PHASE 1 ARCHAEOLOGICAL IMPACT ASSESSMENT

For

The Proposed Expansion of the Samancor Mining Operation on Portion 139 and the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ, North West

Author ©:

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A Phase 1 Archaeological Impact Assessment for the Proposed Expansion of the Samancor Mining Operation on Portion 139 and the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ, North West

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I, Tobias Coetzee, declare that –

- I act as the independent specialist;
- I am conducting any work and activity relating to the proposed Samancor Mining Expansion in an objective manner, even if this results in views and findings that are not favourable to the client;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have the required expertise in conducting the specialist report and I will comply with legislation, regulations and any guidelines that have relevance to the proposed activity;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this declaration are true and correct.

Date: 10 July 2023

List of Abbreviations

AIA – Archaeological Impact Assessment

CRM – Cultural Resource Management

EIA – Environmental Impact Assessment

ESA – Early Stone Age

GPS – Global Positioning System

ha – Hectare

HIA – Heritage Impact Assessment

km – Kilometre

LIA – Late Iron Age

LSA – Later Stone Age

m – Metre

MASL – Metres Above Sea Level

MEC – Member of the Executive Council

MSA – Middle Stone Age

NHRA – National Heritage Resources Act

SAHRA – South African Heritage Resources Agency

NEMA Appendix 6

NEMA Specialist reports	
Item	**Section / Page No**
1. (1) A specialist report prepared in terms of these Regulations must contain—	
(a) details of-	
(i)the specialist who prepared the report; and	P1, P2
(ii)the expertise of that specialist to compile a specialist report including a curriculum vitae;	P1, P2
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	P2
(c) an indication of the scope of, and the purpose for which, the report was prepared;	1.1, 2.2
(cA) an indication of the quality and age of base data used for the specialist report;	2.1, 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	2, 3.2
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	3
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	5, 7.1
(g) an identification of any areas to be avoided, including buffers;	P40
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	P40
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	3.2
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment]or activities;	5 – 7
(k) any mitigation measures for inclusion in the EMPr;	7.2
(l) any conditions for inclusion in the environmental authorisation;	7.2
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	7.2, Appendix C
(n) a reasoned opinion—	
(i)[as to] whether the proposed activity, activities or portions thereof should be authorised	7.2
(iA) regarding the acceptability of the proposed activity or activities; and	7.2
(ii)if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	7.2, Appendix C
(o)a description of any consultation process that was undertaken during the course of preparing the specialist report;	None

NEMA Specialist reports	
Item	**Section / Page No**
(p)a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)any other information requested by the competent authority.	Nothing received to date
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Noted

Executive Summary

The author was appointed by Elemental Sustainability (Pty) Ltd to undertake a Phase 1 Archaeological Impact Assessment for the proposed expansion of the Samancor Mining Operation on Portion 139 and the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ near Mooinooi in the North West Province. The proposed development falls within the Madibeng Local Municipality and the Bojanala District Municipality. The aim of the study is to determine the scope of archaeological resources that could be impacted by the proposed mining development.

Historical topographical maps indicated the presence of huts in the north-eastern corner of the study area. These structures, unfortunately, are not visible on aerial imagery. The site, labelled as B01 and delineated from a combination of field observations and georeferenced historical topographical maps, consists of a combination and angular and circular stone-walled enclosures and undecorated potsherds. Unmarked graves are also likely to be associated with this area. This site is likely to date to the Historic Period, but certain elements might be older. Site B01 is therefore considered to be significant from a heritage perspective. Since this site has been impacted by mining development since the field assessment in 2021, the impacting mining activities should be ceased and the demarcated sensitive area should be fenced-off. Should further impact to the demarcated sensitive aera be unavoidable, a Phase 2 AIA must be conducted.

One Later Stone Age stone tool was observed near the southern border of the study area. The artefact occurs in a disturbed context, is not associated with additional artefacts/features and is not considered to be of high significance. The artefact was sufficiently recorded during the study.

Three sites consisting of undecorated potsherds (B02, B03, B04) and one severely dilapidated section of stone walling (B07) were located in the north-western quadrant of the demarcated study area. These sites generally appear in a disturbed context, are not associated with additional artefacts/features and are not considered to be of high significance. The recording done during the study is therefore considered to be sufficient.

A section of stone walling (Site B06) was observed near the north-eastern corner of the study area and appears to form part of Site B01. The site, however, falls outside of the demarcated study area and is unlikely to be impacted by the proposed mining development.

One contemporary site, consisting of a building ruin and closed mining shaft, was located during the pedestrian survey (Site B08). Topographical maps confirmed the site to be a closed mining shaft dating to recent times. The site is therefore not considered to be significant from a heritage perspective and no further action is required.

Subject to adherence to the recommendations and approval by South African Heritage Resources Agency, the proposed mining development as per the indicated boundaries may continue. Should skeletal remains be exposed during development and construction phases, all activities must be suspended and the relevant heritage resources authority contacted (See National Heritage and Resources Act, No. 25 of 1999 section 36 (6)). Also, should culturally significant material be discovered during the course of the said development, all activities must be suspended pending further investigation by a qualified archaeologist.

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1. Project Background

1.1 Introduction

Elemental Sustainability (Pty) Ltd appointed the author to undertake a Phase 1 Archaeological Impact Assessment (AIA) for the proposed expansion of the Samancor Mining Operation on the Farm Buffelsfontein 465 JQ (**Table 1**) to the northeast of Mooinooi in the North West Province (**Figures 1 – 3**). The proposed mining expansion falls within the Madibeng local municipality. The purpose of this study is to examine the demarcated study area in order to determine if any archaeological resources of heritage value will be impacted by the proposed mining expansion, as well as to archaeologically contextualise the general study area. The aim of this report is to provide the developer with information regarding the location of heritage resources on the demarcated study area. It should be noted that the project area was initially assessed in 2021 and that the updated site boundary shifted slightly to the south.

In the following report, the implication for the Samancor mining expansion on Portion 139 and the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ with regard to heritage resources is discussed. The development will consist of opencast mining methods and the associated infrastructure to the estimated extent of 114 ha. The legislation section included serves as a guide towards the effective identification and protection of heritage resources and will apply to any such material unearthed during development.

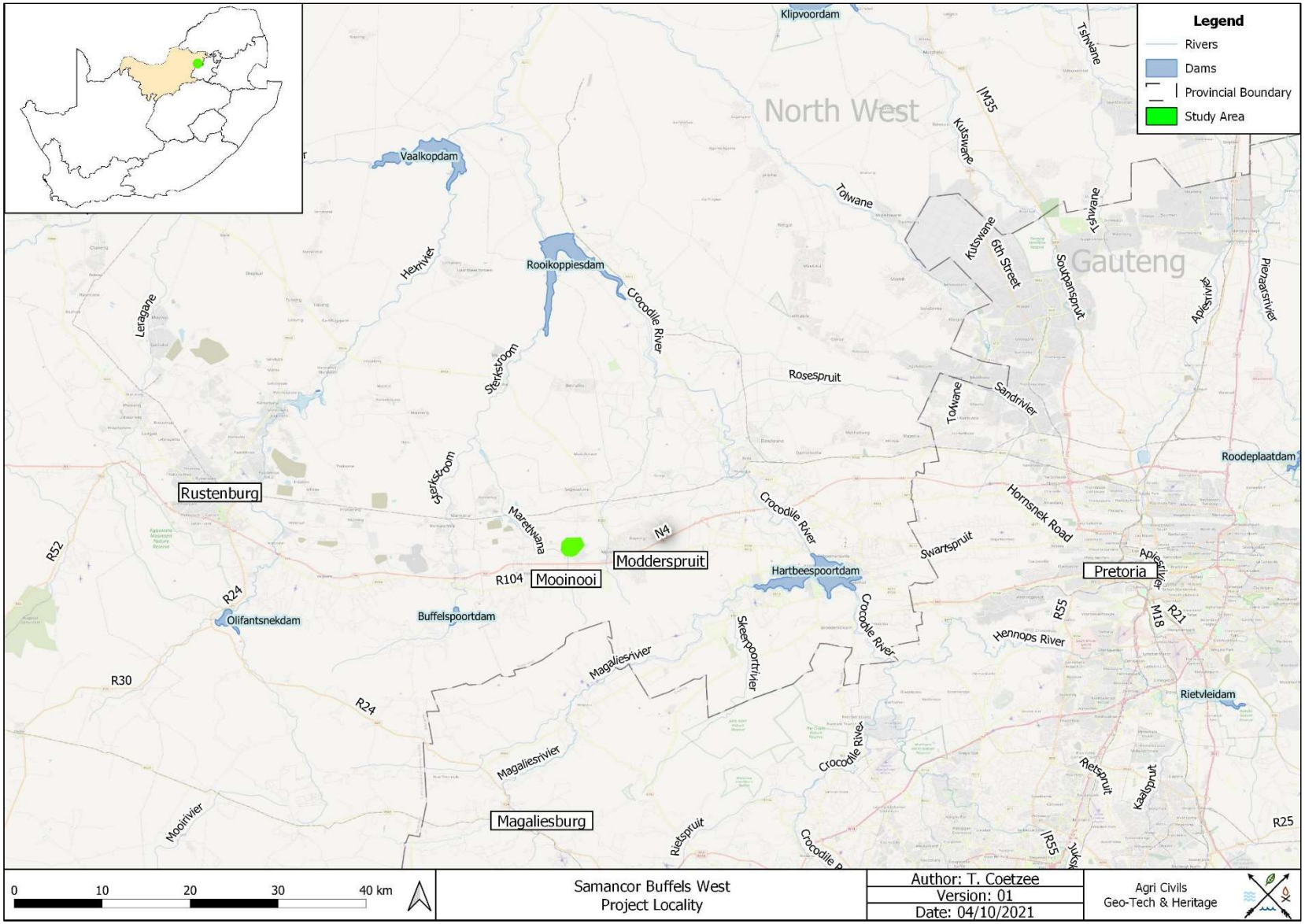

Figure 1: Regional and Provincial location of the study area.

1.2 Legislation

The South African Heritage Resources Agency aims to conserve and control the management, research, alteration and destruction of cultural resources of South Africa and to prosecute if necessary. It is therefore crucially important to adhere to heritage resource legislation contained in the Government Gazette of the Republic of South Africa (Act No. 25 of 1999), as many heritage sites are threatened daily by development. Conservation legislation requires an impact assessment report to be submitted for development authorisation that must include an AIA if triggered.

AIAs should be done by qualified professionals with adequate knowledge to (a) identify all heritage resources that might occur in areas of development and (b) make recommendations for protection or mitigation of the impact of the sites.

1.2.1 The EIA (Environmental Impact Assessment) and AIA processes

Phase 1 Archaeological Impact Assessments generally involve the identification of sites during a field survey with assessment of their significance, the possible impact that the development might have, and relevant recommendations.

All Archaeological Impact Assessment reports should include:

a. Location of the sites that are found;

b. Short descriptions of the characteristics of each site;

c. Short assessments of how important each site is, indicating which should be conserved and which mitigated;

d. Assessments of the potential impact of the development on the site(s);

e. In some cases a shovel test, to establish the extent of a site, or collection of material, to identify the associations of the site, may be necessary (a pre-arranged SAHRA permit is required); and

f. Recommendations for conservation or mitigation.

This AIA report is intended to inform the client about the legislative protection of heritage resources and their significance and make appropriate recommendations. It is essential to also provide the heritage authority with sufficient information about the sites to enable the authority to assess with confidence:

a. Whether or not it has objections to a development;

b. What the conditions are upon which such development might proceed;

c. Which sites require permits for mitigation or destruction;

d. Which sites require mitigation and what this should comprise;

e. Whether sites must be conserved and what alternatives can be proposed to relocate the development in such a way as to conserve other sites; and

f. What measures should or could be put in place to protect the sites which should be conserved.

When a Phase 1 AIA is part of an EIA, wider issues such as public consultation and assessment of the spatial and visual impacts of the development may be undertaken as part of the general study and may not be required from the archaeologist. If, however, the Phase 1 project forms a major component of an AIA it will be necessary to ensure that the study addresses such issues and complies with Section 38 of the National Heritage Resources Act.

1.2.2 Legislation regarding archaeology and heritage sites

National Heritage Resource Act No.25 of April 1999

Buildings are among the most enduring features of human occupation, and this definition therefore includes all buildings older than 60 years, modern architecture as well as ruins, fortifications and Farming Community settlements. The Act identifies heritage objects as:

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives;
- any other prescribed category.

With regards to activities and work on archaeological and heritage sites this Act states that:

"No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority." (34. [1] 1999:58)

and

"No person may, without a permit issued by the responsible heritage resources authority:

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites."(35. [4] 1999:58)

and

"No person may, without a permit issued by SAHRA or a provincial heritage resources authority:

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) and excavation equipment, or any equipment which assists in the detection or recovery of metals." (36. [3] 1999:60)

On the development of any area the gazette states that:

"…any person who intends to undertake a development categorised as:

(a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site-

i. exceeding 5000m² in extent; or

ii. involving three or more existing erven or subdivisions thereof; or

iii. involving three or more erven or divisions thereof which have been consolidated within the past five years; or

iv. the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10000m² in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development." (38. [1] 1999:62-64)

and

"The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

(a) The identification and mapping of all heritage resources in the area affected;

(b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;

(c) an assessment of the impact of the development on such heritage resources;

(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;

(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(f) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(g) plans for mitigation of any adverse effects during and after the completion of the proposed development." (38. [3] 1999:64)

Human Tissue Act and Ordinance 7 of 1925

The Human Tissues Act (65 of 1983) and Ordinance on the Removal of Graves and Dead Bodies (Ordinance 7 of 1925) protects graves younger than 60 years. These fall under the jurisdiction of the National Department of Health and the Provincial Health Departments. Approval for the exhumation and re-burial must be obtained from the relevant Provincial MEC (Member of the Executive Council) as well as the relevant Local Authorities. Graves 60 years or older fall under the jurisdiction of the National Heritage Resources Act (NHRA) as well as the Human Tissues Act, 1983.

2. Study Area and Project Description

2.1 Location & Physical Environment

The proposed mining expansion is situated to the northeast of Mooinooi. The farm portions are listed below:

Table 1: Property name & coordinates

Property	Portion	Map Reference (1:50 000)	Lat	Lon	Parcel Size (ha)	Proposed development (ha)
Buffelsfontein 465 JQ	RE/35	2527 DA	-25.718272	27.605552	185.6	**114**
Buffelsfontein 465 JQ	139	2527 DA	-25.723523	27.604235	29.7	
Total					**215.3**	

The study area is located 4 km northwest of Modderspruit, 5.5 km northeast of Mooinooi, 31 km north-northeast of Magaliesburg and 40 km east of Rustenburg (**Figures 1 – 3**). The study area falls within the Madibeng Local Municipality and the Bojanala District Municipality in the North West Province. In terms of vegetation, the study area falls within the Savanna Biome and Central Bushveld Bioregion. According to the vegetation classification by Mucina & Rutherfords (2006), the study area falls within the Marikana Thornveld vegetation unit.

