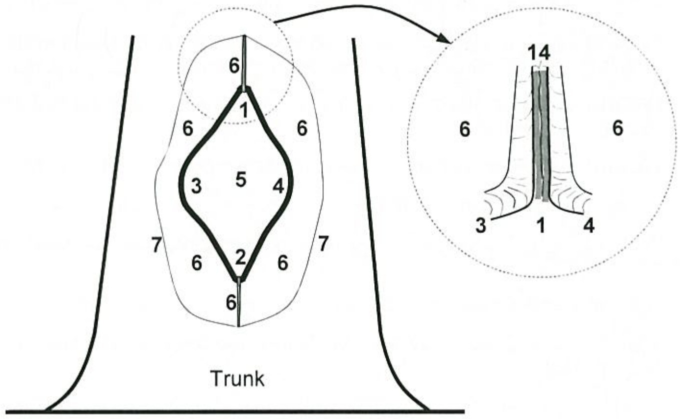
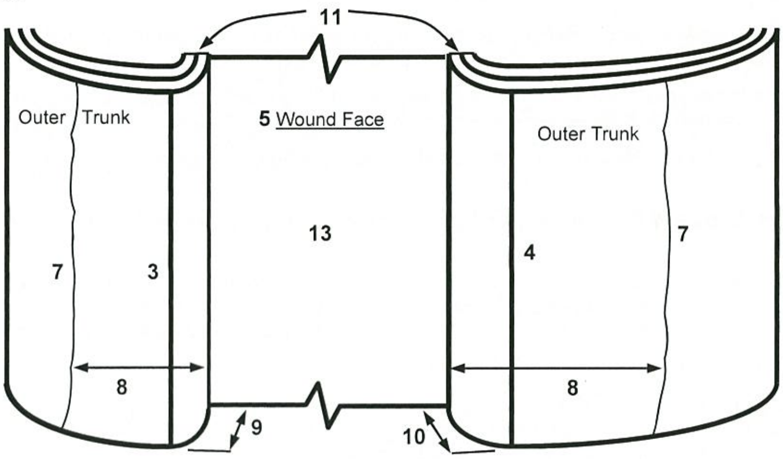
Wound Diagrams

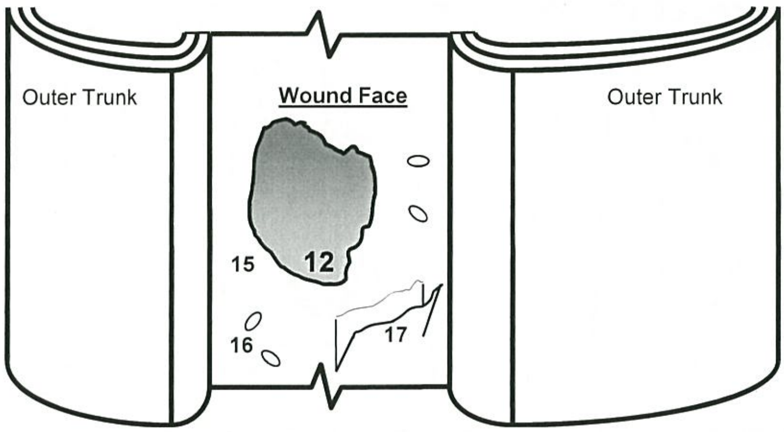
Wound Parts

1. Apex
2. Base
3. Wound Margin Left
4. Wound Margin Right
5. Wound Face
6. Partial Occlusion
7. Initial Wound Margin
8. Margin Width
9. Left Margin Depth
10. Right Margin Depth
11. Wound Wood
12. Cavity
13. Wound Face Entire
14. Occlusion Seam



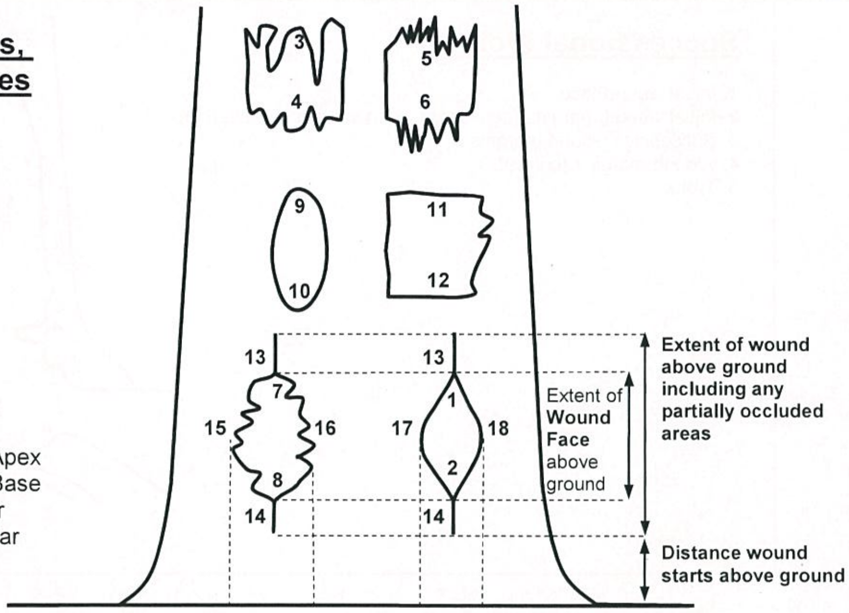


Examples of other Wound Faces
15. Wound face extending from dead sapwood to cavity in heartwood.
16. Oval shaped borer exit holes evident indicative of Longicorn Borer (Family Cerambycidae).
17. Linear laceration as made by an axe.



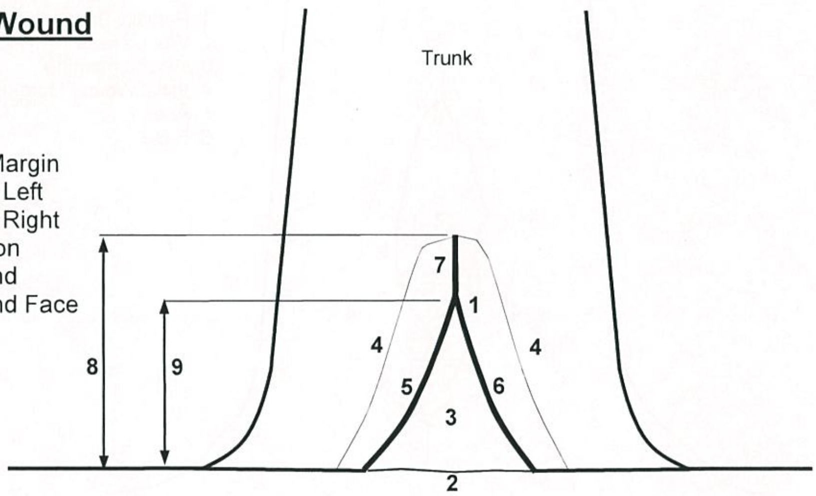
Wounds, Margins, Apexes and Bases

1. Apex Acute
2. Base Acute
3. Apex Irregular
4. Base Irregular
5. Apex Jagged
6. Base Jagged
7. Apex Obtuse
8. Base Obtuse
9. Apex Rounded
10. Base Rounded
11. Apex Truncate
12. Base Truncate
13. Partially Occluded Apex
14. Partially Occluded Base
15. Left Margin Irregular
16. Right Margin Irregular
17. Left Margin Entire
18. Right Margin Entire



