Archaeological Survey:
Finding Archaeological Sites

Reconstructing the historic garden patterns from soil features
at George Washington's home at Mount Vernon

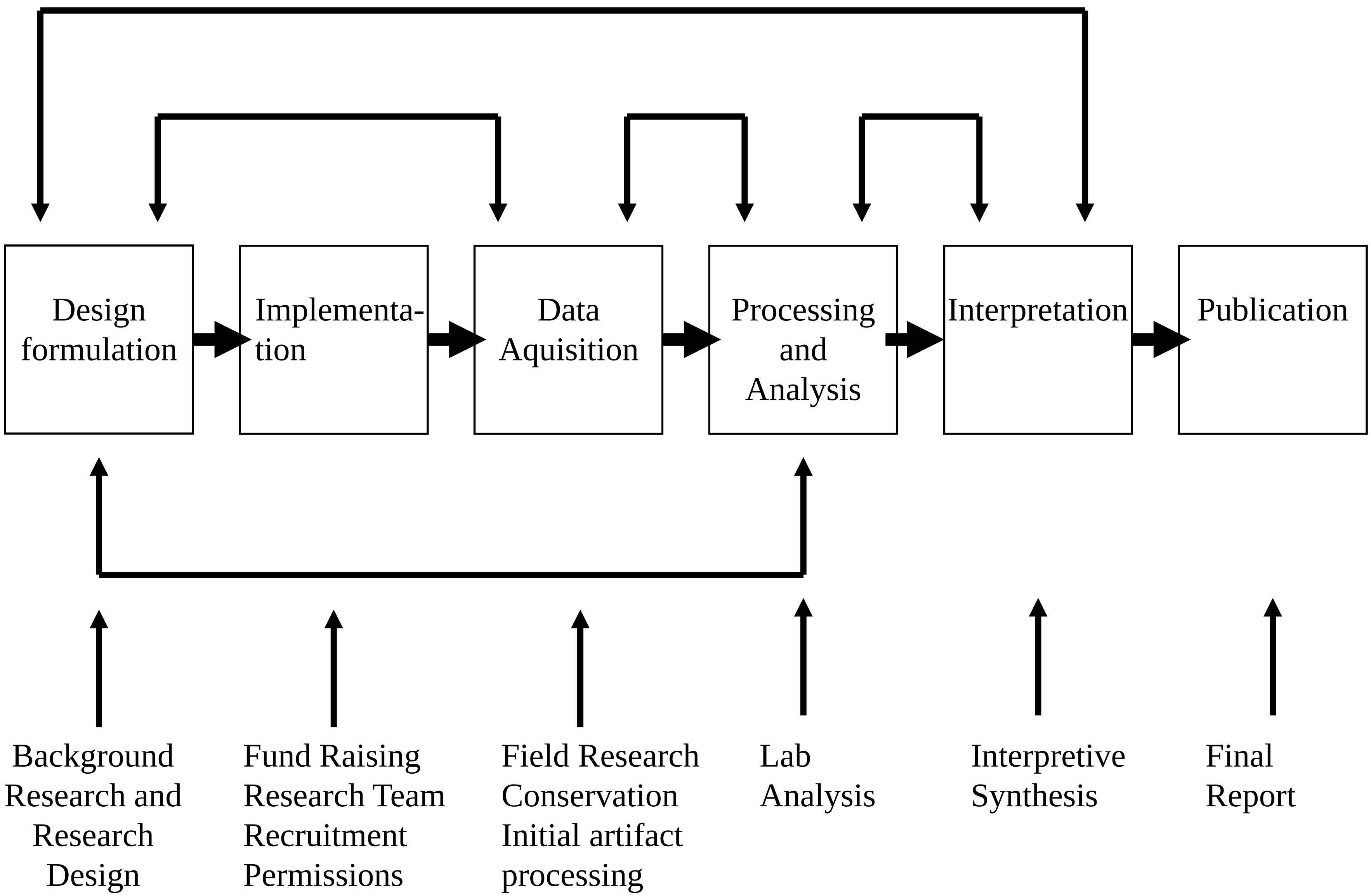
The Process of Archaeological Research

Research Design

- regional archaeology is a more complex process than mere site investigation
- research problems dictate the creation of systematic, detailed research designs
- research designs are like flow charts, created to monitor the validity of research results and to maximize efficient use of resources (money, people and time)
- divides the research process into specific stages, each of which is carefully designed to carry out certain functions;

- together they form a sequence of investigation that divides the flow chart into stages
- the stages do not necessarily follow one up on the other in close order and several may be carried out simultaneously
- the design must be flexible and fluid enough to accommodate ever-changing circumstances in the field
- it must also accommodate the diverse researchers in the group and bring together all relevant research for publication;

The Process of Archaeological Research



Design and Formulation

- the problem is defined, its feasibility tested, and the entire background for the project is researched very carefully
- background library research is especially important, as it provides an opportunity to refine research questions
- including a definition of the research problem and also a statement of specific goals, including sampling strategies to be used and specific hypotheses to be tested
- it is necessary to accurately define the kinds of data the research team will be looking for to test its hypotheses

Implementation

- fund-raising
- gaining permission for access to land for survey or excavation
- acquiring equipment and work force

Data acquisition

field research can have a variety of scales:

- a preliminary reconnaissance of the research area
- various forms of survey
- excavation

Assessing the sites

- non-intrusive archaeology which involves recording the location of the site, surface finds, and sometimes by electronic subsurface detection

Excavation

- investigating the site by excavation

Processing of finds

Faunal (animal) remains

pottery

human remains

Processing and analysis

Finds come in many forms:

- artifacts
- food remains
- remains of houses
- human skeletons;

These data, as well as detailed notes, drawings and other recorded data are analyzed

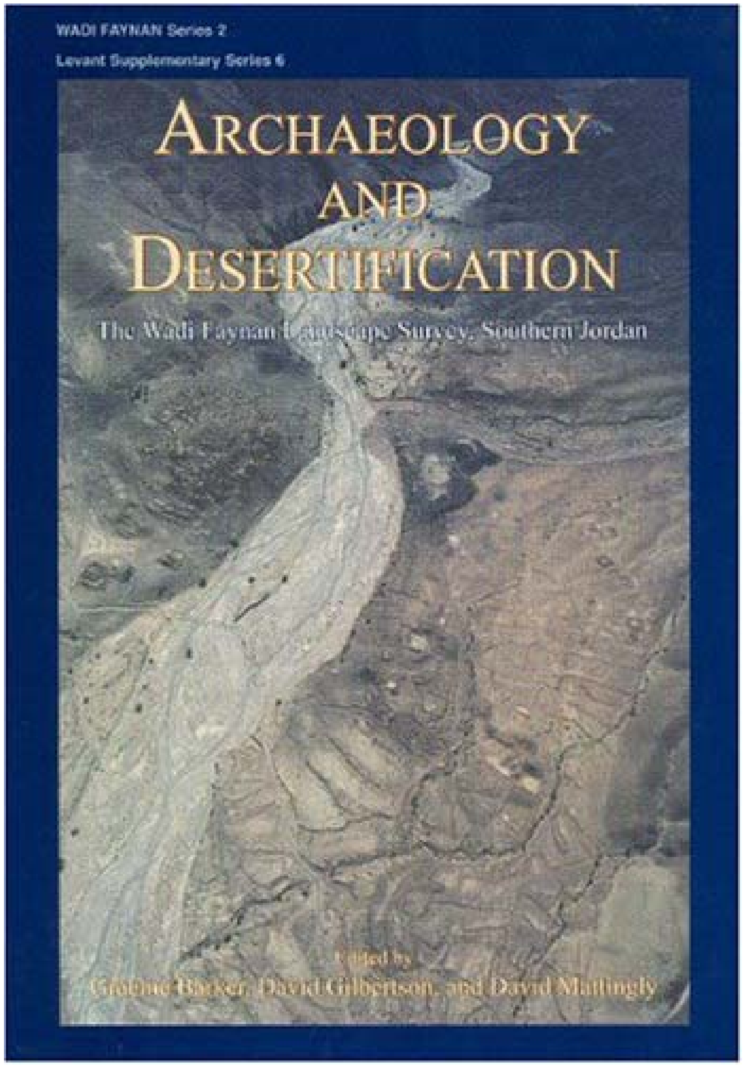
- some specific materials, such as radiocarbon samples and pollen grains are sent to specialists for analysis
- most lab analysis involves detailed artifact classification and study

Interpretation

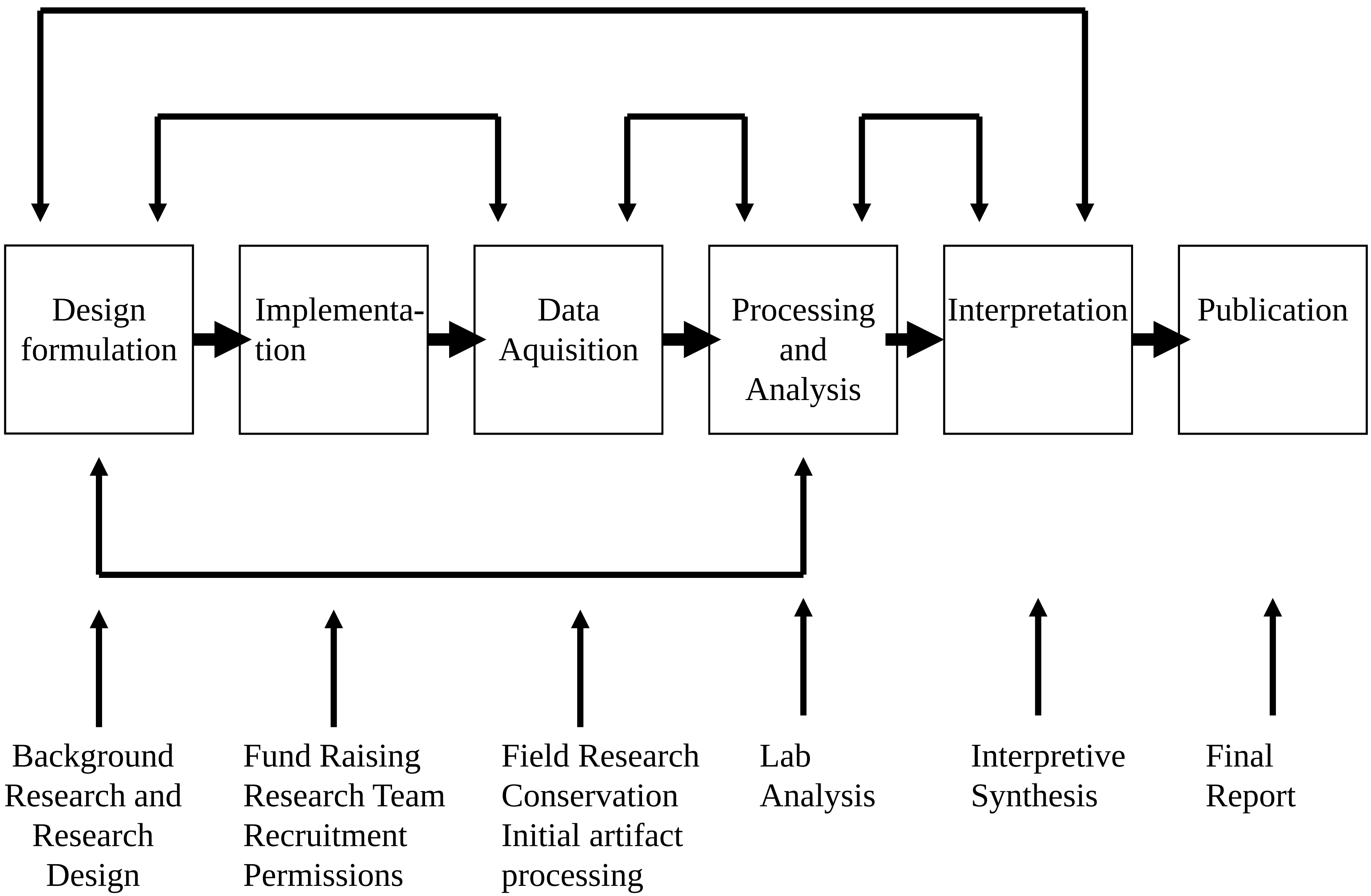
- during this phase, everything is brought together into an interpretive synthesis to answer the research questions posed in the original design

Publication

- final results are published in a form accessible to other scholars



The Process of Archaeological Research



Finding Archaeological Sites

- Most archaeological sites are inconspicuous
- Many consist of limited artifacts (such as a few sherds of pottery
- They may be buried metres underground

Accidental Discoveries

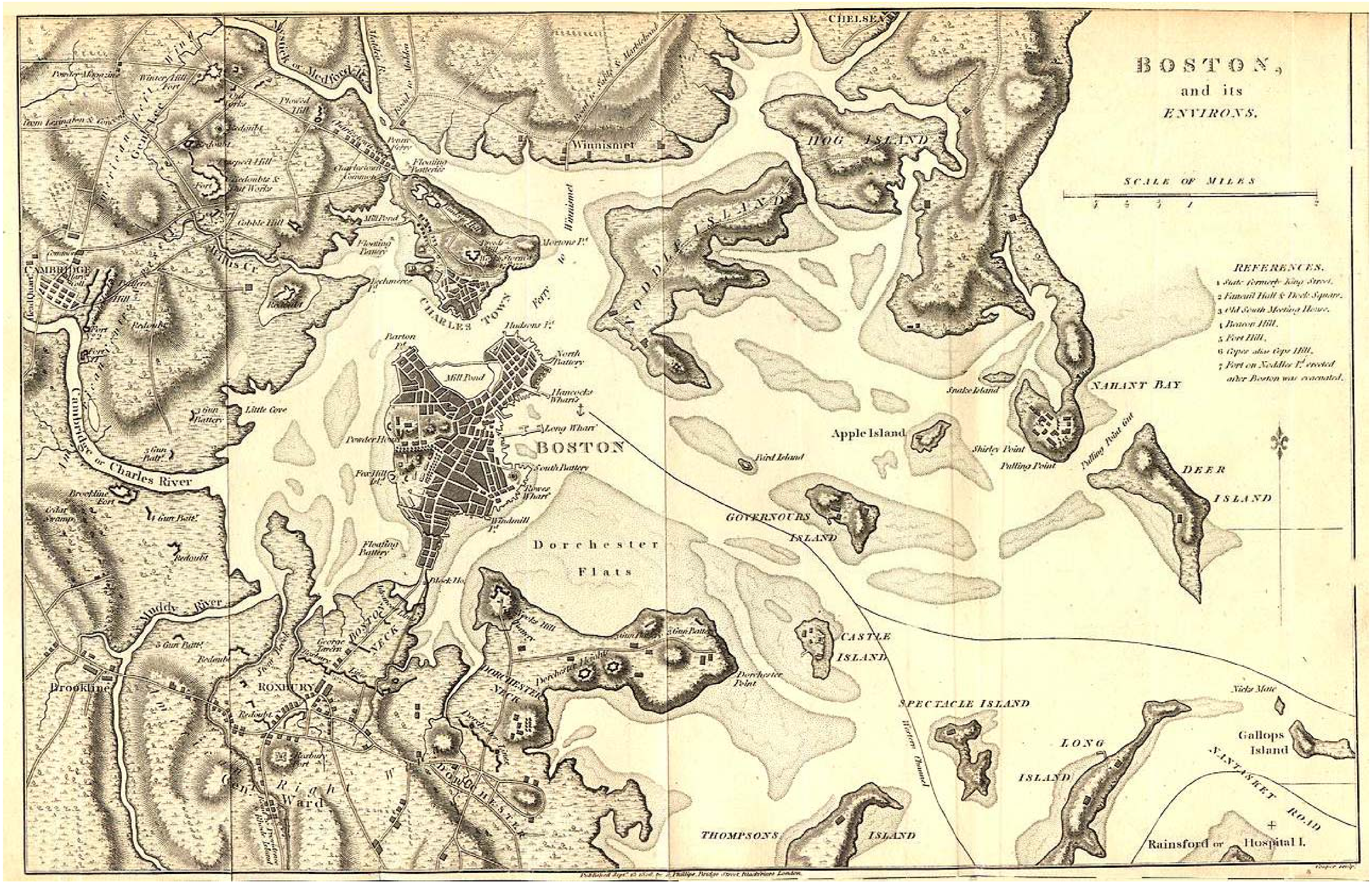
Ice-man as an example

At its most basic level, analytical field survey requires nothing more than keen observation skills and an inquisitive mind