Marikana Thornveld is found in the North West and Gauteng Provinces only and occurs on the plains from Rustenburg in the west, through Marikana and Brits to the Pretoria area in the east. In terms of conservation, Marikana Thornveld is considered endangered with a conservation target of 19%. Less than 1% is statutorily conserved in the Magaliesberg Nature Reserve, while more is conserved in the De Onderstepoort Nature Reserve. Cultivation, urban or built-up areas transformed about 48% of the vegetation unit and erosion is generally low. Alien invasive plants generally occur in high densities along drainage lines (Mucina & Rutherfords 2006).

According to (Mucina & Rutherfords 2006) the average elevation for Marikana Thornveld varies between 1050 MASL (Metres Above Sea Level) and 1450 MASL. The average elevation for the study area is 1990 MASL and slopes from the slightly more elevated north-eastern section towards the lower south-western area.

In terms of rainfall, the study area falls within the summer rainfall region and the average annual rainfall is roughly 626 mm. The average annual temperature is 18.9 ºC. The average summer temperature is 23.1 ºC, while the winter temperature averages 12 ºC (Climate-data.org accessed 04/07/2021).

The north-eastern corner of the study area falls within the A21J Quaternary catchment, while the remaining area falls within the A21K Quaternary catchment within the Crocodile West and Marico Water Management Area. The closest major rivers to the study area are Maretlwane 7 km to the northwest and Kareespruit 7.2 km to the east. A non-perennial offshoot also intersects the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ at the northern boundary of the study area. Buffelspoort Dam is located 14 km to the southwest and Hartbeespoort Dam 20 km to the east-southeast.

When the surrounding environment is considered, the general area is associated with mining activity to the east and west, with sections of open veldt to the north and south. Access to the study area is via local mining roads and tertiary roads turning from the N4 national road to the south (**Figures 2 & 3**). On a local scale, the area is associated with current and previous mining activities, open veldt, and previously cultivated land.

Historical aerial images and topographical maps (**Appendix A**) show that a significant section of the study area has been disturbed by past cultivation and mining activities. The agricultural activities date to at least 1949 and the earliest mining activity to at least 1968. The earliest buildings observed on the aerial images date to 1962. However, these buildings have been demolished by subsequent mining activities. Several huts, although not visible on aerial imagery, were also observed on the topographical map dating to 1968.

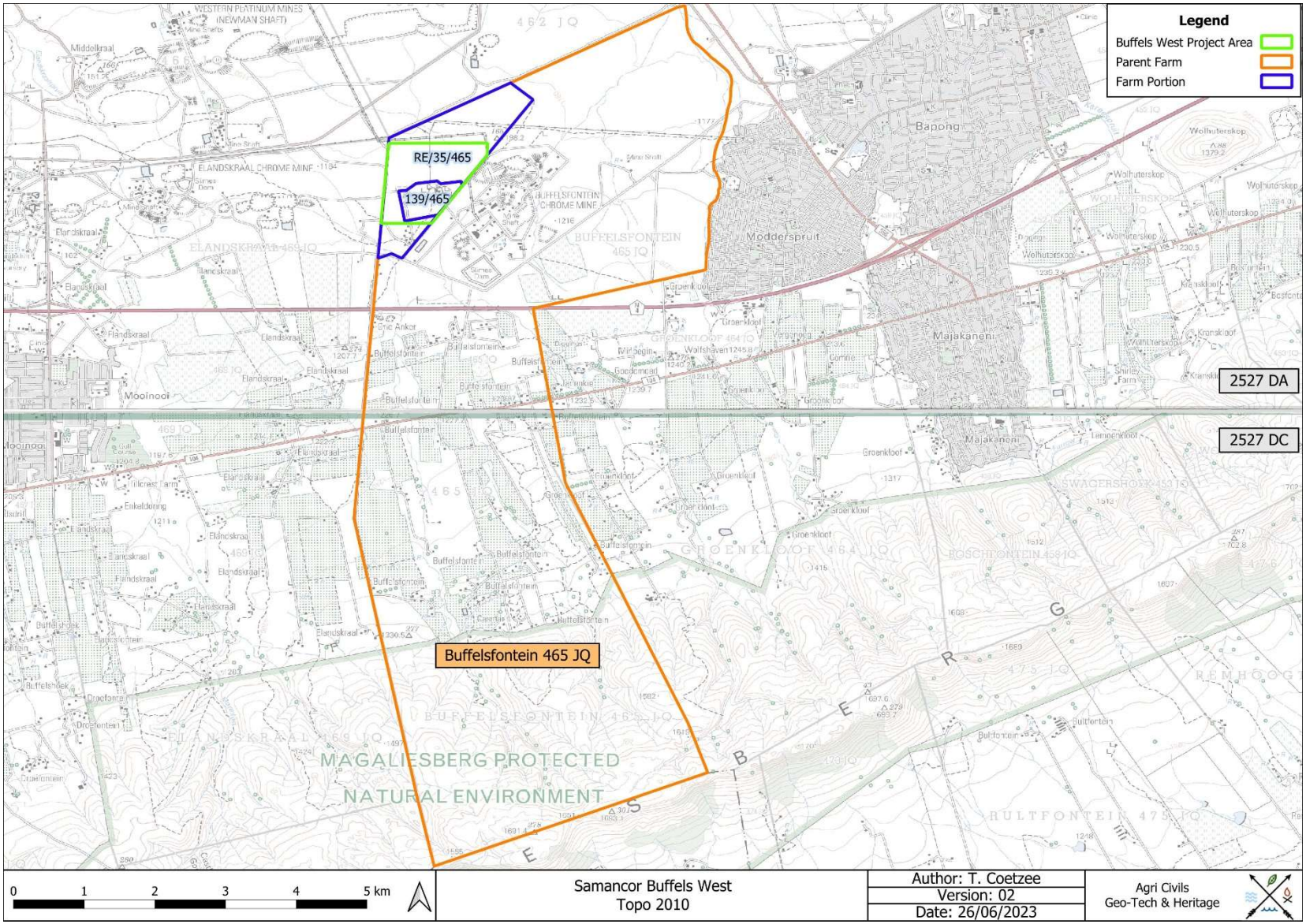

Figure 2: Segments of SA 1: 50 000 2527 DA & DC indicating the study area.

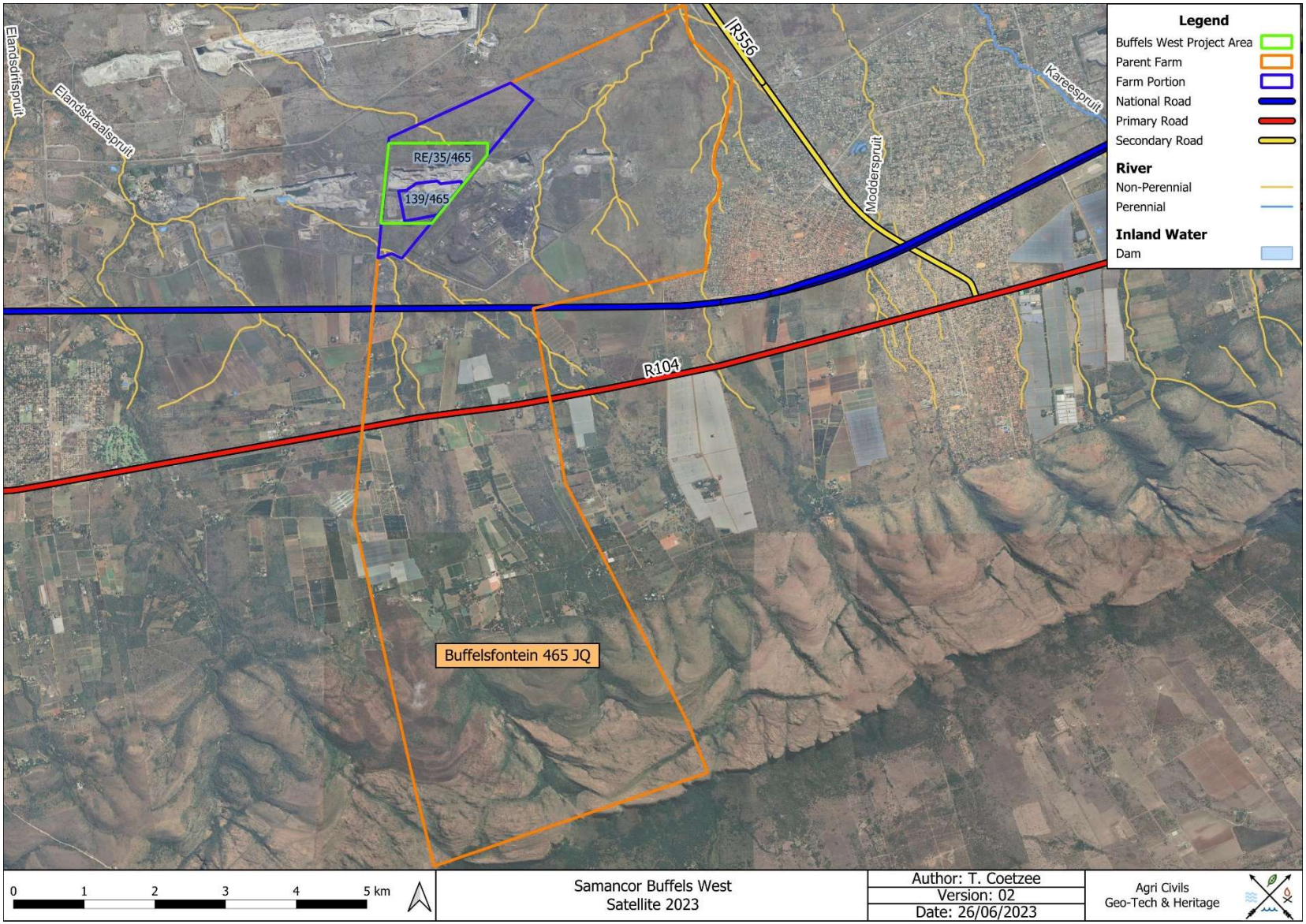

Figure 3: Satellite imagery of the study area and surrounding environment.

2.2 Project Description

Samancor – Western Chrome Mine is in the process of expanding their current mining operations at the Buffelsfontein West Mine. Opencast mining operations are proposed on Portion 139 and the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ (**Figure 4**). The total proposed impact area is 114 ha. However, it should be noted that since the initial assessment in 2021, a significantly larger area has been impacted by mining activities.

The following development and infrastructure are proposed:

- Crown Pillar
- Engineering Containers
- Fence
- Gravel Roads
- Offices & LDV Parking
- Opencast Area
- Parking
- Pedestrian Walkway
- Security Gate
- Security Office
- Safety Berm
- Stockpad
- Stockpile Area
- Topsoil Dump
- Waste Dump
- Weighbridge
- Workshop

3. Methodology

Archaeological reconnaissance of the study area was initially conducted during April and September 2021 through systematic pedestrian surveys (**Figure 4**). The transects were spaced roughly 60 m apart where possible. A section of the study area was completely disturbed by contemporary mining activity and was fenced-off. This area was delineated using satellite imagery and was not surveyed. The initial study area boundary, however, excluded the southern-most section of the current boundary. During the first site visit in April 2021, dense vegetation that somewhat hampered free movement and visibility was encountered in the north-western section of the proposed study area. The second site visit was conducted in September 2021 and was associated with slightly less dense vegetation. Dense patches, however, were encountered in the north-eastern section of the study area.

In June 2023, an updated boundary of the proposed study area was provided, as well as a proposed layout. With updated satellite imagery dating to 2023, it was noted that a significantly larger area has since been affected by mining activities and that several previously identified heritage sites have been impacted. Based on the updated satellite imagery, new recommendations and revised site maps indicating the new boundaries are provided in this report.

General site conditions were recorded via photographic record (**Figures 5 – 11**). Also, the entire project area was inspected on Google Earth, historical aerial imagery and topographical maps in order to identify potential heritage remains (**Appendix A**). One potential site (B01), was noted on historical topographical maps and inspected during the survey. Seven additional sites where cultural remains were observed were recorded during the pedestrian survey. The demarcated sensitive area associated with Site B01 was delineated from a combination of field observations and the inspection of historical topographical maps.

The prefix '2527DA' is not used when referring to the site names due to the length of the name, but is recorded as such in **Tables 2 & 7**. The topographical datasets dating to 1943, 1968, 1979, 1980, 1985, 1996, and 2010, as well as the historical aerial photographs dating to 1949, 1962, 1964, 1968 and 1985 proved useful in terms of providing an indication of the location and age of some of the buildings, structures and features associated with the study area. The total area inspected was roughly 114 ha. Since heritage resources are often associated with perennial and non-perennial rivers, the rivers and streams located within close proximity of the study area were buffered by a distance of 500 m, indicating a potentially sensitive area (**Figure 30**).

The reconnaissance of the area under investigation served a twofold purpose:

- To obtain an indication of heritage material found in the general area as well as to identify or locate archaeological sites on the area demarcated for development. This was done in order to establish a heritage context and to supplement background information that would benefit developers through identifying areas that are sensitive from a heritage perspective.

- All archaeological and historical events have spatial definitions in addition to their cultural and chronological context. Where applicable, spatial recording of these definitions were done by means of a handheld GPS (Global Positioning System) during the site visit, as well as by plotting the boundaries from aerial imagery and topographical maps.

Table 2: Site coordinates & description.

