

# **Appendix 2: Risk Assessment Models**

# Model 1: English Heritage's Adjusted Model

Adjusted Risk Assessment Method														
Hazard: Damage from cultivation														
Likelihood of occurrence		Depth of buffer between base of cultivation and surface of <i>in situ</i> archaeology												
		None/visible earthworks	0.01-0.05m	0.06-0.1m	>0.11-0.2m	>0.2m								
		Highly likely	Likely	Possible	Unlikely	Highly unlikely								
Applied likelihood of occurrence result														
Revised likelihood of occurrence result after Phase 2.3														
Hazard: Intensive and persistent damage from drainage and soil permeability enhancement measures (pan-busting etc)														
Source: Handouts at ADAS seminar – need to check origin.														
Note: Some sands and peats can have low hydraulic conductivity		Soil Hydraulic Conductivity Class												
		Low	Low-Medium			Medium				High				
Crops also ranked by relative value <i>High</i> Medium, <i>Low</i>		Soil texture→	Silty Clay	Clay	Silty clay loam	Sandy Clay	Silty Loam	Sandy Clay Loam	Clay Loam	Loam	Sandy Loam	Loamy Sand	Sand	Fen peat
		↓Field crops												
Crop susceptibility to inadequate soil water control  Note: the crop list will be reduced or augmented as the range of crops encountered becomes apparent	High	<i>Early Potatoes</i> <i>Main crop Potatoes</i> <i>Brussels sprouts</i> <i>Winter greens</i>	Highly Likely		Likely		Possible				Unlikely			
	Medium	<i>Sugar beet</i> <i>Autumn cauliflower</i> <i>Winter cereals</i> <i>Grass-intensive</i> <i>Summer cabbage</i> <i>Spring cereals</i> <i>Field beans</i> <i>Spring peas</i>	Possible				Likelihood of Occurrence							
	Lower	<i>Grain maize</i> <i>Grass-extensive</i>	Unlikely				Highly unlikely							
Applied likelihood of occurrence result														
Revised likelihood of occurrence result after Phase 2.3														
Information on nature and impact of drainage		Soil texture	Silty clay	Clay	Silty clay loam	Sandy clay	Silty loam	Sandy clay loam	Clay loam	Loam	Sandy Loam	Loamy Sand	Sand	Fen peat
Drainage type		Depth of drainage from field surface (metres)												
		Pipe	0.8	0.8	1-0.8	1.1-0.8	1.1-0.8	1-0.8	1-0.8	1.2-0.8	1.5-1.0	1.8-1.0	1.8-1.0	1.4-1.2
		Mole	0.7-0.5	0.7-0.5	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA
		Subsoil	>0.6	>0.6	>0.6	0.6-0.5	0.6-0.5	0.6-0.5	0.6	0.6	0.6	NA	NA	NA
Hazard: damage from root systems														
Likelihood of occurrence: Insufficient research to calculate – especially needed for biomass crops?														
Hazard: Susceptibility to deeper cultivation through soil loss during harvesting														
Crop type		Roots/tubers						Combinable crops						
Likelihood of occurrence		Highly likely						Highly unlikely						
Applied likelihood of occurrence result														
It is possible that the likelihood of occurrence can be further refined according to soil texture but more research needs to be carried out/made available.														