Archaeological Survey

Ground Reconnaissance

- to record all traces of ancient settlement in an area
- no survey will ever achieve total coverage
- the key lies in carefully designing the research in advance of fieldwork and in using techniques to estimate the probable density of archeological sites in the region to be studied


BOSTON,
and its
ENVIRONS.
SCALE OF MILES
REFERENCES.
1 State formerly King Street.
2 Faneuil Hall & Dock Square.
3 Old South Meeting House.
4 Beacon Hill.
5 Fort Hill.
6 Copse alias Cops Hill.
7 Fort on Noddles Id. erected after Boston was evacuated.
CHELSEA
Winnismet
HOG ISLAND
NODDLES ISLAND
NAHANT BAY
Snake Island
Apple Island
Bird Island
Shirley Point
Pulling Point
Pulling Point Gut
DEER ISLAND
GOVERNOURS ISLAND
CASTLE ISLAND
SPECTACLE ISLAND
LONG ISLAND
THOMPSONS ISLAND
Nicks Mate
Gallops Island
NANTASKET ROAD
Rainsford or Hospital I.
Western Channel
Dorchester Flats
Dorchester Point
DORCHESTER NECK
DORCHESTER
BOSTON
North Battery
Hancocks Wharf
Long Wharf
South Battery
Windmill Pt.
Fox Hill
Powder House
Mill Pond
Barton Pt.
Hudsons Pt.
CHARLES TOWN
Mortons Pt.
Floating Battery
Little Cove
BOSTON NECK
Block Ho.
George Tavern
ROXBURY
Roxbury Fort
Right Wing
Redoubt
Brookline
Brookline Fort
Cedar Swamps
4 Gun Batty.
3 Gun Batty.
Muddy River
Cambridge or Charles River
CAMBRIDGE
Winter Hill Fort
Plowed Hill
Powder Magazine
Cobble Hill
Charlestown Common
Penny Ferry
Mistick or Medford R.
Road to Salem & Marblehead

Documentary evidence

Historical sources, documents and maps

Recent word of mouth sources
(involves collecting as much information about as many sites as possible from local informants and landowners)

Reconnaissance survey

- look for the most prominent remains in a landscape, i.e. remnants of walled buildings, burial mounds, etc.
- signs: gray soil from a rodent burrow, a blurred mark in a plowed field, a potsherd
- has evolved in the last few decades from being simply the preliminary stage in fieldwork to a more or less independent kind of inquiry
- an area of research in its own right which can produce information quite different from that achieved by digging

Archaeologists in Lincolnshire England discover a Late Roman cemetery discovered upon demolition of a derelict pub prior to building of a new supermarket

Wood from the hull of the 18th century ship at the ground Zero site in New York, in an area where the Hudson River used to run.

Salvage archaeology

- In many countries the majority of archaeological sites are found through chance finds due to development and construction work
- Most countries have strict guidelines about reporting sites found
- Salvage archaeology is done in advance of construction work to locate and record as many sites as possible before they are destroyed by new roads, buildings, or dams, or by peat-cutting and drainage in wetland environments

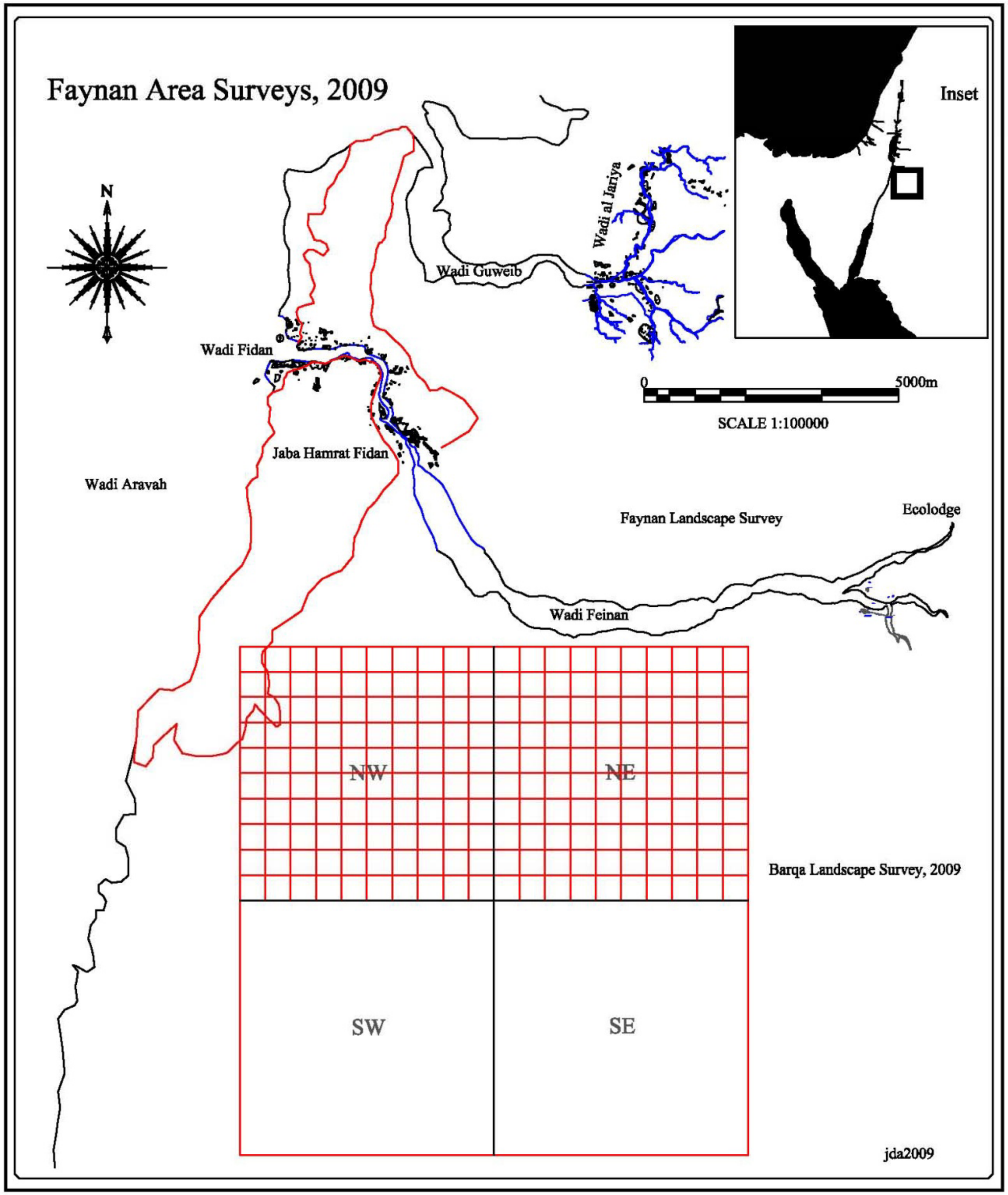
- Salvage archaeology also responds to unexpected chance discoveries in construction and development work

- in some cases, excavation may not take place at all

- perhaps because permission to dig was not forthcoming, or because of lack of time or funds

Steps

- the region to be surveyed needs to be defined: its boundaries may be either natural, cultural, or arbitrary
- need to study the area's history of development to assess previous archeological work and local materials, as well as the extent to which surface material may have been covered or removed by geomorphological processes
- intensity of surface coverage needs to be determined, on the basis of time and resources available, and how easy it is actually to reach and record an area
- conduct a systematic or unsystematic survey



Surveys in Faynan, Jordan
1997-2009

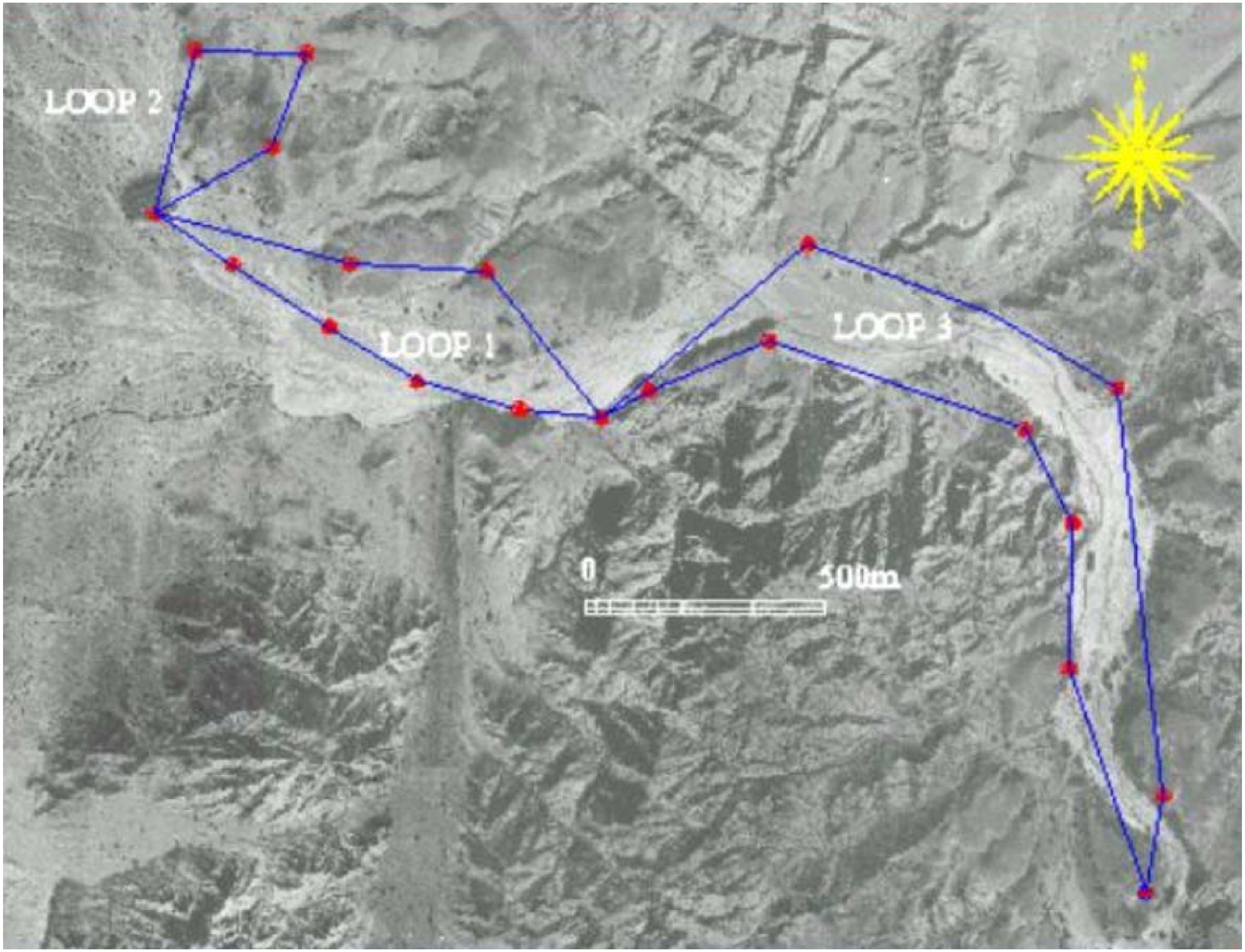
Extensive and intensive survey

- surveys can be made more extensive by combining results from a series of individual projects in neighboring regions to produce very large-scale views of change in landscape, land-use, and settlement though time