Abbreviated name	Site Name	Longitude	Latitude	Description	Age
B01	2527DA-B01	27.611297	-25.716424	Stone Walling & Potsherds	LIA/Historical
B02	2527DA-B02	27.600998	-25.716534	Potsherds	LIA/Historical
B03	2527DA-B03	27.600657	-25.717306	Potsherds	LIA/Historical
B04	2527DA-B04	27.600639	-25.71979	Potsherds	LIA/Historical
B05	2527DA-B05	27.601256	-25.724704	Stone Tool	LSA
B06	2527DA-B06	27.613957	-25.716585	Stone Walling	LIA/Historical
B07	2527DA-B07	27.602479	-25.718181	Stone Walling	LIA/Historical
B08	2527DA-B08	27.607189	-25.717043	Building Ruin	Contemporary

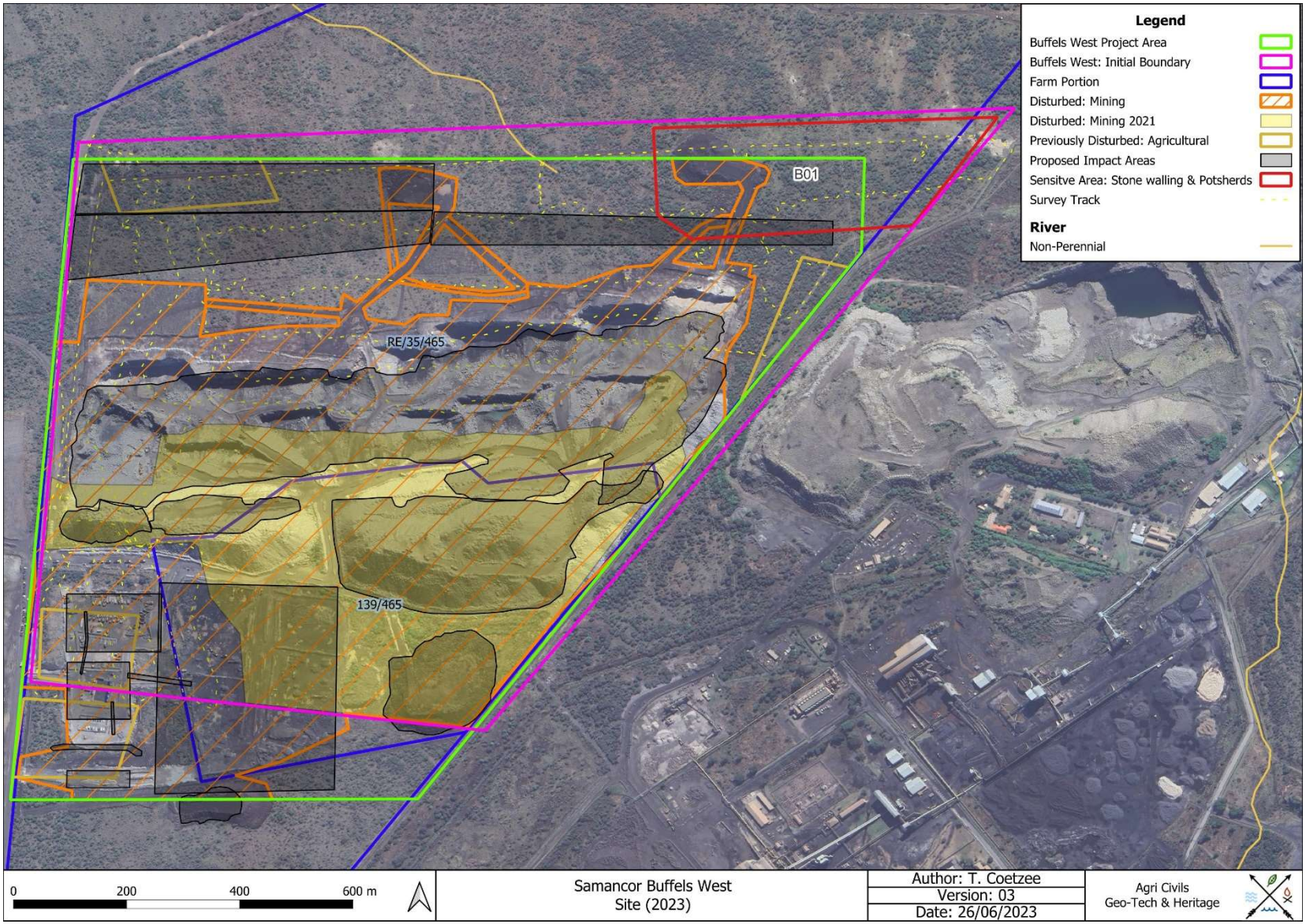

Figure 4: Study area with pre-recorded sites on a 2023 satellite image.

Figure 5: Environment in the north-western corner of the study area.

Figure 6: Environment along the northern boundary of the study area.

Figure 7: Environment in the north-eastern corner of the study area.

Figure 8: Environment along the eastern boundary of the study area.

Figure 9: Environment in the south-western corner of the study area.

Figure 10: Patches of sparse vegetation near the centre of the study area.

Figure 11: Disturbed section.

3.1 Sources of information

At all times during the survey, standard archaeological procedures for the observation of heritage resources were followed. As most archaeological material occur in single or multiple stratified layers beneath the soil surface, special attention was paid to disturbances; both man-made such as roads and clearings, and those made by natural agents such as burrowing animals and erosion. Locations associated with archaeological material remains were recorded by means of a Garmin Oregon 750 GPS and were photographed with a Samsung S7 mobile phone.

A literature study, which incorporated previous work done in the region, was conducted in order to place the study area into context from a heritage perspective.

3.1.1 Previous Heritage Studies

Buffelsfontein East & West Expansion Project

A Heritage Impact Assessment was conducted by Pelser & Van Vollenhoven (2008) for the initial Buffelsfontein East and West mining expansion on the Farm Buffelsfontein 465 JQ. The surface impact for the initial project, however, was significantly smaller compared to the expansion currently proposed. The study recorded one angular stone-walled enclosure and an extensive Late Iron Age (LIA) stone-walled site. It was assumed that an angular enclosure was likely to relate to recent quarrying and mining activities and was considered to be of low significance. The site was subsequently demolished. The LIA stone-walled site was determined to be highly significant as this site appears to form part of a larger complex that was identified by Dr Julius Pistorius. Accordingly, the site is associated with the ancestors of the Tswana and dates form the 17th Century onwards. Material culture observed during their survey included hut enclosures, middens etc. Due to the site already being impacted and the possibility of future expansion, the Heritage Impact Assessment (HIA) proposed a detailed mapping and drawing of the site, as well as archaeological excavations. An alternative consisting of the fencing-off of the site and compiling a management plan was proposed as well. These measures, however, were not

implemented and sections of the site have been demolished by mining activity. It should also be noted that the initial heritage study did not record any sites within the demarcated Buffels West project boundary.

The heritage study conducted by Coetzee (2021) for the Buffels East project located roughly 1 km to the east of the project area, revealed several heritage sites. The study built on the HIA conducted by Pelser & Van Vollenhoven (2008) and found that the LIA site was significantly larger and expands further to the west than initially thought. A large cemetery, potential grave and several building ruins and features dating to the Historic Period were identified as well.

3.2 Limitations

The majority of the area to the north of the current mining activities is characterised by patches of dense vegetation cover, especially in the north-eastern and north-western corners (**Figures 12 & 13)**. The initial survey during April 2021 was generally characterised by denser vegetation compared to the survey in September 2021. A boundary fence that roughly followed the area disturbed by previous mining activity also prevented access to a small section near the north-eastern corner of the disturbed section. No field assessment occurred since 2021 and the current condition of the demarcated area is unknown. The updated recommendations are therefore based on satellite imagery dating to 2023. Also, since the project area boundary was altered, the southernmost section was not inspected during the survey.

Figure 12: Dense vegetation associated with the north-western section of the study area.

Figure 13: Dense vegetation associated with the north-eastern section of the study area.

4. Archaeological Background

Southern African archaeology is broadly divided into the Early, Middle and Later Stone Ages; Early, Middle and Later Iron Ages; and Historical or Colonial Periods. This section of the report provides a general background to archaeology in South Africa and focuses on more site-specific elements where relevant.

4.1 The Stone Ages

The earliest stone tool industry, the Oldowan, was developed by early human ancestors which were the earliest members of the genus *Homo,* such as *Homo habilis*, around 2.6 million years ago. It comprises tools such as cobble cores and pebble choppers (Toth & Schick 2007). Archaeologists suggest these stone tools are the earliest direct evidence for culture in southern Africa (Clarke & Kuman 2000). The advent of culture indicates the advent of more cognitively modern hominins (Mitchell 2002: 56, 57)

The Acheulean industry completely replaced the Oldowan industry. The Acheulian industry was first developed by *Homo ergaster* between 1.8 to 1.65 million years ago and lasted until around 300 000 years ago. Archaeological evidence from this period is also found at Swartkrans, Kromdraai and Sterkfontein. The most typical tools of the ESA (Early Stone Age) are handaxes, cleavers, choppers and spheroids. Although hominins seemingly used handaxes often, scholars disagree about their use. There are no indications of hafting, and some artefacts are far too large for it. Hominins likely used choppers and scrapers for skinning and butchering scavenged animals and often obtained sharp ended sticks for digging up edible roots. Presumably, early humans used wooden spears as early as 5 million years ago to hunt small animals.

Middle Stone Age (MSA) artefacts started appearing about 250 000 years ago and replaced the larger Early Stone Age bifaces, handaxes and cleavers with smaller flake industries consisting of scrapers, points and blades. These artefacts roughly fall in the 40-100 mm size range and were, in some cases, attached to handles,

indicating a significant technical advance. The first *Homo sapiens* species also emerged during this period. Associated sites are Klasies River Mouth, Blombos Cave and Border Cave (Deacon & Deacon 1999).

Although the transition from the Middle Stone Age to the Later Stone Age (LSA) did not occur simultaneously across the whole of southern Africa, the Later Stone Age ranges from about 20 000 to 2000 years ago. Stone tools from this period are generally smaller, but were used to do the same job as those from previous periods; only in a different, more efficient way. The Later Stone Age is associated with: rock art, smaller stone tools (microliths), bows and arrows, bored stones, grooved stones, polished bone tools, earthenware pottery and beads. Examples of Later Stone Age sites are Nelson Bay Cave, Rose Cottage Cave and Boomplaas Cave (Deacon & Deacon 1999).

4.2 The Iron Age & Later History

The Early Iron Age marks the movement of farming communities into South Africa in the first millennium AD, or around 2500 years ago (Mitchell 2002: 259, 260). These groups were agro-pastoralist communities that settled in the vicinity of water in order to provide subsistence for their cattle and crops. Archaeological evidence from Early Iron Age sites is mostly artefacts in the form of ceramic assemblages. The origins and archaeological identities of this period are largely based upon ceramic typologies. Some scholars classify Early Iron Age ceramic traditions into different "streams" or "trends" in pot types and decoration, which emerged over time in southern Africa. These "streams" are identified as the Kwale Branch (east), the Nkope Branch (central) and the Kalundu Branch (west). Early Iron Age ceramics typically display features such as large and prominent inverted rims, large neck areas and fine elaborate decorations. This period continued until the end of the first millennium AD (Mitchell 2002; Huffman 2007). Some well-known Early Iron Age sites include the Lydenburg Heads in Mpumalanga, Happy Rest in the Limpopo Province and Mzonjani in Kwa-Zulu Natal.

The Middle Iron Age roughly stretches from AD 900 to 1300 and marks the origins of the Zimbabwe culture. During this period cattle herding appeared to play an increasingly important role in society. However, it was proved that cattle remained an important source of wealth throughout the Iron Age. An important shift in the Iron Age of southern Africa took place in the Shashe-Limpopo basin during this period, namely the development of class distinction and sacred leadership. The Zimbabwe culture can be divided into three periods based on certain capitals. Mapungubwe, the first period, dates from AD 1220 to 1300, Great Zimbabwe from AD 1300 to 1450, and Khami from AD 1450 to 1820 (Huffman 2007: 361, 362).

The Late Iron Age roughly dates from AD 1300 to 1840. It is generally accepted that Great Zimbabwe replaced Mapungubwe. Some characteristics include a greater focus on economic growth and the increased importance of trade. Specialisation in terms of natural resources also started to play a role, as can be seen from the distribution of iron slag which tend to occur only in certain localities compared to a wide distribution during earlier times. It was also during the Late Iron Age that different areas of South Africa were populated, such as the interior

of KwaZulu Natal, the Free State, the Gauteng Highveld and the Transkei. Another characteristic is the increased use of stone as building material. Some artefacts associated with this period are knife-blades, hoes, adzes, awls, other metal objects as well as bone tools and grinding stones.

In terms of general project area, the region is well known for LIA sites. The area west of Wonderboompoort is associated with one of the earliest LIA sites. Further to the west a high concentration of sites is also found that stretches to Olifantspoort in the Magaliesberg. These sites date to the Moloko period that roughly stretched from AD 1100 – 1500 (Van Vollenhoven 2006).

A later Ndebele invasion that was led by Mzilikaze in 1827, settled at Kungwini, present day Wonderboom in Pretoria North. In 1832, the Zulu king Dingane attacked Mzilikaze at Kungwini. According to Van Vollenhoven (2006), the Sotho-Tswana groups are the largest Bantu language speaking people who are formed by the Northern and Southern Sotho, as well as the Tswana. These groups are responsible for large stone-walled towns and according to oral histories, these groups re-established themselves after the 1827 arrival of Mzilikaze during the Mfecane/Difaquane.

5. Archaeological and Historical Remains

5.1 Stone Age Remains

One stone tool dating to the LSA was observed on the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ (**Table 3 & Figure 14**). Site B05 is located 200 m north of the revised southern boundary of the proposed study area and is not associated with additional surface material. The area appears to have been impacted by mining activities since the initial assessment in 2021.

Table 3: Stone Age Sites

Name	Type	Source	Status	Age	Number of artefacts	Parcel
B05	Stone tool	Field	Intact	LSA	1	RE/35/465

Figure 14: LSA artefact at site B05.

Stone Age artefacts are often associated with rocky outcrops or water sources. **Figures 15 – 17** below are examples of stone tools often associated with the Early, Middle and Later Stone Age of southern Africa.

The previous archaeological studies conducted in the immediate surroundings did not locate material pertaining to the Stone Age.

According to Bergh (1999: 5), several LSA sites are located in the Magaliesberg between Pretoria and Brits: Rissik, Jubilee Shelter, Silkaatsnek, Elizabeth Shelter, Cave James, Seprent Quarry, Xanadu, Hope Hill Shelter, Kloofendalskuiling. Another LSA site, Krugergrot, is located between Brits and Rustenburg.

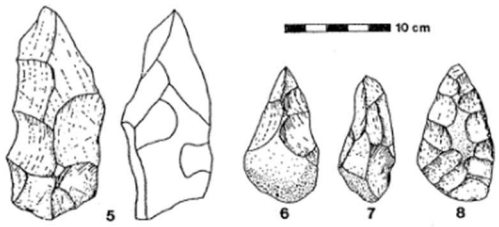

Figure 15: ESA artefacts from Sterkfontein (Volman 1984).

