APPENDIX 1

FIELD SURVEY AND RECORDING METHODS

This monograph reports on the results of field programs conducted in the course of compliance works associated with the development of FMG Christmas Creek and Cloudbreak mines and their associated infrastructure (Figure A1.1). No additional fieldwork has been undertaken and the analysis relies entirely on data collected in the context of site assessment and salvage in association with the development of the mine.

Depending on the mine development program requirements, some areas were inspected on several occasions during the life of the compliance project. Site recording often occurred over repeated visits, including site identification, detailed field recording and, finally, salvage. Therefore, sites may have cumulative records. Site boundaries were sometimes redefined and some sites were amalgamated during follow-up work. This cumulative approach to fieldwork and recording, as well as the organisation of the work around client requests, means that compiling and checking data for this analysis required considerable care. This was intended to ensure that the most complete and accurate field records were used and, particularly, to minimise the use of duplicate records. Fieldwork and reporting in the FMG survey area continued during this study. This meant that many sites were at different stages of recording, reporting and salvage, and therefore

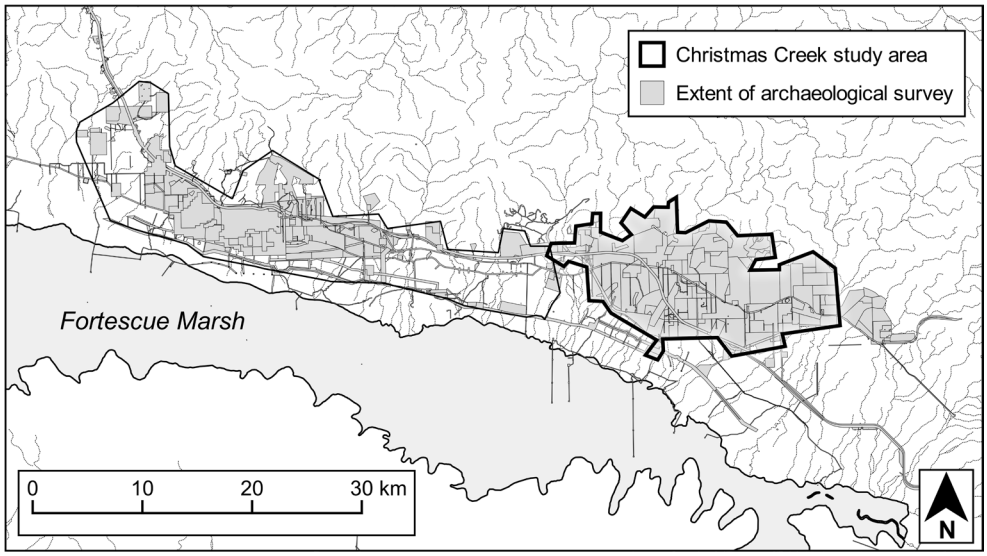

FIGURE A1.1: Extent of archaeological survey in relation to Fortescue Metals Group's Christmas Creek and Cloudbreak mines, and associated infrastructure.

subject to updates during the analysis period. This analysis thus only uses data from sites recorded up to the end of 2012, primarily from the Christmas Creek area rather than Cloudbreak, as these data were the most complete and comprehensively recorded. This area also contained all the excavated rockshelters containing cultural material.

Numerous reports prepared by Archae-aus staff for FMG constitute the primary documentation for these sites. Together, they outline the methods followed for survey and analysis. We summarise them here for reference.

SITE DEFINITIONS

Sites were classified in accordance with definitions used by the Department of Aboriginal Affairs when registering sites under the *Aboriginal Heritage Act 1972* (WA) and following standard practice in compliance archaeology in the region and elsewhere in Australia (e.g. Burke and Smith 2004, 202ff.). The site types typical of the inland Pilbara occurring in the survey area are surface artefact scatter, reduction area, quarry, rockshelter, modified tree and structure. Isolated artefacts were also recorded by Archae-aus staff to characterise the 'background scatter'. Rock art is absent from the survey area. This is most likely because the banded iron

formation rock surfaces in the survey area are not suitable for the execution or survival of pigment or engraved art.

About 2000 sites were identified and recorded in the Cloudbreak–Christmas Creek area between 2006 and 2012. Nine hundred and fifty occur within the boundaries of the Christmas Creek study area as defined in Chapter 1, including 19 rockshelters where test excavations were conducted. More than 8000 isolated artefacts were also recorded within the boundaries of the survey area.