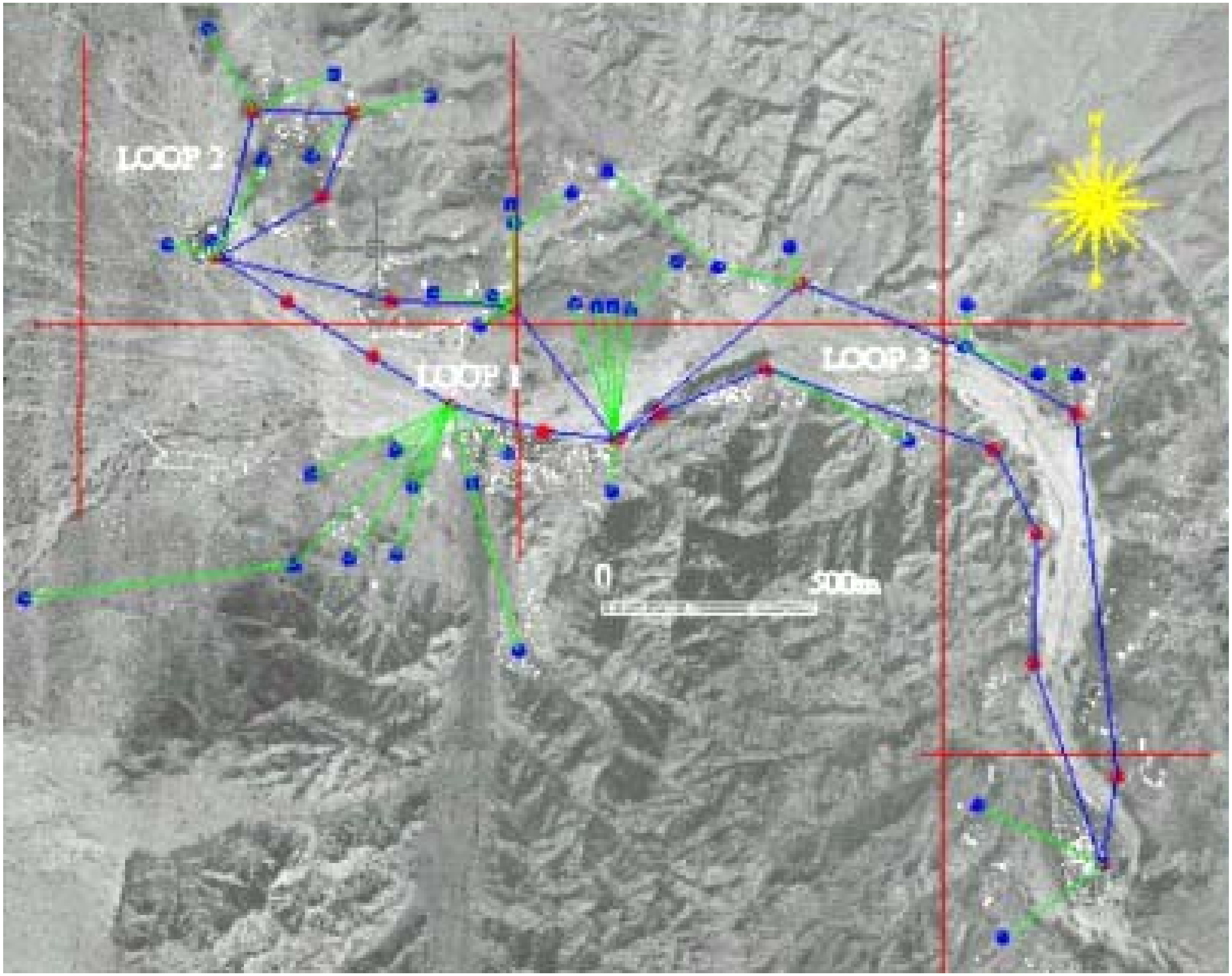
Surveying using a Total Station

Creating ‘Bench Marks’ or permanent survey points

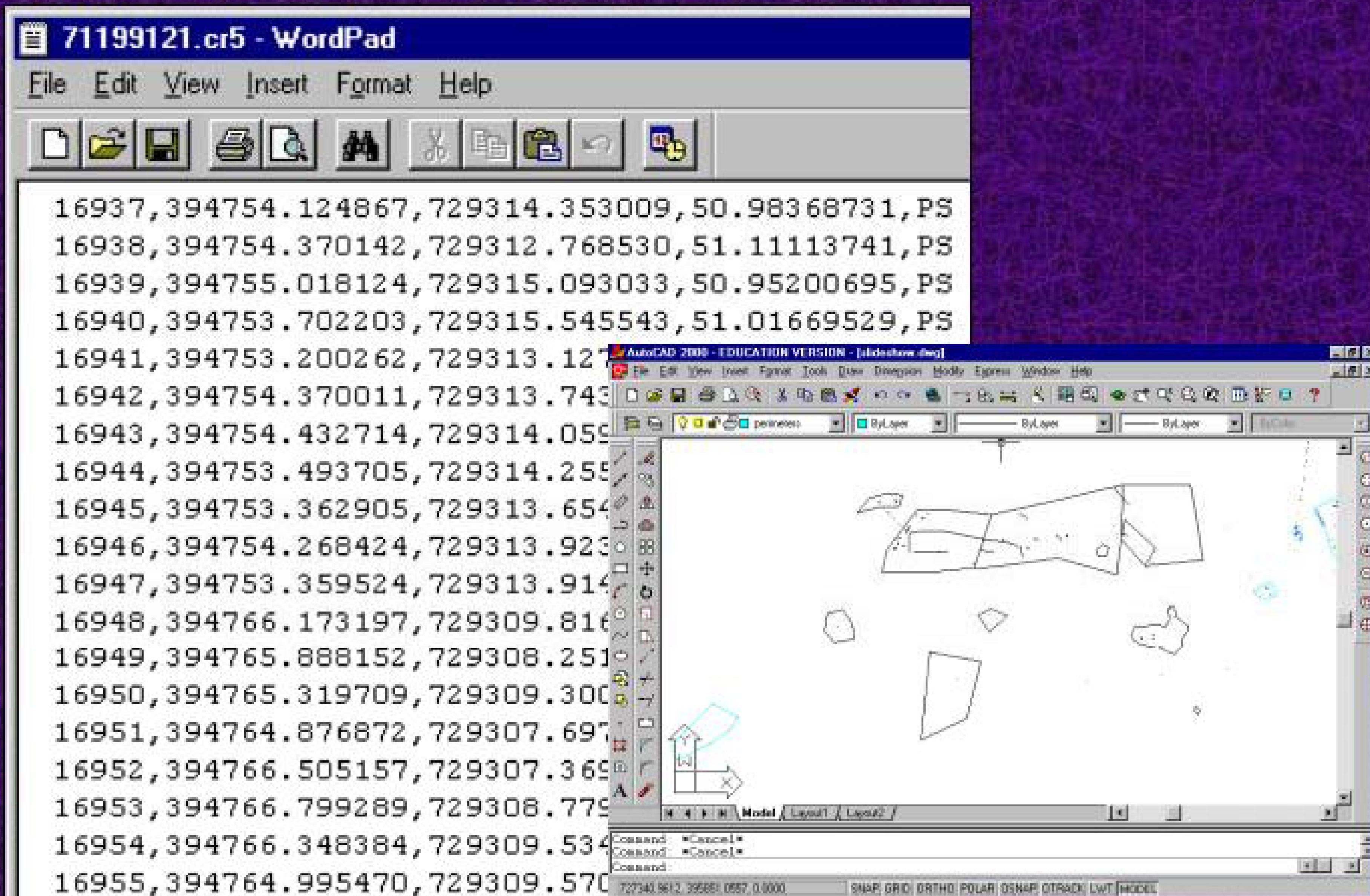
Control Networks

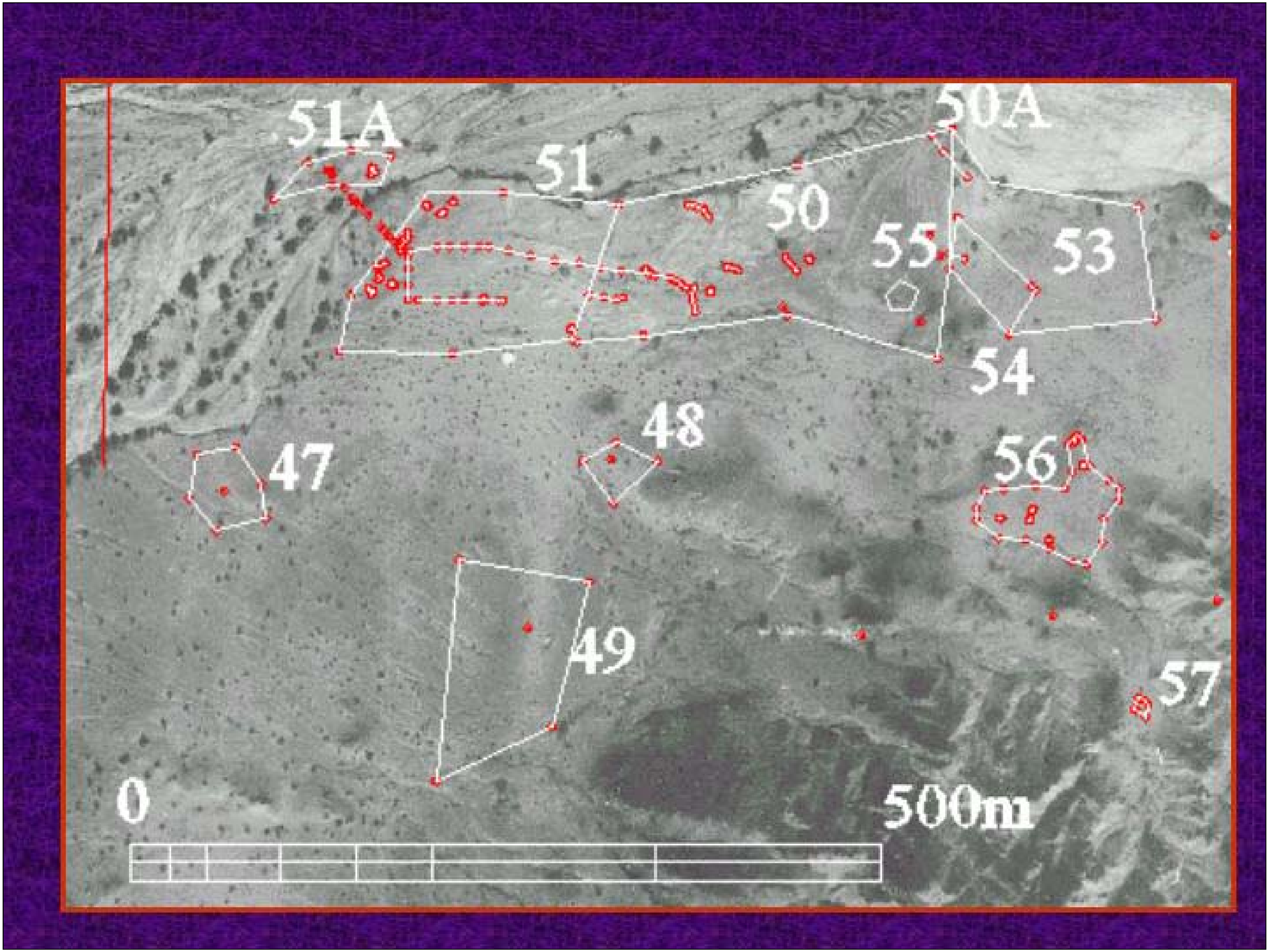


Secondary Loop and collection points

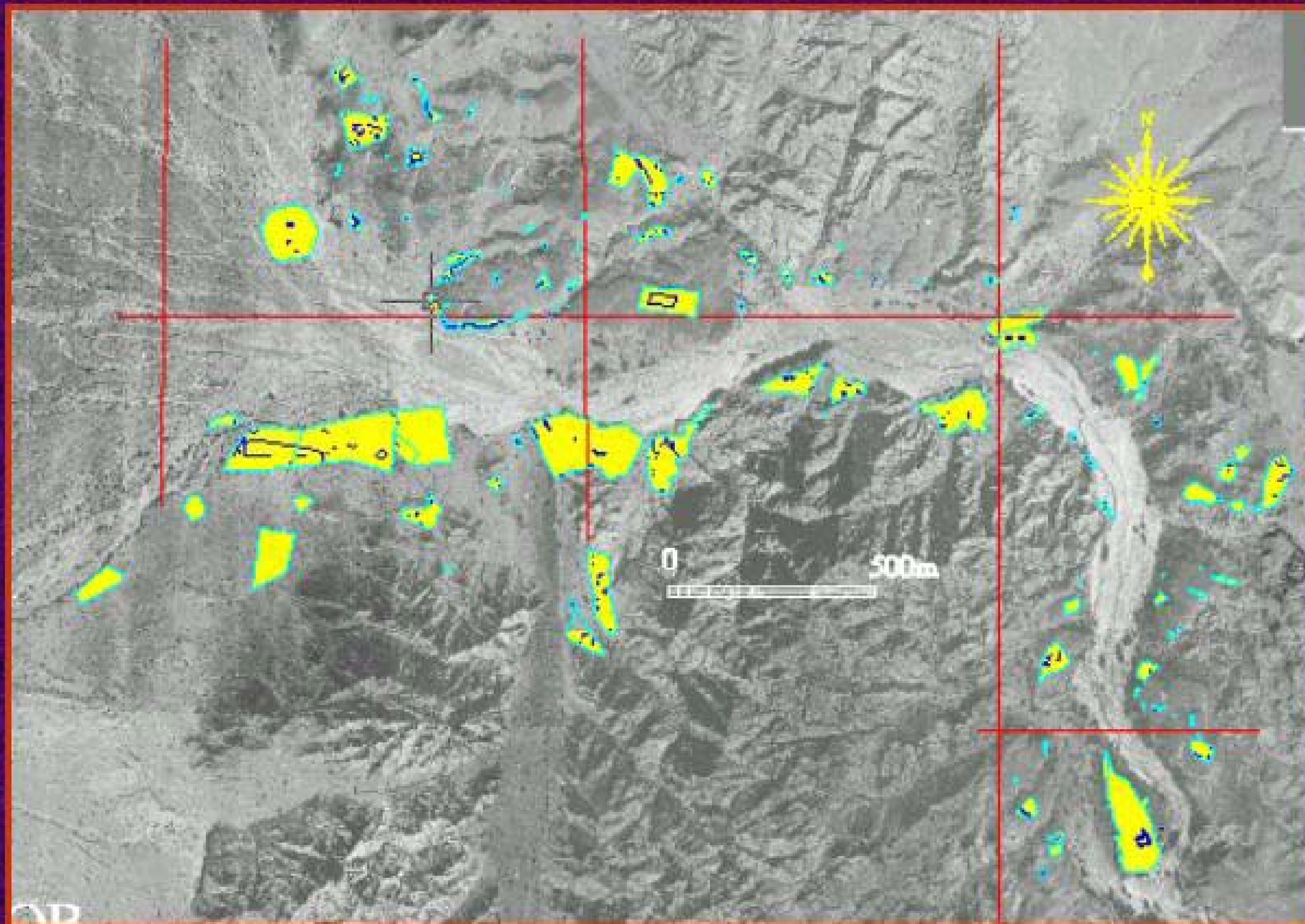


Draughting: Sites and Structures




51A
51
50A
50
55
53
54
48
47
56
49
57
0
500m

General Sites and Structures



Sampling and Archaeological Survey

- as so many sites are being destroyed today, archaeologists hurry to locate as many sites as possible
- the only way the archaeologists can estimate the extent of the site resource base is to survey selected areas in great detail, using formal sampling methods

Sampling definition

"the science of controlling and measuring the reliability of information through the theory of probability"

- systematic and carefully controlled sampling of archaeological data is essential if we are to rely heavily on statistical approaches in studying ancient adaptations to changing environmental conditions
- sampling ensures a statistically reliable basis of archaeological data from which we can make generalizations about our research data
- these generalizations are often estimates of probability, which means they have to be based on unbiased data


BLS 09
0080 a
23-7-09

What to look for:

- concentration of artifacts, enriched soil, modification to earth's surface (pits, mounds, etc.)
- "non-sites": areas with low density of artifacts, but still cultural remains (individual fields, plowmarks, field boundaries)

Importance of sampling:

- Through sampling we can examine entire landscapes and relationships within
- This is a much less expensive and quicker process than excavation, is less destructive and provides different information

Types of Sampling

Non-probabilistic sampling

- some sites in a region may be more accessible than others, or more prominent in the landscape, which may prompt a less formally scientific research design
- areas selected on the basis of opinion (asking locals, using historical documents, early maps)

Example: simple pedestrian survey

Involves walking across each part of the area, scanning the strip of ground along one’s path, collecting or examining artifacts on the surface, and recording their location together with that of any surface features.

Problems with this approach:

- Results may be biased or misleading
- Surveyors have an inherent desire to find material
- Tend to concentrate on those areas that seem richer
- Rather than obtaining a sample representative of the whole area
- Without which the archaeologist is unable to assess the varying distribution of material of different periods or types

Probabilistic Sampling

Employs either a grid system or a series of equally spaced transects

- Transects are preferred in areas of dense vegetation
- It is far easier to walk along a series of paths than to locate accurately and investigate a large number of randomly distributed squares
- Using squares will expose more area to the survey, thus increasing the probability of intersecting sites
- A combination of the two methods is often best: using transects to cover long distances, but squares when larger concentrations of material are encountered
- The larger and better designed the sample, the more likely the results are to be valid

Probabilistic Sampling vs. non-Probabilistic Sampling


JHF 2002
SURVEY
SITE WAG 7
DATE SEPT 27
WEST
JHF 2002
SURVEY
SITE WAG 103
DATE SEPT 27 02

Random sampling

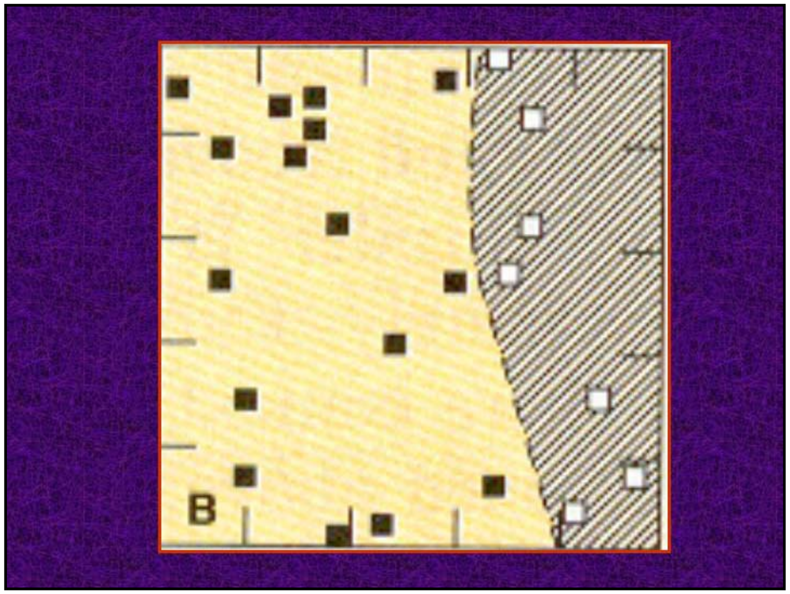
Simple random sample

- The areas to be sampled are chosen using a table of random numbers;
- Choose the limits, then the units (size of squares, or quadrats in grid), sample fraction (how many squares to investigate)