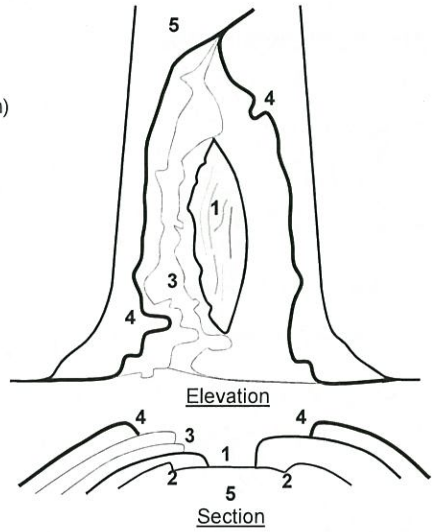
Basal Trunk Wound

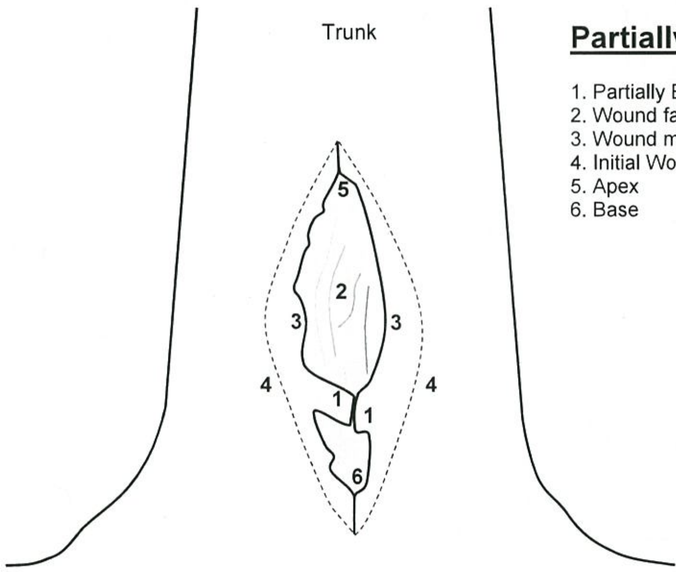
1. Apex
2. Base
3. Wound Face
4. Initial Wound Margin
5. Wound Margin Left
6. Wound Margin Right
7. Partial Occlusion
8. Extent of Wound
9. Extent of Wound Face



Successional Wound

1. Initial wound face
2. Initial wound margins (concealed when viewed in Elevation)
3. Successive wound margins
4. Wound margins (current)
5. Trunk





Partially Bridged Occlusion

1. Partially Bridged Occlusion
2. Wound face
3. Wound margins
4. Initial Wound Margins
5. Apex
6. Base

Condition of Trees

Condition A tree's *crown form* and growth habit, as modified by its *environment* (aspect, suppression by other trees, soils), the *stability* and *viability* of the *root plate*, trunk and structural branches (first (1st) and possibly second (2nd) order branches), including structural defects such as wounds, cavities or hollows, *crooked* trunk or weak trunk/branch junctions and the effects of predation by pests and diseases. These may not be directly connected with *vigour* and it is possible for a tree to be of *normal vigour* but in *poor condition*. Condition can be categorized as *Good Condition*, *Fair Condition*, *Poor Condition* and *Dead*.

Good Condition Tree is of good habit, with *crown form* not severely restricted for space and light, physically free from the adverse effects of *predation* by pests and diseases, obvious instability or structural weaknesses, fungal, bacterial or insect infestation and is expected to continue to live in much the same condition as at the time of inspection provided conditions around it for its basic survival do not alter greatly. This may be independent from, or contributed to by vigour. See also *Condition*, *Fair Condition* and *Poor Condition*.

Fair Condition Tree is of good habit or *misshapen*, a form not severely restricted for space and light, has some physical indication of *decline* due to the early effects of *predation* by pests and diseases, fungal, bacterial, or insect infestation, or has suffered physical injury to itself that may be contributing to instability or structural weaknesses, or is faltering due to the modification of the *environment* essential for its basic survival. Such a tree may recover with remedial works where appropriate, or without intervention may stabilise or improve over time, or in response to the implementation of beneficial changes to its local environment. This may be independent from, or contributed to by vigour. See also *Condition*, *Good Condition* and *Poor Condition*.

Poor Condition Tree is of good habit or *misshapen*, a form that may be severely restricted for space and light, exhibits symptoms of advanced and *irreversible decline* such as fungal, or bacterial infestation, major die-back in the branch and *foliage crown*, *structural deterioration* from insect damage e.g. termite infestation, or storm damage or lightning strike, ring barking from borer activity in the trunk, root damage or instability of the tree, or damage from physical wounding impacts or abrasion, or from altered local environmental conditions and has been unable to adapt to such changes and may decline further to death regardless of remedial works or other modifications to the local *environment* that would normally be sufficient to provide for its basic survival if in *good* to *fair* condition. Deterioration physically, often characterised by a gradual and continuous reduction in vigour but may be independent of a change in vigour, but characterised by a proportionate increase in susceptibility to, and *predation* by pests and diseases against which the tree cannot be sustained. Such conditions may also be evident in trees of advanced senescence due to normal phenological processes, without modifications to the growing environment or physical damage having been inflicted upon the tree. This may be independent from, or contributed to by vigour. See also *Condition*, *Good Condition* and *Fair Condition*.

Dead Tree is no longer capable of performing any of the following processes or is exhibiting any of the following symptoms;
Processes
Photosynthesis via its foliage crown (as indicated by the presence of moist, green or other coloured leaves);
Osmosis (the ability of the root system to take up water);
Turgidity (the ability of the plant to sustain moisture pressure in its cells);
Epicormic shoots or *epicormic strands* in Eucalypts (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a *lignotuber*);
Symptoms
Permanent leaf loss;
Permanent wilting (the loss of turgidity which is marked by desiccation of stems leaves and roots);
Abscission of the *epidermis* (bark desiccates and peels off to the beginning of the sapwood).

Removed No longer present, or tree not able to be located or having been cut down and retained on a site, or having been taken away from a site prior to site inspection.

Periods of Time

Periods of Time The life span of a tree in the urban environment may often be reduced by the influences of encroachment and the dynamics of the environment and can be categorized as *Immediate*, *Short Term*, *Medium Term* and *Long Term*.

Immediate An *episode* or occurrence, likely to happen within a twenty-four (24) hour period, e.g. tree failure or collapse in full or part posing an imminent danger. See also *Short Term*, *Medium Term* and *Long Term*.

Short Term A period of time less than <1 – 15 years. See also *Periods of Time*, *Immediate*, *Medium Term* and *Long Term*.

Medium Term A period of time 15 – 40 years. See also *Periods of Time*, *Immediate*, *Short Term* and *Long Term*.

Long Term A period of time greater than >40 years. See also *Periods of Time*, *Immediate*, *Medium Term* and *Short Term*.

Vigour

Vigour Ability of a tree to sustain its life processes. This is independent of the *condition* of a tree but may impact upon it. Vigour can appear to alter rapidly with change of seasons (seasonality) e.g. dormant, deciduous or semi-deciduous trees. Vigour can be categorized as *Normal Vigour, High Vigour*, *Low Vigour* and *Dormant Tree Vigour*.

Normal Vigour Ability of a tree to maintain and sustain its life processes. This may be evident by the *typical* growth of leaves, *crown cover* and *crown density*, branches, roots and trunk and *resistance* to *predation*. This is independent of the *condition* of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation. See also *Vigour*, *Low Vigour* and *High Vigour*.

High Vigour *Accelerated growth* of a tree due to incidental or deliberate artificial changes to its growing *environment* that are seemingly beneficial, but may result in *premature aging* or failure if the favourable conditions cease, or promote *prolonged senescence* if the favourable conditions remain, e.g. water from a leaking pipe; water and nutrients from a leaking or disrupted sewer pipe; nutrients from animal waste, a tree growing next to a chicken coop, or a stock feed lot, or a regularly used stockyard; a tree subject to a stringent watering and fertilising program; or some trees may achieve an extended lifespan from continuous *pollarding* practices over the life of the tree.

Low Vigour Reduced ability of a tree to sustain its life processes. This may be evident by the *atypical* growth of leaves, reduced *crown cover* and reduced *crown density*, branches, roots and trunk, and a deterioration of their functions with reduced *resistance* to *predation*. This is independent of the *condition* of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation. See also *Vigour*, *Normal Vigour* and *High Vigour*.

Dormant Tree Vigour Determined by existing turgidity in lowest order branches in the outer extremity of the crown, with good bud set and formation, and where the last *extension growth* is distinct from those most recently preceding it, evident by bud scale scars. Normal vigour during dormancy is achieved when such growth is evident on a majority of branches throughout the crown.

Good Vigour See *Normal Vigour*.

Poor Vigour See *Low Vigour*.

Health A tree's *vigour* as exhibited by *crown density*, *crown cover*, leaf colour, presence of epicormic shoots ability to withstand *predation* by pests and diseases, *resistance* and the degree of *dieback*.

Age of Trees

Age Most trees have a stable biomass for the major proportion of their life. The estimation of the age of a tree is based on the Knowledge of the expected lifespan of the taxa in situ divided into three distinct stages of measurable biomass, when the exact age of the tree from its date of cultivation or planting is unknown and can be categorized as *Young*, *Mature* and *Over-mature* (British Standards 1991, p. 13, Harris *et al*, 2004, p. 262).

