Appendix 1. Principal sources of project data

Sources	Aerial Photographs	Geophysics	Excavation	Finds
Archaeological Services WYAS		X	X	X
ARCUS			X	
Birmingham University Field Archaeology Unit			X	
Boston Spa and District Community Archaeology Group				X
Clifton Park Museum, Rotherham				X
Doncaster Museum and Art Gallery				X
East Leeds History and Archaeology Society				X
English Heritage Archaeometry Division		X		
Field Archaeology Specialists, University of York			X	
GeoQuest Associates		X		
GSB Prospection		X		
John Samuels Archaeological Consultants			X	
Kippax and District Historical Society				X
Leeds City Museum				X
Lindsey Archaeological Services			X	
MAP Archaeological Consultancy Ltd			X	
The National Monuments Record (NMR)	X	X	X	
Northamptonshire Archaeology			X	
Northern Archaeological Associates			X	
The North Yorkshire Heritage Unit	X	X	X	X
Nottinghamshire County Council Planning Specialists Team		X	X	X
On Site Archaeology			X	
Oxford Archaeology North			X	
Pontefract District Archaeological Society				X
Pontefract Museum				X
Portable Antiquities Co-ordinator for South and West Yorkshire				X
Portable Antiquities Co-ordinator for North Yorkshire and Humberside				X
Portable Antiquities Co-ordinator for Nottinghamshire and Derbyshire				X
Pre-Construct Archaeology Ltd			X	
South Yorkshire Archaeology Service	X	X	X	X
Trent and Peak Archaeological Unit			X	
Unit for Landscape Modelling, University of Cambridge	X			
University of Manchester Field Archaeology Unit			X	
University of Bradford		X	X	
Wakefield Museum				X
Wetland Archaeology & Environments Research Centre			X	
West Yorkshire Archaeology Advisory Service		X	X	X
Yorkshire Archaeological Society				X
York Archaeological Trust			X	
Yorkshire Museum				X
Yorkshire Quern Survey				X

Appendix 2. Summary of archaeological mitigation works carried out at aggregates quarries in the study area

Quarry	Cty	Assessment	Geophysical Survey	Fieldwalking	Excavation
Firgreen	WY				
Highmoor	WY/ NY				
Swillington	WY		• Abramson 1990a • Bunn and Palmer-Brown 2006		• York Environs Project 1992
Moss Carr Wood	WY	• Keith *et al.* 2000b	• Keith *et al.* 2000b • Webb and Whittingham 2000 • Whittingham 2001a	• Keith *et al.* 2000b	• Martin 2000 • McNaught 2001a • Roberts and Richardson 2002 • Cudlip 2002
Altofts/ Newlands Lane	WY		• GSB 1997		• Wild 1997 • MAP 2002
Park Balk	WY		• GSB 1996		• Timms 1998 • OSA 2003a • OSA 2004a
Nostell	WY	• JSAC 2001			• JSAC 2002
Brackenhill	WY	• English Heritage MPP 1999			
Peckfield	WY				
Methley	WY	• Yarwood and Marriott 1986 • Boucher and Webb 1996 • Keith 1999 • Keith and Roberts 2001 • Newton 2005	• Marriott and Yarwood 1992 • Yarwood and Marriot 1989a • Yarwood and Marriott 1988b • Yarwood and Marriott 1989b • Yarwood and Marriott 1990 • Boucher and Webb 1996 • Webb 2000b	• Yarwood and Marriott 1986 • Marriott and Yarwood 1992 • Mc Cluskey and Roberts 2003	• Yarwood and Marriott 1988a • Yarwood and Marriott 1990 • Burgess 1993 • Wright 1994 • MAP 1996a • MAP 1996b • MAP 1997b • MAP 1999a; b • MAP 2002a • MAP 2002b • MAP 2003c • Mc Cluskey and Roberts 2003
Barnsdale Bar	NY	• Boucher 1996	• Abramson 1989a • Abramson 1990b • Webb 1993a • Webb 1995b • Webb 1996b • Cottrell 1996	• Webb 1995b	• Abramson 1989b • Simpson 1990 • Webb 1993b • Brown and Morris 1997 • Speed 1997a • O'Neill 1999 • ASWYAS forthcoming
Smaws	NY	• MAP 1996a	• Shiel 1992 • MAP 1996a		• Shiel 1992 • Finney 1992 • Finney 1993 • Finney 1994 • MAP 1996a • MAP 1997 • Parry 2001b
Jackdaw Crag	NY				
Old London Road	NY				
Copley Lane	NY				
Sherburn	NY				
Betteras Hill	NY				