Drawbacks:

- It entails defining the site's boundaries beforehand, and these are not always known with certainty
- the nature of random numbers results in some areas being allotted clusters of squares, while others remain untouched

Stratified random sample



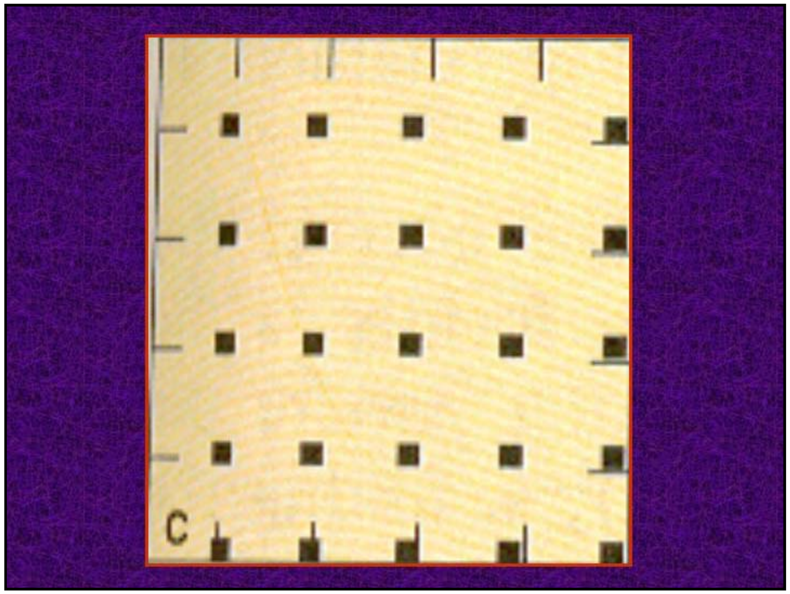
- the region or site is divided into its natural zones (strata) these could be cultivated land and forest

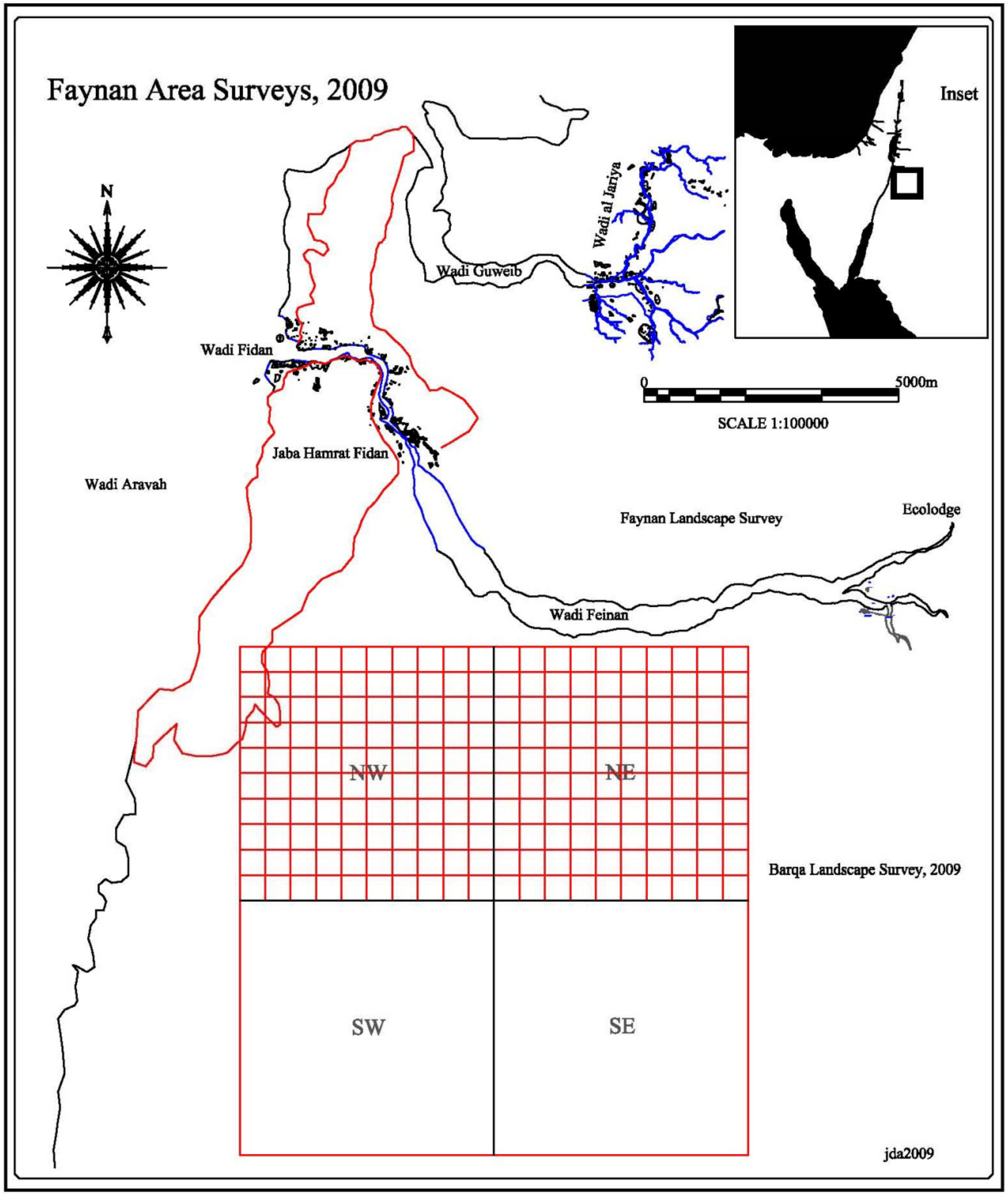
- squares are then chosen by the same random-number procedure, except that each zone has the number of squares proportional to its area

- if forest comprises 85 percent of the area, it must be allotted 85 percent of the squares

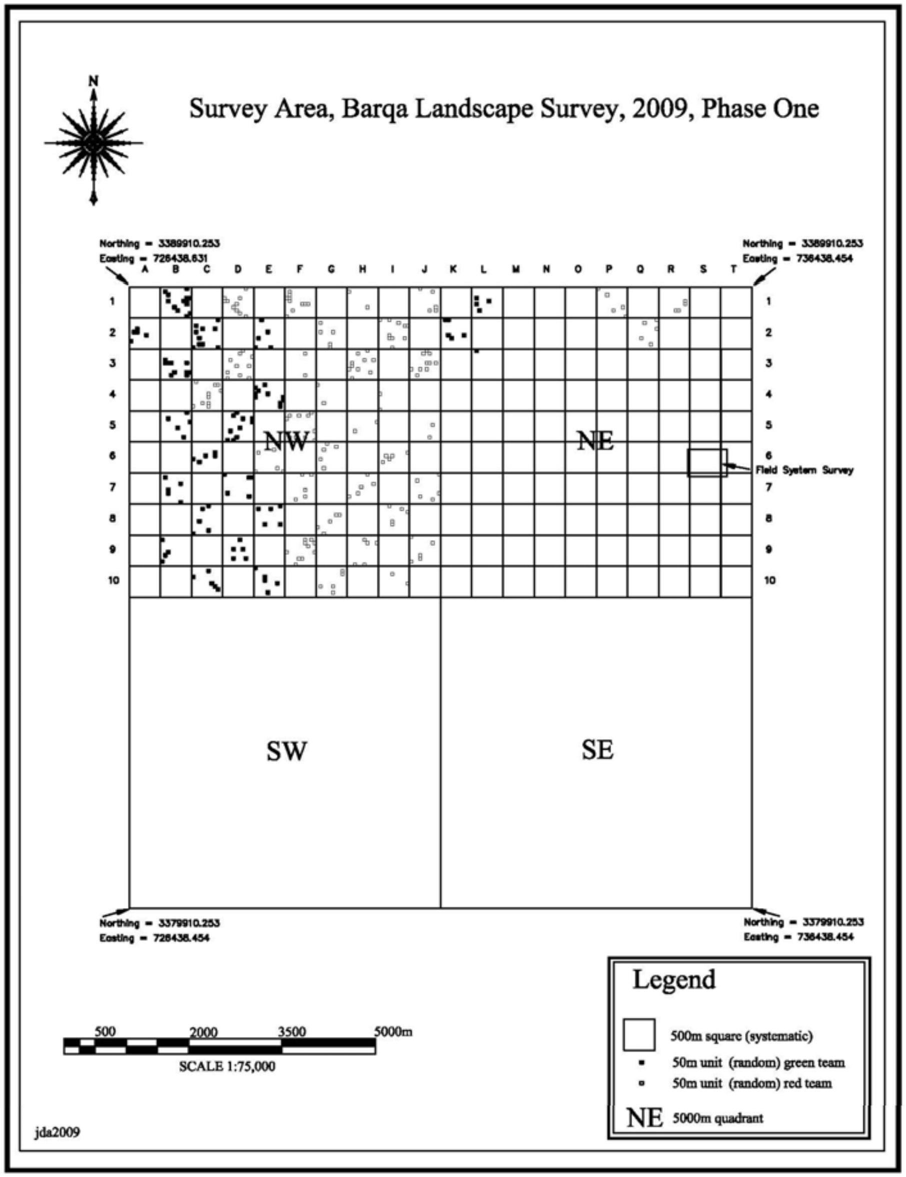
Systematic sampling

- The selection of a grid of equally spaced locations: choosing every other square
- However, one might miss or hit every single example in an equally regular pattern of distribution

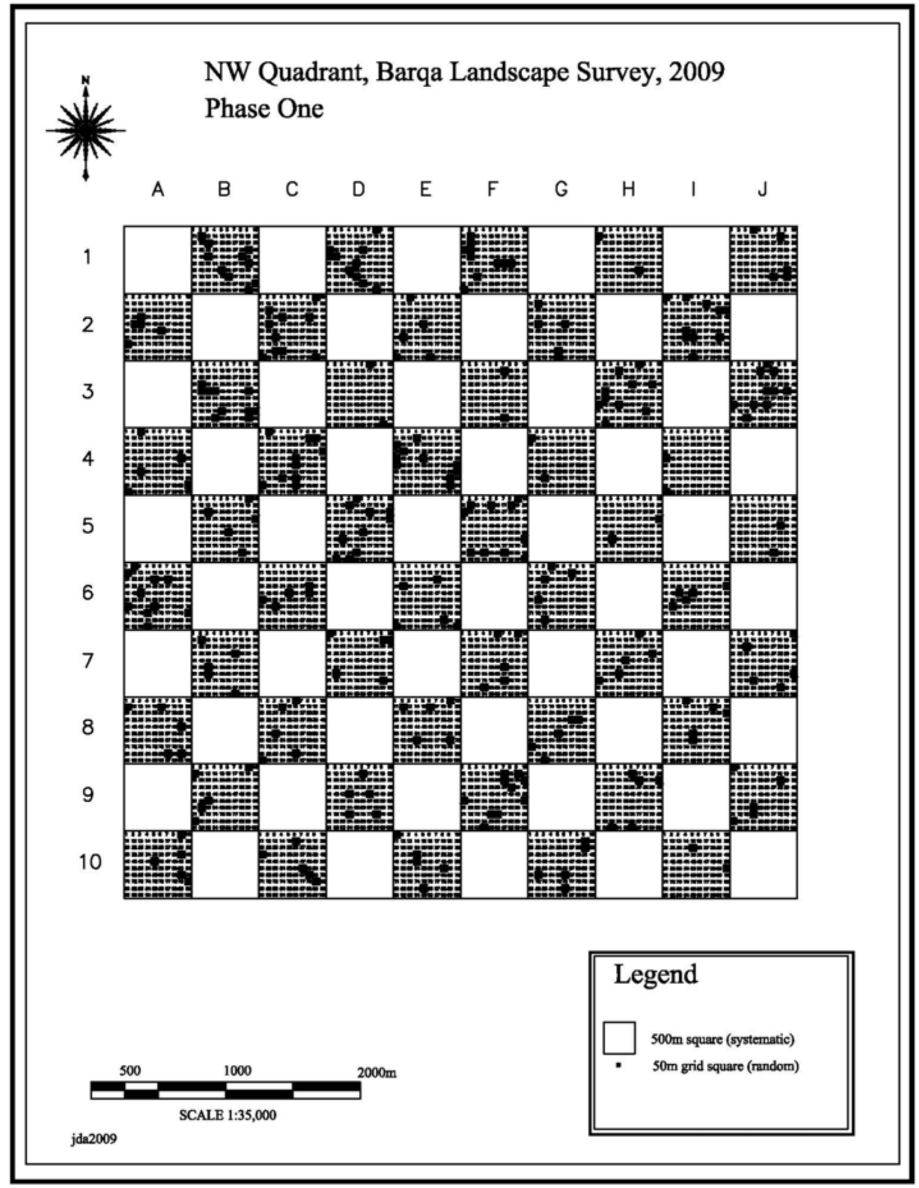




Barqa Landscape Survey, Jordan 2009



N
Survey Area, Barqa Landscape Survey, 2009, Phase One
Northing = 3389910.253
Easting = 726438.631
Northing = 3389910.253
Easting = 736438.454
A B C D E F G H I J K L M N O P Q R S T
1 2 3 4 5 6 7 8 9 10
NW
NE
Field System Survey
SW
SE
Northing = 3379910.253
Easting = 726438.454
Northing = 3379910.253
Easting = 736438.454
500 2000 3500 5000m
SCALE 1:75,000
Legend
500m square (systematic)
50m unit (random) green team
50m unit (random) red team
NE 5000m quadrant
jda2009

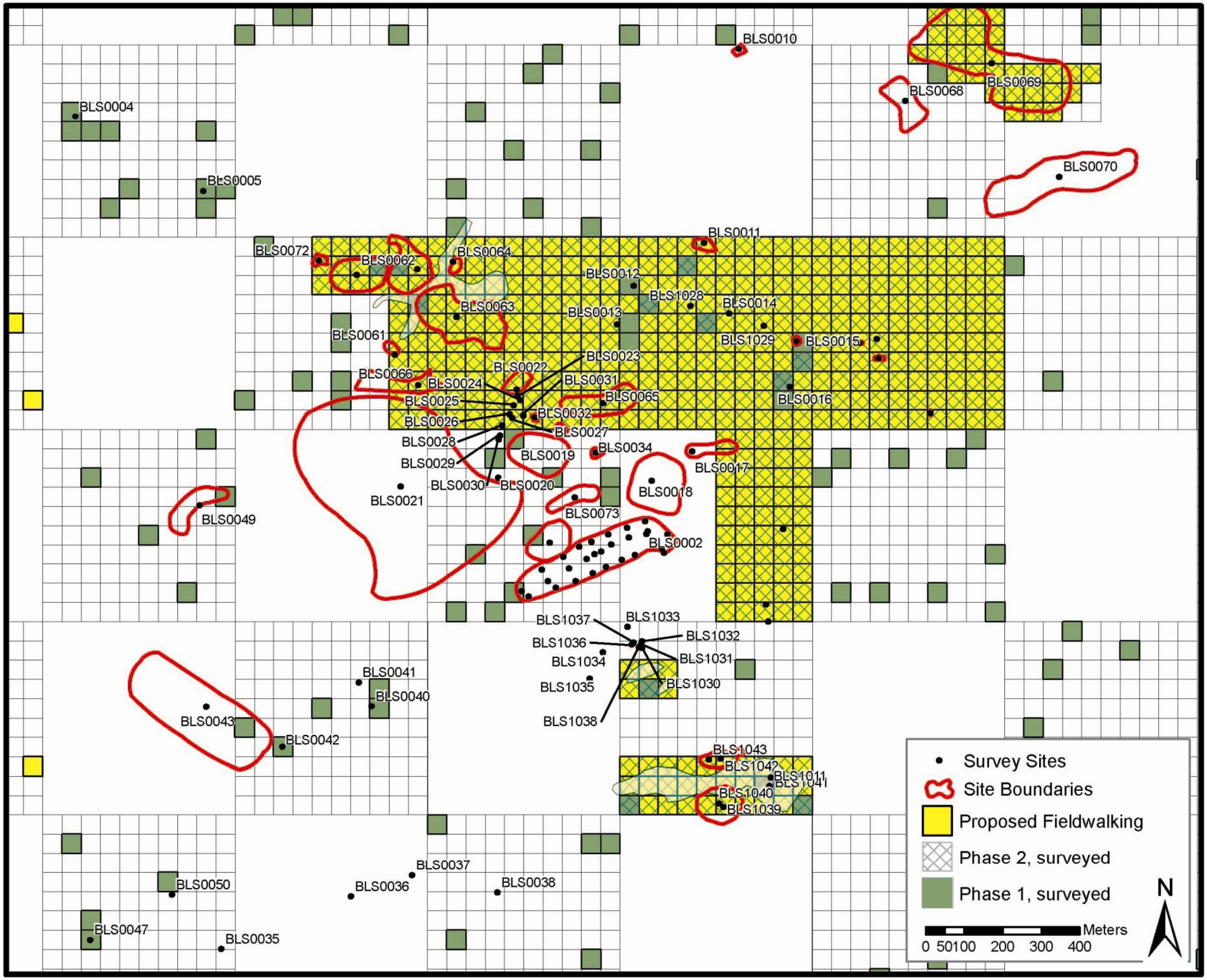


N
NW Quadrant, Barqa Landscape Survey, 2009
Phase One
A B C D E F G H I J
1 2 3 4 5 6 7 8 9 10
500 1000 2000m
SCALE 1:35,000
Legend
500m square (systematic)
50m grid square (random)
jda2009

