburg for analysis, which will be carried out from December 2022 to March 2023.

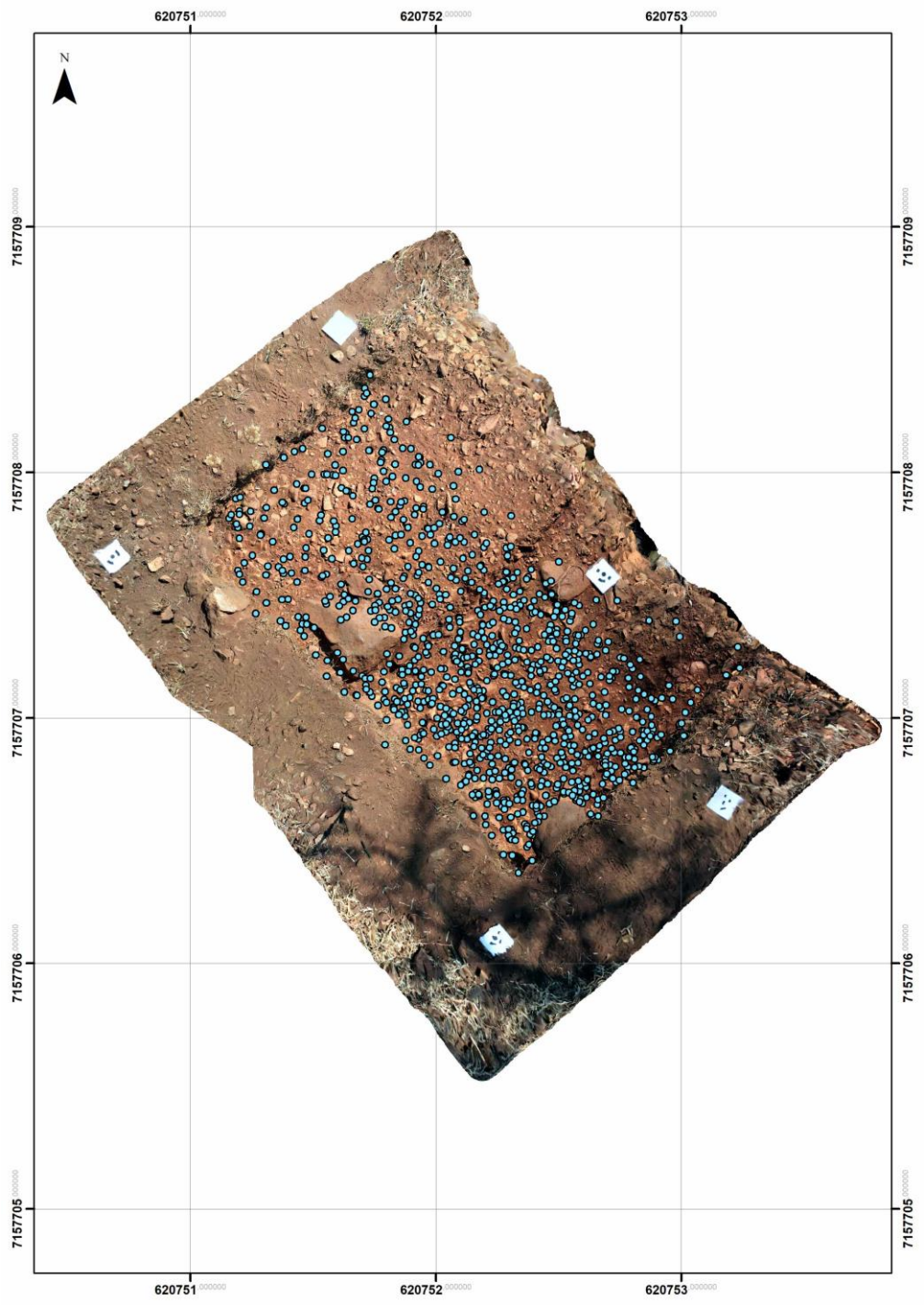

Figure 10. Plotted Finds. A Geographic Information Systems (ArcGIS) map of plotted finds (blue dots) from the Wonderboom excavation, geo-rectified onto a UTM grid (squares= 1 meter).