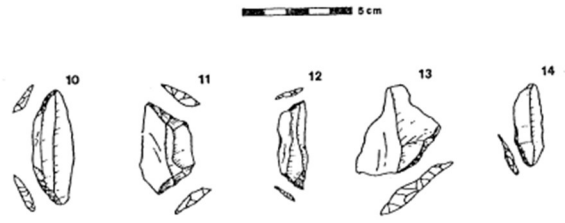

Figure 16: MSA artefacts from Howiesons Poort (Volman 1984).

Figure 17: LSA scrapers (Klein 1984).

5.2 Iron Age Farmer Remains

No definite Iron Age Farmer remains were observed within the demarcated study area. Due to the majority of the potsherds being associated with angular and circular stone walling, as well as the absence of decoration, the sites associated with potsherds and stone walling are discussed under the Historical section. However, it should be noted that the large Iron Age site observed in the studies by Pelser & Van Vollenhoven (2008) and Coetzee (2021) are located approximately 1.4 km to the southeast. Since the greater area is characterised by a rich archaeological landscape, and due to the proximity of some of the identified sites to the LIA site to the southeast, the sites might be related.

5.3 Historical

Six historic sites were identified during the pedestrian survey (**Table 4**). Some of these sites, or parts of the sites, might date to the Iron Age, especially since a large Iron Age settlement is located approximately 1.4 km to the southeast. However, several angular stone-walled enclosures were noted, indicating a more recent origin. Also, no decorations were observed on the potsherds and several huts are indicated on the 1968 topographical map. **Figures 18 – 27** indicate the photographed remains.

The area marked as 'Sensitive' on **Figure 30** measures approximately 10.2 ha and consists of several sites associated with LIA/historic material culture that were not labelled individually. The site number 'B01' was assigned to the collection of recorded instances falling within this boundary. The extent of the boundary was determined using a combination of historical topographical maps and field observations.

The structures associated with site B01 are not visible on any of the aerial images, but several huts are shown on the 1968 and 1979 topographical maps in the north-eastern corner of the study area on the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ (**Appendix A: Figures 36 & 37**). No huts are indicated on the 1943 and 1980 topographical maps (**Appendix A: Figures 31 & 38**), suggesting that the structures were constructed between 1943 and 1968. However, the possibility exists that the structures were omitted from the 1943 map. The site visit revealed the presence of several angular and circular stone-walled enclosures in a dilapidated state (**Figures 18 – 21**). Several of the enclosures consist of a single row of stones, but dense vegetation cover hampered determining the extent of several enclosures. A relatively high number of undecorated potsherds were

also observed in the general area associated with Site B01 (**Figure 22**). Based on contemporary satellite imagery, a section of the demarcate site B01 area was disturbed by mining development after 2021, and additional impacts are planned for the area along the southern boundary.

Sites B02, B03 and B04 are associated with undecorated potsherds on the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ near the western boundary of the study area (**Figures 23 – 25**). A single potsherd was observed at Sites B02 and B04, while several sherds were noted at Site B03. No additional features, structures or other artefacts were observed in the vicinity of these sites and no buildings are indicated on the historical topographical maps and aerial photographs. Although no river lines are noted on the topographical datasets, observations made in the field suggest the presence of significant surface water action. This suggests the possibility of water erosion exposing the potsherds or the possibility of water runoff transporting the potsherds from elsewhere. It should also be noted that topographical maps indicate no cultivated fields near these sites, but when the historical aerial images dating to 1949 & 1964 are inspected, a cultivated field appears to be present at site B02 and potentially at the other sites as well (**Appendix A: Figures 32 & 34**). Also, based on contemporary satellite imagery, the area associated with site B04 was disturbed by mining activities after 2021 and additional development is planned for the area where site B03 was observed.

Site B06, located on the Remaining Extent of Portion 12 of the Farm Buffelsfontein 465 JQ and directly east of Site B01, consists of a section of stone walling of which the extent is roughly 5 m (**Figure 26**). This section of stone walling is better preserved compared to the rest of the stone walling encountered and consists of stones stacked on top of each other. Due to the dense vegetation and dilapidated sections, the exact extent could not be determined. Also, no additional material remains were observed at the site. This site, however, falls outside of the demarcated study area, but is likely to form part of Site B01.

Site B07 (**Figure 27**) is located in the north-western quadrant of the study area and on the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ. The site consists of what appears to be a linear section of severely dilapidated stone walling measuring roughly 8 m. Due to poor preservation, the exact extent of the site could not be determined. No additional features, structures or artefacts were observed in the vicinity of this site and no buildings are indicated on the historical topographical maps and aerial photographs.

The heritage study conducted by Coetzee (2021) recorded several structures dating to the Historic Period, but appeared to be of a more recent origin than the structures identified in this study. This is mainly due to the presence of cement and more intact structures.

Table 4: Historic sites.

Name	Type	Source	Status	Age	Estimated extent	Parcel
B01	Stone walling & potsherds	Topo (1968) & field	Intact, dilapidated, sherds	Historic/LIA	±10.2 ha	RE/35/465, RE/12/465
B02	Potsherds	Field	Sherds	Historic/LIA	±1 m²	RE/35/465
B03	Potsherds	Field	Sherds	Historic/LIA	± 1 m²	RE/35/465
B04	Potsherds	Field	Sherds	Historic/LIA	± 1 m²	RE/35/465
B06	Stone walling	Field	Intact	Historic/LIA	± 5 m	RE/12/465
B07	Stone walling	Field	Dilapidated	Historic/LIA	± 8 m	RE/35/465

Figure 18: Angular stone walling at Site B01.

Figure 19: Circular stone walling at Site B01.

Figure 20: Circular stone enclosure at Site B01.

Figure 21: Unclear stone walling at Site B01.

Figure 22: Undecorated potsherds at Site B01.

Figure 23: Undecorated potsherd at Site B02.

Figure 24: Undecorated potsherds at Site B03.

Figure 25: Undecorated potsherd at Site B04.

Figure 26: Circular stone walling at Site B06.

Figure 27: Dilapidated linear stone walling at Site B07.

5.4 Contemporary Remains

One contemporary site, B08, was identified during the pedestrian survey on the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ. The site consists of building foundation remains and concrete and based on the topographical map dating to 1996 (**Appendix A: Figure 41**) the site used to be a mining shaft (**Figures 28 & 29**). Accordingly, the shaft was constructed between 1985 (**Appendix A: Figure 40**) and 1996, and was closed by 2010 (**Appendix A: Figure 42**).

Table 5: Contemporary Sites

Name	Type	Source	Status	Age	Estimated extent	Parcel
B08	Building ruin	Topo (1996), Field	Demolished	Contemporary	±0.1 ha	RE/35/465

Figure 28: Contemporary building ruin at Site B08.

Figure 29: Closed contemporary shaft at Site B08.

The archaeological studies conducted by Pelser & Van Vollenhoven (2008) and Coetzee (2021) did not mention significant contemporary remains.

5.5 Graves

No graves or burial sites were noted within the demarcated study area. However, the possibility exists that unmarked burial sites might be associated with site B01.

The archaeological study conducted by Pelser & Van Vollenhoven (2008) did not mention the presence of graves or burial sites. However, a large cemetery consisting of 100+ graves was located by Coetzee (2021). The cemetery is located approximately 1.4 km to the southeast, near an Iron Age settlement and is covered by dense vegetation.

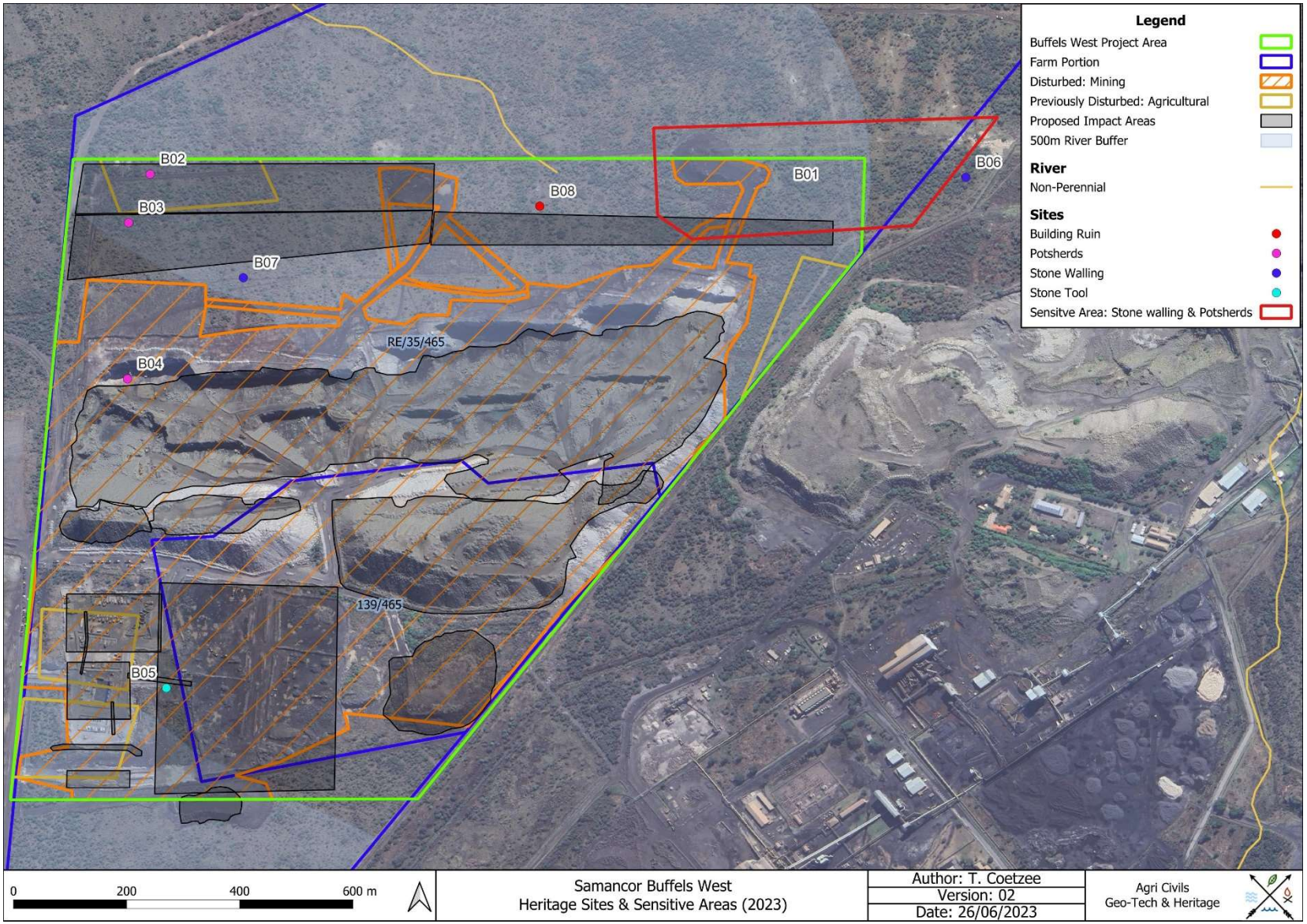

Figure 30: Heritage Sites indicated on a 2023 satellite image.

6. Evaluation

The significance of an archaeological site is based on the amount of deposit, the integrity of the context, the kind of deposit and the potential to help answer present research questions. Historical structures are defined by Section 34 of the National Heritage Resources Act, 1999, while other historical and cultural significant sites, places and features, are generally determined by community preferences.

A fundamental aspect in the conservation of a heritage resource relates to whether the sustainable social and economic benefits of a proposed development outweigh the conservation issues at stake. There are many aspects that must be taken into consideration when determining significance, such as rarity, national significance, scientific importance, cultural and religious significance, and not least, community preferences. When, for whatever reason the protection of a heritage site is not deemed necessary or practical, its research potential must be assessed and if appropriate mitigated in order to gain data / information which would otherwise be lost. Such sites must be adequately recorded and sampled before being destroyed.

6.1 Field Ratings

All sites should include a field rating in order to comply with section 38 of the National Heritage Resources Act (Act No. 25 of 1999). The field rating and classification in this report are prescribed by SAHRA.

Table 6: Prescribed Field Ratings

Rating	Field Rating/Grade	Significance	Recommendation
National	Grade 1		National site
Provincial	Grade 2		Provincial site
Local	Grade 3 A	High	Mitigation not advised
Local	Grade 3 B	High	Part of site should be retained
General protection A	4 A	High/Medium	Mitigate site
General Protection B	4 B	Medium	Record site
General Protection C	4 C	Low	No recording necessary

Table 7: Individual Site Ratings.

Site / Survey Point Name	Type	Rating	Field Rating/Grade	Significance	Recommendation
2527DA-B01	Stone Walling & Potsherds	General protection A	4 A	High	Mitigate site
2527DA-B02	Potsherds	General Protection B	4 B	Medium	Record site
2527DA-B03	Potsherds	General Protection B	4 B	Medium	Record site
2527DA-B04	Potsherds	General Protection B	4 B	Medium	Record site
2527DA-B05	Stone Tool	General Protection B	4 B	Medium	Record site
2527DA-B06	Stone Walling	General Protection B	4 B	Medium	Record site
2527DA-B07	Stone Walling	General Protection B	4 B	Medium	Record site
2527DA-B08	Building Ruin	General Protection C	4 C	Low	No recording necessary

*Note – These ratings are based on the specific surface infrastructure boundaries and are project specific – A change in these boundaries and/or activities will require the ratings to be revised.

7. Statement of Significance & Recommendations

7.1 Statement of Significance

The study area: The proposed mining development on Portion 139 and the Remaining Extent of Portion 35 of the Farm Buffelsfontein 465 JQ

The greater study area is considered to be significant from a heritage perspective since the area is associated with Stone Age sites, LIA settlements, historic sites and cemeteries. The demarcated study area is also partially located within 500 m of rivers/streams, a zone that is generally associated with a higher heritage site probability.

Site B01 consists of a high number of stone-walled sites and potsherds. Because angular and circular enclosures are present, and due to huts being indicated on historical topographical maps, it is likely that the stone walling and potsherds date to the Historic Period. Unfortunately, the site is not visible on historical aerial imagery, but it is likely that the structures were constructed between 1943 and 1968, meaning that the possibility exists that the site exceeds 60 years of age and could therefore be protected under the NHRA (Act No. 25 of 1999). The possibility also exists that some features might date to the LIA. The site is therefore considered to be significant.