METHODS

FIELD SURVEY

For most of the area, field survey was conducted by walking parallel transects about 30 to 35 metres apart with team members inspecting areas for archaeological material. Parts of the survey area with gradients too steep to be accessed safely were inspected less intensively. However, all rockshelters that could be reached safely were inspected. As a result, the entire area has been inspected for archaeological material as far as practicable.

Archaeologists commonly distinguish between relatively dense, localised concentrations of archaeological material, termed sites, and a background scatter of more sparsely distributed archaeological materials or isolated artefacts. The implications of this distinction between on site and off site or non-site archaeology were formally recognised in the late 1970s and widely debated since (e.g. Dunnell and Dancey 1983; Foley 1981a; Thomas 1975). Although it is now well recognised that the distribution of archaeological material is effectively continuous in most landscapes, the practical requirements of the administration of cultural heritage legislation call for the delineation of discrete sites. Archaeologists have, however, struggled to find effective methods to analyse such data, as discussed in Chapter 2. Definitions of what constitutes a site can vary enormously, and are often inconsistent. Indeed, defining a site is commonly dependent on contextual information and can vary locally or regionally. More recently, site definitions have been developed that account for the almost ubiquitous, though sparse, scatter of artefactual material across most landscapes, with reference to the general character of the local and regional archaeological context. Hiscock

(1988), for example, has developed a formula that defines sites, within a local context, by the density of artefacts as a multiple of the background density of isolated artefacts, or the background scatter. This method has been usefully applied in a number of different landscapes (e.g. Green et al. 1994; Hook and Veitch 1999; Hughes and Quartermaine 1992). Such methods commonly also consider effective survey coverage in terms of ground visibility, so as to apply suitable correction factors (Green et al. 1994; Hiscock 1988). In this study, the analysis of surface artefacts is assessed mostly at a landscape scale, rather than at the level of the individual site. In this context, therefore, the distinction between sites and isolated artefacts is of little relevance.

RECORDING OF SURFACE ARTEFACTS

In the Cloudbreak–Christmas Creek survey program, an artefact scatter is defined as any concentration having the following characteristics:

- more than five artefacts
- minimum average artefact density of 0.2 artefacts per m^2
- an average density of more than five times the density of isolated artefacts.

Artefact scatters are commonly inferred to represent locations where activities such as the manufacture and maintenance of tools and food processing have occurred in the past.

A reduction area is defined as a cluster of stone artefacts that represents the remains of the flaking of a core. This is often determined by refitting some of the flakes back onto a core, or sometimes, where the cluster comprises material from a single distinctive piece of raw material, constituting an analytical nodule. Reduction areas may occur as discrete locations or as elements of more extensive artefact scatters. Discrete reduction areas were recorded in the same manner as artefact scatters.

Isolated artefacts do not occur in clusters of sufficient density to be identified as discrete sites. As already discussed (see Chapter 2), it is well recognised that the distribution of archaeological remains is more or less continuous across the landscape.

Detailed records of the attributes of all stone artefacts were made for all isolated artefacts, all artefacts at small sites, and a sample of the artefacts from larger and more extensive sites. Sampling of larger sites was purposive and aimed to characterise the range of variation present. The attributes recorded during the survey are listed and defined below.

The information recorded for a small number of sites was incomplete and lacked metrical data. This was generally because the sites were not going to be affected by development and were thus not documented in detail. These samples have not been excluded from the analysis, and are included in discussions of overall assemblage composition, but not analysis of metrical attributes.

SURFACE ARTEFACT SCATTERS

Generally, all surface artefact scatters were recorded at least to what is called site identification level. This level of recording is designed to provide:

- sufficient information that the nature of the archaeological assemblage can be understood
- sufficient information and documentation that would mitigate against its loss should an application be made under Section 18 of the Aboriginal Heritage Act, and
- sufficient information to allow an assessment of archaeological significance under the Aboriginal Heritage Act.

For sites recorded to this level, the following recording procedure was followed:

- The boundary of an artefact scatter was determined by walking radial transects from an identified concentration. The boundary was defined once artefact densities dropped below the minimum distinguishing an artefact scatter from the background scatter. The boundary was recorded as a polygon defined by a series of waypoints recorded using a hand-held GPS.