Young Tree aged less than <20% of life expectancy, *in situ*. See also *Age*, *Mature* and *Over-mature*.

Mature Tree aged 20-80% of life expectancy, *in situ*. See also *Age*, *Young* and *Over-mature*.

Over-mature Tree aged greater than >80% of life expectancy, *in situ,* or *senescent* with or without reduced *vigour*, and declining gradually or rapidly but irreversibly to death. See also *Age*, *Young* and *Mature*.

Premature Aging Apparent hastened aging and deterioration of a tree where it has been subject to conditions or practices adverse to expected normal growth, resulting in a *spiral of decline*. The following are examples of processes that may start such cycles:

- Top lopping of a mature tree
- In a new car park, the excavation of soil severing the roots of a tree close to its trunk and then sealing the soil surface with asphalt or concrete up to the trunk
- Open trenching alongside a street tree severing all roots in the trench, then top lopping it for power line clearance, and then extensive damage to bark by abrasion by trucks and excavation equipment as tree is adjacent to a construction site
- Root damage from *soil compaction* to substantial areas of the root plate.

Prolonged Senescence A phenomenon in an *over-mature* tree or tree with *structural deterioration* in its *condition* and often *vigour* as *abnormal vigour* as a result of modifications to the tree or the growing environment essential for its survival where it is sustained beyond the *typical* extent of its life cycle, or prevented from failing in full or part from *structural deterioration* by a beneficial artificial modification to its growing environment either by deliberate or incidental intervention, e.g. water from a leaking tap, water and nutrients from a leaking sewer pipe creating a *hydroponic* environment, or by physically propping up a tree with *structural deterioration* as with a *veteran tree*, or by it *leaning* or growing against another tree or structure for support.

Axiom of Uniform Stress The principle that a tree is mechanically optimized growing only sufficient wood for support and loading. As a result, no area is under-loaded to breaking point or over-loaded with excess material (Mattheck & Breloer 1994, pp. 12-13).

Visual Tree Assessment (VTA) A visual inspection of a tree from the ground based on the principle that, when a tree exhibits apparently superfluous material in its shape, this represents repair structures to rectify *defects* or to reinforce weak areas in accordance with the *Axiom of Uniform Stress* (Mattheck & Breloer 1994, pp. 12-13, 145). Such assessments should only be undertaken by suitably competent practitioners.

Drop Zone The distance away from a tree that may be physically influenced by a falling branch.

Fall Zone The distance away from a tree that may be physically influenced if it was cut down or subject to *collapse*.

Leaning Trees

Leaning A tree where the *trunk* grows or moves away from upright. A lean may occur anywhere along the *trunk* influenced by a number of contributing factors e.g. genetically predetermined characteristics, competition for space or light, prevailing winds, aspect, slope, or other factors. A *leaning* tree may maintain a *static lean* or display an increasingly *progressive lean* over time and may be hazardous and prone to *failure* and *collapse*. The degrees of leaning can be categorized as *Slightly Leaning, Moderately Leaning, Severely Leaning* and *Critically Leaning.*

Slightly Leaning A leaning tree where the trunk is growing at an angle within 0^{o}-15^{o} from upright.

Moderately Leaning A leaning tree where the trunk is growing at an angle within 15^{o}-30^{o} from upright.

Severely Leaning A leaning tree where the trunk is growing at an angle within 30^{o}-45^{o} from upright.

Critically Leaning A leaning tree where the trunk is growing at an angle greater than >45^{o} from upright.

Progressively Leaning A tree where the degree of *leaning* appears to be increasing over time.

Static Leaning A leaning tree whose lean appears to have stabilized over time.

Windthrow Tree failure and collapse when a *force* exerted by wind against the *crown* and *trunk* overcomes resistance to that force in the *root plate*, such that the *root plate* is lifted from the soil on one side as the tree tips over.

Symmetry

Symmetry Balance within a *crown,* or *root plate,* above or below the *axis* of the trunk of branch and foliage, and root distribution respectively and can be categorized as *Asymmetrical* and *Symmetrical.*

Asymmetrical Imbalance within a crown, where there is an uneven distribution of branches and the foliage *crown* or *root plate* around the vertical *axis* of the trunk. This may be due to *Crown Form Codominant* or *Crown From Suppressed* as a result of natural restrictions e.g. from buildings, or from competition for space and light with other trees, or from exposure to wind, or artificially caused by pruning for clearance of roads, buildings or power lines. An example of an expression of this may be, crown asymmetrical, bias to west. See also *Symmetrical* and *Symmetry.*

Symmetrical Balance within a crown, where there is an even distribution of branches and the *foliage crown* around the vertical *axis* of the trunk. This usually applies to trees of *Crown Form Dominant* or *Crown Form Forest.* An example of an expression of this may be crown symmetrical. See also *Symmetry* and *Asymmetrical.*

Crown Spread Orientation Direction of the *axis* of *crown spread* which can be categorized as *Orientation Radial* and *Orientation Non-radial.*

Crown Spread Orientation Non-radial Where the crown extent is longer than it is wide, e.g. east/west or E/W. Further examples, north/south or N/S, and may be *Crown Form Codominant*, e.g. **A** or **B**, *Crown Form Intermediate* e.g. **A**, or *Crown Form Suppressed* e.g. **B**, *and* crown symmetry is *symmetrical* e.g. **A**, or *asymmetrical* e.g. **B**.

Crown Spread Orientation Radial Where the *crown spread* is generally an even distance in all directions from the trunk and often where a tree has *Crown Form Dominant* and is *symmetrical.*

Diameter at Breast Height (DBH) Measurement of trunk width calculated at a given distance above ground from the base of the tree often measured at 1.4 m. The trunk of a tree is usually not a circle when viewed in cross section, due to the presence of *reaction wood* or *adaptive wood*, therefore an average diameter is determined with a *diameter tape* or by recording the trunk along its narrowest and widest axes, adding the two dimensions together and dividing them by 2 to record an average and allowing the orientation of the longest axis of the trunk to also be recorded. Where a tree is growing on a lean the distance along the top of the trunk is measured to 1.4m and the diameter then recorded from that point perpendicular to the edge of the trunk. Where a *leaning* trunk is *crooked* a vertical distance of 1.4m is measured from the ground. Where a tree branches from a trunk that is less than 1.4m above ground, the trunk diameter is recorded perpendicular to the length of the *trunk* from the point immediately below the base of the flange of the *branch collar* extending the furthest down the trunk, and the distance of this point above ground recorded as *trunk* length. Where a tree is located on sloping ground the DBH should be measured at half way along the side of the tree to average out the angle of slope. Where a tree is *acaulescent* or *trunkless* branching at or near ground an average diameter is determined by recording the radial extent of the trunk at or near ground and noting where the measurement was recorded e.g. at ground.

Significant Important, weighty or more than ordinary.

Significant Tree A tree considered important, weighty or more than ordinary. Example: due to prominence of location, or *in situ*, or contribution as a component of the overall landscape for *amenity* or aesthetic qualities, or *curtilage* to structures, or importance due to uniqueness of taxa for species, subspecies, variety, *crown form*, or as an historical or cultural planting, or for age, or substantial dimensions, or habit, or as *remnant vegetation*, or habitat potential, or a rare or threatened species, or uncommon in cultivation, or of aboriginal cultural importance, or is a commemorative planting.