Sites B02, B03 and B04, consisting of undecorated potsherds along the western boundary of the demarcated study area, might relate to Site B01. No additional features were observed in the vicinity of these sites and potential past agricultural activities, as well as surface water, appear to have disturbed the context of these sites. These sites are therefore not considered to be of high significance. Also, the area where Site B04 was observed, has completely been disturbed by mining activities since the surveys in 2021. Additional mining activities are planned for the areas associated with Sites B02 and B03 as well.

Site B05, a single LSA stone tool, was observed on the surface and is not associated with any other artefacts. The context appears to be disturbed and the site is therefore not considered to be highly significant.

Site B06, stone walling located to the east of the north-eastern corner of the study area, is likely to form part of Site B01 and is considered to be significant. The site, however, falls outside of the proposed impact area.

Site B07 appears to consists of severely dilapidated stone walling. Due to the poor level of preservation of the site, the absence of any additional features, structures and artefacts, as well as the potential impact of agricultural activities in the past, the site is considered to be of low significance.

Site B08 is associated with modern mining remains that do not exceed 60 years of age. The structures are not considered to be significant.

7.2 Recommendations

The following recommendations are made in terms with the National Heritage Resources Act (Act No. 25 of 1999) in order to avoid the destruction of heritage remains associated with the area demarcated for development:

- The demarcated B01 sensitive area (**Figure 30**), delineated from a combination of field observations and georeferenced historical topographical maps, is associated with a relatively dense concentration of angular and circular stone-walled enclosures and potsherds that might include unmarked graves. The layout of the site, however, could not be determined due to dense vegetation cover and the dilapidated state of the stone walling. Although the site appears to be historic, certain elements might be older. Since additional impact appears to have occurred since 2021, current activities impacting the demarcated B01 area should be ceased and due to the high sensitivity of the general area, it is recommended that the area be fenced-off. Should further impact to the demarcated sensitive area be unavoidable, a Phase 2 AIA must be conducted.

- Site B05 consist of a single LSA artefact in a disturbed context. The site is not considered to be highly significant and the recording done during the Phase 1 AIA is considered to be sufficient.
- Site B06, consisting of stone walling that appears to form part Site B01, falls outside of the demarcated project area and is unlikely to be impacted by the proposed mining development. No further action is therefore required.

- Sites B02, B03, B04 and B07 consist of undecorated potsherds and a section of dilapidated stone walling. These sites fall outside of the sensitive area, appear in a disturbed context and are not considered to be highly significant. The recording done during the Phase 1 AIA is considered to be sufficient.

- Site B08, remnants of a contemporary mining shaft and building, is not considered to be significant from a heritage perspective and no further action is required.

General Recommendations

- The recommendations are based on the specific project activities and extents as indicated in the figures of this report. Should the proposed surface impact areas be changed, a qualified archaeologist must conduct a pedestrian survey on the new areas and amend the report accordingly.

- Should uncertainty regarding the presence of heritage remains exist, or if heritage resources are discovered by chance, it is advised that the potential site be avoided and that a qualified archaeologist be contacted as soon as possible.

- As archaeological artefacts generally occur below surface, the possibility exists that culturally significant material may be exposed during the construction and development phases, in which case all activities must be suspended pending further archaeological investigations by a qualified archaeologist. Also, should skeletal remains be exposed during development and construction phases, all activities must be suspended and the relevant heritage resources authority must be contacted (See National Heritage Resources Act, No. 25 of 1999 section 36 (6)).

8. Conclusion

The proposed Buffelsfontein West Mining Development will consist of opencast mining activities and surface infrastructure impacting approximately 114 ha. The project area is associated with a combination of LSA and LIA/Historic remains, some which could be protected by legislation. Should the recommendations made in this study be adhered to and with the approval of the South African Heritage Resources Agency, the proposed Buffelsfontein West Mining Development may proceed.

9. Addendum: Terminology

Archaeology:

The study of the human past through its material remains.

Artefact:

Any portable object used, modified, or made by humans; e.g. pottery and metal objects.

Assemblage:

A group of artefacts occurring together at a particular time and place, and representing the sum of human activities.

Context:

An artefact's context usually consist of its immediate *matrix* (the material surrounding it e.g. gravel, clay or sand), its *provenience* (horizontal and vertical position within the matrix), and its *association* with other artefacts (occurrence together with other archaeological remains, usually in the same matrix).

Cultural Resource Management (CRM):

The safeguarding of the archaeological heritage through the protection of sites and through selvage archaeology (rescue archaeology), generally within the framework of legislation designed to safeguard the past.

Excavation:

The principal method of data acquisition in archaeology, involving the systematic uncovering of archaeological remains through the removal of the deposits of soil and other material covering and accompanying it.

Feature:

An irremovable artefact; e.g. hearths or architectural elements.

Ground Reconnaissance:

A collective name for a wide variety of methods for identifying individual archaeological sites, including consultation of documentary sources, place-name evidence, local folklore, and legend, but primarily actual fieldwork.

Matrix:

The physical material within which artefacts is embedded or supported, i.e. the material surrounding it e.g. gravel, clay or sand.

Phase 1 Assessments:

Scoping surveys to establish the presence of and to evaluate heritage resources in a given area.

Phase 2 Assessments:

In-depth culture resources management studies which could include major archaeological excavations, detailed site surveys and mapping / plans of sites, including historical / architectural structures and features. Alternatively, the sampling of sites by collecting material, small test pit excavations or auger sampling is required.

Sensitive:

Often refers to graves and burial sites although not necessarily a heritage place, as well as ideologically significant sites such as ritual / religious places. *Sensitive* may also refer to an entire landscape / area known for its significant heritage remains.

Site:

A distinct spatial clustering of artefacts, features, structures, and organic and environmental remains, as the residue of human activity.

Surface survey:

There are two kinds: (1) unsystematic and (2) systematic. The former involves field walking, i.e. scanning the ground along one's path and recording the location of artefacts and surface features. Systematic survey by comparison is less subjective and involves a grid system, such that the survey area is divided into sectors and these are walked ally, thus making the recording of finds more accurate.

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Human Tissue Act No. 65 of 1983, Government Gazette, Cape Town

National Heritage Resource Act No.25 of 1999, Government Gazette, Cape Town

Removal of Graves and Dead Bodies Ordinance No. 7 of 1925, Government Gazette, Cape Town

Appendix A: Historical Aerial Photographs and Topographical Maps

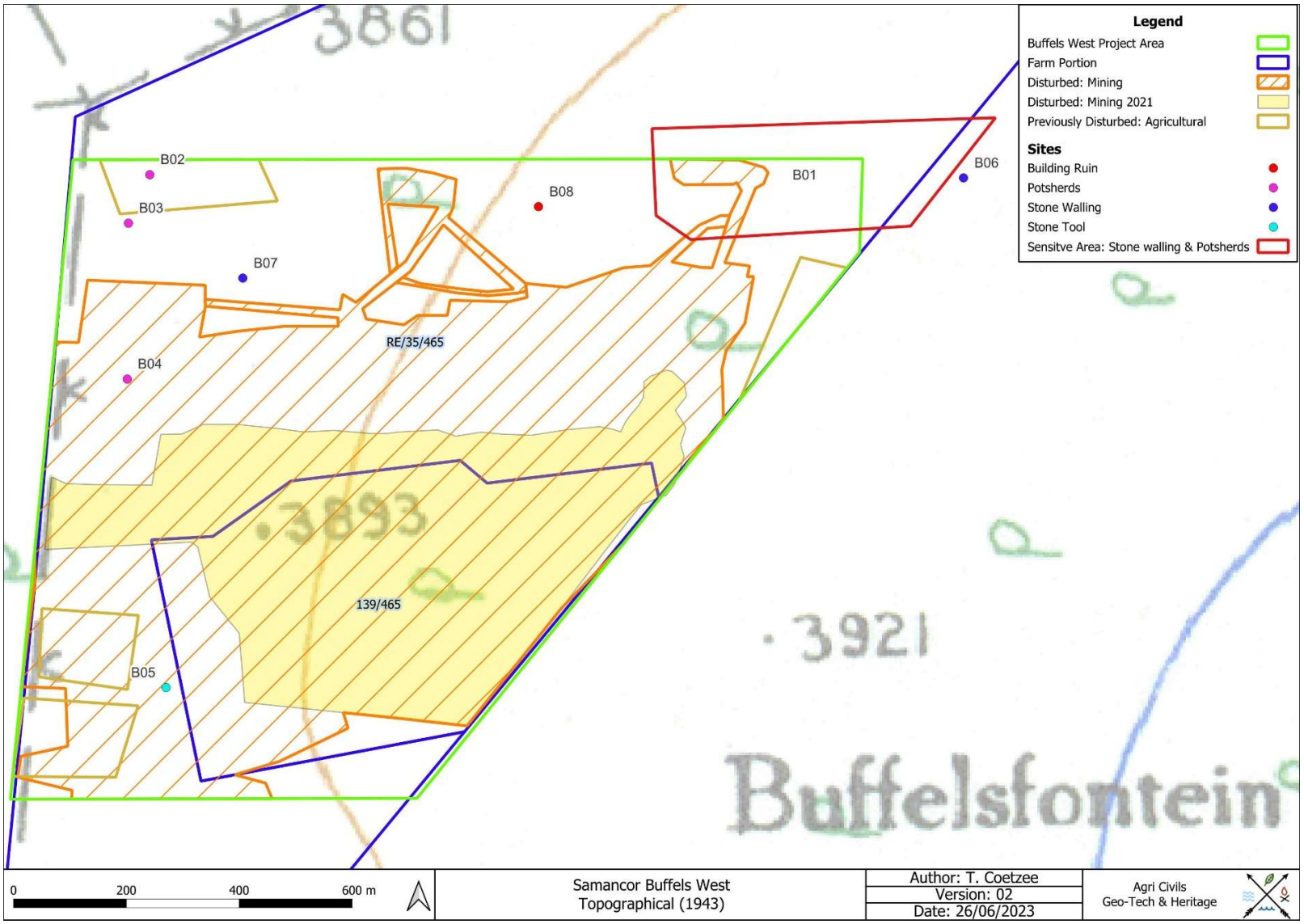

Figure 31: Study area superimposed on a 1943 1: 50 000 2527 DA topographical map.

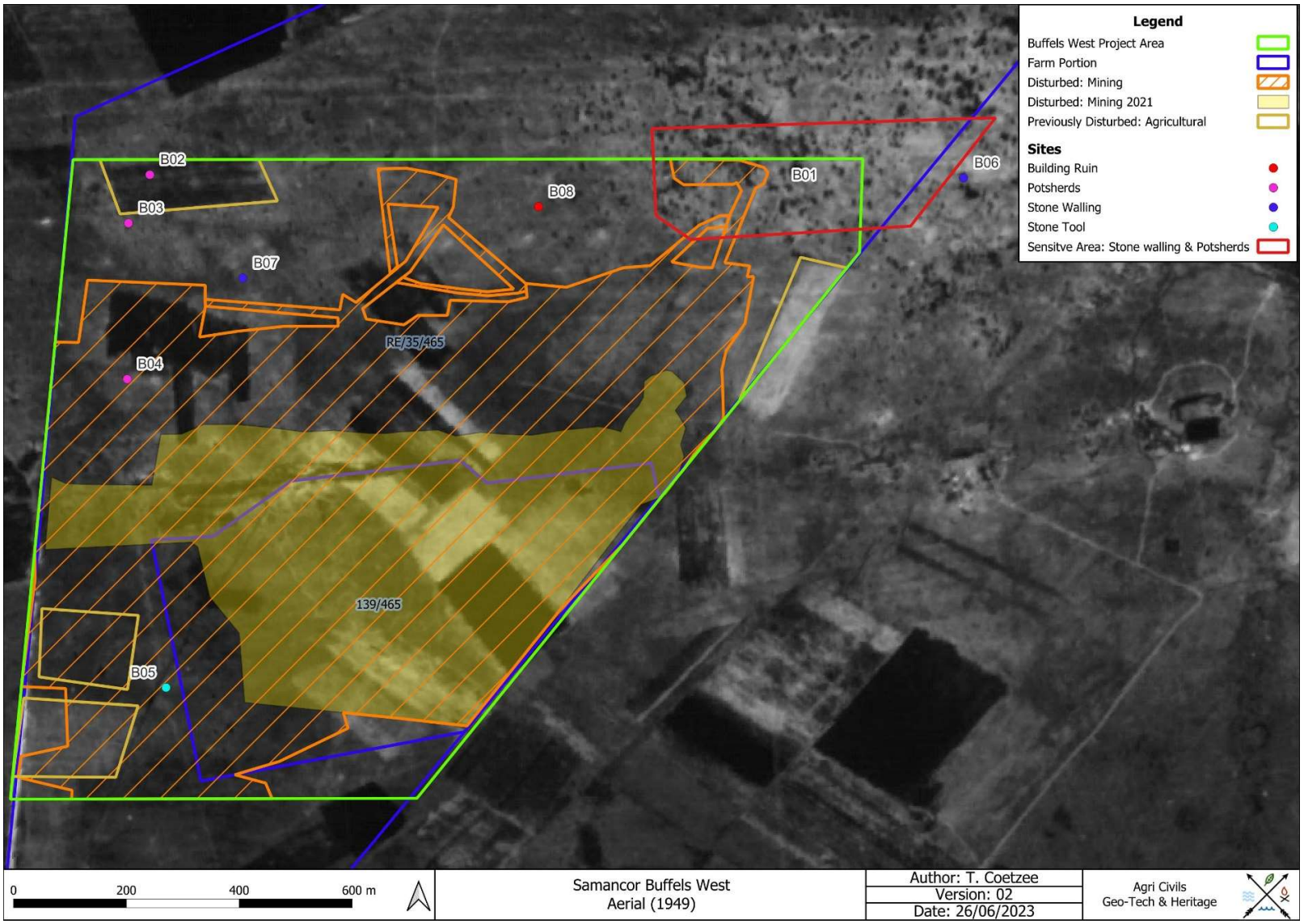

Figure 32: Study area superimposed on a 1949 aerial photograph.