Stratified unaligned systematic sample

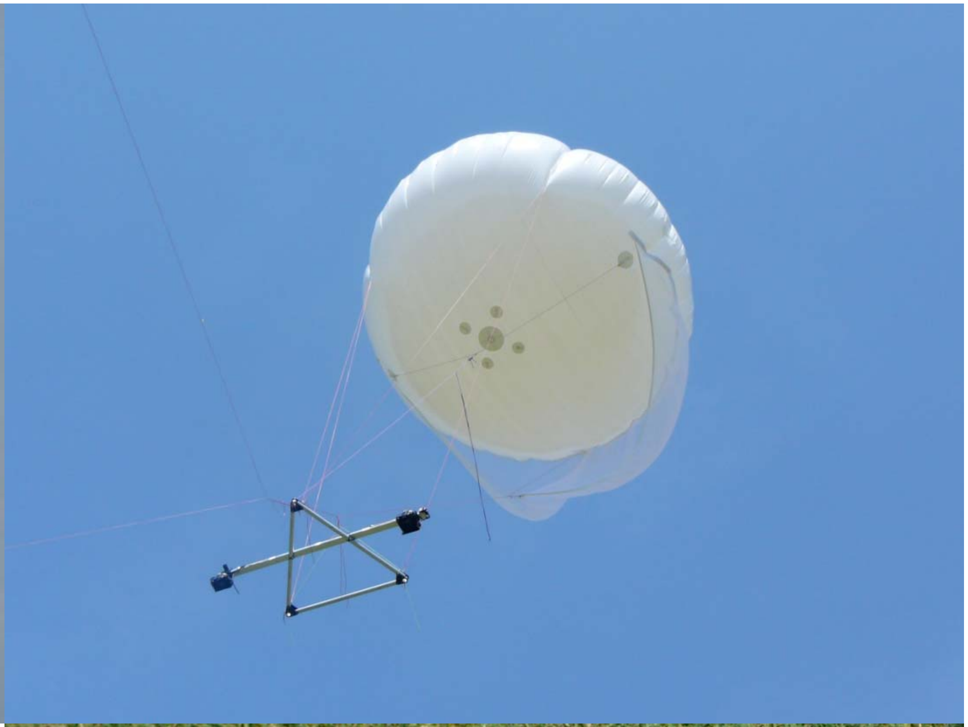
Example:

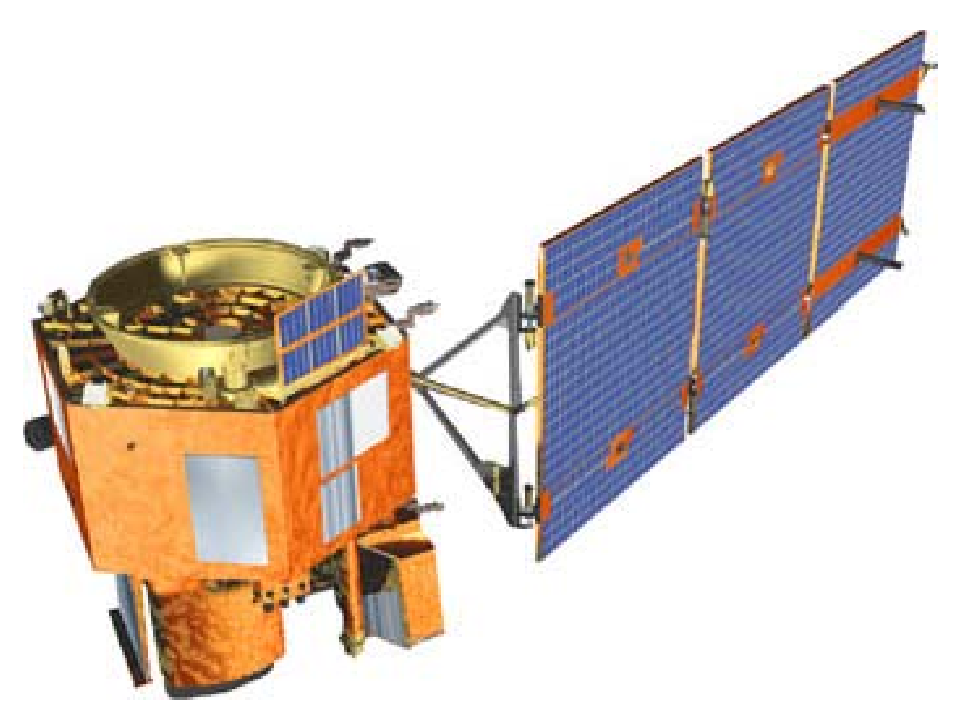
- Use a grid oriented along the site's main N-S and E-W axes
- Selects samples with reference to these axes
- Choose strata to investigate blocks, choosing one square in each block for excavation by selecting its N-S/E-W coordinates from a table of random numbers
- This method will ensures an unbiased set of samples, more evenly distributed over the whole site
- It also makes it unnecessary to define the boundaries since the grid can be extended in any direction


BLS0010
BLS0068
BLS0069
BLS0004
BLS0070
BLS0005
BLS0011
BLS0072
BLS0062
BLS0064
BLS0012
BLS1028
BLS0014
BLS0063
BLS0013
BLS0061
BLS1029
BLS0015
BLS0023
BLS0022
BLS0066
BLS0024
BLS0031
BLS0025
BLS0065
BLS0032
BLS0016
BLS0026
BLS0027
BLS0028
BLS0034
BLS0019
BLS0029
BLS0017
BLS0030
BLS0020
BLS0018
BLS0021
BLS0049
BLS0073
BLS0002
BLS1037
BLS1033
BLS1032
BLS1036
BLS1034
BLS1031
BLS0041
BLS1035
BLS1030
BLS0040
BLS1038
BLS0043
BLS0042
BLS1043
BLS1042
BLS1011
BLS1041
BLS1040
BLS1039
BLS0037
BLS0050
BLS0036
BLS0038
BLS0047
BLS0035
Survey Sites
Site Boundaries
Proposed Fieldwalking
Phase 2, surveyed
Phase 1, surveyed
N
Meters
0 50100 200 300 400

Non-probabilistic sampling	**Probabilistic Sampling**
Simple pedestrian surveys	Random sampling
Less formal site location and visits	Stratified Random sampling
Local knowledge	Systematic sampling
Historical maps and documents	Stratified unaligned systematic sample


G-BHYP





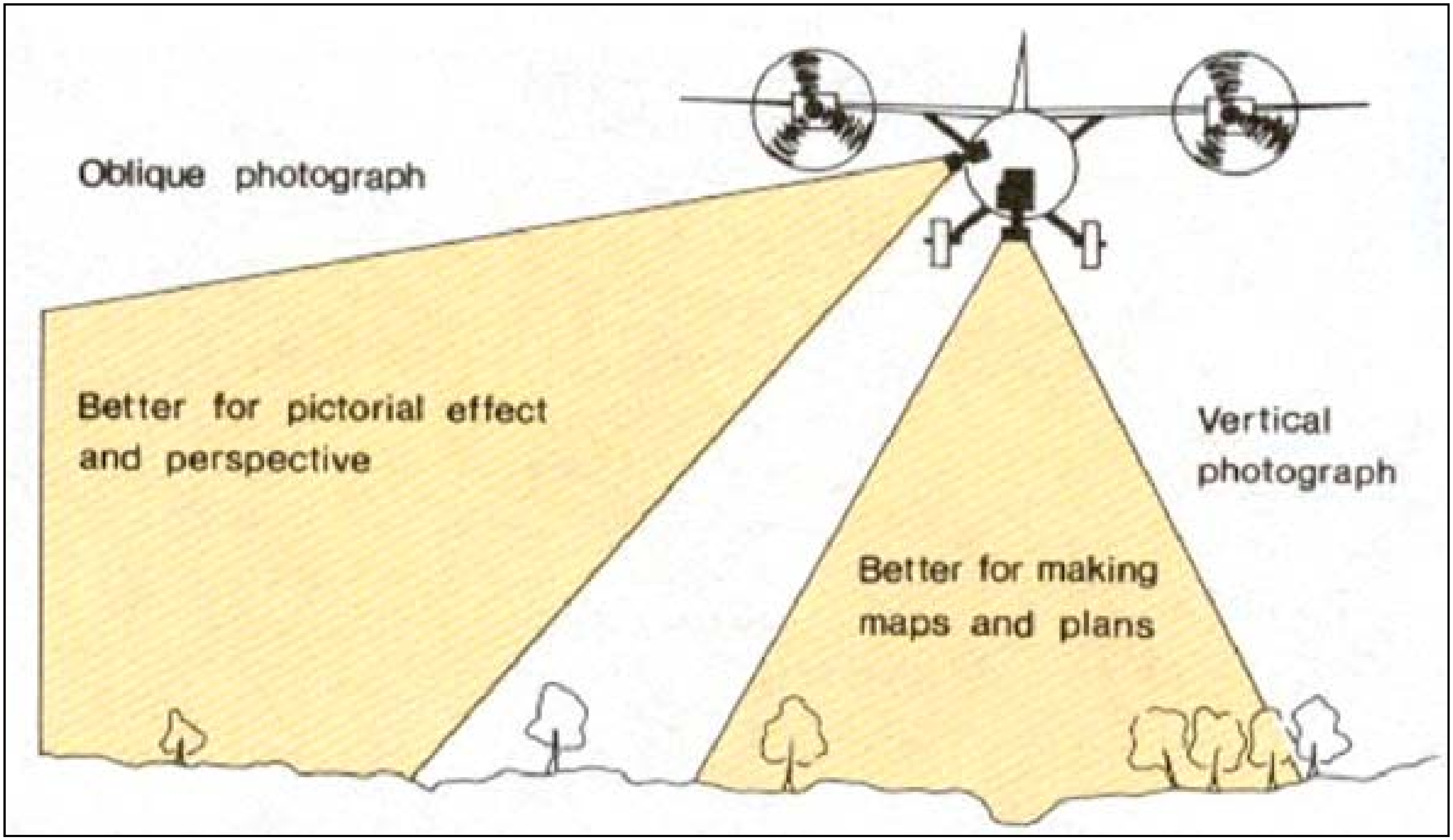

Canon

Aerial Reconnaisance

Remote Sensing

Aerial Photography

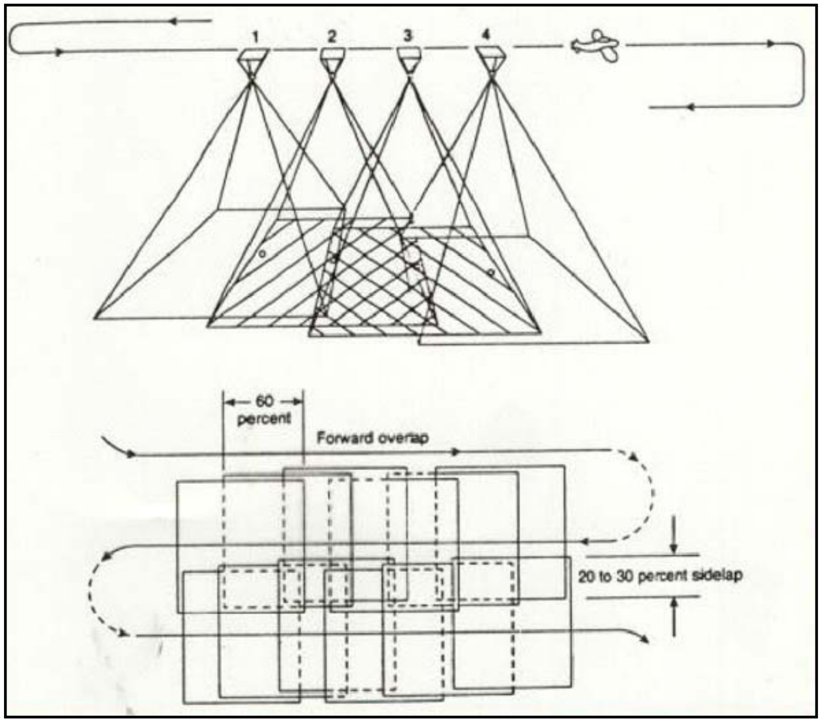
- began in 1900 or so with the photographs taken in a balloon of Roman Ostia
- much of the world has been photographed from 24,000 ft by military photographers
- sites can be photographed from many directions, at different times of day, and at various seasons;
- numerous sites that left almost no surface traces have been discovered by analyzing aerial photographs
- Wide variety of technology used, from balloons, to low and medium altitude aircraft, to satellites.