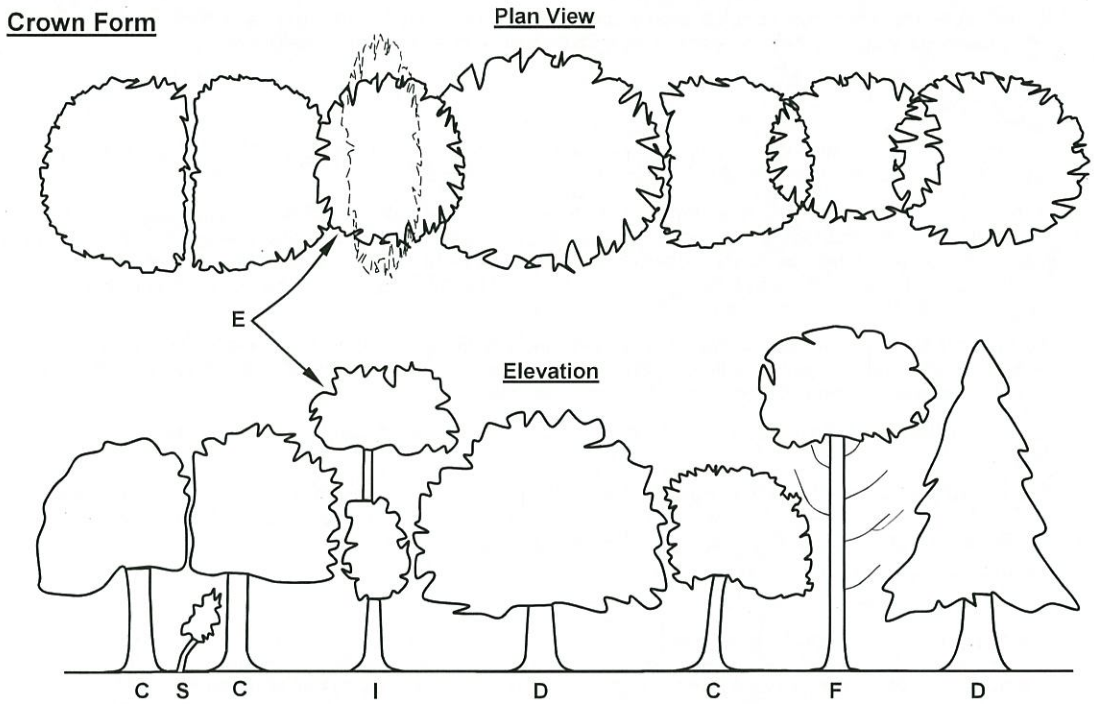
Sustainable Retention Index Value (SRIV) A visual tree assessment method to determine a qualitative and numerical rating for the viability of urban trees for development sites and management purposes, based on general tree and landscape assessment criteria using classes of *age*, *condition* and *vigour*. SRIV is for the professional manager of urban trees to consider the tree *in situ* with an assumed knowledge of the *taxon* and its growing environment. It is based on the physical attributes of the tree and its response to its environment considering its position in a matrix for age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property. This also factors the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement. SRIV is supplementary to the decision made by a tree management professional as to whether a tree is retained or removed (IACA - Institute of Australian Consulting Arboriculturists 2005).

Form of Trees

Crown Form The shape of the crown of a tree as influenced by the availability or restriction of space and light, or other contributing factors within its growing environment. Crown Form may be determined for tree shape and habit generally as *Dominant*, *Codominant*, *Intermediate*, *Emergent*, *Forest* and *Suppressed*. The habit and shape of a *crown* may also be considered qualitatively and can be categorized as *Good Form* or *Poor Form*. See also *Forest Grown* and *Open Grown*.

Good Form Tree of *typical* crown shape and habit with proportions representative of the taxa considering constraints such as origin e.g. indigenous or exotic, but does not appear to have been adversely influenced in its development by environmental factors in situ such as *soil water* availability, prevailing wind, or cultural practices such as lopping and competition for space and light. See also *Poor Form*.

Poor Form Tree of *atypical* crown shape and habit with proportions not representative of the species considering constraints and appears to have been adversely influenced in its development by environmental factors in situ such as *soil water* availability, prevailing wind, cultural practices such as lopping and competition for space and light; causing it to be *misshapen* or disfigured by disease or vandalism. See also *Good Form*.



(Source: **D**, **C**, **I** and **S**, and Elevation, Matheny and Clark 1998, **E**, **F** and Plan View, IACA 2005)

D. Dominant, **F.** Forest, **C.** Codominant, **E.** Emergent, **I.** Intermediate, **S.** Suppressed

Crown Form Codominant Crowns of trees restricted for space and light on one or more sides and receiving light primarily from above e.g. constrained by another tree/s or a building.

Crown Form Dominant Crowns of trees generally not restricted for space and light receiving light from above and all sides. See also *Crown Form Emergent* and *Open Grown*.

Crown Form Emergent Crowns of trees restricted for space on most sides receiving most light from above until the *upper crown* grows to protrude above the canopy in a stand or forest environment. Such trees may be *crown form dominant* or transitional from *crown form intermediate* to *crown form forest* asserting both *apical dominance* and *axillary dominance* once free of constraints for space and light.

Crown Form Forest Crowns of trees restricted for space and light except from above forming tall trees with narrow spreading crowns with foliage restricted generally to the top of the tree. The trunk is usually erect, straight and continuous, tapering gradually, crown often excurrent, with first order branches becoming structural, supporting the live crown concentrated towards the top of the tree, and below this point other first order branches arising radially with each *inferior* and usually temporary, divergent and ranging from horizontal to ascending, often with internodes exaggerated due to competition for space and light in the *lower crown*.

Crown Form Intermediate Crowns of trees restricted for space on most sides with light primarily from above and on some sides only.

Crown Form Suppressed Crowns of trees generally not restricted for space but restricted for light by being *overtopped* by other trees and occupying an understorey position in the canopy and growing slowly.

Forest Grown A tree with *crown form forest* grown in a group with competition for space and light protected from wind, often resulting in a taller tree with a narrow spreading crown that is concentrated towards the top of the tree (Matheny & Clark 1998, p. 18).

Open Grown A tree with *crown form dominant*, grown singly without competition for space and light, exposed to wind, often resulting in a shorter tree with a broad spreading crown that extends towards the ground (Matheny & Clark 1998, p. 18).

Deadwood

Deadwood Dead branches within a tree's crown and considered quantitatively as separate to *crown cover* and can be categorised as *Small Deadwood* and *Large Deadwood* according to diameter, length and subsequent *risk* potential. The amount of dead branches on a tree can be categorized as *Low Volume Deadwood*, *Medium Volume Deadwood* and *High Volume Deadwood*. See also *Dieback*.

Deadwooding Removing of dead branches by *pruning*. Such pruning may assist in the prevention of the spread of *decay* from *dieback* or for reasons of safety near an identifiable target.

Small Deadwood A dead branch up to 10mm diameter and usually <2 metres long, generally considered of low *risk* potential.

Large Deadwood A dead branch >10mm diameter and usually >2 metres long, generally considered of high *risk* potential.

Low Volume Deadwood Where <5 dead branches occur that may require *removal*.

Medium Volume Deadwood Where 5-10 dead branches occur that may require *removal*.

High Volume Deadwood High Volume Deadwood Where >10 dead branches occur that may require *removal*.

Dieback

Dieback The death of some areas of the *crown*. Symptoms are leaf drop, bare twigs, dead branches and tree death, respectively. This can be caused by root damage, root disease, bacterial or fungal canker, severe bark damage, intensive grazing by insects, *abrupt changes* in growth conditions, drought, water-logging or over-maturity. Dieback often implies reduced *resistance, stress* or *decline* which may be temporary. Dieback can be categorized as *Low Volume Dieback*, *Medium Volume Dieback* and *High Volume Dieback*.

Low Volume Dieback Where <10% of the *crown cover* has died. See also *Dieback*, *High Volume Dieback* and *Medium Volume Dieback*.

Medium Volume Dieback Where 10-50% of the *crown cover* has died.

High Volume Dieback Where >50% of the *crown cover* has died.

Epicormic Shoots

Epicormic Shoots Juvenile shoots produced at branches or trunk from *epicormic strands* in some Eucalypts (Burrows 2002, pp. 111-131) or sprouts produced from dormant or latent buds concealed beneath the bark in some trees. Production can be triggered by fire, pruning, wounding, or root damage but may also be as a result of *stress* or *decline*. Epicormic shoots can be categorized as *Low Volume Epicormic Shoots*, *Medium Volume Epicormic Shoots* and *High Volume Epicormic Shoots*.

Low Volume Epicormic Shoots Where <10% of the *crown cover* is comprised of live *epicormic shoots*.

Medium Volume Epicormic Shoots Where 10-50% of the *crown cover* is comprised of live *epicormic shoots*.

High Volume Epicormic Shoots Where >50% of the *crown cover* is comprised of live *epicormic shoots*.