We also excavated a small 50x50 cm geological square in the northeast corner of Mason's square to search for bedrock, which was reached at a depth of ~30-35 cm below the square floor (Fig. 11).

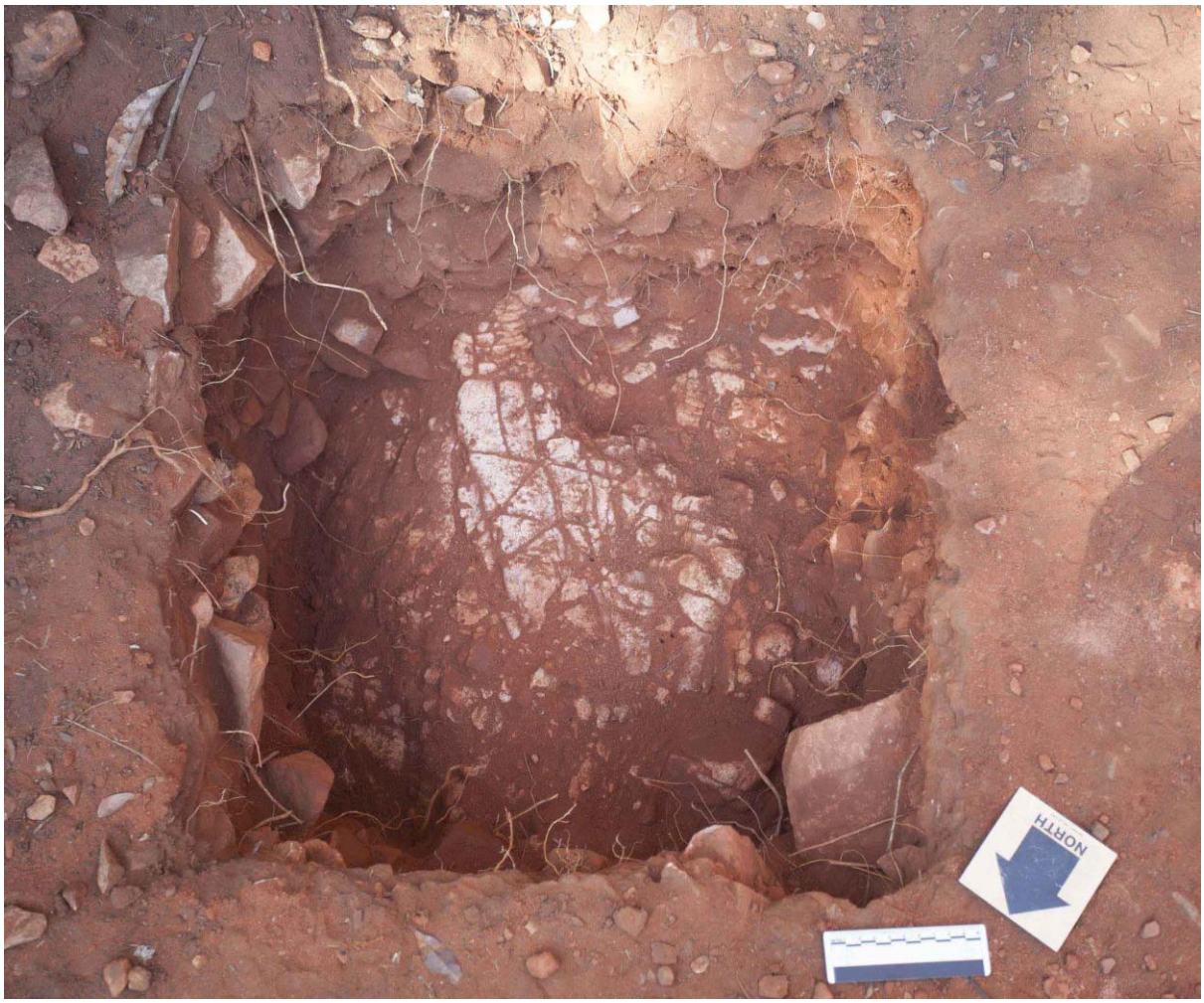

Figure 11. Geological square.