<b>Hazard: Susceptibility to deeper cultivation through soil movement by water erosion</b>						
Source: After <i>Controlling Soil Erosion</i> , MAFF 1999						
Slope→	Steep Slopes >7°	Moderate Slope 7°-3°	Gentle Slopes 3° -2°	Level Ground <2°		
↓ Soil Texture						
Sand Loamy sand Sandy loam Sandy silt loam Silt loam	Highly Likely (Likely)*	Likely (Possible)*	Possible (Unlikely)*	Highly unlikely		
Silty clay loam	Likely (Possible)*	Possible	Unlikely	Highly unlikely		
Other mineral soils	Unlikely	Highly unlikely	Highly unlikely	Highly unlikely		
* Where average annual rainfall is less than 800mm, the likelihood of occurrence class in brackets applies						
<b>Applied likelihood of occurrence result</b>						
<b>Revised likelihood of occurrence result after Phase 2.3</b>						
<b>Hazard: Susceptibility to deeper cultivation through soil movement by wind erosion</b>						
Source:						
Main soil group	Peats	Silts	Sands	Clays		
Likelihood of occurrence	Highly likely	Likely	Possible	Unlikely		
Note: further refinement required? – texture/topography?						
<b>Applied likelihood of occurrence result</b>						
<b>Risk Calculation</b>						
<b>Risk calculation for current position</b>						
Likelihood of damage from cultivation						
Likelihood of intensive damage from soil drainage and permeability Measures		<b>Highly likely</b>	<b>Likely</b>	<b>Possible</b>	<b>Unlikely</b>	<b>Highly Unlikely</b>
	<b>Highly likely</b>	Serious	Serious	Serious	High	Moderate
	<b>Likely</b>	Serious	Serious	High	Moderate	Low
	<b>Possible</b>	Serious	High	Moderate	Low	Low
	<b>Unlikely</b>	Serious	High	Moderate	Low	Minimal
<b>Highly unlikely</b>	Serious	High	Moderate	Low	Minimal	
<b>Risk calculation result</b>						
<b>Revised risk calculation result after Phase 2.3</b>						
<b>Risk calculation for future position</b>						
Likelihood of water erosion						
Likelihood of wind erosion		<b>Highly likely</b>	<b>Likely</b>	<b>Possible</b>	<b>Unlikely</b>	<b>Highly unlikely</b>
	<b>Highly likely</b>	Serious	Serious	High (Serious)*	Moderate (High)*	Low (High)*
	<b>Likely</b>	Serious	High (Serious)*	High (Serious)*	Moderate (High)*	Low (High)*
	<b>Possible</b>	Serious	High (Serious)*	Moderate (High)*	Moderate (High)*	Low (High)*
<b>Unlikely</b>	Serious	High (Serious)*	Moderate (High)*	Low (High)*	Low (High)*	
* Where likelihood of soil loss through harvesting is very likely, the risk class in brackets applies (but further research needed)						
<b>Risk calculation result</b>						
<b>Revised risk calculation result after Phase 2.3</b>						
<b>Integrated risk calculation</b>						
Current risk from cultivation damage and drainage						
Future risk of damage from cultivation/drainage through soil erosion		<b>Serious</b>	<b>High</b>	<b>Moderate</b>	<b>Low</b>	<b>Minimal</b>
	<b>Serious</b>	Serious	Serious	High	Moderate	Low
	<b>High</b>	Serious	Serious	High	Moderate	Low
	<b>Moderate</b>	Serious	High	Moderate	Low	Minimal
<b>Low</b>	Serious	High	Moderate	Low	Minimal	
<b>Integrated risk calculation result</b>						
<b>Revised integrated risk calculation result after Phase 2.3</b>						