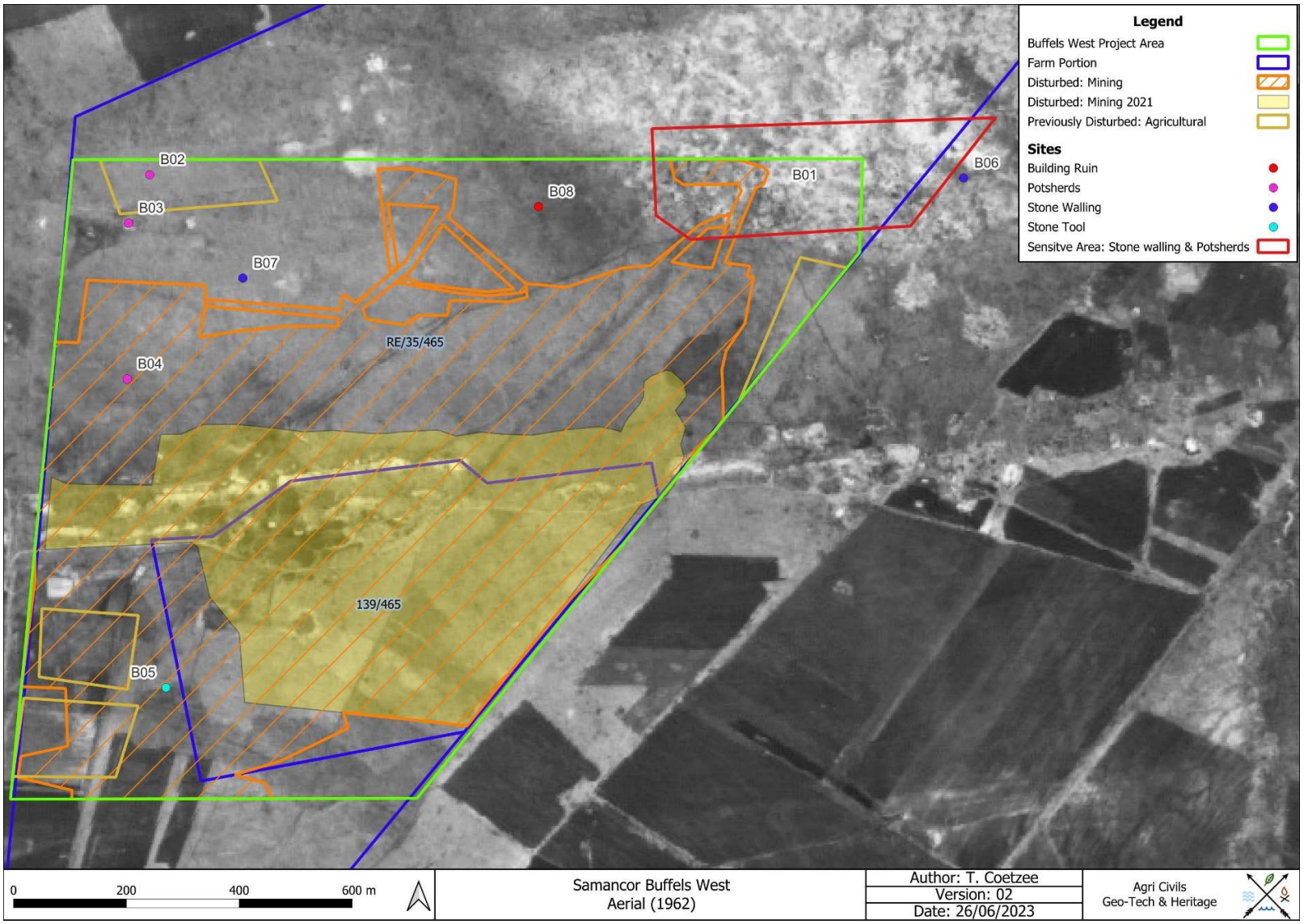

Figure 33: Study area superimposed on a 1962 aerial photograph.

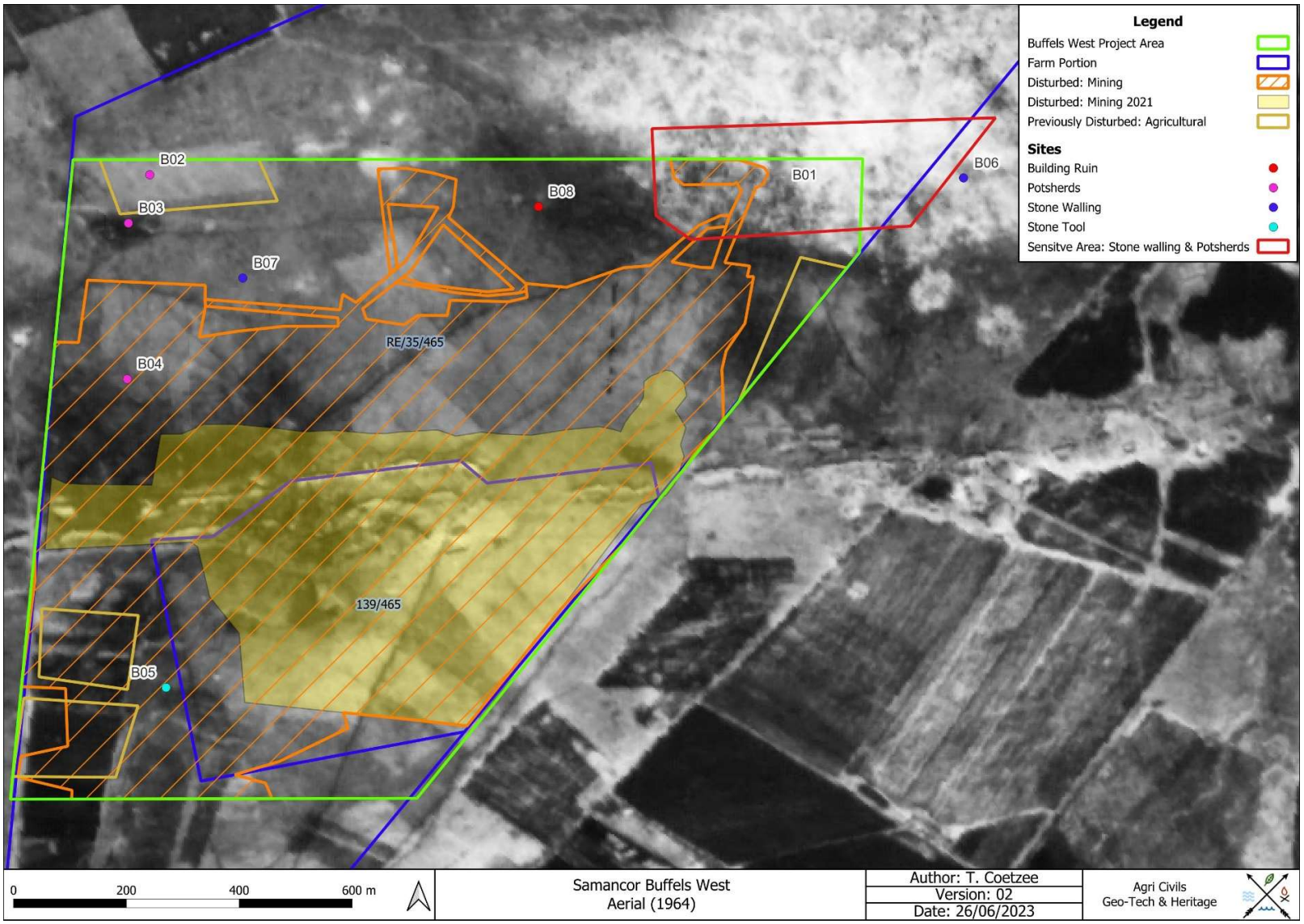

Figure 34: Study area superimposed on a 1964 aerial photograph.

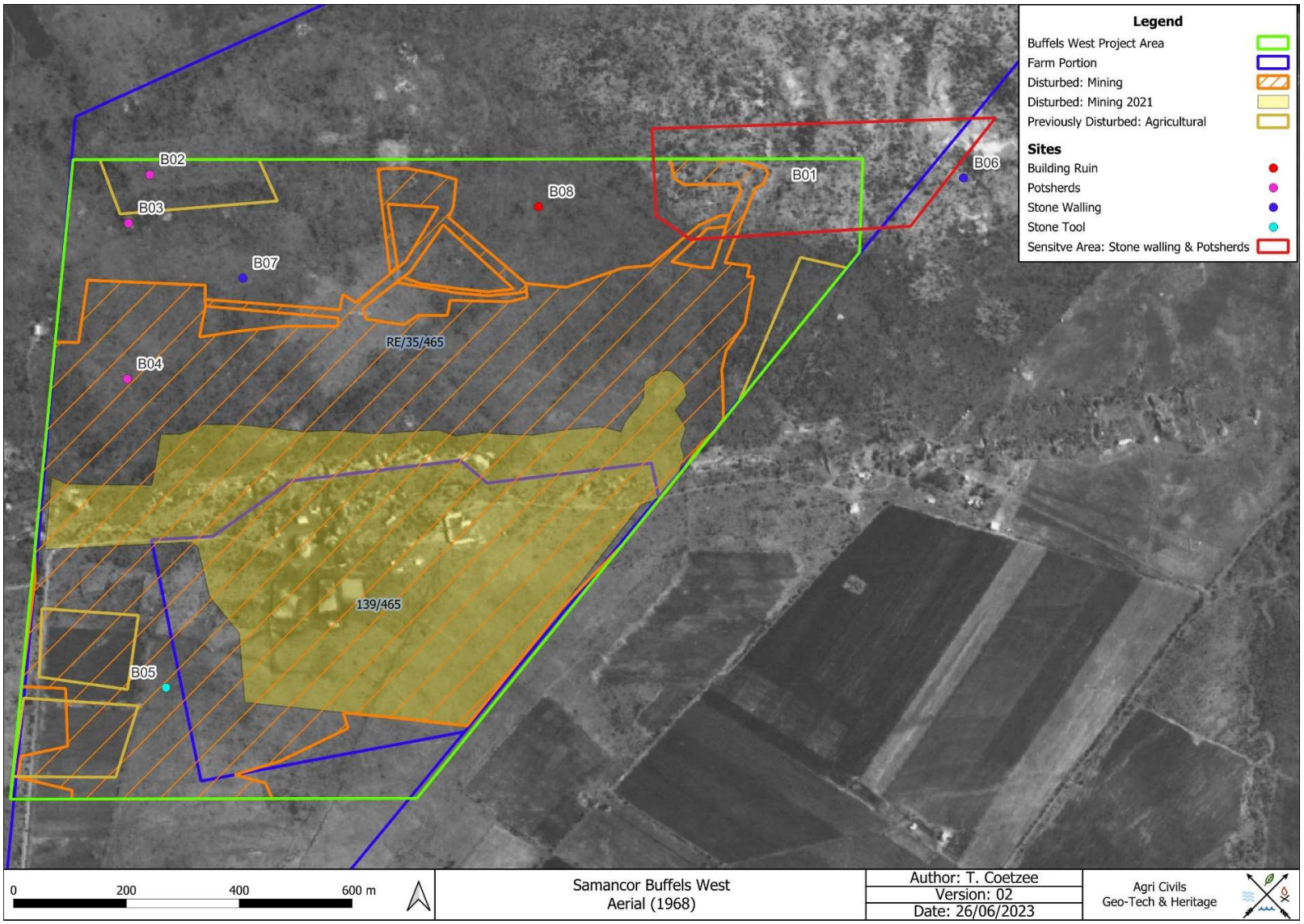

Figure 35: Study area superimposed on a 1968 aerial photograph.

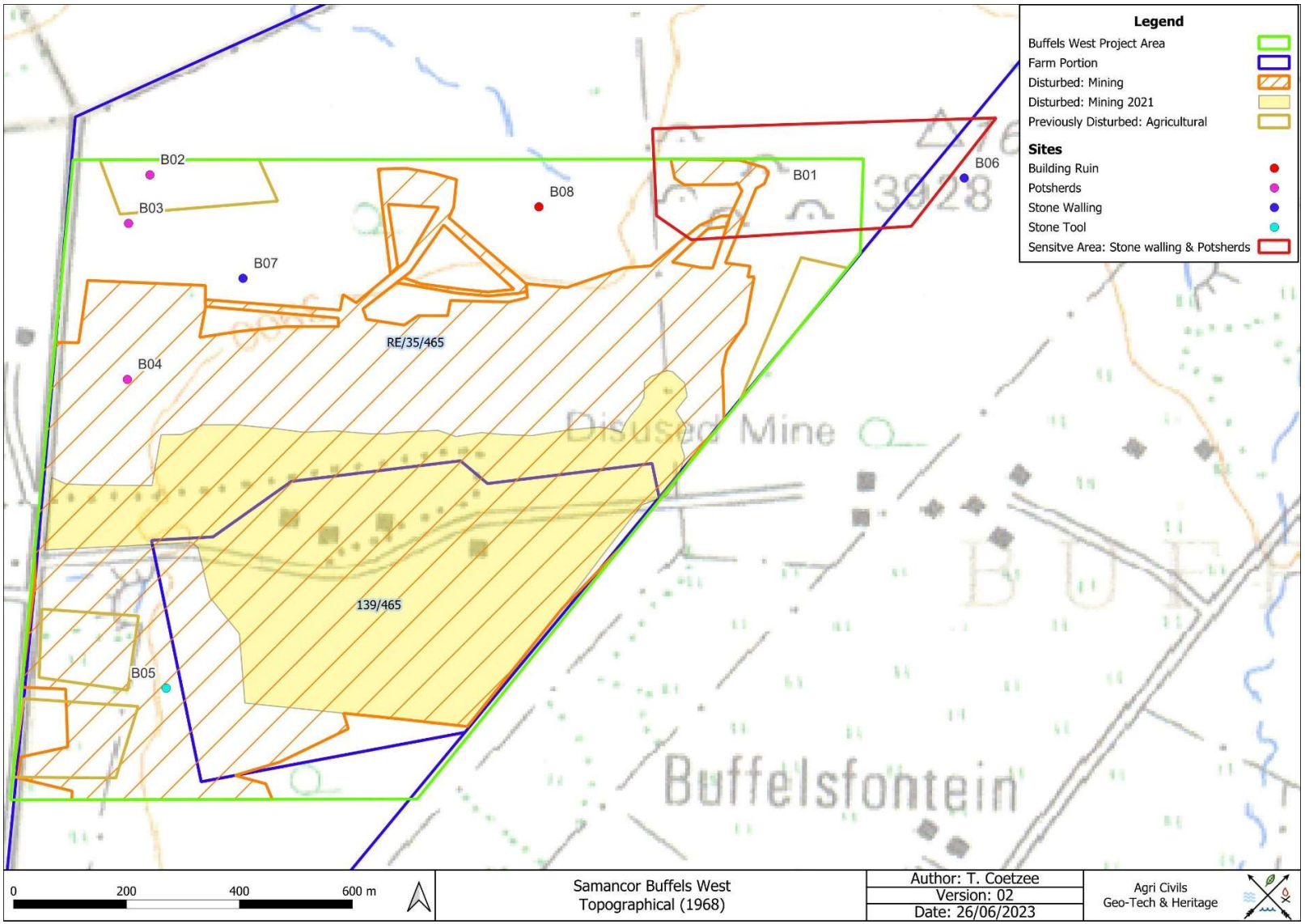

Figure 36: Study area superimposed on a 1968 1: 50 000 2527 DA topographical map.