Site Management

On July 29th, we ended our excavation season and the site was protected with geotextile fabric to allow rainwater to evaporate, which was then covered with sandbags filled with sediments from our sieve pile (Fig. 12). MVC will periodically visit the site over the coming year to ensure that our protection measures last throughout the year.

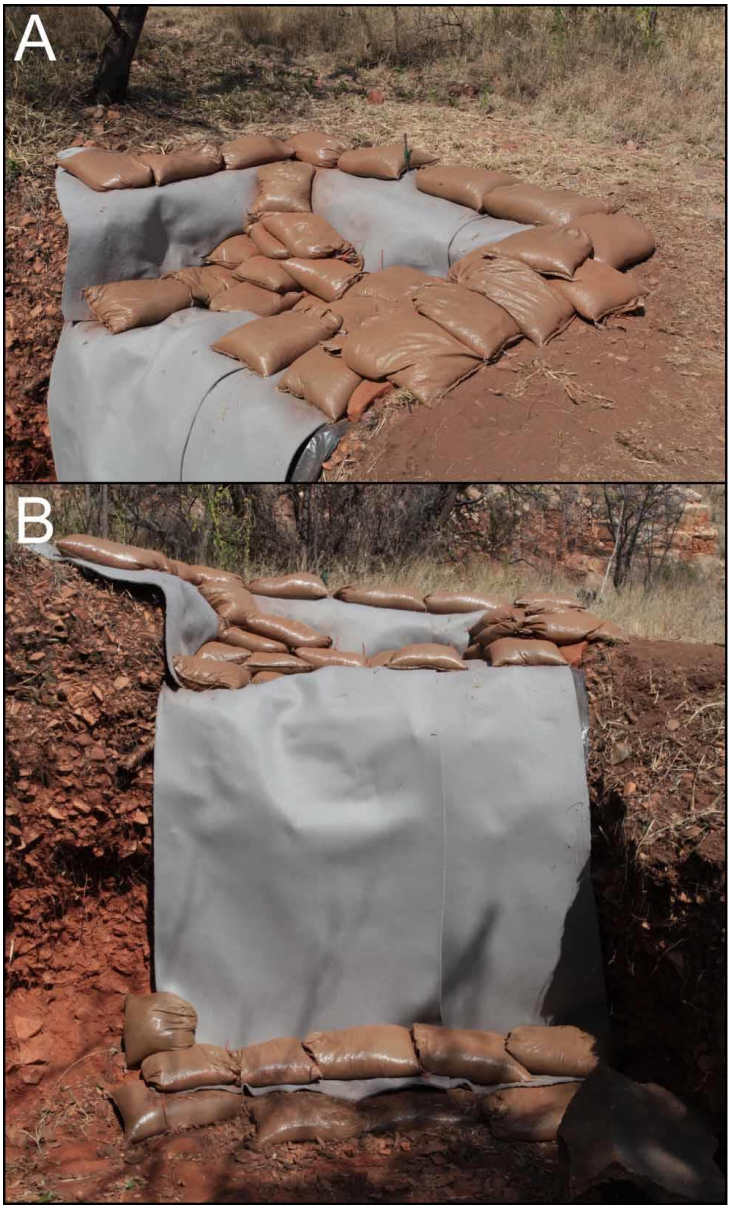

Figure 12. Site Closure. Geotextile fabric and sandbags were used to cover and protect the excavation squares. A) a sideview of the protected excavation squares; B) south-facing photograph showing the protection of the profile wall.

Publications

To date, we have published two papers in peer-reviewed, international journals on Mason's collections from Wonderboom, with one submitted manuscript:

Lotter, M.G., Caruana, M.V. and Lombard, M., 2022. The Large Cutting Tools from Wonderboom, South Africa. *Lithic Technology* 47(2): 117-132.

Lombard, M., Lotter, M.G. and Caruana, M.V., 2021. Wonderboompoort, South Africa: A Natural Game Funnel for Meat Harvesting During the Later Acheulean. *Journal of Archaeological Science: Reports* 39: 103193.

Caruana, M.V., Lotter, M.G., Lombard, M. A Techno-Functional Analysis of Acheulean Backed Knives from Wonderboom, South Africa. *Journal of Field Archaeology*. Submitted.