## Appendix 2

## Model 2: Scoring Model

<b>Site Intrinsic Factors</b>						
<b>LIKELIHOOD OF IMPACT</b>	<b>Serious Score 4</b>	<b>High Score 3</b>	<b>Medium Score 2</b>	<b>Low Score 1</b>	<b>Minimum Score 0</b>	<b>Score*</b>
<i>Buffer zones: previous cultivation depth/ extent in relation to archaeology</i>	Cultivation of areas or encroachment on parts of sites not previously in cultivation or where this is planned in future; evidence of new disturbance	Present cultivation likely to be at interface with archaeology	Shallow buffer (eg. 0.10-0.20m); previous cultivation has left differential cut and fill	Consistent moderate undisturbed buffer (eg. 0.20-0.75m) of old colluvium or alluvium	Deeply buried (eg > 0.75m)	<b>A</b> <b>B</b> <b>C</b>
<i>Soils</i>		Light soils subject to rapid erosion; heavy clay soils subject to deep cultivation, compaction, drainage	Medium soils with some difficulties	Medium, well drained, well structured soils with no difficulties		<b>A</b> <b>B</b> <b>C</b>
<i>Micro-topography and slopes</i>		Upper slopes or top of slope; steep to moderate slopes	Mid slope; variable slope; moderate to shallow slopes	Slope bottom; flat ground		<b>A</b> <b>B</b> <b>C</b>
<b>Site Management Factors</b>						
<i>Cultivation method and depth</i>	New significantly deeper ploughing with clear fresh disturbance (or where planned in future) eg. presence of fresh subsoil	Regular deep ploughing, deep rotavating, stone cleaning etc (or proposed in the future)	Normal ploughing, chisel ploughing	Shallow minimum cultivation methods	Continuous direct drilling with no subsoiling	<b>A</b> <b>B</b> <b>C</b>
<i>Cropping regime</i>		Cropping includes sugar beet, potatoes, etc needing deep soils (or proposed in the future)	Cropping includes cereals, non-root crops	Cropping includes long term grass ley (or set-aside) > 5yrs;		<b>A</b> <b>B</b> <b>C</b>
<i>Compaction and drainage</i>	New regular subsoiling < 3 yrs old, or where this proposed in the future	Regular or occasional subsoiling required; wetland water table lowering (or proposed in the future)	Rare subsoiling required; moling and drains	Subsoiling unlikely; irrigation [No risk scores 0, but not weighted]		<b>A</b> <b>B</b> <b>C</b>
<b>Initial score (In box to Right)</b>						
Intrinsic site factor. Weighting	<b>Any of above = Total score x 1.5</b>				<b>Any of above (where 0) = Total score x 0.5</b>	
<b>Probability of Occurrence score to be calculated in boxes a) and b) to right: Initial score multiplied by any weighting derived from 'Serious' and/or 'Minimum' columns as applicable. Do not weight scores at this stage if 'no serious' or 'minimum' risk issues arise.</b>				<b>a) Score above to multiply by serious/minimum weightings:</b>  ..... X .....		<b>b) Result = Final Score (may be graded A,B,C*)</b> A ..... B ..... C .....