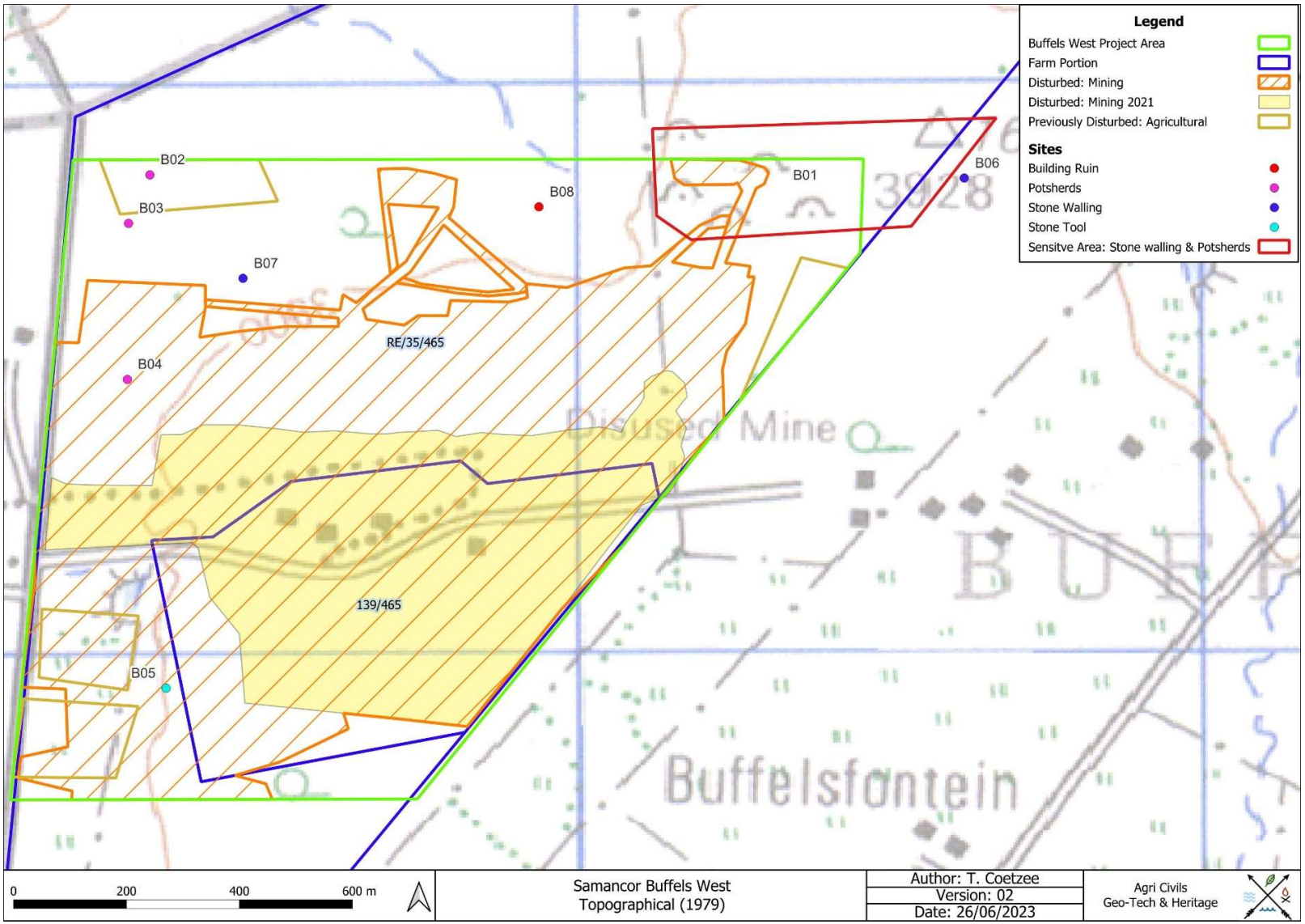

Figure 37: Study area superimposed on a 1979 1: 50 000 2527 DA topographical map.

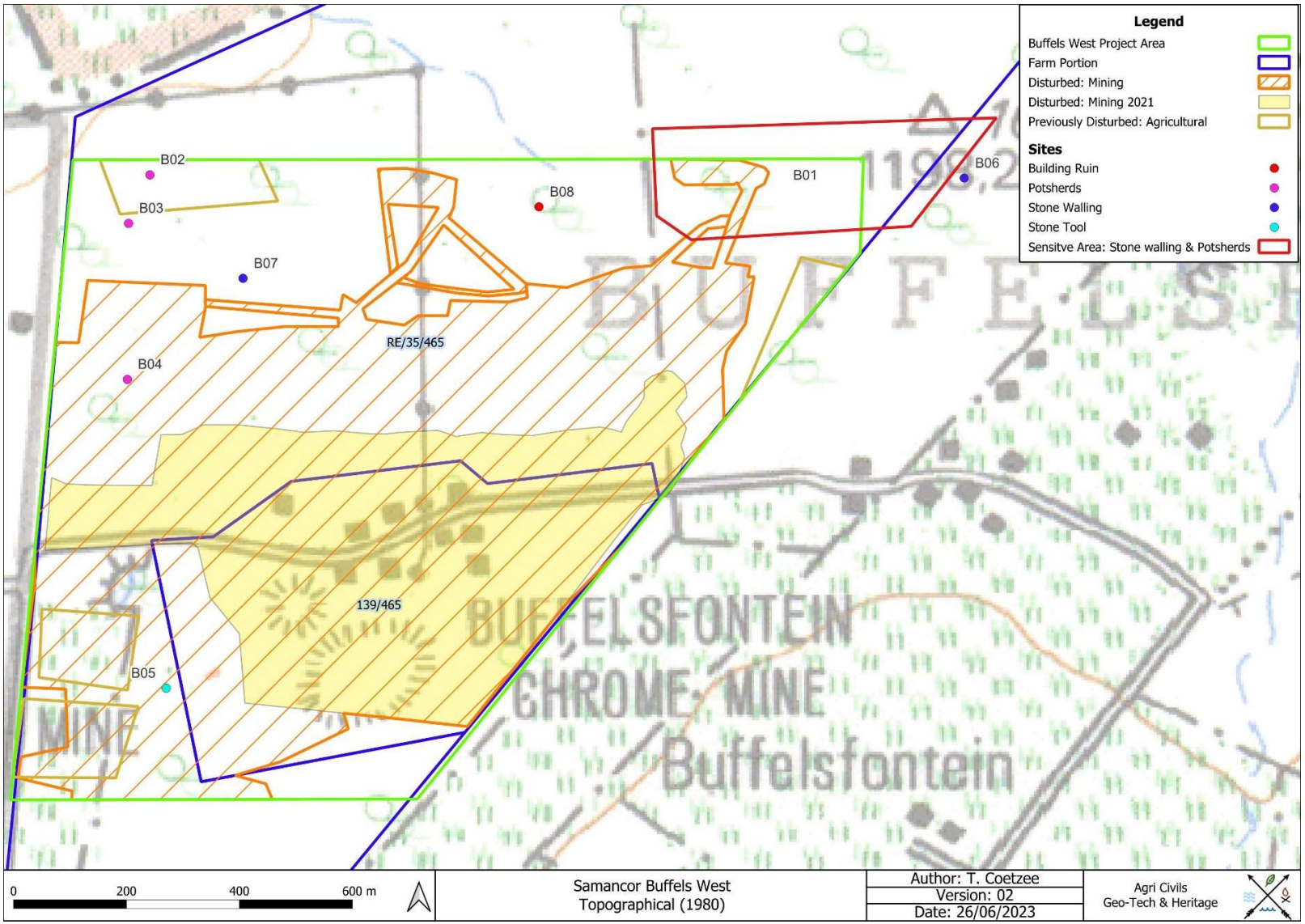

Figure 38: Study area superimposed on a 1980 1: 50 000 2527 DA topographical map.

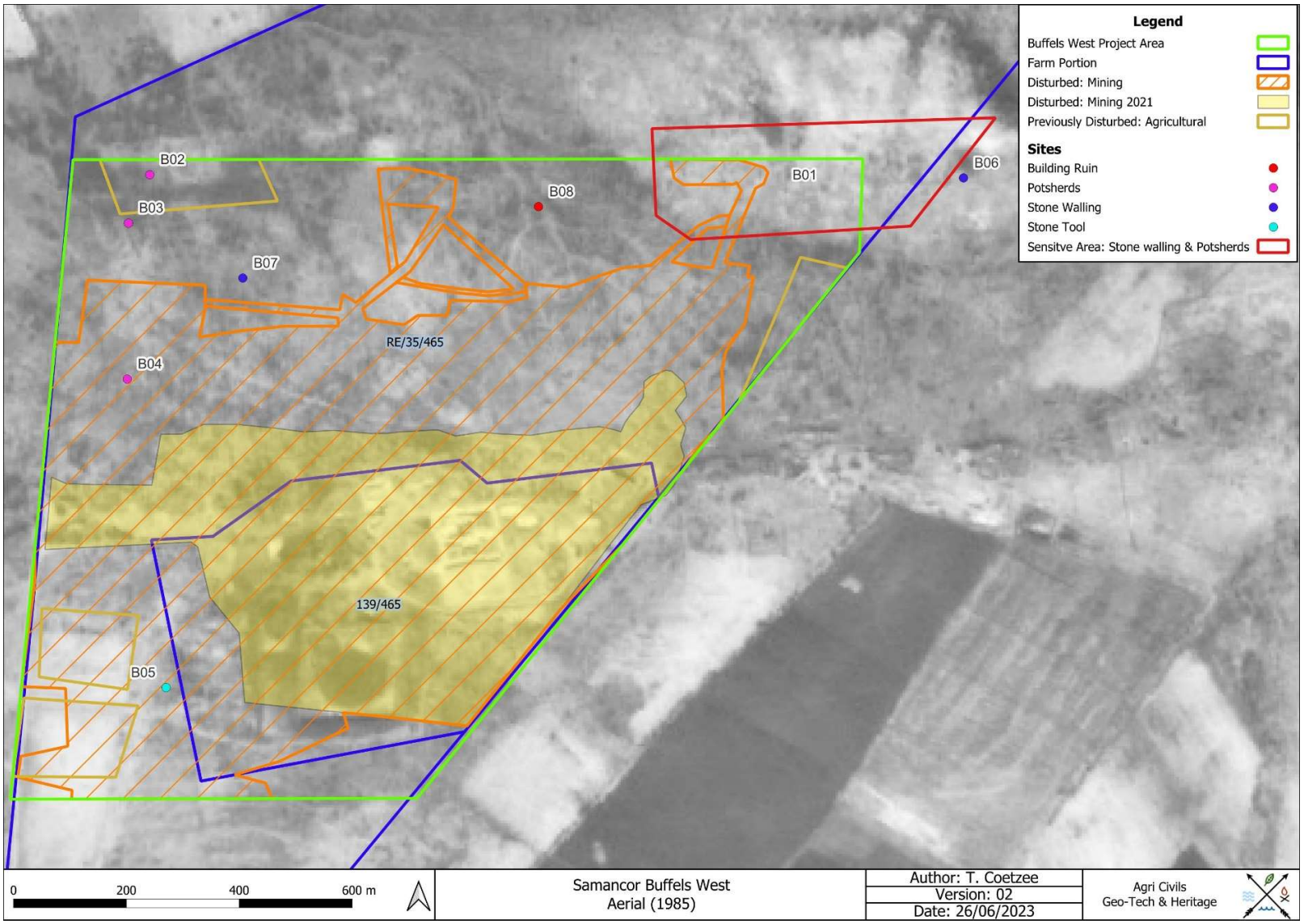

Figure 39: Study area superimposed on a 1985 aerial photograph.

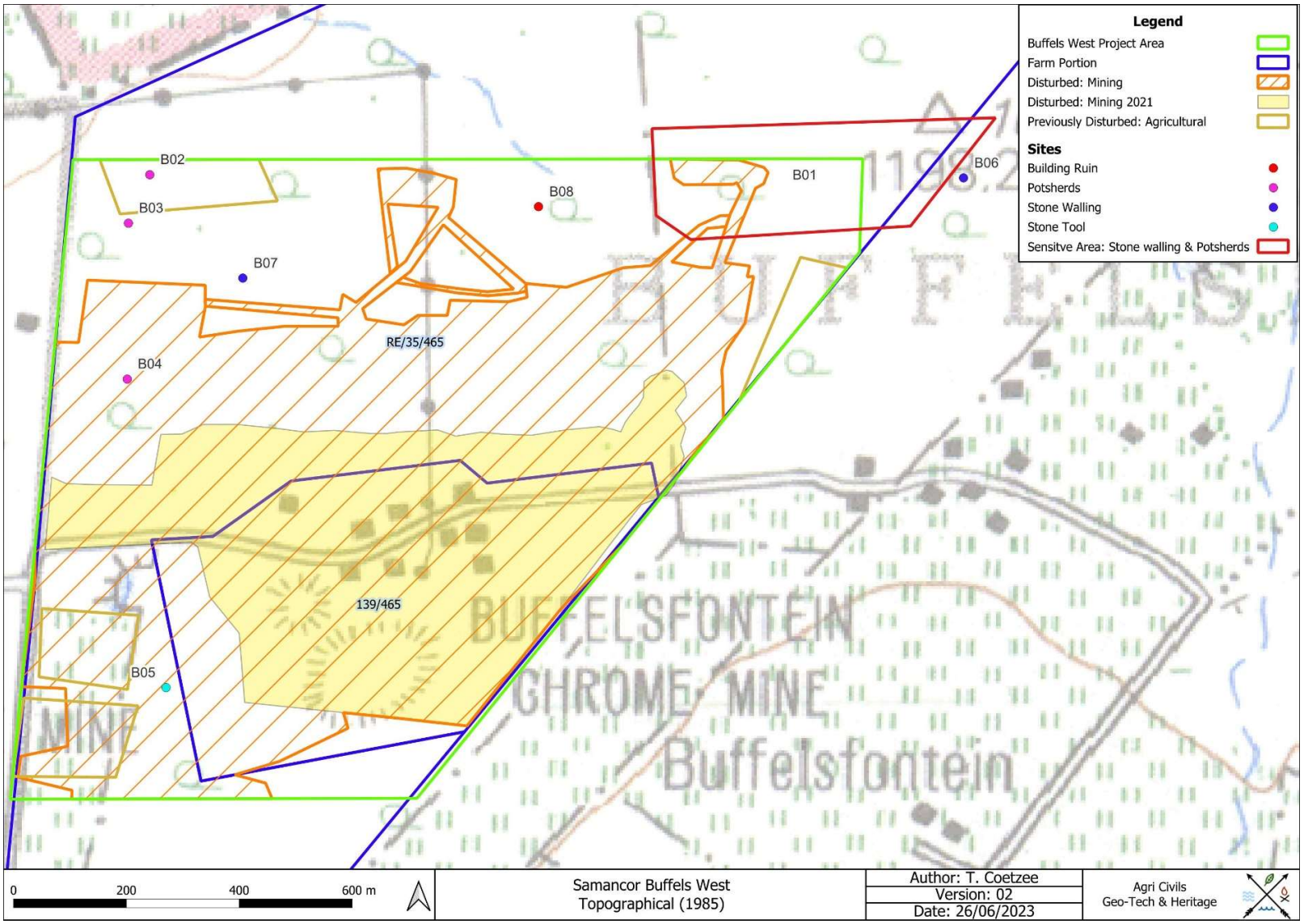

Figure 40: Study area superimposed on a 1985 1: 50 000 2527 DA topographical map.