- The artefact assemblage was recorded on standard forms by classifying and measuring all artefacts in one or more sample squares (see below). These squares were selected to sample the range of variation within the site. For small sites, all artefacts were recorded.
- Detailed site plans were drawn illustrating major topographic features, the site boundary, sample square locations and GPS coordinates.
- The recording of environmental features was also standardised. Topography, soil/ground surface, plant formation, dominant plant species, ground surface visibility, ground disturbance, distance to the nearest water source, type of water source and site size were the key features noted. Verbal descriptions were also provided. Photographs were taken showing general topography, major site features and a sample of artefacts.

When mitigating development impact was recommended (under the conditions of relevant Section 18 approvals under the *Aboriginal Heritage Act 1972* [WA]), sites were recorded in more detail prior to salvage. This involved checking and, where necessary, adjusting site boundaries, in addition to artefact recording and recovery of artefacts from sample squares.

Details of any variation to the standard methods applied to particular sites and survey areas can be found in the relevant consultancy reports.

ISOLATED ARTEFACTS

All isolated artefacts were classified, measured and their location (UTM, datum GDA 1994) recorded using a hand-held GPS. The number of isolated artefacts recorded in a given area corrected for an estimate of archaeological visibility was used to calculate the density of the background scatter in consultancy reports.

EXCAVATION METHODS

Excavations only occurred at rockshelters and were undertaken in accordance with the requirements of the relevant Section 16 Permit under the *Aboriginal Heritage Act 1972* (WA). One or more test pits were excavated in each shelter. The location of test pits was determined by a number of factors including the presence of surface cultural material or features, the estimated depth of deposit as determined by probing, the distribution of roof fall, and the overall configuration of the shelter in terms of floor space, ventilation and lighting.

During excavation, observable stratigraphy was followed where possible, otherwise arbitrary excavation units of approximately 3–5 cm were removed. The Munsell colour and pH of the deposit were recorded for each excavation unit. Any potential cultural items observed during the excavation, such as flaked stone artefacts and samples from charcoal concentrations, were bagged and recorded in three dimensions.

The Johnson 'bucket' method of treating excavated material was followed (Johnson 1979). The (bucket) weight and volume of excavated material removed from each excavation unit were recorded. All the excavated material was passed through a nest of 6 mm and 3 mm sieves on site. All potential cultural material, including charcoal, bone, plant remains and flaked stone, observed during excavation and in the sieve, were bagged separately. The 6 mm residue was sorted on site and cultural material bagged. Solid samples were collected from any hearth features. A 25% sample of the 3 mm residue was collected for sorting under laboratory conditions in Perth.

In the laboratory, material from both the 6 mm and 3 mm fractions was sorted and catalogued. Each category of material from each sieve for each excavation unit was weighed. The 6 mm flaked stone artefacts were catalogued and recorded in detail using the same attributes as for surface artefacts, with the addition of weight. The 3 mm flaked stone artefact sample was sorted according to lithology and artefact type, and each artefact was weighed.

Samples of charcoal were selected for radiometric dating and sent to the Waikato Radiocarbon Dating Laboratory in New Zealand, following the protocols for collecting material for standard determinations. When

selecting radiometric dating samples, material from features thought to be hearths was preferred. In situ samples were selected next, with samples from the 6 mm sieve fraction the lowest priority.

STONE ARTEFACT ATTRIBUTES

The approach to classification used for stone artefacts corresponds generally to standard definitions widely used by Australian archaeologists (e.g. Hiscock 1984; Holdaway and Stern 2004). The attributes recorded are listed and defined below.

RAW MATERIAL

Raw material was recorded for all stone artefacts. The geology of the Chichester Range is diverse and includes a range of rocks suitable for flaking (see Chapter 3). Field identification was generally based on the definitions in Pellant (2000). The following raw materials occur in assemblages in the study area: banded iron formation (BIF), basalt, chalcedony, chert, dolerite, granite, ironstone, mudstone, quartz, crystal quartz, quartzite, silcrete, and siltstone. In addition, glass is occasionally found at sites, while the occasional artefact whose lithology cannot be clearly identified is classified as 'other'.

FLAKED STONE ARTEFACTS

The identification of stone objects as flaked artefacts followed standard observations on features commonly associated with flaked stone technology (Andrefsky 2005, 16ff.; Hiscock 1984, 128–9; Holdaway and Stern 2004, 4ff.). Three broad categories of flaked stone artefacts were identified: flakes, cores and debris. In describing the products of percussion flaking, cores are conventionally regarded as the nodule or objective piece of rock from which the detached pieces (generally flakes) are removed by striking. Debris is used here for all products of percussion flaking that do not fall into the conventional categories described below. Other terms that are sometimes used for this category are: shatter, angular fragments, flaked pieces, chips and chunks (Holdaway and Stern 2004, 113–4).