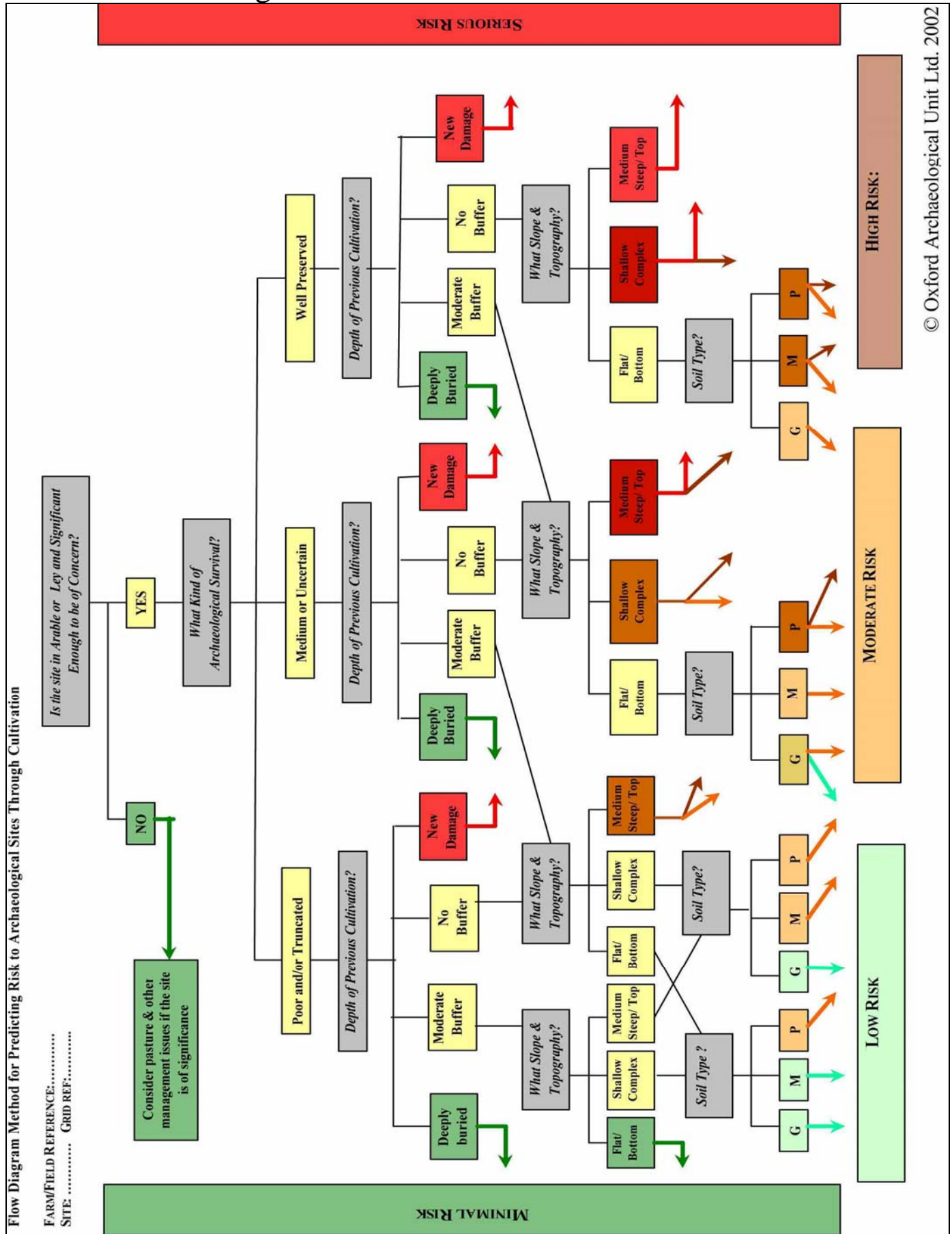
**\*Scores to be given by quality of supporting evidence: A = Good evidence; B = Some evidence; C = Poor evidence, mainly assumption**

<b>Archaeological Weighting</b>						
<b>SCALE OF ARCHAEOLOGICAL HAZARD</b>	<b>Serious Hazard Score 4</b>	<b>High Hazard Score 3</b>	<b>Medium Hazard Score 2</b>	<b>Low Hazard Score 1</b>	<b>Minimum Hazard Score 0</b>	<b>Score*</b>
<i>Archaeological survival and vulnerability</i>	Clear upstanding earthworks and structures Low earthworks etc coupled with buried ground surface 'Soft' horizontal stratigraphy, floor and occupation surfaces	Low earthworks; Shallow negative features with important contents (eg shallow graves)	Incomplete and damaged upstanding archaeology or stratigraphy; Shallow negative features; Surface finds not reflected in underlying archaeology	Site already substantially damaged; Only deep negative features likely to survive.	Site largely destroyed leaving very little potential	<b>A</b> <b>B</b> <b>C</b>
<i>Archaeological significance</i>	SM/ national significance	Regional or county significance	County or regional significance	Clear local significance	No obvious significance	<b>A</b> <b>B</b> <b>C</b>
Archaeological Hazard score						
<b>Weighting to be applied to Probability of Occurrence score on the basis of Scale of Archaeological Hazard</b>	For Archaeological Hazard Score of <b>7-8</b> use weighting factor = <b>3</b> ; For score of <b>6</b> use weighting factor = <b>1.5</b> ; For score of <b>5</b> use weighting factor = <b>1.3</b> ; For score of <b>4</b> use weighting factor = <b>1</b> ; For score of <b>2-3</b> use weighting factor = <b>0.5</b> .				Plus additional weighting of <b>0.5</b> , if any of the above scores 0	<b>Score</b>
<b>TOTAL WEIGHTED SCORE:</b> Initial Score (from Intrinsic Site and Management Factors), multiplied by overall weighting			<b>Probability of Occurrence Score x Archaeological Hazard Score:</b> ..... X .....	<b>Enter Final Score against Confidence grade*</b>		<b>A</b> ..... <b>B</b> ..... <b>C</b> .....