Epicormic Strands In some taxa of the Myrtaceae family narrow bands of meristematic tissue radiate in stems from pith extending to the outer bark containing bud primordia evident as small prickle or dimple structures up to 10 mm diameter, that after the stimulus of a trauma event such as fire or defoliation develop to form new buds allowing *crown regeneration* (Burrows 2001, Pp. 111-131).

Trunk

Acaulescent A *trunkless* tree or tree growth forming a very short *trunk*. See also *Caulescent*.

Caulescent Tree grows to form a *trunk*. See also *Acaulescent*.

Trunk A single stem extending from the *root crown* to support or elevate the *crown*, terminating where it divides into separate *stems* forming *first order branches*. A trunk may be evident at or near ground or be absent in *acaulescent* trees of *deliquescent* habit, or may be continuous in trees of *excurrent* habit. The trunk of any *caulescent* tree can be divided vertically into three (3) sections and can be categorized as *Lower Trunk*, *Mid Trunk* and *Upper Trunk*. For a *leaning* tree these may be divided evenly into sections of one third along the trunk.

APPENDIX J

Research Design and Methodology

Research Design and Methodology

Research Design

The research design approved by the DECC (now OEH) and the registered Aboriginal parties for the subsurface testing and salvage of all Aboriginal objects/sites/PADs/ATUs (under all prior Aboriginal Heritage Impact Permits) within the Lynwood Quarry project area focused on four themes:

1. Is the distribution and density of the surface artefacts within the ATUs a true reflection of Aboriginal occupation patterns?

2. Does the distribution and density of the surface (including scarred trees, boulder used for grinding and the stone arrangement) and subsurface artefacts and features (if any) reflect the pattern of differential use of the landscape predicted from the ethnography/ethnohistory and Aboriginal oral history?

3. What does the artefactual evidence recovered indicate about Aboriginal use of the landscape?

4. Is it possible to provide some chronology for Aboriginal use of the Lynwood Quarry project area?

Research Theme 1 and 2 related to refining predictive models for site location within the Southern Tablelands. Research Theme 3 related to answering questions posed by the registered Aboriginal parties in relation to how their ancestors were using the landscape. Research Theme 4 was an important consideration as obtaining dates for the use of sites by Aboriginal people would assist with providing a chronological framework for Aboriginal use of the area (though it should be noted that it has not currently been possible to locate datable material).

In order to address the research themes a series of questions was posed; the ability to answer these questions; however, depended on the results of the subsurface investigations (how many artefacts were located and their distribution, artefact type, the variety of raw materials present, the location of datable material etc.).

1. Does the surface distribution and density of artefacts within the ATUs reflect the distribution and density of artefacts in a subsurface context?

2. Are there differences (e.g. artefact and raw material types, reduction methods, retouch type) between the surface and subsurface assemblages and/or between the ATUs?

3. What are the locally available resources (environmental and cultural)?

4. Have local resources influenced site location and site use?

5. What stone resources were transported into the area and from where?

6. How far back in time does Aboriginal occupation of the area extend?

7. Is there evidence to indicate Aboriginal occupation continued after initial European settlement?

As part of prior artefact analysis a residue and use-wear study was undertaken to provide further information in relation to what Aboriginal people where doing in the sites. If possible and where applicable, it was also proposed to use direct dating to assist with understanding the chronology of the Aboriginal use of the area. This has not been possible to date.

It is proposed to use the same research themes and questions for the requisite archaeological investigation for the Granite Pit Area to be undertaken in compliance with a variation to s.87/90 AHIP #1100264.

Methodology

It is proposed to use the methodology for all subsurface testing, salvage and artefact analysis for the Granite Pit Area as previously undertaken under s.87/90 AHIP #1100264. This methodology is set out in **Sections 2.1** to **2.3**.

<u>Subsurface Testing of Sites with Potential Archaeological Deposits (and their associated Archaeological Terrain Units)</u>

It is proposed to collect the surface artefacts within the sites assessed as having potential archaeological deposit (PAD) so that their analysis can add to the information recovered during the testing program.

The subsurface testing methodology proposed is as follows:

- flag surface artefacts;
- photograph artefact distribution;
- record grid coordinates for individual artefacts;
- prepare a site plan;
- collect surface artefact(s);
- excavate 0.5 metre squares along two lines set at right angles to each other that cut through the site/PAD area;
- the 0.5 metre squares will be at 5 metre intervals and will extend across the site/PAD area and at least 5 metres beyond;
- the 0.5 metre squares will be excavated using a spade and/or trowel;
- the soil will be removed as 10 centimetre arbitrary spits;
- the excavation will continue to clay or bedrock except in areas of deep sands where excavation will not exceed 50 cm (for safety reasons – if there are still artefacts at this depth the site may be subject to further salvage). Excavation will also cease following the removal of two sterile spits if agreed by the registered Aboriginal party representatives and the archaeologist;
- all excavated soil will be sieved using 5 mm and 2 mm nested sieves;
- soil samples will be collected from each spit for geomorphological analysis as required; and
- all artefacts collected will be retained for analysis.

Subsurface Testing of Potential Archaeological Deposits (and their associated Archaeological Terrain Units) not Associated with Sites

The methodology proposed for the subsurface testing of PADs (and their associated ATUs) will be as follows:

- each of the subsurface testing locations will be marked out with a 50 metre by 5 metre grid
- a series of 0.5 metre squares will be excavated at 5 metre intervals along the 50 metre length of one side of the grid (a total of 11 x 0.5 metre squares). If no artefacts are located there will be no further subsurface testing required. If artefacts are located in any of the squares a parallel second row of squares will be excavated along the second side of the grid (a further 11 x 0.5 metre squares)
- each square will be excavated using a spade and/or trowel
- soil will be removed as 10 centimetre spits
- excavation will continue to clay or bedrock, except in areas of deep soils/sands where the excavations will cease at 50 centimetre or when two sterile spits have been removed (whichever occurs first)
- all soil/sand excavated will be sieved using 5 millimetre and 2 millimetre nested sieves
- soil samples will be collected from each spit for geomorphological analysis as required
- squares with artefacts will have their stratigraphic profile recorded, and
- all artefacts collected will be retained for analysis (refer to **Section 2.5**).

Reporting Requirements

In compliance with s.87/90 AHIP #1100264, following each subsurface testing program component (which may relate to one or several sites/PADs), Holcim Australia, in consultation with the registered Aboriginal parties, will have a suitably qualified archaeologist prepare a report on the outcomes of the subsurface testing. In addition to reporting on the outcomes of the subsurface testing this report will set out the requirements for further subsurface salvage (as required) under s.87/90 AHIP #1100264. This report will be provided to OEH and no further salvage and/or site/PAD impact by works will be undertaken until OEH has approved the salvage methodology and/or impact by works without further salvage.

Reports will also be provided to OEH following the surface collection of sites and the removal of the LKST1 and LKST2 scarred trees.

At the conclusion of the archaeological investigations across the whole of the Granite Pit Area, Holcim Australia will prepare a report that will analyse the results of the surface collections, subsurface testing and salvage program and which will build on the information gained from the archaeological investigations within the Approved Project Area and from other archaeological investigations in the Marulan area that have been completed and reported at that time.

Aboriginal Site Impact Recording Forms

Aboriginal Site Impact Recording (ASIR) forms will be provided to OEH following site collection, scarred tree removal and following subsurface testing and salvage of sites/PADs.

Artefact Analysis

All artefacts recovered through subsurface testing will be analysed using at least x10 magnification. Edges and artefacts suspected of having use-wear or residues will be inspected using at least x30 magnification. Artefacts suitable for residue and use-wear analysis will be set aside for this form of analysis as part of the final investigation and reporting.

Numerous attributes (as described below) will be recorded, though not all may be analysed as part of the investigations. Full details of the artefact data for all of the assemblages will be presented within each report and in the final report, so that the data will be available for other analysts.

Discussion of Attributes to be Recorded for Analysis

The attributes to be recorded for the artefacts recovered from the Granite Pit Area disturbance footprint are outlined below. A discussion follows each attribute, detailing the proposed method of recording, potential problems with the method proposed, and the possible behavioural implications of each attribute.

Not all attributes can be measured on all artefacts (e.g. termination type cannot be measured on proximal flake pieces). Therefore, after a discussion of the most basic common attributes, subsequent attributes are divided into sections, with subsections for categories.

Umwelt systematically records the same attributes for all assemblages with the ultimate objective of setting up a database that is comparable intra and inter-regionally.