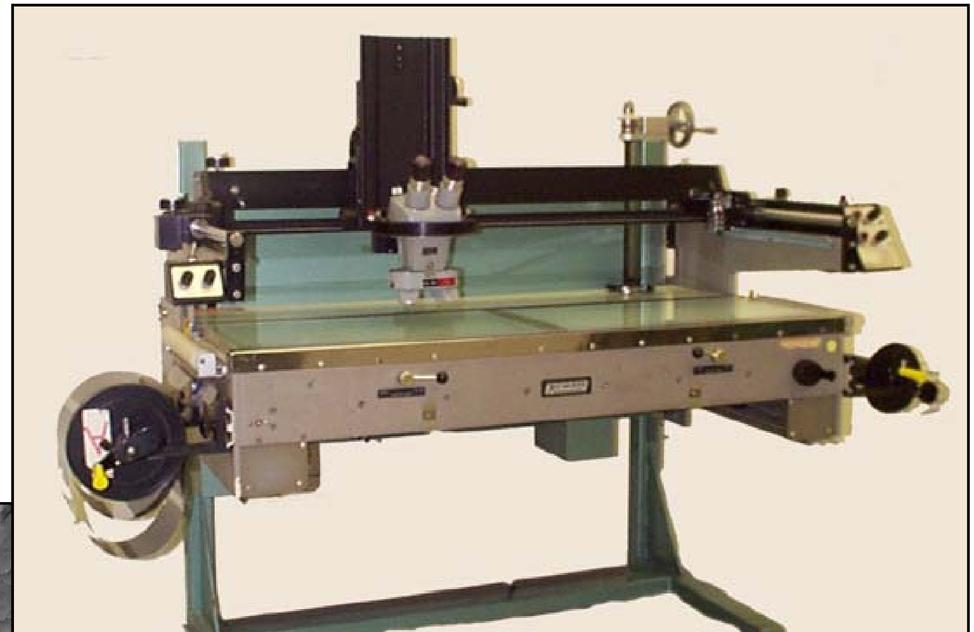


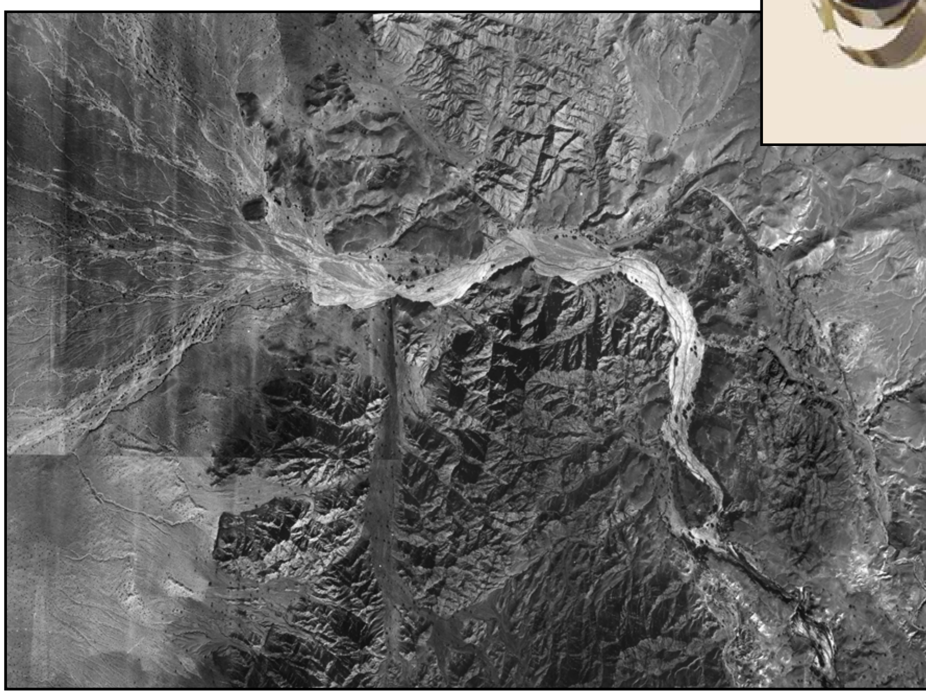
oblique photographs: better for pictorial effect and perspective

vertical photographs: better for making plans and maps and for photogrammetry

Vertical photographs

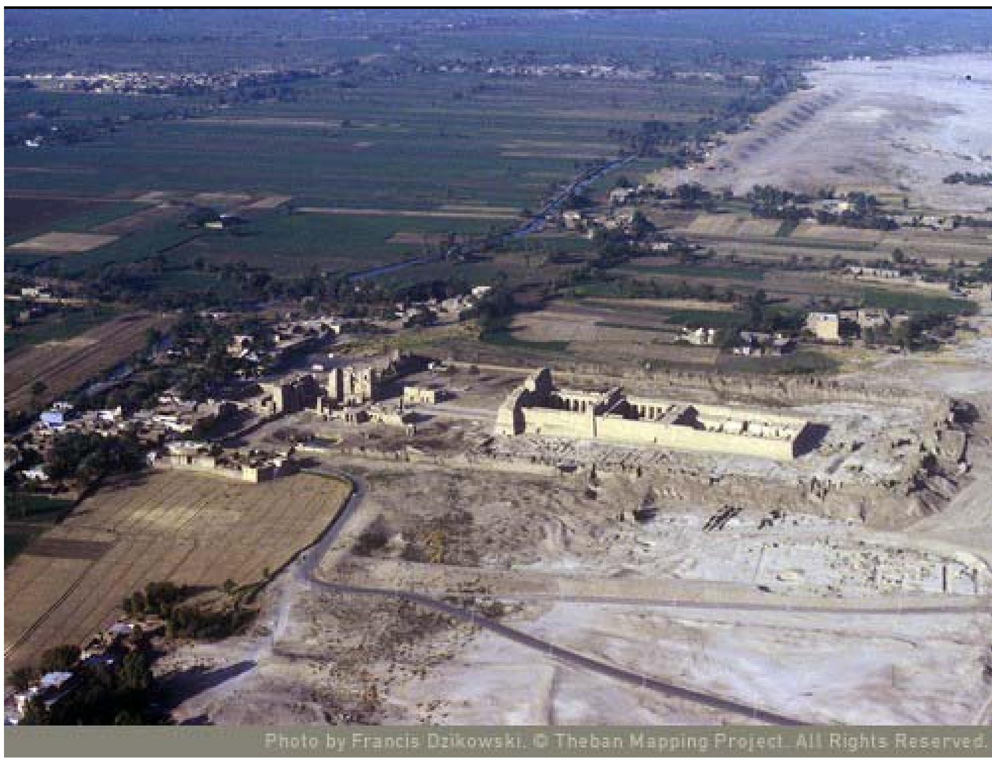






vertical photographs: better for making plans and maps and for photogrammetry



oblique photographs:
better for pictorial effect and perspective

(right)
Historic building inventory, UK
(left)
Theban mapping project, Egypt

Oblique Aerial Photographs

Crop marks and features

Sun Marks

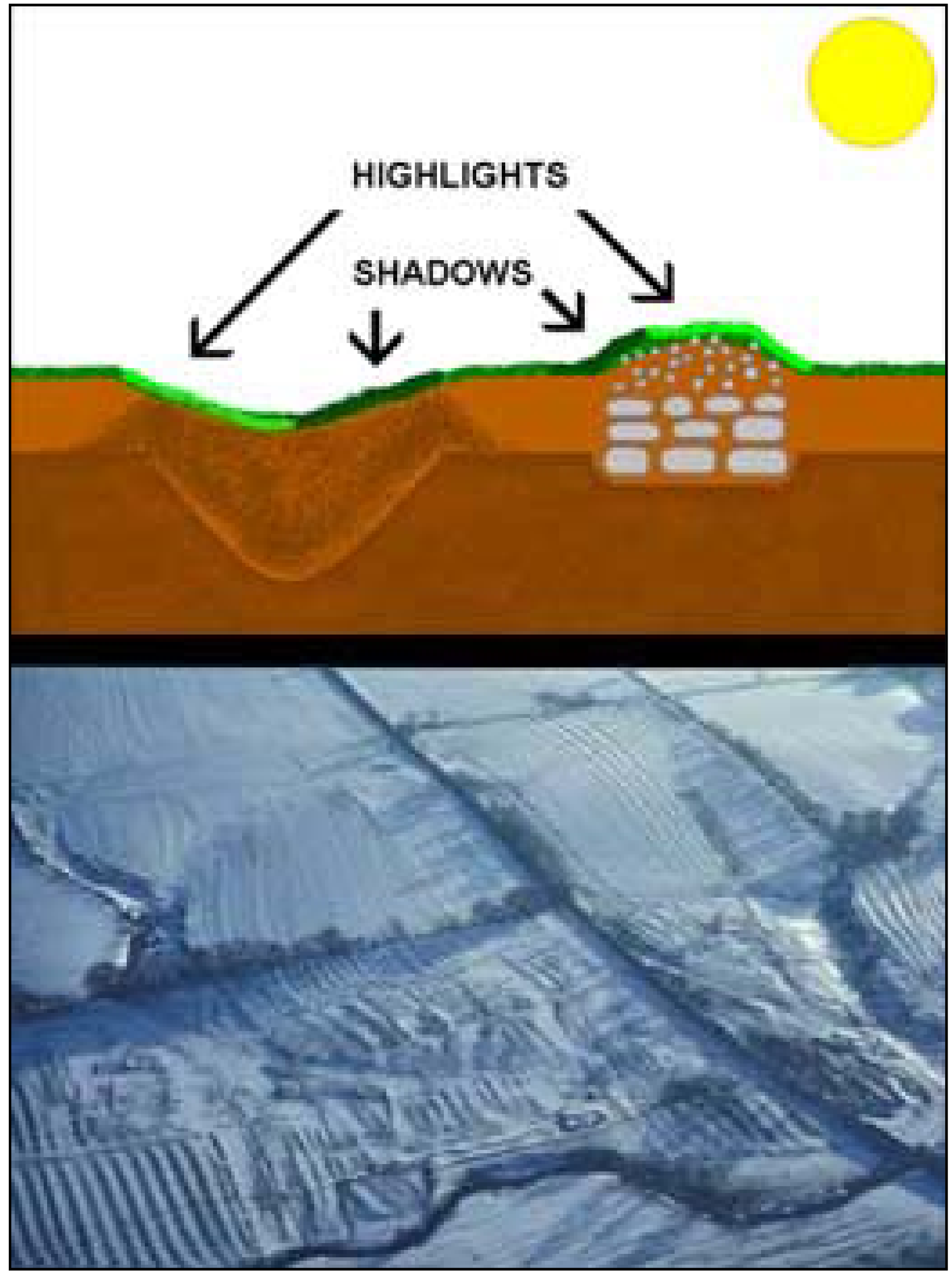
- Earthworks are banks and associated ditches, or stone-walled features
- The sun can make shadows, emphasizing the relief of almost-vanished banks or ditches
- They show in relief:
    - when viewed as a stereoscopic pair, in oblique light
    - differences in vegetation supported by banks and ditches
    - by differential melting or drifting of snow
    - or by retention of water in ditches in times of flood

Maiden Castle
Dorset, England
Iron Age Hillfort

Dunsinnan Hill Fort

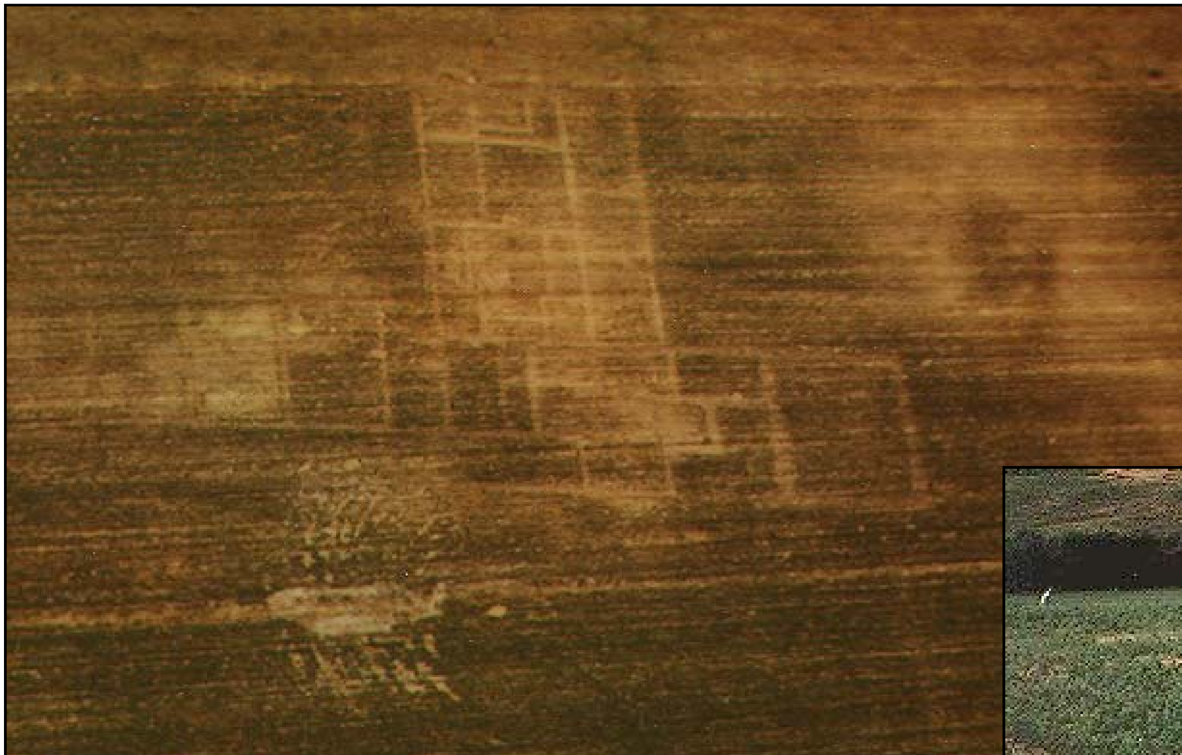
Perthshire, Scotland
(long associated with MacBeth's castle)

Snow also causes shadows



Soil marks

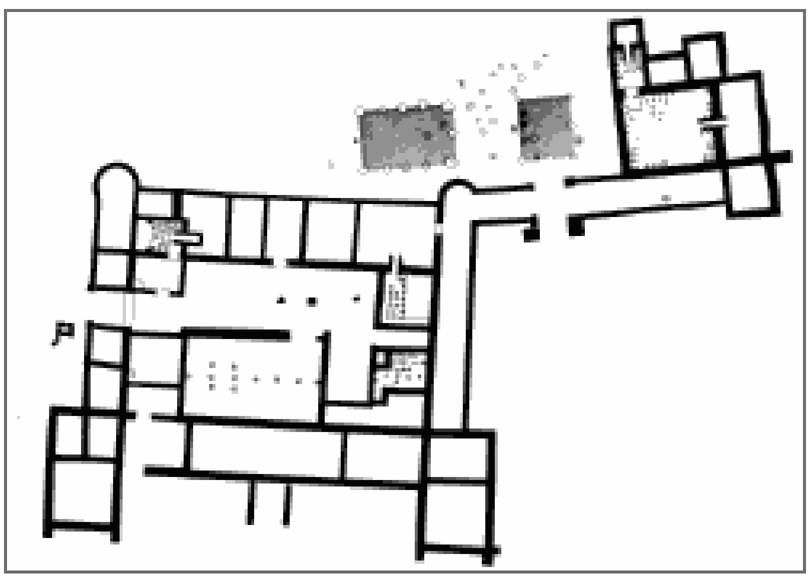
- reveal presence of buried ditches, banks, or foundations by the changes in subsoil colour caused when plowing catches and turns over part of the buried feature, bringing it to the surface
- most soil-marked sites are being destroyed by modern cultivation
- they are mostly visible in photographs taken in winter months