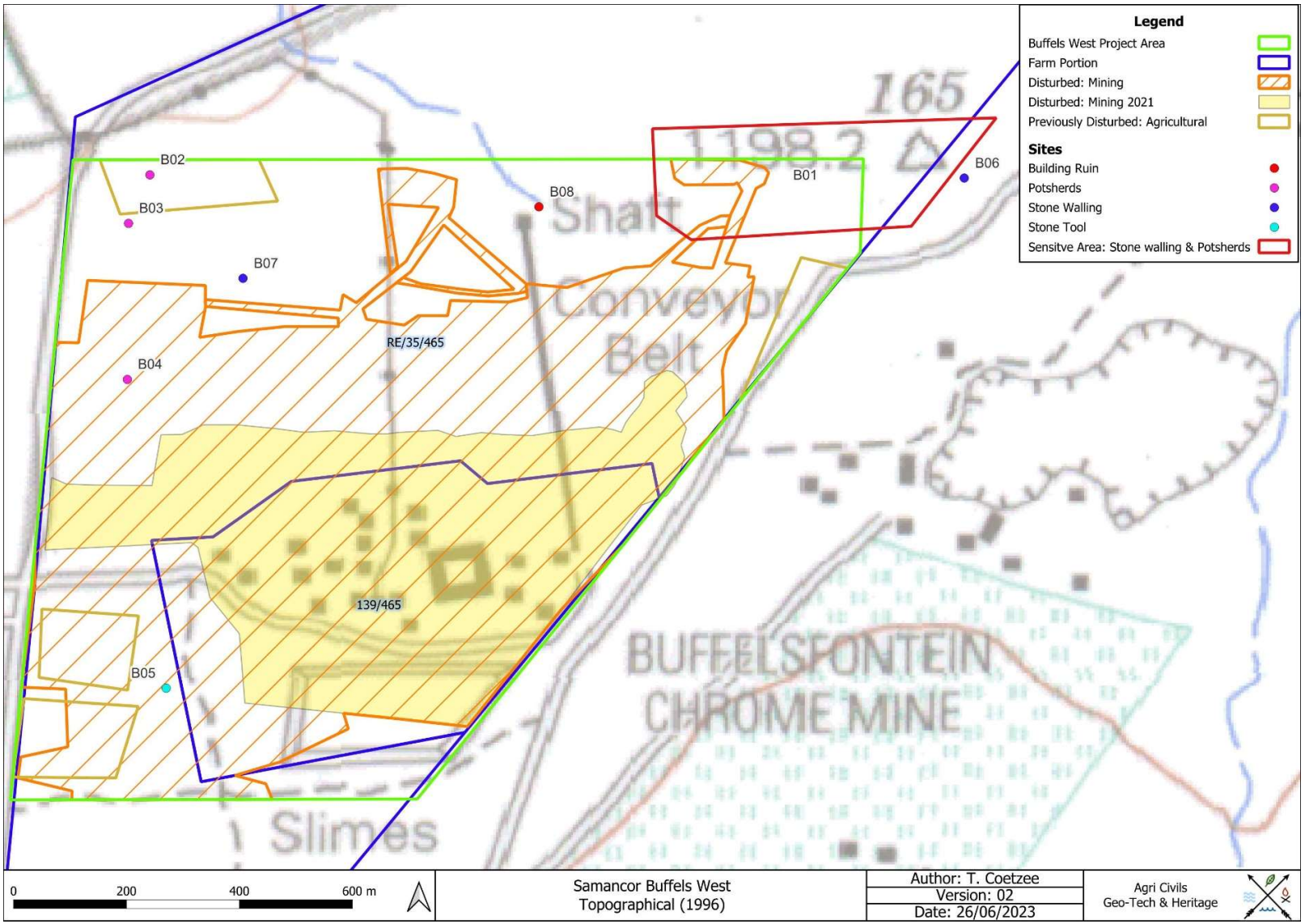

Figure 41: Study area superimposed on a 1996 1: 50 000 2527 DA topographical map.

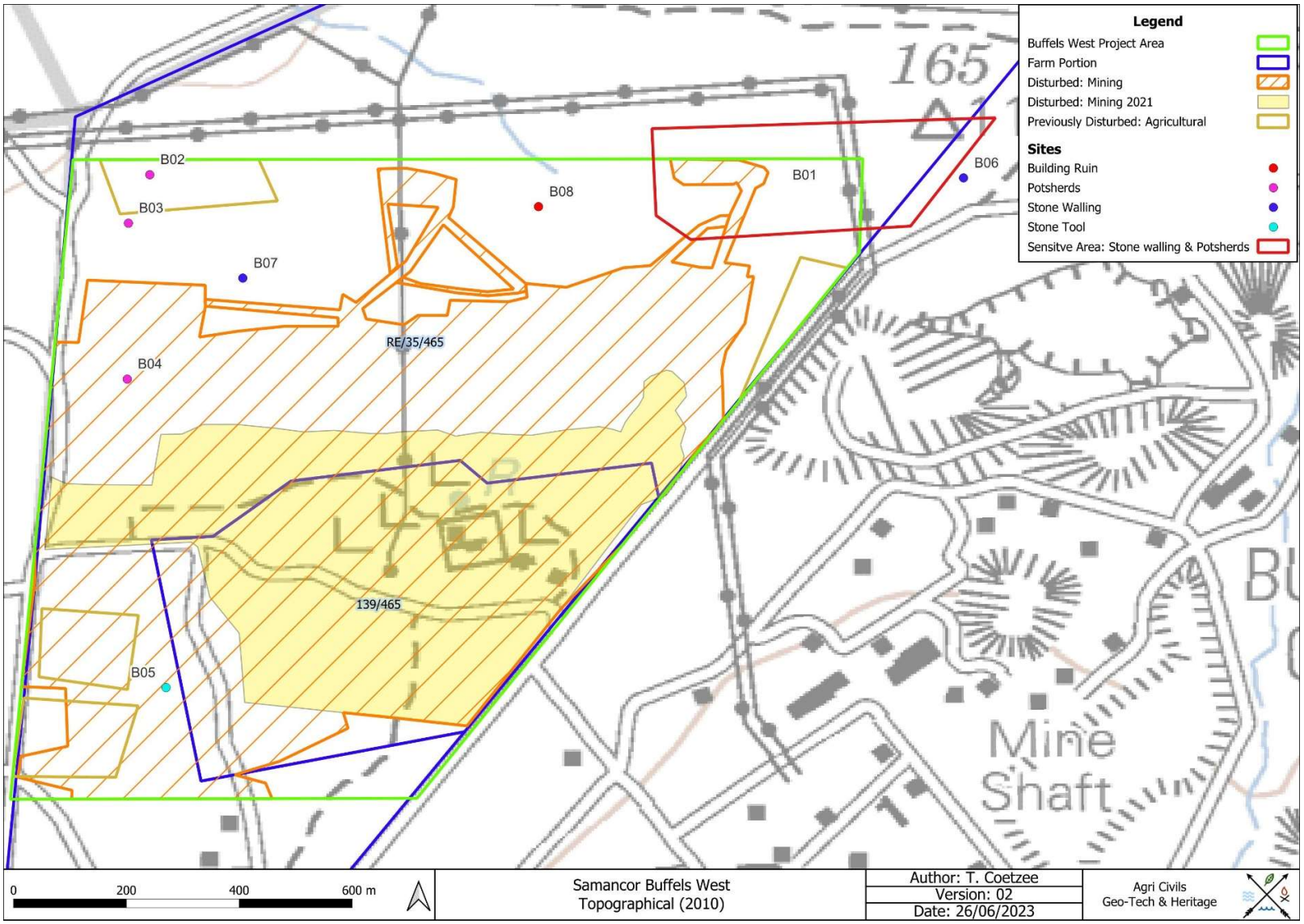

Figure 42: Study area superimposed on a 2010 1: 50 000 2527 DA topographical map.

Appendix B: NEMA Risk Assessment Methodology

1.1 RISK ASSESSMENT

The first stage of impact assessment is the identification of environmental activities, aspects and impacts. The receptors and resources are also identified, which allows for an understanding of the impact pathway and assessment of the sensitivity to change.

The purpose of the rating is to develop a clear understanding of influences and processes associated witheach impact. The values for the likelihood and consequence (severity, spatial scope and duration) of the impact are then used to determine whether mitigation is necessary.

1.1.1 Methodology used in Determining the Significance of Environmental impacts

The Environmental Impact Assessment (EIA) 2014 Regulations [as amended] promulgated in terms of Sections 24 (5), 24M and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) [as amended] (NEMA), requires that all identified potential impacts associated with the project be assessedin terms of their overall potential significance on the natural, social and economic environments. The criteriaidentified in the EIA Regulations (2014) include the following:

- Nature of the impact;
- Extent of the impact;
- Duration of the impact
- Probability of the impact occurring;
- Degree to which impact can be reversed;
- Degree to which impact may cause irreplaceable loss of resources;
- Degree to which the impact can be mitigated; and
- Cumulative impacts.

The impact assessment methodology used to determine the significance of impacts prior and after mitigation is presented below

Extent of the impact

The EXTENT of an impact is the physical extent/area of impact or influence.

Score	Extent	Description
1	Footprint	The impacted area extends only as far as the actual footprint of the activity.
2	Site	The impact will affect the entire or substantial portion of the site/property.
3	Local	The impact could affect the area including neighbouring properties and transport routes.
4	Region	Impact could be widespread with regional implication.
5	National	Impact could have a widespread national level implication.

Duration of the impact

The DURATION of an impact is the expected period of time the impact will have an effect.

Score	Duration	Description
1	Short term	The impact is quickly reversible within a period of less than 2 y limited to the construction phase, or immediate upon the commenof floods.
2	Short to medium term	The impact will have a short term lifespan (2–5 years).
3	Medium term	The impact will have a medium term lifespan (6 – 10 years)
4	Long term	The impact will have a medium term lifespan (10 – 25 years)
5	Permanent	The impact will be permanent beyond the lifespan of the developm

Intensity of the impact

The INTENSITY of an impact is the expected amplitude of the impact.

Score	Intensity	Description
1	Minor	The activity will only have a minor impact on the affected environment i a way that the natural processes or functions are not affected.
2	Low	The activity will have a low impact on the affected environment.
3	Medium	The activity will have a medium impact on the affected environment function and process continue, albeit in a modified way.
4	High	The activity will have a high impact on the affected environment which be disturbed to the extent where it temporarily or permanently ceases
5	Very High	The activity will have a very high impact on the affected environment may be disturbed to the extent where it temporarily or permanently ce

Reversibility of the impact

The REVERSIBILITY of an impact is the severity of the impact on the ecosystem structure

Score	Reversibility	Description
1	Completely reversible	The impact is reversible without any mitigation measures and manag measures
2	Nearly completely reversible	The impact is reversible without any significant mitigation management measures. Some time and resources required.
3	Partly reversible	The impact is only reversible with the implantation of mitigation management measures. Substantial time and resources required.
4	Nearly irreversible	The impact is can only marginally be reversed with the implantatio significant mitigation and management measures. Significant time resources required to ensure impact is on a controllable level.
5	Irreversible	The impact is irreversible.

Probability of the impact

The PROBABILITY of an impact is the severity of the impact on the ecosystem structure

Score	Probability	Description
1	Improbable	The possibility of the impact occurring is highly improbable (less than of impact occurring).
2	Low	The possibility of the impact occurring is very low, due either to circumstances, design or experience (5% to 30% of impact occurring
3	Medium	There is a possibility that the impact will occur to the extent that provision must be made therefore (30% to 60% of impact occurring).
4	High	There is a high possibility that the impact will occur to the extent t provision must be made therefore (60% to 90% of impact occurring).
5	Definite	The impact will definitely take place regardless of any prevention plan and there can only be relied on migratory actions or contingency plato contain the effect (90% to 100% of impact occurring).

Calculation of Impacts – Significance Rating of Impact

Significance is determined through a synthesis of the various impact characteristics and represents the combined effect of the Irreplaceability (Magnitude, Extent, Duration, and Intensity) multiplied by the Probability of the impact. The significance of an impact is rated according the scores a presented below:

Equation 1:

Significance = Irreplaceability (Reversibility + Intensity + Duration + Extent) X Probability

Significance Rating		
Score	**Significance**	**Colour Code**
1 to 20	Very low	
21 to 40	Low	
41 to 60	Medium	
61 to 80	High	
81 to 100	Very high	

Mitigation Efficiency	
Degree to which the impact can be mitigated: *The effect of mitigation measures on the impact and itsdegree of effectiveness:* *Equation 2:* *Significance Rating = Significance x Mitigation Efficiency*	
High	0,2
Medium to High	0,4
Medium	0,6
Low to Medium	0,8
Low	1,0

Confidence rating: *Level of certainty of the impact occurring*.

- **Certain**
- **Sure**
- **Unsure**

Cumulative impacts: *The effect the combination of past, present and "reasonably foreseeable" futureactions have on aspects.*

- Very Low cumulative impact
- Low cumulative impact
- Medium cumulative impact
- High cumulative impact

Appendix C: Monitoring – Heritage

Site	Impact	Applicable Phase	Action	Frequency	Responsible person
Sensitive area	Potential damage to surface / subsurface remains	Construction/Development	Fence off area	Once	ECO/Mine/Archaeologist
All surface impacts	Potential damage to subsurface culturally significant material	Construction/Development	Chance finds procedure	Duration of construction / development	ECO