Common Attributes

Artefact Type

Description: Artefact class is a technological category reflecting the mechanical processes which resulted in the physical form of the artefact at the time of recovery. Classes used will include flakes, broken flakes, retouched flakes, flaked pieces, cores, flakes used as cores, hammerstones, grindstones, ground-edge axes, heat-shattered fragments, and non-diagnostic fragments.

Problems: Classing artefacts does not usually entail significant problems, other than occasional ambiguities between flaked pieces and broken flakes, and between (retouched) flakes and flakes used as cores (see **Retouch** for a further explanation).

Uses: This category will be used to assess differences in provisioning strategies (e.g. core provisioning vs. flake provisioning), differences in site function/use (e.g. presence/absence of grindstones), and the taphonomic effects of fire on site integrity (e.g. differences in the ratio of heat-shattered fragments: other artefact classes).

Raw Material

Description: A largely self-explanatory attribute, raw materials expected to be present include silcrete, quartz, crystalline tuff, quartzite, chert and basic volcanics.

Problems: This category is usually without problems, for analysts with a geological background.

Uses: Raw material is an important attribute, which may broadly indicate the place of origin of an artefact. The dominance of one raw material or another may also be used to group or differentiate sites. Raw material is also frequently used in concert with attributes in the creation of analytic units for more in-depth inter and intra site comparisons.

Artefact Weight

Description: Artefact weight will be measured for all artefacts to one tenth of a gram.

Problems: This attribute does not entail any difficulties.

Uses: Weight is an effective approximation of volume for a given raw material. As such it most accurately reflects the amount of stone being brought to a site. Average weight within a given artefact class is also a good indication of the amount of 'stress' that has been placed on the provisioned material. Large pieces of stone still retaining usable potential are unlikely to be discarded when people are conserving their technological resources (for example, as they move increasingly away from places where replacement material is available). Alternatively, when people are close to the raw material source, or when they are provisioning larger amounts of material to a site, the pressure on the 'exhaustion threshold' is relieved and there should be a resultant rise in the average weight of discarded artefacts.

Dimensions

Percussive Dimensions

Description: Percussive dimensions measure the length of the flake in the direction of force application from the point that force was applied. In this regard it relates to the length of core face that was removed during the manufacture of the artefact. Width is oriented across the face of the flake from the mid-point of length, and thickness from the mid-point of length and width of the ventral to the corresponding point on the ventral.

Problems: While not as arbitrary as maximum dimensions, there is some uncertainty as to what these attributes are actually measuring in terms of the flake manufacturing process.

Use: Variations in average flake dimensions, and in the distribution of flake sizes in histograms, are expected to correlate with differences in the provisioning and reduction strategies at different places. For example, the reduction of cores at a site will produce a large number of moderate to small flakes and some larger flakes. As a result, the histogram of flake length will show a relatively consistent increase in number of flakes from large to small. Contrastingly, when most flakes are the result of retouching or maintenance tasks on other flakes, the majority of the flakes remaining should be very small, with comparably few large to moderate flakes. However, it may be the case that a few moderate to large flakes will be discarded at the site as they are exhausted through excessive/heavy retouch or simply thrown away prior to a reprovisioning event. In such a case, a histogram of artefact size should show a bimodality in regard to length (a small peak in the moderate range and a large peak in the small range), and an even more pronounced bimodality in regard to thickness (most retouching flakes being very thin).

Maximum Dimensions

Description: Maximum length, width and thickness will be measured on all artefacts. 'Length' will arbitrarily be measured along the longest plain, with width the longest of the plains at 90° to length, and thickness measured at 90° to both.

Problems: There are no problems associated with taking this measurement, although it needs to be noted that the definitions of length, width and thickness are entirely arbitrary and do not reflect any aspect of artefact manufacture.

Uses: This measure is most useful as a broad measure of size, and may have a role in assessing fragmentation rates (particularly in the case of heat-shattered fragments) and calculating Minimum Numbers of Artefacts (MNA).

Cortex - Amount and Type

Description: Cortex refers to the 'skin' of a rock – the surface that has been weathered to a different texture and colour by exposure to the elements over a long period. The amount of cortex as a percentage of surface area will be measured on all artefacts (in relation to flakes, cortex can, by definition only occur on the dorsal and platform surfaces). The nature of cortex – its shape and texture – will vary depending on where the raw material was sourced. Cortex will be recorded in all instances where cortex is present.

Problems: This is a relatively unambiguous descriptive category.

Use: When a natural cobble is first selected it will usually be covered in cortex. Therefore the first artefacts produced from it will have a complete coverage of cortex on the dorsal side (primary reduction). As the cobble is increasingly reduced the amount of cortex on each artefact will rapidly decrease (secondary reduction) until it ceases to be present on artefacts (tertiary reduction). As a result of this trend, it should be possible to determine how early in the reduction sequence the artefact was produced. If large numbers of artefacts or a high proportion of the artefacts of a raw material retain cortex it may indicate that the site is located in close proximity to the source. Differences between the proportions of artefacts retaining cortex between different raw material sites indicates relative differences in distance to source. This does not necessarily mean distance in terms of measurable distance across the landscape; it may also reflect length of time since leaving the source. For example, the last campsite when a group is returning to the source of the raw material may be very close to the source in terms of distance, but distant in terms of time elapsed since the group left the source. If artefacts with cortex are occurring in sites a long distance from the place of origin of the natural cobble, then it is likely that cobbles were being transferred to the site when still only slightly reduced. This would imply an attempt to maximise the amount of stone being provisioned with the weight of transported material being a relatively minor concern.

Cortex type may help to clarify the source of the raw material (e.g. from river gravels [rounded, cortex many microscopic conchoidal fractures], surface scree [cortex weathered, porous, often oxidised, can be angular or rounded] or from outcrops [dependent on raw material type, more likely to have flat angular surfaces or recorticated flake scars]).

Attributes to be Recorded on Flakes

In most circumstances flakes, whether broken or whole, will account for the majority of artefacts in an assemblage. Flakes are frequently produced in large numbers during reduction events, though most are never subject to use. Flakes are generally inferred to be the most utilitarian of the basic artefact categories, usually possessing a sharp edge along the entire circumference when whole and amenable to reworking patterns which may yield formal 'implements' or 'tools', such as backed artefacts and scrapers.

Knapping Type

<u>Description:</u> Three main knapping methods are used in the production of flakes, resulting in flakes with distinctive characteristics. The first is freehand percussion, where the objective piece is held in the hand and struck with a hard hammer (e.g. a hammerstone), resulting in 'classic' flakes with a single bulb, and a ringcrack/PFA. The second is bipolar, where the objective piece is rested against an anvil and struck. This results in flakes that have straight sheer faces and crushing at both ends. The third is pressure flaking, where an indenter is placed against the edge from which the flake is to be removed and force is applied. The resulting flakes have a characteristically diffuse bulb, with no errailure scar and no PFA.

<u>Problems:</u> Ambiguities do exist in this classification, and the identification of pressure flakes in particular may be difficult, however difficulties are expected to be relatively infrequent.

<u>Use:</u> Freehand percussion, bipolar and pressure flaking are all different approaches to reduction, with different advantages and disadvantages. Pressure flaking is the most controlled method, in terms of how much force is applied and to where. However, pressure flaking does not produce large flakes and is usually associated with fine retouching work. Bipolar reduction is usually viewed as a system employed to increase core use-life. As cores become small their inertia thresholds drop making it difficult to reduce flakes via the freehand method. Resting the core and applying bipolar technique allows flakes to be reduced from a core too small to hold or from small round pebbles with no platform angle to initiate reduction. Pressure flaking when undertaken using an anvil often results in a form of bipolar reduction. Patterns in the distribution of flakes resulting from backing may be used to locate areas of backed artefact manufacture. Patterns in the distribution of flakes produced by bipolar knapping maybe used to indicate where there was pressure to maximize core potential.

Artefact Type

<u>Description:</u> Artefact type is a formal (e.g. less strictly technological), nominal category, similar to artefact class. Artefact types expected to be located include bondi points, microliths, scrapers, and adzes.

<u>Problems:</u> Ambiguity is an inherent feature of artefact typology, with the lines between different types frequently imprecise. Working definitions for each class used will be specified in the text of the analysis.