Foxcliffe/ Brotherton/ Byram Park	NY	• Atkinson 1995 • Fletcher and Keith 1997 • May 2003		• May 2003 • ASWYAS in prep. a	• O'Neill 1998a • Howell and Cudlip 2001 • McNaught 2001 • Dean 2003
Darrington	NY	• NAA 2003a	• Boucher and Webb 1991 • Webb 1995a	• NAA 2003	• Buckland and Dolby 1987 • O'Neill 2000 • McQueen 2002 • ASWYAS forthcoming
Went Edge	NY		• Hancock 2002		• Noel 1994 • Gidman and Whittaker 2004
Campsall	SY	• Adams *et al.* 2002	• Adams *et al.* 2002		• Morris *et al.* 2002
Suttonfield/ Sutton	SY				
Hatfield	SY				
Cadeby	SY				
Warmsworth	SY	• Latham 1994			
Wroot Road	SY	• TVAS 2003	• Stratascan 2003		
Bank End	SY				
Austerfield	SY				• SYAS 1997 • NAA 2000
Batty Holt/ Glen/Holme Hall/Stainton	SY	• Symonds 1993	• Gaffney 1994	• Merrony 1994	• ARCUS 2005
Maltby	SY	• Wardell Armstrong 2000			
Harris	SY				
Barnsdale Bar	SY	• Roberts 2003b	• Webb 2000c • Webb 2003		• Burgess 2000 • Burgess 2001 • Gidman 2004 • Gidman & Roberts 2005
Long Lane	SY	•	• Webb 1997b		• O'Neill 1997
Hazel Lane	SY	• Cumberpatch 1993 • Sidebottom 1999	• Noel and Lambert 1994a • Noel and Lambert 1994b • Webb and Whittingham 2001b • GeoQuest 2002 • Roseveare and Roseveare 2003	• ARCUS 2001a	• Hale and Noel 1994 • Brown 1997 • ARCUS 2001b • ARCUS 2001c • TVAS 2002a • TVAS 2002 • Taylor 2003
Skelbrooke	SY		• Nicholls and Webb 1996		• Speed 1996 • Speed 1997b
Brodsworth	SY				• Sydes 1993
Armthorpe	SY	• RMC Aggregates 2000 • ARCUS 2006			
Dunsville	SY		• Magilton 1978	• Van de Noort and Ellis 1997	• Magilton 1978
Nutwell Lane	SY				
Hurst Plantation	SY	• Badcock and Symonds 1994b			
Stripe Road	SY				• Sydes 1991
Hayfield Farm	SY				• Atkinson 1993
Stancil	SY				

Finningley (Misson Grange)	N		• Webb 2000a • Whittingham 2001b • Webb and Whittingham 2001a • Webb 2001a	• MAP 2000d	• Walker and Woodhouse 1994 • TPAT 1995 • Challis 1996 • MAP 2000a • MAP 2000b • MAP 2003b
Newington	N				
Bryan's Close	N				
Finningley (Bawtry Road)	N				
Misson Bawtry Road (Rowley)	N	• Collcutt and Griffiths 1993 • Keith *et al.* 2000a		• Collcutt and Griffiths 1993	• Gidman 2002 • ASWYAS in prep.
Misson West	N				
Newington North	N		• GSB 2000		• NAA 2002 • NAA 2003b • Simpson 2004
Newington 2	N				• TPAT 1994b
Styrrup	N				
Serlby Sand	N				
Scrooby North	N				• Stead 2000
Mattersey	N				
Newthorpe	NY				• Signorelli and Roberts 2006

Appendix 3. Archaeology from the air

by A. Deegan

Aerial photographs taken in the appropriate conditions can record buried archaeological features as cropmarks or soilmarks and upstanding remains either as earthworks or structures. Aerial photographs can reveal the presence of levelled and buried archaeological remains that are undetectable from the ground, either as variations in vegetation growth or marks in bare soil.