FLAKES

Flakes show one or more of the following characteristics (Andrefsky 2005, Figure 2.7; Holdaway and Stern 2004, Figures 1.31, 3.1.1, 3.2.1):

- a ring crack at the point of impact, where the percussor struck the core
- a positive bulb of percussion, or force
- a bulbar scar, sometimes called an éraillure scar, beneath a striking platform
- undulations or ripple marks radiating from the bulb of percussion
- very small cracks or fissures radiating from the point of impact
- one or more negative flake scars on the dorsal surface.

Flakes can be complete or broken. The process of fragmentation affects quantification and measurement, and therefore interpretation. Flakes can be further subdivided into complete flakes and transverse or longitudinal fragments (Hiscock 2002, Figure 1; Holdaway and Stern 2004, 111–18).

- Complete flakes have their ventral surface largely intact and have an identifiable impact point, lateral margins and a termination. These flakes are sufficiently intact for metrical attributes of length, width and thickness to be recorded.
- Transverse fragments are fragments resulting from a break that occurs at right angles to the axis of percussion or flaking axis. An identifiable ventral surface and portions of both lateral margins are present, but a termination, or evidence of an impact point, or both are absent. Proximal flake fragments preserve evidence of the impact point, distal flake fragments retain the fracture termination and medial flake fragments exhibit portions of both lateral margins but lack a termination and impact point (Holdaway and Stern 2004, Figure 3.3.1).

- Longitudinal fragments result from a break that runs parallel to the flaking axis. Each fragment usually retains a portion of the platform, one lateral margin and the termination. These are further classified into left and right fragments (Holdaway and Stern 2004, Figure 3.4.1).
- Marginal flake fragments preserve a portion of one lateral margin only and do not preserve evidence of an impact point or termination.

Flakes which are at least twice as long as they are wide, with parallel lateral margins and one or more dorsal ridges, are commonly defined as blades.

CORES

Cores are defined as artefacts that show negative flake scars, indicating where flakes were removed and where the objective can be inferred to be the production of such flakes (Andrefsky 2005, 14; Holdaway and Stern 2004, Figure 1.5.1). Cores are further classified as single platform or multiplatform. Single platform cores have negative flake scars all of which originate from a single platform and have been struck in the same direction. Multiplatform cores have been turned (rotated) one or more times during the flaking process and have negative flake scars originating from two or more platforms. Core fragments show evidence of negative flake scars but are clearly incomplete.

RETOUCHED PIECES AND FORMAL TOOLS

Retouched pieces are those where the edge has been modified by the removal of a series of small flakes usually originating from the ventral surface and extending onto the dorsal surface. Identifying retouch can be difficult because edge damage can occur to the margins of flaked stone artefacts inadvertently through treadage after discard or during use as well as through deliberate modification to shape or resharpen the edge of a tool. The following major categories are defined here:

- Adzes are distinctive heavily retouched flakes with steep working edge. They are commonly found as a characteristic

'slug' form. These are assumed to be hafted woodworking tools (Holdaway and Stern 2004, 251ff.). Adzes are further categorised into two types:

  - Tula (Holdaway and Stern 2004, Figure 6.24.1). Tula flakes have prominent bulbs of percussion, wide striking platform and an obtuse angle between the platform and the ventral surface. The distal and lateral margins are steeply retouched to form a semi-discoidal tool that is mounted in a haft. Progressive resharpening of the working edge results in characteristic reduction of the body of the tool until no further retouch is possible and the worn-out slug is discarded (Holdaway and Stern 2004, Figure 6.25.1).
  - Burren, or non-tula, adze. Burren adzes have steep heavily retouched, working edges and show progressive resharpening similar to tulas resulting in discard in 'slug' form. However, they are not made on the characteristic tula flake and retouch may be on one or both lateral margins rather than on the distal margin (Holdaway and Stern 2004, Figure 6.26.1).

- Backed artefacts have abrupt unidirectional or bidirectional retouch on one lateral margin opposing a sharp unretouched edge (Holdaway and Stern 2004, 259ff.). Backed artefacts in the survey area are all geometric in form (Holdaway and Stern 2004, Figure 6.30.1).
- Macroblades are large flakes (more than 40 mm long), more than twice as long as they are wide, with parallel lateral margins and one or more dorsal ridges along the length of the flake (Hook 2009, Figures 3, 4; Mulvaney and Kamminga 1999, 241–3). They can be retouched.
- Retouched artefact. This category includes a range of amorphous flakes or fragments showing evidence of retouch or macroscopic edge damage resulting from use, but which do not fit into defined formal categories.