<u>Use:</u> Despite the problem discussed above, typology proceeds on the basis that at different places and at different times people manufactured artefacts with specific shapes and characteristics. As a result, the general period during which an artefact was made can be inferred if it is of a specific form. It is also not uncommon to infer that a given artefact form implies a given artefact function, and that from the shape of the artefact the activities taking place at the site can be specified, though these suggestions so far lack archaeological support. The problems with both of these uses are well documented, and any such inferences drawn here will be sparing. There is, however, some potential benefit in approaches based on subsistence patterns and the organization of technology. On this basis, it may be possible to make some assertions from artefact typology as to the way subsistence may have been organized at different places through the landscape.

Artefact Breakage

Description: At a basic level, flakes break in six different ways. Three are transverse (at 90° to the direction of percussion) – proximal, medial, distal; two are longitudinal (along the plane of percussion) – left, right (oriented from the ventral view); and one ambiguous – marginal (where dorsal and ventral can be clearly distinguished, but the margin from which the piece has detached is uncertain). All such breaks will be recorded.

Problems: It is occasionally difficult to be certain of the breakage on an artefact. In most cases, however, the kind of breakage can be ascertained.

Use: It is important to differentiate broken from complete flakes for the purposes of analysis, as the two are not comparable in regard to a number of measures. The amount of artefact breakage in an assemblage also indicates the degree of fragmentation to which the assemblage has been subject. In highly fragmented assemblages, the actual number of artefacts represented may be significantly exaggerated. Quantifying breakage allows a more accurate approximation of artefact numbers to be made.

Heat Affect

Description: Heat will affect artefacts in different ways, depending on the way it has occurred. Most heat affected flakes on fine-grained material will reveal a greasy surface lustre on newly flaked surfaces and some discoloration (e.g. porcellanite turns from white to blue), however as heat becomes excessive signs such as potlidding (the 'popping' of small plate-like pieces off the flake) or crazing (multiple fracture lines in multiple directions across the face of the flake) will occur. The presence of any of these features will be recorded.

Problems: This is a relatively unambiguous descriptive attribute for fine-grained materials – its application to coarse-grained materials is perhaps less certain.

Use: Trends in the spatial distribution of heat-affected artefacts may be used to indicate either heat-treatment (the controlled application of heat to improve flaking qualities) or post-depositional burning (uncontrolled heating through bush-fires or stump burning) depending on the signs of heating and associated archaeological features (e.g. hearths).

Platform Size – Width and Thickness

Description: The platform is the surface into which force is applied in the formation of a flake. Platform width is measured across the platform in the same direction as flake width, while platform thickness follows flake thickness.

Problems: Some ambiguity exists on 'where to stop measuring' platform width and thickness, particularly on primary cortical flakes on rounded cobbles (the first flakes removed from a natural cobble), and platform surfaces comprised of multiple flake scars. Despite this the measure appears to work quite well for the majority of flakes.

Use: Platform size is expected to decrease under two circumstances. The first is when flakes are produced from small cores. The second is somewhat more speculative and based on the premise of a correlation between very small (focalized) platforms and the production of parallel-sided flakes (blades) associated with backed artefact manufacture.

Differences in platform size averages within and between sites will be examined to test these correlations and to infer what these mean in terms of human behaviour patterns e.g. curation of stone, expedient use of stone.

Platform Surface

Description: Platform surface will be recorded as one of the following: cortical, single flake scar, multiple flake scars, or facetted.

Problems: This is a largely unambiguous descriptive attribute.

Use: The surface of a platform provides information about the history of the core prior to the detachment of the flake, and also about methods employed to control the flaking process. Faceting in particular has been linked to the systematic production of 'blades'. Patterns in the spatial distribution of these attributes may be used to infer differences in reduction strategies.

Overhang Removal

Description: Frequently prior to the detachment of a flake from a core, the thin overhanging 'lip' of the core was removed in order to stop 'crushing' or force dissipation at the point of force application. This process is known as overhang removal.

Problems: This is a largely unambiguous descriptive attribute.

Use: Overhang removal is often seen as a form of raw material conservation. If a knapper desires to remove thin flakes from the face of the core by striking close to its edge, overhang removal may avoid the platform crushing and the resultant flake ending in a step termination which must be removed from the face of the core before flake production can continue. Thus, raw materials within assemblages, that have high relative proportions of overhang removal, or total assemblages that have high relative proportions of overhang removal, will be used to indicate raw material conservation, which can then be interpreted in relation to human resource use patterns/preferences.

Dorsal Scar Count

Description: The dorsal face of a flake provides a partial record of previous flaking episodes to have occurred down the core face at or near the same point. The number of flake scars on the dorsal surface of a flake which can be oriented relative to their direction of percussion and which are clearly discernible will be recorded.

Problems: There is some ambiguity in this measure, hence the use of the term 'clearly discernible' above. Furthermore, by the nature of the flaking process, each subsequent scar will remove traces of the previous scars, resulting in an incomplete record. For these reasons, this measure needs to be treated with some caution.

Use: Dorsal scar count is a rough indication of how much flaking has occurred prior to the detachment of the flake in question. It also provides a maximum against which to form ratios of 'aberrant to non-aberrantly terminating scars', 'parallel to non-parallel scars' and 'number of scars per rotation' (see next three attributes), all of which may assist in clarifying the reduction process and assist in understanding differences in the Aboriginal use of raw materials and sites.

Number of Aberrantly Terminating Dorsal Scars

Description: Aberrant terminations are further discussed below under **Terminations**. For the purposes of this description it is sufficient to say that flake scars terminating as steps and hinges will be recorded as aberrant in this assessment.

Problems: The problem(s) with this count are the same as those for the previous.

Use: As cores become smaller and more heavily reduced, the inertia threshold will fall and platform angle will increase, resulting in an increase in the number of aberrant terminations as a percentage of the number of flakes removed. Flakes which have a high number of aberrantly terminating flake scars as a percentage of the total are expected to have been produced towards the exhaustion threshold of the core. This measure will be used to indicate pressure on raw material availability and provisioning strategies.

Number of Parallel Flake Scars

Description: A basic count of the number of parallel flake scars.

Problems: As previous.

Use: Examining the ratio of parallel to non-parallel scars on the dorsal surface of flakes may help to clarify the prevalence of 'blade' production in the reduction systems at different places. It may also be possible from examining this ratio in relation to flake size to test whether blade production occurred at a specific stage in the reduction sequence, or whether it was present throughout the complete reduction sequence.

Presence of Parallel Arrises

Description: Arrises or dorsal ridges are a way of controlling artefact morphology. Flakes struck down an existing ridge will tend to follow the direction that the ridge takes. This attribute will involve noting the presence or absence of dorsal ridges that run parallel to the length of the flake.

Problems: Unlike the previous measures, this attribute is largely unambiguous.

Use: Like faceting, the presence of parallel arrises is associated with more controlled flaking methods such as blade production. The relationship between flake size and the presence of parallel arrises may provide similar information to the previous attribute (while at a lower resolution, being presence/absence based, this attribute is less ambiguous than number of parallel scars), as well as helping clarify the spatial distribution of different reduction strategies.

Dorsal Scar Rotation Count

Description: As a core is reduced it may be turned or rotated to provide new platforms or overcome problems with increasing platform angles. As a result, flakes may be detached which cut across old flake scars. The result should be apparent as dorsal scars in different direction to the direction of percussion of the flake being recorded.

Problems: The problem with this measure is the same as that for dorsal scar counts in general.

Use: Core rotation is increasingly likely towards the exhaustion threshold of cores, when platform angles increasingly approach or exceed 90° (it becomes very difficult to remove flakes from platforms with angles exceeding 90°). If it is possible to show a correlation between flake size and number of dorsal scar rotations then it will become possible infer from differences in the spatial distribution of this data that core exhaustion was more frequently approached in some areas than in others. If it is not possible to show this correlation, then it may be taken to suggest that core rotation was part of the reduction strategy throughout the reduction continuum.

Termination

Description: Termination refers to the way in which force leaves a core during the detachment of a flake. Every complete flake has a termination. There are patterns in the form which terminations will take, with the four major categories (those to be used here) being: feather, hinge, step, and outrepasse (or plunging).

Problems: This is a largely unambiguous descriptive attribute. The only point at which uncertainty does enter is in differentiating some transversely snapped flakes from step terminated flakes. In the majority of cases, however, this problem does not arise.