**\*Scores to be given by quality of supporting evidence: A = Good evidence; B = Some evidence; C = Poor evidence, mainly assumption**

Final Scores over 15 may warrant specific management prescriptions and over 20 will very likely do so. B a scores under (or over) 15 may warrant further investigation to confirm or clarify any critical assumptions (especially if these affect the weighting

# Model 3: Flow Diagram Model



## Appendix 2

## Model 4: Final Model

<b>Site Management factors</b>						
<b>LIKELIHOOD OF IMPACT</b>	<b>Serious Risk Score 5</b>	<b>High Risk Score 4</b>	<b>Medium Risk Score 3</b>	<b>Low Risk Score 2</b>	<b>Minimum Risk Score 1</b>	<b>Score + confide nce grade (CF)*</b>
<i>Buffer zones: previous cultivation depth/ extent in relation to archaeology</i>	Cultivation of areas or encroachment on parts of sites not previously in cultivation (or proposed in the future); Evidence of new disturbance or earthworks present.	Present cultivation likely to be at interface with archaeology	Shallow buffer (eg. 0.10-0.20m); Previous cultivation has left differential cut and fill	Consistent moderate undisturbed buffer (of old colluvium or alluvium eg. 0.20-0.25 m)	Deeply buried (eg > 0.25m)	A ..... B..... C.....
<i>Cultivation method and depth</i>	New significantly deeper ploughing with clear fresh disturbance eg. presence of fresh subsoil (>0.30m) (or proposed in the future)	Regular deep ploughing, deep rotavating, stone cleaning (0.26-0.30m) (or proposed in the future)	Normal ploughing, chisel ploughing (0.20-0.25m)	Shallow minimum cultivation methods (0.10-0.19m)	Continuous direct drilling with no subsoiling (<0.10m)	A..... B..... C.....
<i>Cropping regime</i>	Cropping includes sugar beet, potatoes, needing deep soils (or proposed in the future)		Cropping includes cereals, non-root crops		Cropping includes long term grass ley (or set-aside) > 5 years	A ..... B..... C.....
<i>Compaction and drainage</i>	New regular subsoiling < 3 yrs old (or proposed in the future)	Regular or occasional subsoiling or pan busting required (3-6 years) wetland water table lowering (or proposed in the future)	Rare subsoiling required; moling and drains (7-15 years)	No subsoiling		A..... B ..... C.....
<b>Initial score (In box to Right)</b>						
Intrinsic site factor. Weighting	<b>Any of above = Total score x 2.5</b>	<b>Any of above = Total score x 1.5</b>			<b>Any of above = Total score x 0.5</b>	
<b>Probability of Occurrence score to be calculated in boxes a) and b) to right: Initial score multiplied by any weighting derived from 'Serious' or 'High' and/or 'Minimum' columns as applicable (if Serious weighting applicable do not apply any High weighting as well). Do not weight scores at this stage if no 'Serious' or 'Minimum' risk issues arise.</b>				<b>a) Score above to multiply by Serious/High/Minimum weightings:</b>  ..... X .....		<b>b) Result = Final Score (may be graded A,B,C*)</b> A ..... B ..... C .....