GROUND STONE ARTEFACTS

Ground stone artefacts have been shaped by abrasive action either during manufacture or use. The following types of ground stone artefacts occurred in the survey area (Smith 1986):

- Mullers are triangular/oval shaped hand-sized pebbles or rocks. The grinding area can occur on one or both end surfaces.
- Millstones are movable large flat slabs with one or two long shallow grooves worn through the process of abrasion. Such artefacts can have flaked margins.
- Amorphous grindstones are expedient, unmodified slabs/blocks with flat and poorly developed ground or abraded patches on one or sometimes more face(s). The ground surfaces may be smooth, but generally lack use-polish and do not form well defined and discrete surfaces.

OTHER ARTEFACTS

Manuports are defined as any natural unmodified object that has been transported and deposited by Aboriginal peoples. Hammer stones are pieces of rock, usually round or ovoid cobbles, used as percussors to strike flakes from a core. They commonly develop evidence of this use in the form of pitting and abrasion.

ATTRIBUTES USED IN THE ANALYSIS

Site name, sample square, type and raw material were noted for all stone artefacts recorded in the field.

Length, width and thickness were recorded in millimetres for all artefacts recorded in the field.

For complete flakes, these were measured as follows:

Length: the distance along the percussion axis from the ring crack to the distal margin (Andrefsky 2005, Figure 5.8a).

Width: the distance between the lateral margins measured at right angles to the percussion axis half way between the ring crack and distal margin (Andrefsky 2005, Figure 5.9b).

Thickness: the maximum distance between the ventral and dorsal surface of the flake half way between the ring crack and the distal margin (Andrefsky 2005, Figure 5.9g).

Flake fragments and debris cannot be oriented in relation to the percussion axis. For these artefacts, length was measured as the maximum dimension, with width at right angles to length and thickness at right angles to both length and width. Both width and thickness were measured at the mid-point of the artefact.

For cores, these were measured as follows (Holdaway and Stern 2004, Figure 5.10.1, Method 2):

- Length: the maximum dimension of the core oriented along the axis of the longest scar.
- Width: the maximum dimension perpendicular to length along the face containing the longest scar.
- Thickness: measured at right angles to width.

For all flakes with platforms, width and thickness were measured in millimetres as follows (Holdaway and Stern 2004, Figure 3.16.1):

- Platform width: the distance along the striking platform from one lateral margin to the other.
- Platform thickness: the distance across the striking platform from the centre of the ring crack to the dorsal surface.

Additional attributes recorded for all flakes were:

- Type of platform. Five platform types were recognised.
  - Cortical. Unmodified original surface, or cortex, of the source rock.
  - Plain. Plain non-cortical surface resulting from a previous flake scar or a heat-fracture scar.
  - Faceted. Surface has evidence of two or more previous flake scars.

  - Focal. Platform with a very small surface area compared to the width and thickness of the flake.
  - Crushed. Platform that has been damaged, usually forming a ridge, but where the point of impact can still be identified.
- Cortex type. Cortex is the outer layer forming the original rock surface resulting from natural processes of chemical or mechanical weathering (Andrefsky 2005, 103; Holdaway and Stern 2004, 26). Two types were recognised in the study area: riverine and terrestrial. Riverine cortex results from mechanical weathering caused by rolling and tumbling in a creek or river. Terrestrial cortex results from the chemical weathering of rocks exposed on the surface.
- Estimated proportion of the dorsal surface with cortex.
- Overhang removal: presence or absence. Overhang removal is indicated by the presence of small scars on the dorsal edge of the platform and running onto the dorsal surface of a flake. These are initiated from the core platform and produced before removal of the flake during platform preparation (Hiscock 1986, 49; Holdaway and Stern 2004, 143–4).
- Retouch. Presence or absence of edge modification.

The estimated proportion of the surface area retaining cortex was also recorded for cores.

The length, width and thickness of all manuports, hammer stones, millstones and mullers were measured. Length was defined as the maximum dimension; width was the dimension at right angles to length and thickness was measured at right angles to width. The length and width of individual grinding surfaces were also measured. The presence of attributes such as pitting, or abrasion, or other evidence of use or shaping was noted.