Use: Different terminations have different implications both for flake and core morphology. A flake with a feather termination (in which force exits the core at a low or gradual angle) will have a continuous sharp edge around the periphery beneath the platform. This has advantages in terms of the amount of the flake edge which can be used for cutting, and also makes the flake far more amenable to subsequent retouching or resharpening activities. Detaching flakes with feather terminations also has minimal impact on the effective platform angle of the core, and so platform angle thresholds are reached relatively slowly while feather terminating flakes continue to be produced.

Hinge and step terminating flakes have none of these advantages. They result in edges which are amenable neither to cutting nor to retouching. Furthermore, hinge and step terminations lead to rapidly increasing effective platform angles, leading to a requirement for core rejuvenation and core exhaustion. For these reasons, such terminations are considered undesirable or *aberrant*. The number of aberrant flake terminations is expected to increase towards the end of a core's uselife, as reduction in core size and increase in core platform angle make it increasingly difficult to detach feather terminating flakes. In areas where aberrantly terminating flakes are relatively common it may be inferred that core potential was more thoroughly exploited. From this it may in turn be inferred that the pressure to realize core potential (e.g. a strategy of heavy raw material conservation) was greater. Increased mobility/emphasis on portability is one possible explanation of such a pattern.

Outrepasse flakes have the opposite effect on core morphology to step and hinge flakes, in that they remove the entire core face and part of the core bottom. As a result, such flakes may be used to rejuvenate cores in which core angles have become high but which still retain useable potential (e.g. are still quite large). The presence of outrepasse flakes may be taken to indicate core rejuvenation and the requirement to increase core use-life.

Retouch

Description: Retouch is the term given to alterations made to a flake by the striking of subsequent flakes from its surface. Retouching may be done either to alter artefact form or to rejuvenate (resharpen) dulled edges, and possibly both. Degree/amount of will be recorded as presence/absence.

Problems: This is a largely unambiguous descriptive attribute. The only area in which difficulty may arise is in instances where edge damage cannot be differentiated from retouch. This occurs infrequently, as edge damage is usually a modern alteration to artefact form which can be noted through differences in surface colour between the flake scar and the rest of the artefact surface.

Use: The two main uses of retouch need to be separated for the purposes of this discussion. Retouch to achieve form (for example, artefact backing) is distinct from retouch for the purposes of edge rejuvenation. 'Formally retouched' artefacts are anticipated to occur at places of manufacture and places of discard. Importantly, such artefacts will be manufactured prior to use as part of a gearing up or preparation for activities such as hunting. The presence of concentrations of such artefacts, including incomplete specimens may indicate the base-camp locations from which mobile subsistence activities were conducted. Such artefacts are also expected to be present among very small assemblages at distances from occupational foci, as the result of discard, loss, or breakage.

Edge rejuvenation retouch is expected to increase as the availability of replacement materials decreases. Such artefacts are expected to represent 'personal gear', an implement carried with a person and maintained for repeated use. Unlike formally retouched pieces, artefacts with edge rejuvenation will not be produced *in preparation for* activities. The sharpest and most useful edge is a fresh edge. Rather, rejuvenation will occur as need arises. The presence of such artefacts at occupational foci is likely to represent discard following use and prior to reprovisioning/retooling. The percentage of artefacts exhibiting retouch is expected to increase in systems where large amounts of replacement raw material are not available.

It needs to be noted that a third type of retouch also occurs, aimed at neither formalisation of shape or edge rejuvenation. This is when a flake (usually a large to very large flake) has been used for the subsequent production of utilitarian flakes (e.g. when it has been used as a core). This strategy is quite prevalent in NSW. Differentiating such artefacts from other retouched artefacts is empirically difficult, however, is intuitively quite easy. Any such intuitive judgements can, however, be tested during the analysis phase, as such flakes are expected to be quite distinct from other retouched artefacts in size and weight.

Retouch Type

Description: Retouch type is a technological attribute relating the way in which retouch was carried out. Categories to be used are steep, acute, unifacial, bifacial, tranchet and/or used as core.

Problems: This is a largely unambiguous descriptive attribute.

Use: Whether retouch results in a steep or acute edge is important in relation to the possible functions of those edges. Acute retouch results in sharp edges suitable for cutting whilst steep retouch can be used to totally remove a sharp edge (to blunt as in backed artefacts) or to produce thick strong edges suitable for adzing or scraping. Thus, artefact function can be suggested by recording this attribute (residue and use-wear analysis is also planned to substantiate these interpretations). The recording of the technique used for retouch addresses questions related to techniques of implement manufacture and thus another form of human behaviour that can be analysed within and between assemblages.

Retouch Location

Description: Each flake will be divided into eight segments: proximal end, proximal left, proximal right, marginal left, marginal right, distal left, distal right, and distal end; with the presence or absence of retouch in each to be recorded.

Problems: Apportioning sections relies on a visual division of the flake, which may be slightly inaccurate. This is not expected to be a significant effect.

Use: An examination of retouch location may reveal trends in distance decay (e.g. increasing number of margins retouched over distance, or may simply reveal non-random patterns in the way retouching was carried out. If the former, then the trend may be used to suggest trajectories along which flakes were being carried as personal gear. In the case of the latter, the information would provide an insight into the manufacturing/reduction systems being employed.

Attributes to be Recorded on Cores

The following attributes are to be recorded on cores. Most information taken from cores concerns the way in which they were reduced – what pressures, controls and systems were applied.

Percentage of Surface Flaked

Description: This attribute involves an estimate of the percentage of the outer surface of the core which has had flake scars removed from it.

Problems: This is a visual estimate and liable to prove reasonably inaccurate and coarse. Nevertheless, it remains useful.

Use: This measure can be useful in assessing degree of core reduction. In particular, it can be useful in locating areas of heavy core reduction, particularly when used in concert with the following two measures.

Number of Flake Scars

Description: This measure mirrors **dorsal scar count** from the previous section. All scars over the length of 10 millimetres will be measured (there are usually large numbers of flake scars between 10-3 millimetres, which relate more to platform preparation than flake production.

Problems: Most of the problems with this measure arise from fact that subsequent scars remove traces of former scars, leaving an incomplete record of the past. As a result, this measure will always underestimate the number of flakes removed from the core.

Use: Dorsal scar count provides an estimate of the amount of reduction to which a core has been subject. Used in concert with measures such as **number of rotations** and **percentage of surface flaked**, it may be help to locate differences in the degree of core reduction at different locations.

Number of Rotations

Description: This measure mirrors **dorsal scar rotation count** as discussed above.

Problems: This measure has the same problems as **number of flake scars**.

Use: Different reduction systems use core rotation in different ways. In some systems, cores are rotated only once, after the striking of the initial flake to form a platform. All subsequent scars are removed in one direction from that platform. Other systems will involve repeated rotations between two platforms, or may involve continuous core rotation and numerous platforms. It may be the case that through the use-life of a core a number of different strategies will be used.

Assessing core rotation may help to clarify reduction systems, and the stage in the reduction system at which the individual core was discarded. This can be used to indicate differences in use of raw materials both within assemblages and between assemblages.

Number of Aberrantly Terminating Scars

Description: Flake scars terminating as steps and hinges will be recorded as aberrant in this assessment.

Problems: There should be no problems with this simple count.

Use: As cores become smaller and more heavily reduced, the inertia threshold will fall and platform angle will increase, resulting in an increase in the number of aberrant terminations as a percentage of the number of flakes removed. Flakes which have a high number of aberrantly terminating flake scars as a percentage of the total are expected to have been produced towards the exhaustion threshold of the core. This measure will be used to indicate pressure on raw material availability and provisioning strategies.

Number of Parallel Flake Scars

Description: A basic count of the number of parallel flake scars.

Problems: There should be no problems with this simple count.

Use: Examining the ratio of parallel to non-parallel scars on cores may help to clarify the prevalence of 'blade' production in the reduction systems at different places. It may also be possible from examining this ratio in relation to flake size to test whether blade production occurred at a specific stage in the reduction sequence, or whether it was present throughout the complete reduction sequence.

Comments

Description: a column will be supplied in the data base for recording comments. This may include comments on attributes such as artefact colour, granularity, presence and nature of inclusions, or other comments that do not fit snugly inside one of the attribute classes.

Problems: There should be no problems.

Use: Descriptions of artefacts can sometimes be useful for assisting in locating conjoins.

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