The mechanisms of cropmark formation are simple but the variables involved are complex. Cropmarks and changes in other vegetation seen from the air are variations in leaf and stalk colour and plant height and vigour. Cropmarks may occur over buried and levelled archaeological features but also infilled natural features such as frost-cracks and palaeochannels. Superficial treatments to the topsoil and vegetation - the uneven application of fertilizers, pesticides and herbicides - or physical damage, may also produce cropmarks. It is the role of the interpreter of aerial photographs to distinguish those that have archaeological significance.

Cropmarks of archaeological features can form at any stage of plant growth, from germination to ripening, but the optimal conditions are met during periods when precipitation (e.g. rainfall) is exceeded by transpiration (water loss). This results in potential soil moisture deficit (SMD) and water-stressed plants (Jones and Evans 1975). A prolonged period of SMD will halt plant growth and then cause wilting of the plant leaves, stem and finally root, in particular it is the cumulative impact of leaf wilt in large areas of crop that is visible from the air. At times of drought, plants rooted in free-draining sub-surface deposits, such as a buried ancient road surface, may deteriorate faster than those rooted on surrounding undisturbed ground. Meanwhile, at times of SMD, plants rooted in the moisture-retentive fills of archaeological ditches and pits may thrive longer and stay greener than their neighbours. Even after ripening, differences in crop height and bulk can indicate the presence of buried features where there are no visible tonal differences. Cropmarks are often clearest in large areas of homogenous cereal cultivation but can also form in grass and some root crops. Under appropriate vegetation,

cropmarks above buried archaeological features can form readily on free-draining soils and permeable geologies, but are more reticent on impermeable clays and the finer alluvial deposits that can better retain water at times of low precipitation. Plant roots are less likely to penetrate the deposits of deeply buried archaeological features and thus be influenced by their presence: deposits of alluvium and colluvium (hill wash) often mask earlier archaeological features.

Even once all the variables required for cropmark formation are met, the appearance of these marks can change by the day and they can disappear overnight. It takes the skill of the experienced aerial photographer to produce maximum results from limited air time by exploiting their local knowledge of the developing conditions.

Parchmarks are a particular form of cropmark, usually occurring in grass at times of drought; the tonal differences between the parched plants and others are often stark and well-defined. Parchmarks may occur over buried stone structures, metalled road surfaces and the remains of rubble banks.

On bare soils archaeological features may be detected as colour and tonal variations against the background ploughsoil or subsoil. Ploughing, which can penetrate the ground to a depth of 450mm, brings to the surface previously buried material and rotates it, exposing the cut surface uppermost. Where the plough cuts sub-surface banks or infilled ditches and furrows it brings slices of these deposits to the surface; bank material will often appear lighter than the surrounding soil and ditch fill, darker. If these slices are sufficiently differentiated from the natural plough or subsoil they can be visible from the air.

The detection and recording of archaeological earthworks from the air are contingent on their condition and visibility. The condition and survival of earthworks are determined by past and present land use: natural erosion processes, deliberate destruction and ploughing can all reduce upstanding features to ground level. Furthermore, even well-preserved remains may be concealed by some types of vegetation such as gorse, heather, scrub and woodland.

Most of the earthworks recorded from aerial photographs for this project were revealed by the pattern of sunlight and shadow but upstanding features may also be highlighted by differential frost or snow cover or the distribution of standing flood water. Even heavily truncated earthworks may be detected in the appropriate conditions, particularly when their appearance is enhanced by changes in vegetation cover or soil tone. Specialist photographers can manipulate the available lighting conditions whilst in the air, circling monuments until the optimal balance of light and shadow is achieved. Both substantial and subtle variations in ground relief are further accentuated when viewed stereoscopically. Most stereo images are in the form of vertical photographs taken at regular intervals along linear flight lines but stereo overlapping can also be achieved from appropriately positioned pairs of oblique views.