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Lombard, M., Lotter, M.G. and Caruana, M.V., 2021. Wonderboompoort, South Africa: A Natural Game Funnel for Meat Harvesting during the Later Acheulean. *Journal of Archaeological Science: Reports* 39: 103193.

Lotter, M.G., Caruana, M.V. and Lombard, M., 2022. The Large Cutting Tools from Wonderboom, South Africa. *Lithic Technology* 47(2): 117-132.

Mason, R.J., 1957. Preliminary Note on an Earlier Stone Age Site at Wonderboom South, Pretoria. *South African Journal of Science* 53(17): 431-434.

Mason, R.J., 1958. An Earlier Stone Age Site at Wonderboom South, Pretoria. *South African Archaeological Bulletin* 13: 36–37.

Mason, R. J. 1962. *Prehistory of the Transvaal*. Johannesburg, ZA: The University of the Witwatersrand Press.

Supplementary Materials

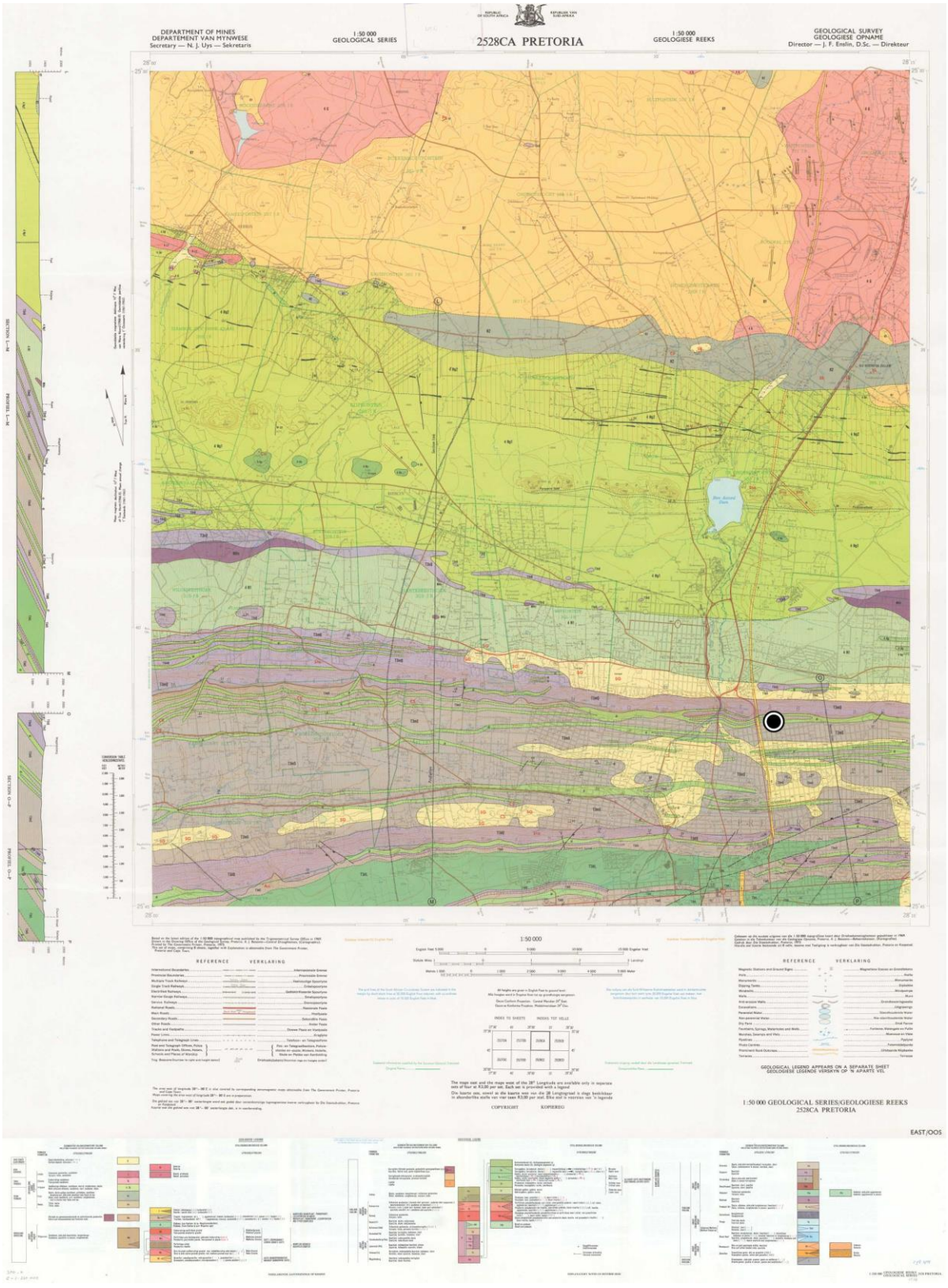

Figure S1. 2528CA (Pretoria) Geology Map. Dot shows the location of the Wonderboom Acheulean site.

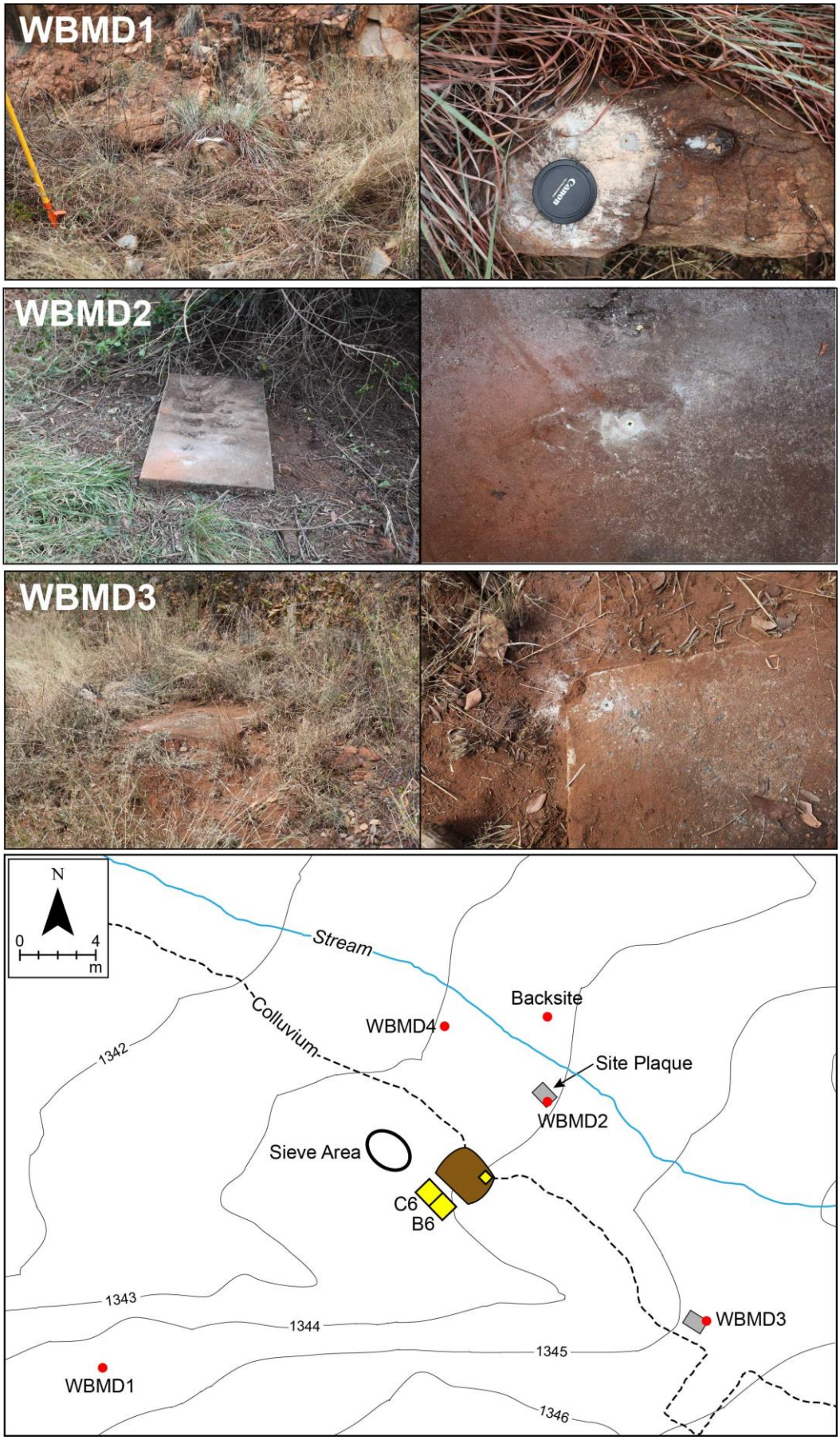

Figure S2. Site datum locations.