\*Scores to be given by quality of supporting evidence: A = Good evidence; B = Some evidence; C = Poor evidence, mainly assumption

Appendix 2

<b>Future soil loss through erosion factors (site intrinsic factors)</b>						
<b>Susceptibility of cultivated soil to water erosion factors, Source : after Controlling Soil Erosion, MAFF 1999</b>						
Soil texture	Slope >	Steep slopes	Moderate slopes	Gentle slopes	Level ground	Score + (CF)*
<b>Light soils:</b> (Sand/loamy sand/sandy loam/silty sand loam/silt/silty loam)		Serious Score 5 (High) (Score 4)	High Score 4 (Medium) (Score 3)	Medium Score 3 (Low) (Score 2)	Minimal Score 1	A..... B..... C.....
<b>Moderate soils:</b> (Silty clay loams/sandy clay/clay loam)		High Score 4 Medium (Score 3)	Medium Score 3	Low Score 2	Minimal Score 1	
<b>Heavy soils:</b> (Silty clay/clay)		Low Score 2	Minimal Score 1	Minimal Score 1	Minimal Score 1	
* Where average annual rainfall is less than 800mm, the likelihood of occurrence class in brackets applies						
<b>Susceptibility to deeper cultivation through soil movement by wind erosion</b>						
Main soil group	Peats	Silts/sands	Loams	Sand clay/silt clay	Clay	Score+ (CF)*
Likelihood of occurrence	Serious Score 5	High Score 4	Medium Score 3	Low Score 2	Minimal Score 1	A..... B..... C.....
<b>Applied likelihood of occurrence result</b>						
<b>Susceptibility to deeper cultivation through soil loss during harvesting</b>						
Crop type	Roots/tubers	Combinable crops	Not under cultivation	Score + (CF)*		
Likelihood of occurrence	Serious (score 5)	Medium (score 3)	Minimal (score 1)	A..... B..... C.....		
Any of above in highlighted grey columns = Total score x 2		Any of above in highlighted grey columns = Total score x 0.5				
Applied likelihood of occurrence result				a) Score above to multiply by Serious/ Minimum weightings: ..... X .....		Result = Final Score (may be graded A,B,C*) A ..... B..... C.....

\*Scores to be given by quality of supporting evidence: A = Good evidence; B = Some evidence; C = Poor evidence, mainly assumption



Appendix 2

<b>Archaeological Weighting</b>						
<b>SCALE OF ARCHAEOLOGICAL RISK</b>	<b>Serious Risk Score 5</b>	<b>High Risk Score 4</b>	<b>Medium Risk Score 3</b>	<b>Low Risk Score 2</b>	<b>Minimum Risk Score 1</b>	<b>Score + (CF)*</b>
<i>Archaeological survival and vulnerability</i>	Clear upstanding earthworks and structures; Low earthworks coupled with buried ground surface; 'Soft' horizontal stratigraphy, floor and occupation surfaces	Settlement activity; Shallow negative features with important contents (eg shallow graves)	Unknown archaeology or stratigraphy; Shallow negative features; Surface finds not reflected in underlying archaeology	Site already substantially damaged; Only deep negative features likely to survive	Site largely destroyed leaving very little potential	A..... B..... C.....
<i>Archaeological significance</i>	SM/national importance	Regional or County importance	County or Regional importance	Clear local importance	No obvious importance	A..... B..... C.....
<b>Archaeological Risk Score</b>						<b>Score</b>
<b>Weighting to be applied for archaeological risk</b>	For Archaeological Risk Score of <b>9-10</b> use weighting factor = <b>2</b> ; For score of <b>8-7</b> use weighting factor = <b>1.5</b> ; For score of <b>5</b> use weighting factor = <b>1.3</b> ; For score of <b>5-4</b> use weighting factor = <b>1</b> ; For score of <b>2-3</b> use weighting factor = <b>0.5</b> .					<b>Weighting</b>
<b>TOTAL WEIGHTED SCORE FOR ARCHAEOLOGICAL RISK:</b>		<b>Score above to multiply by weighting:</b>  ..... X .....		<b>Result = Final Score against Confidence grade*</b> A..... B..... C.....		

*\*Scores to be given by quality of supporting evidence: A = Good evidence; B = Some evidence; C = Poor evidence, mainly assumption*

Management factors (out of 50)	
Erosion factors (out of 30)	
Archaeological Weighting (out of 20)	
Total risk score (out of 100)	