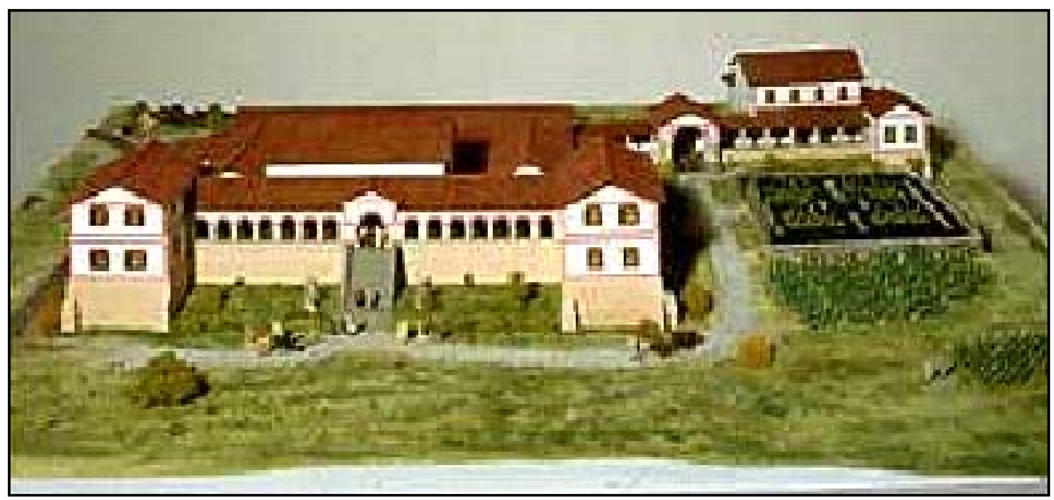


Soil colour marks

Gallo-Roman villa

Arroux Valley, France





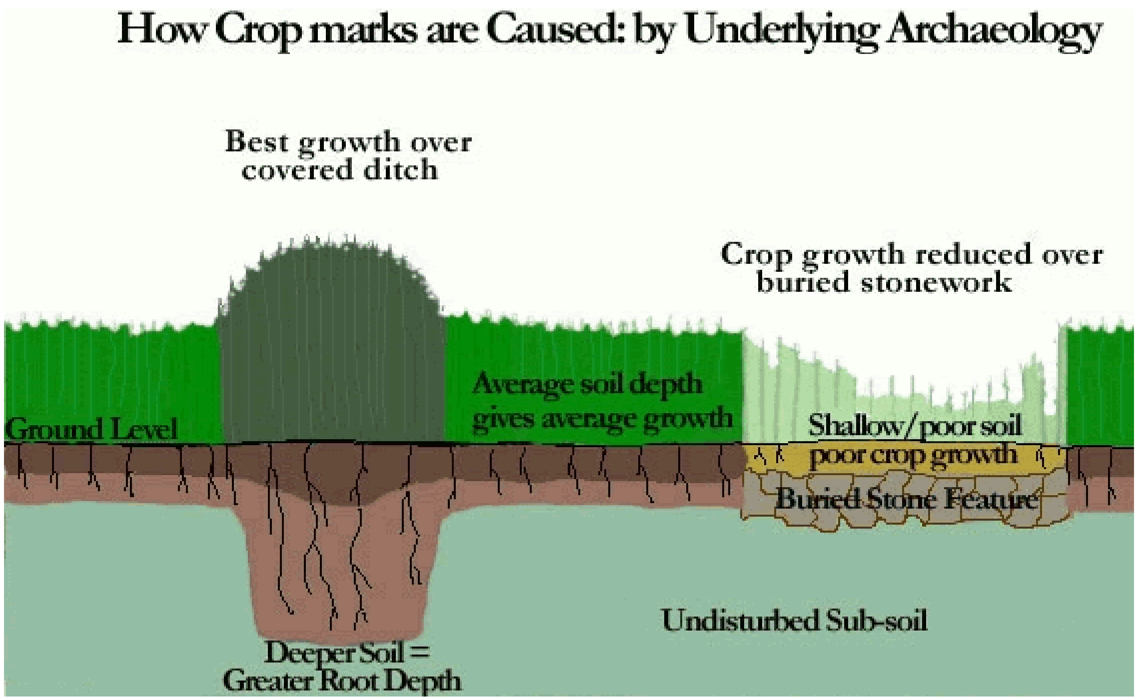
Soil marks

Bronze Age cemetery (above) and Ring-Ditch (right)
Essex, England

Crop-marks

- develop when a buried wall or ditch either decreases (negative crop marks) or enhances (positive crop marks) crop growth by affecting he availability of moisture and nutrients through changing the depth of soil
- suitable crops, such as wheat, barley, and some root vegetables, provide a perfect medium for revealing features in the underlying soil

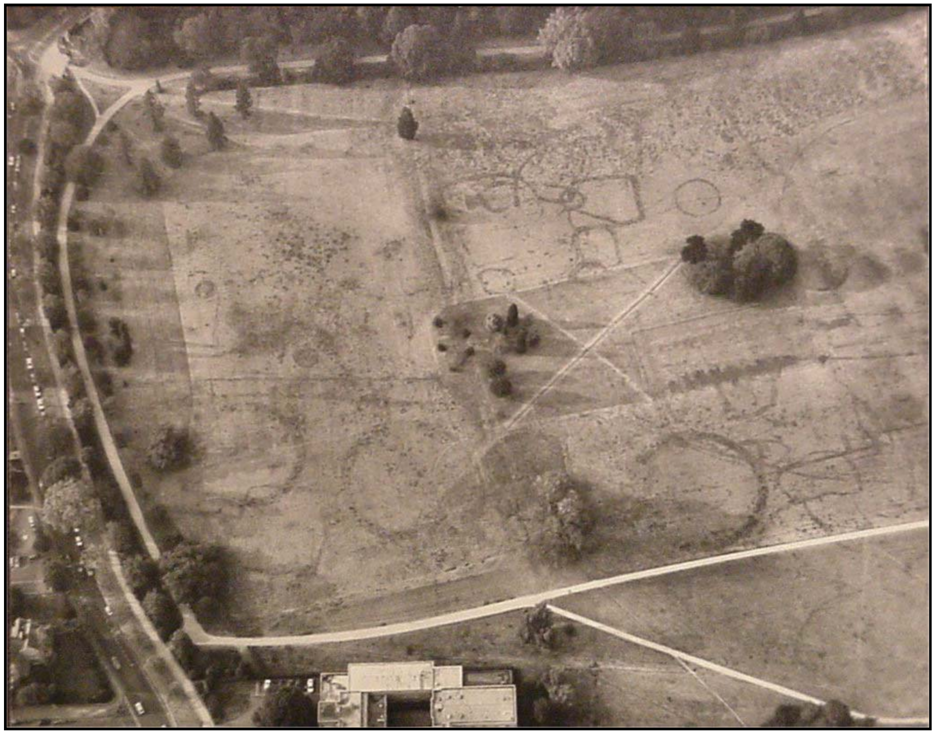
Positive crop marks

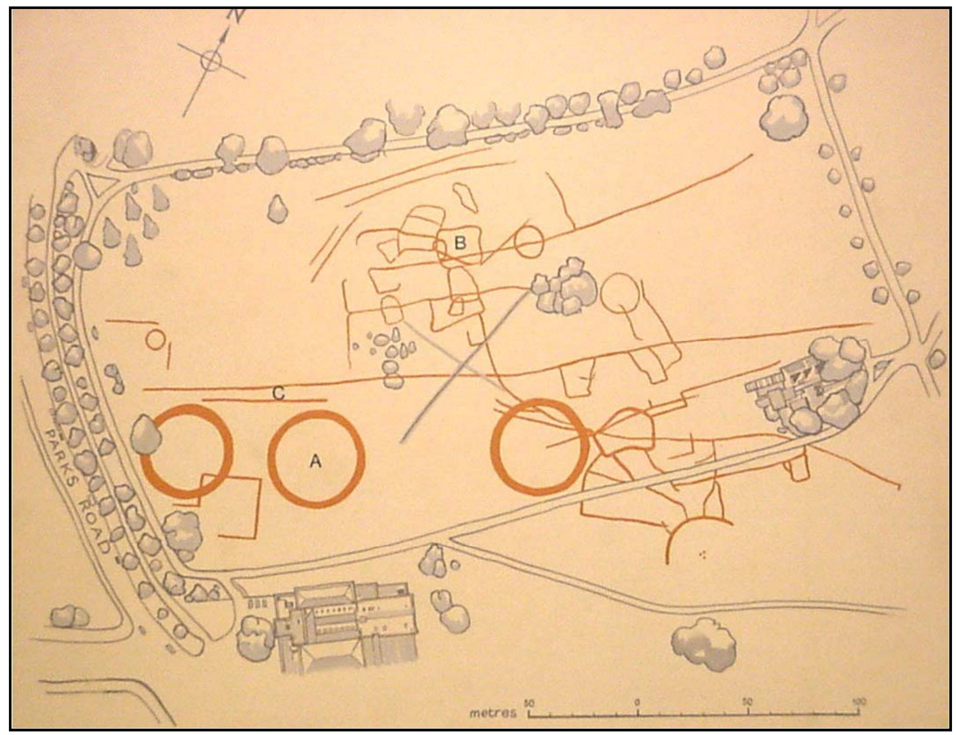


Negative crop marks

Variation in crop marks due to types of crop

Oxford University Parks,
Oxford, England

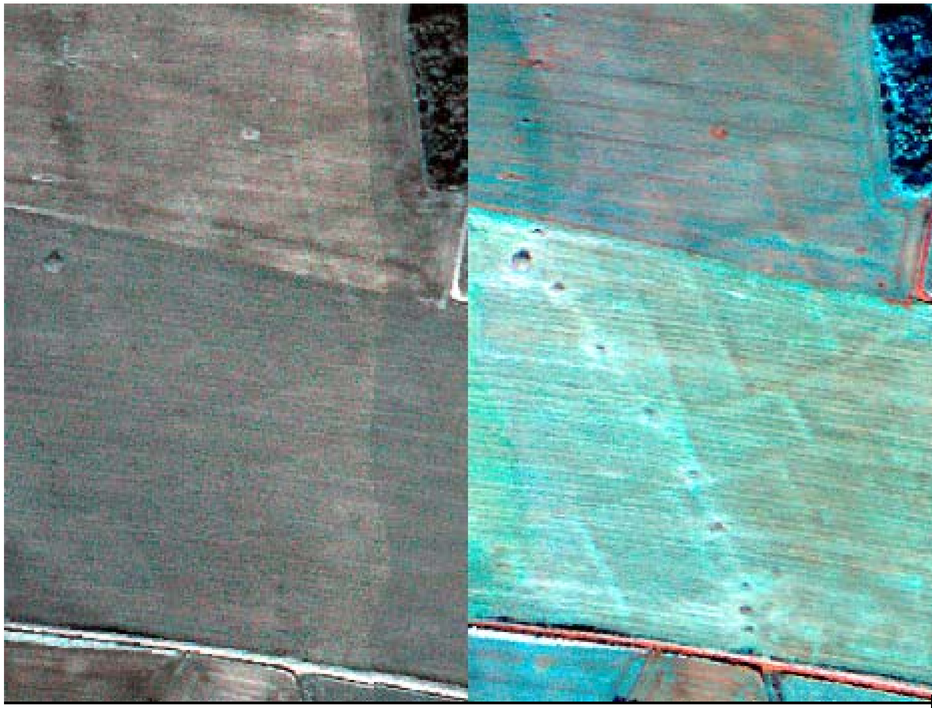




Bloodgate Iron Age Hill Fort,
Norfolk, England

Aerial photo and crop marks

Artists reconstruction

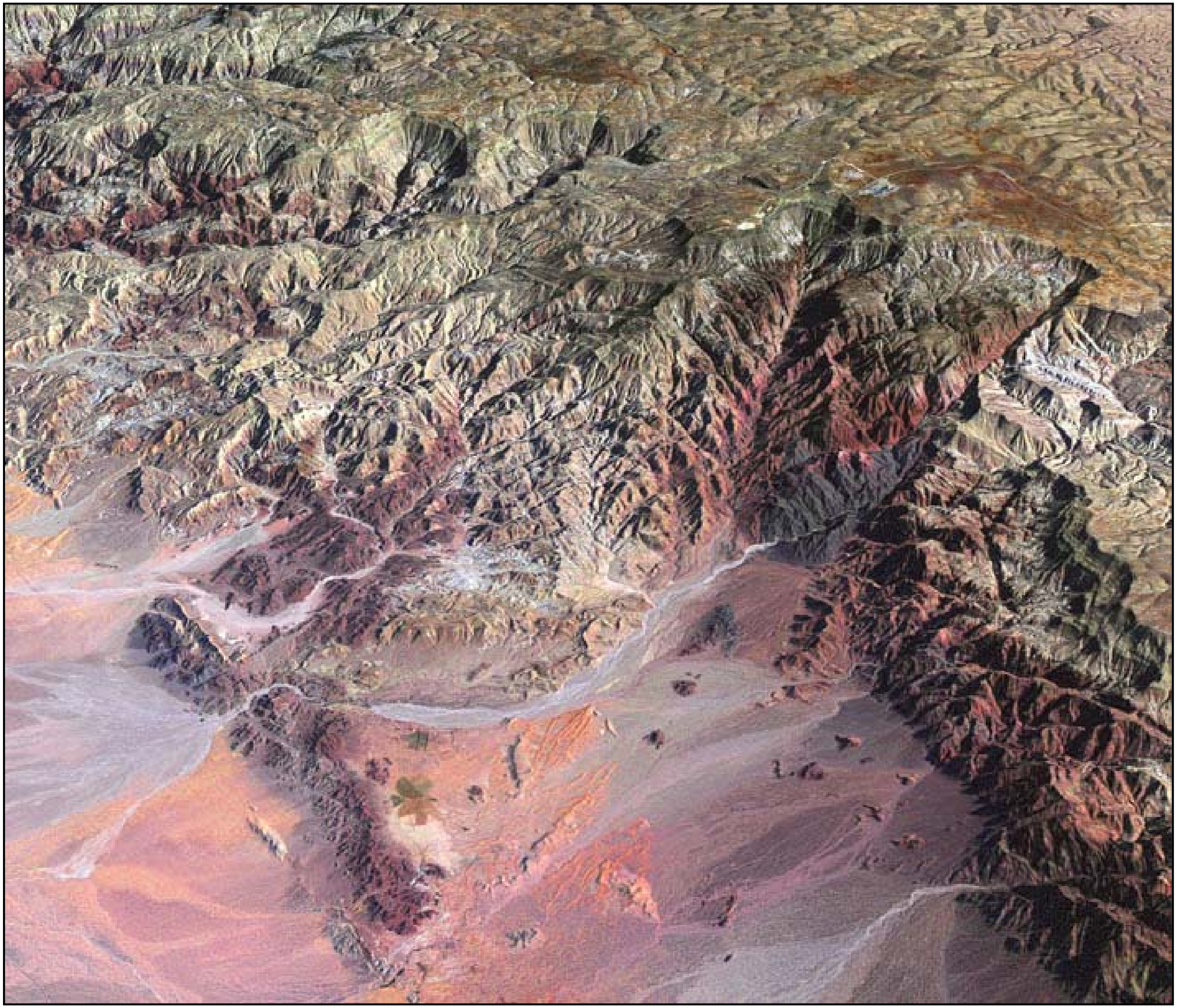


Multi-spectral photography

- provide multi-spectral data, covering at least the near infra red (NIR) and several other wavelengths rather than being confined to the standard visible spectrum.
- By manipulating the different wavelengths it is possible to reveal features not easily discernible on conventional photography.
- This is particularly valuable for environmental monitoring, but also has some potential for archaeological survey.