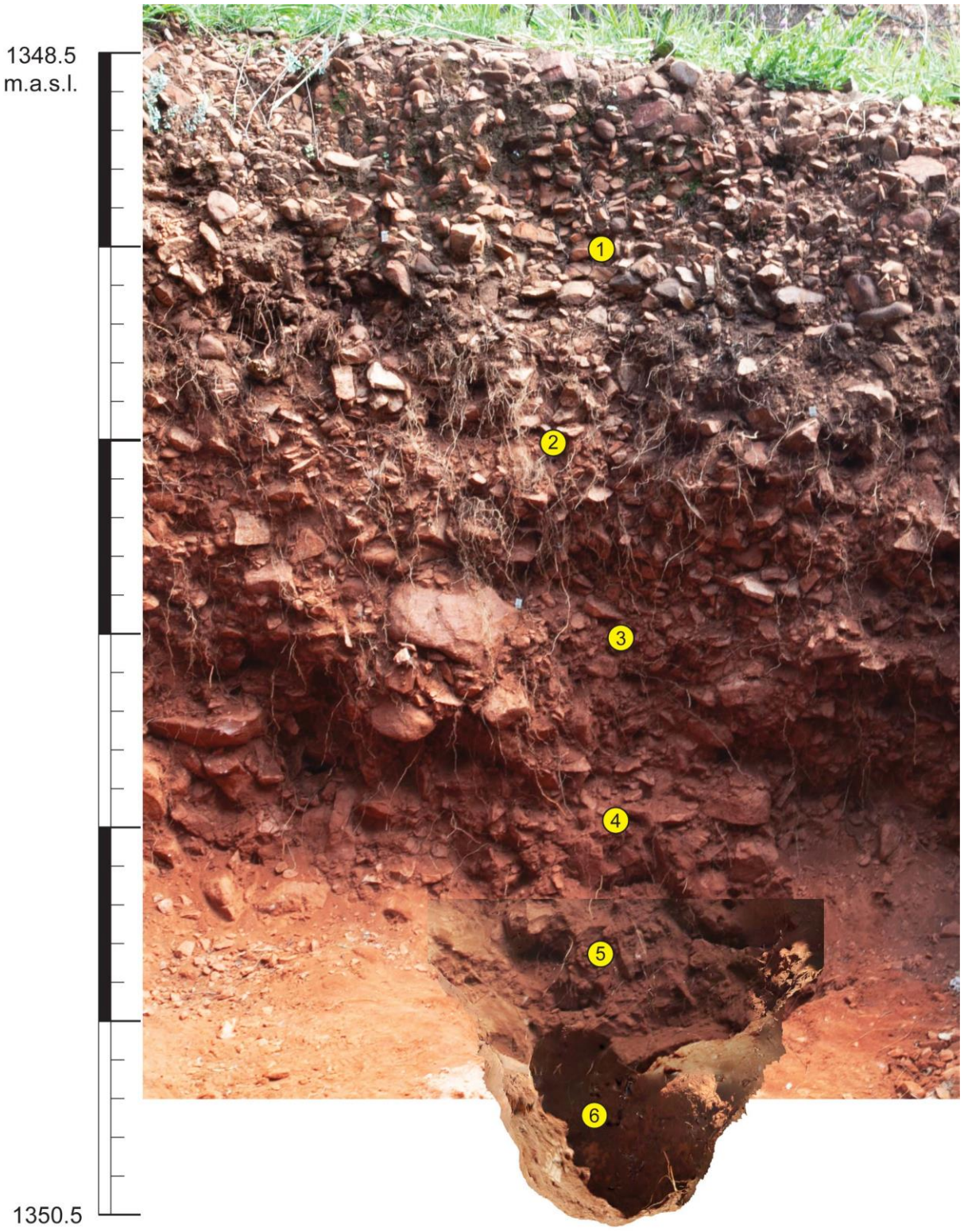

Figure S3. Cosmogenic sampling locations along Mason's excavation profile.

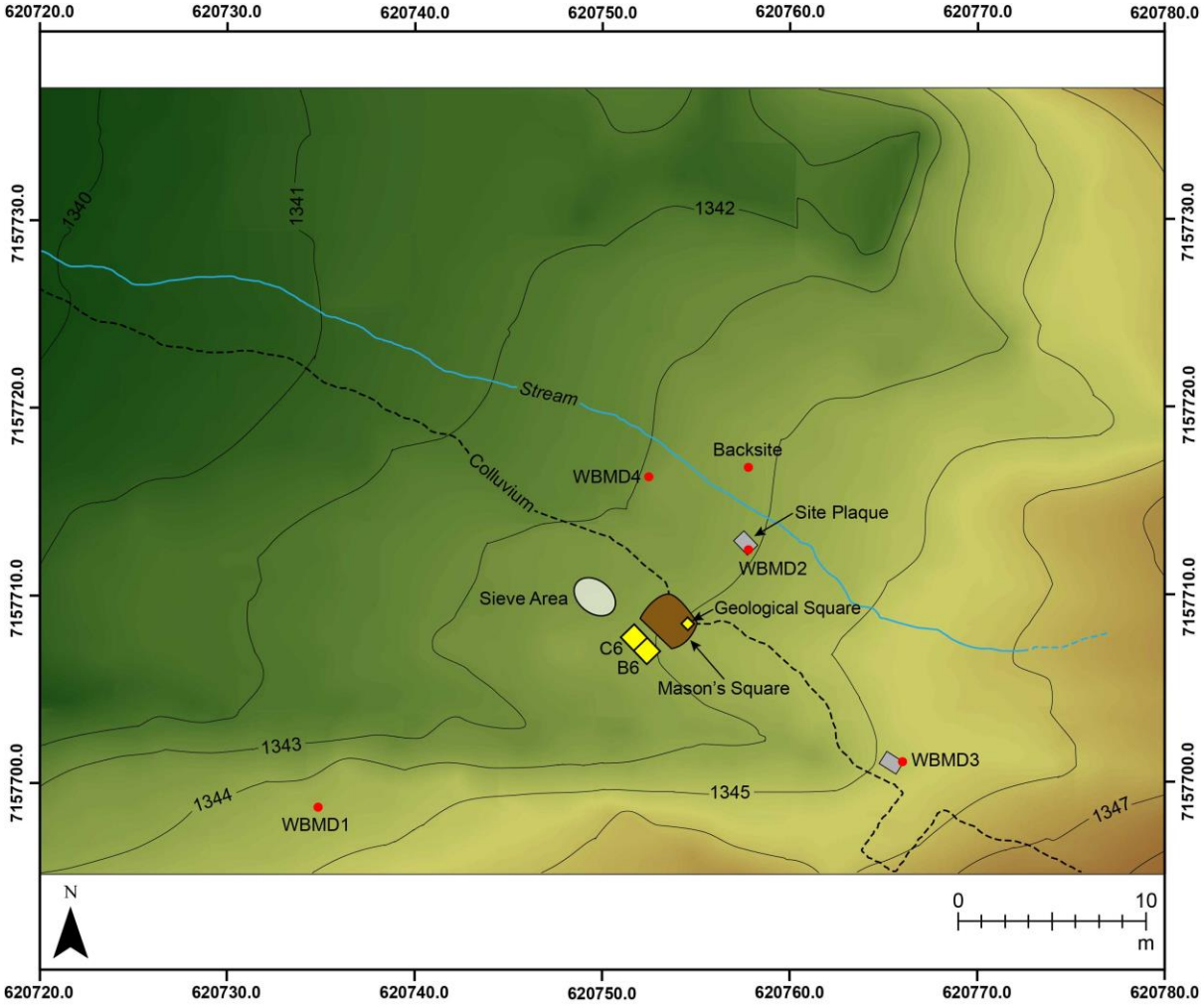

Figure S4. Site map. UTM Zone 35 South grid.