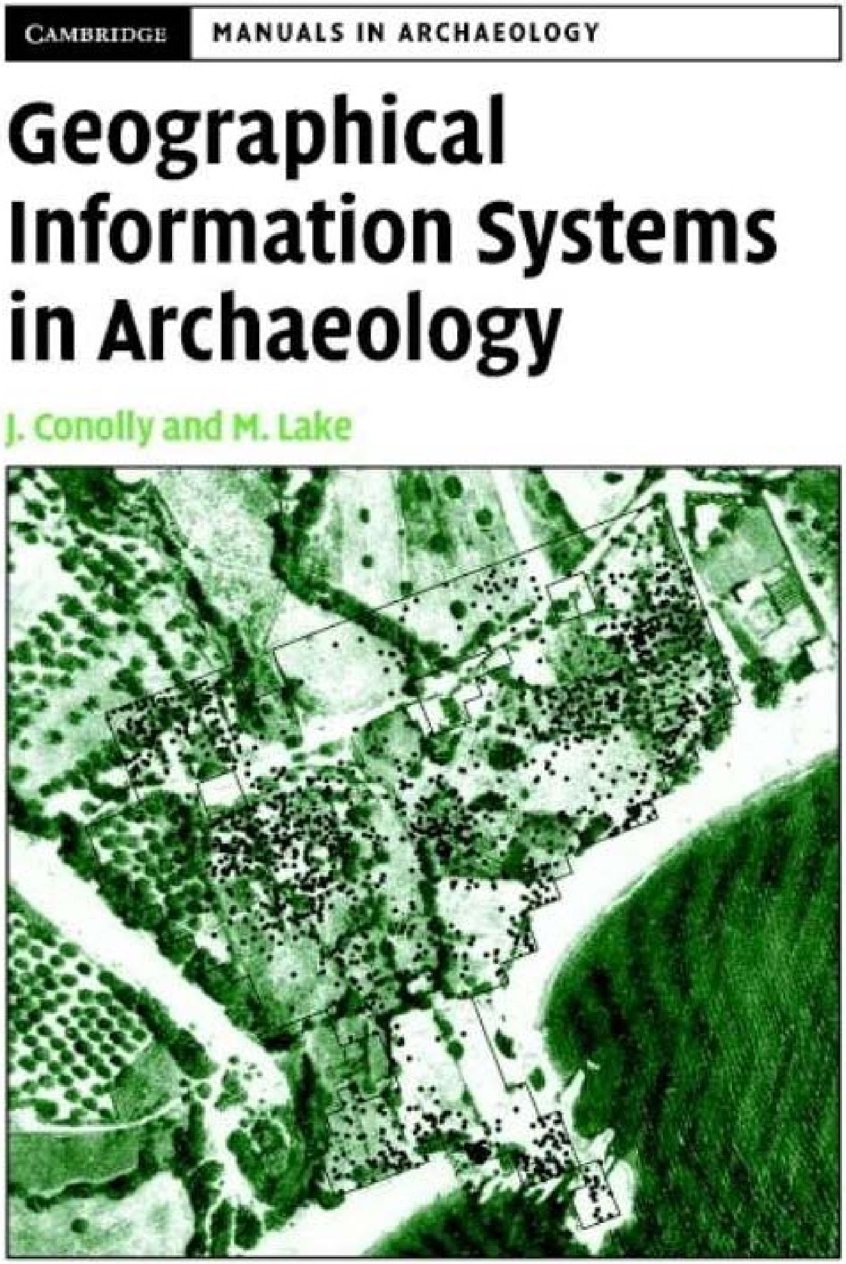
Film

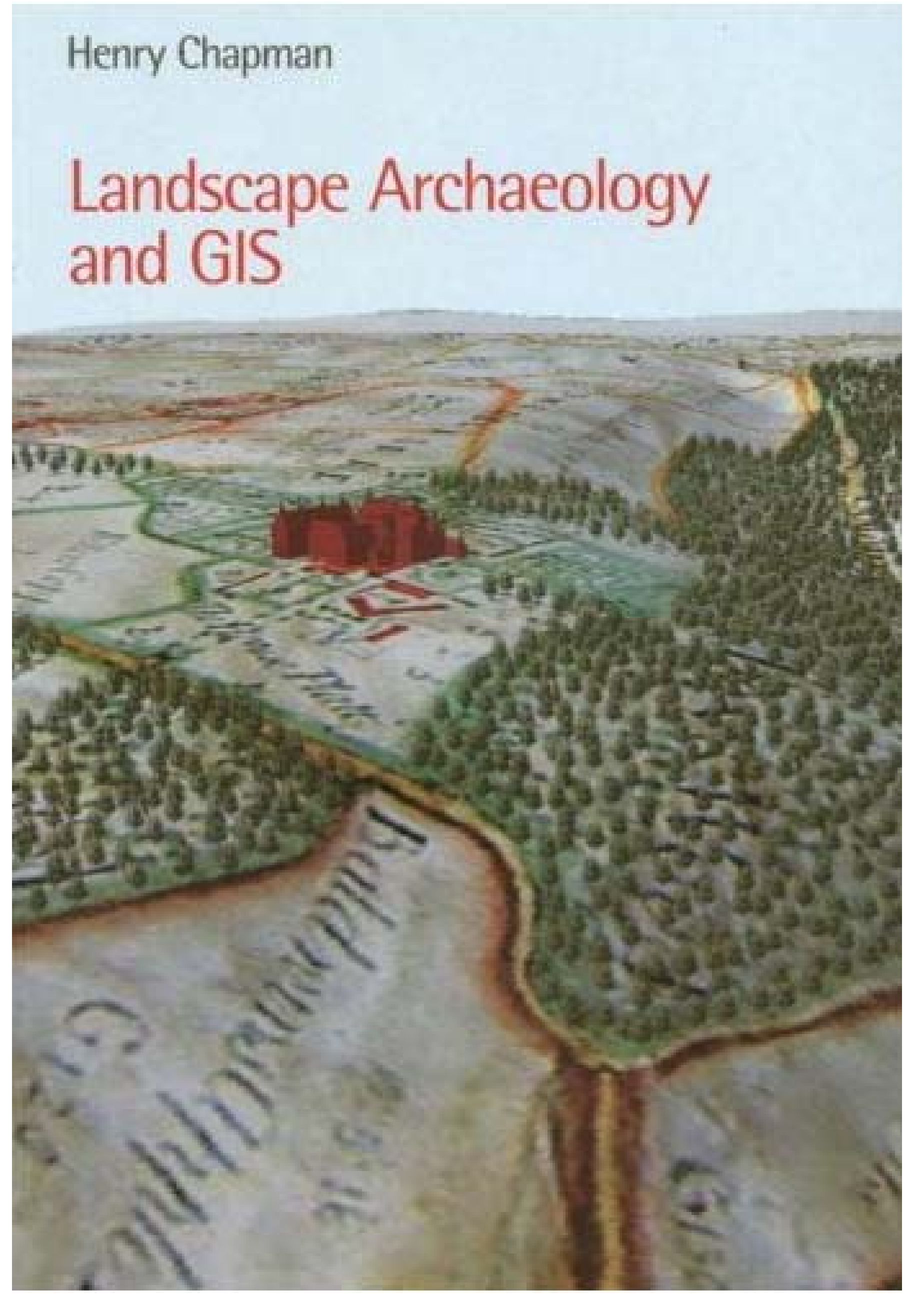
- black-and-white panchromatic film;
- infra-red film: has three layers sensitized to green, red, and infrared
- detects reflected solar radiation at the near end of the electromagnetic spectrum
- some of this radiation is invisible to the naked eye
- the different reflections from cultural and natural features are translated by the film into distinctive ‘false’ colours
- vigorous grass growth on river plains shows up in bright red

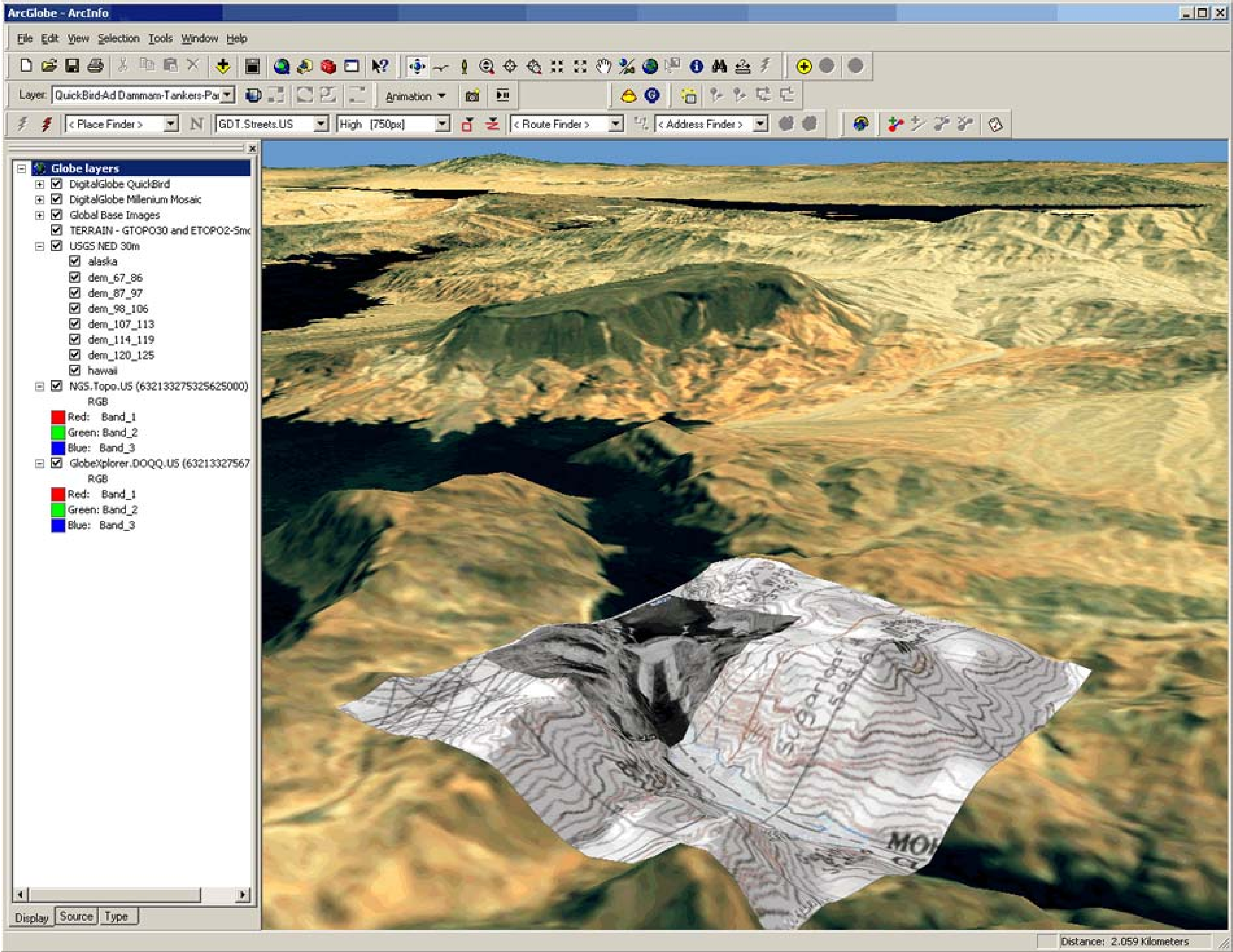


LANDSAT: satellite sensor imagery

- scan the earth with readers that detect the intensity of reflected light and infrared radiation form the earth's surface
- the latest images pick up features only 90 feet wide, while the French SPOT satellites can work to within 60 feet
- can be expensive, but increasingly available for free
- offers an integrated view of a large region and is made of light reflected from many components of the earth: soil, vegetation, topography
- computer enhanced LANDSAT images can be used to construct environmental cover maps of large survey regions that are a superb backdrop for both aerial and ground reconnaissance for archaeology, at 1:1,000,000;


CAMBRIDGE
MANUALS IN ARCHAEOLOGY
Geographical Information Systems in Archaeology
J. Conolly and M. Lake


Henry Chapman
Landscape Archaeology and GIS

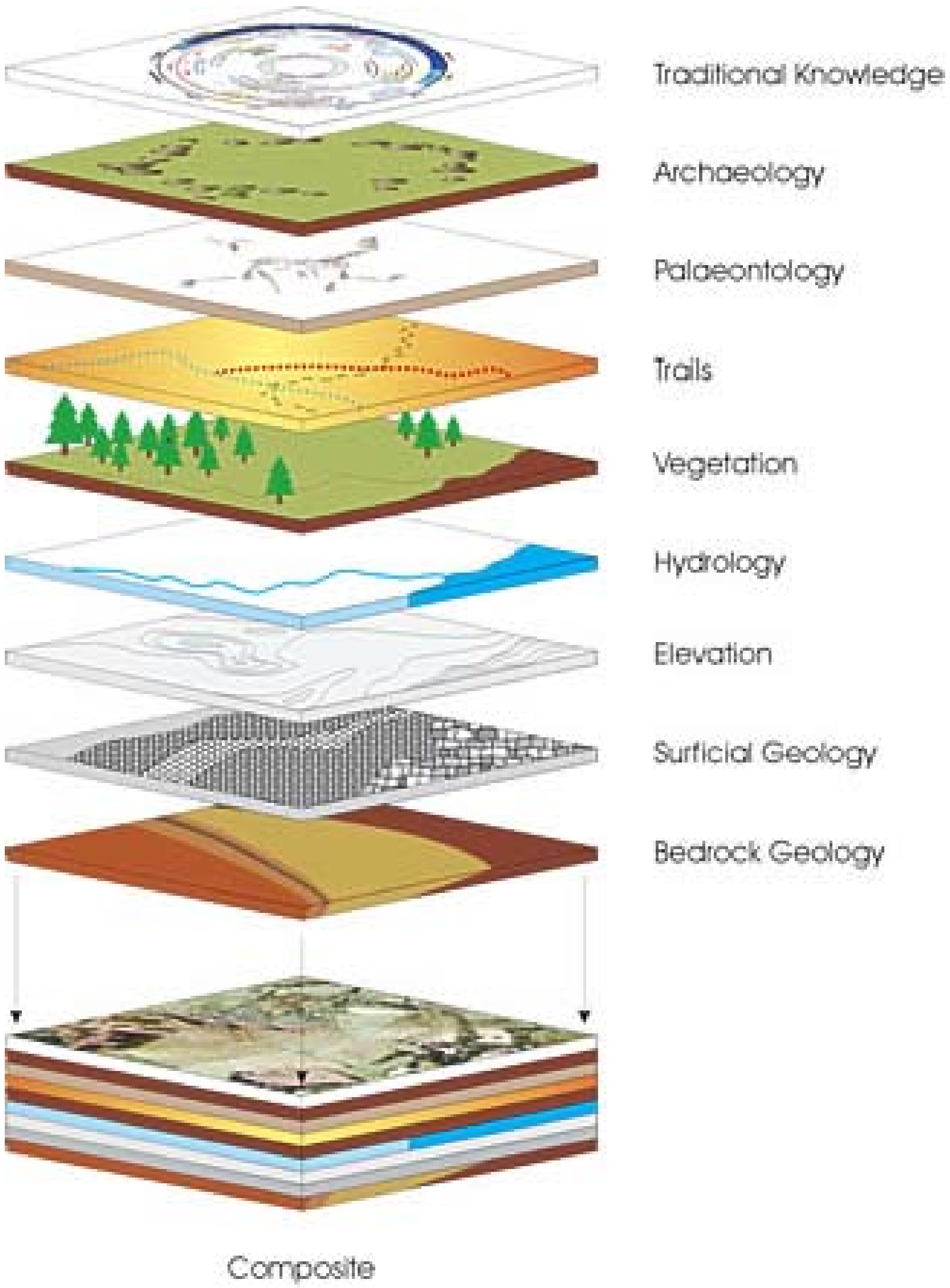

ArcGlobe - ArcInfo
File Edit View Selection Tools Window Help
Layer: QuickBird-Ad Dammam-Tankers-Pa
Animation
< Place Finder >
GDT.Streets.US
High [750px]
< Route Finder >
< Address Finder >
Globe layers
DigitalGlobe QuickBird
DigitalGlobe Millenium Mosaic
Global Base Images
TERRAIN - GTOPO30 and ETOPO2-5m
USGS NED 30m
alaska
dem_67_86
dem_87_97
dem_98_106
dem_107_113
dem_114_119
dem_120_125
hawaii
NGS.Topo.US (632133275325625000)
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
GlobeXplorer.DOQQ.US (63213327567
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
Display
Source
Type
Distance: 2.059 Kilometers

Mapping: Geographic Information Systems (GIS)

Description

computer-aided systems for the collection, storage, retrieval, analysis and presentation of spatial data of all kinds

- Developed for geographic sciences, now widely used in a variety of disciplines including archaeology
- Incorporates computer-aided mapping, computerized data bases and statistical packages, and is best thought of as a computer data base with mapping capabilities
- It also has the ability to generate new information based on the data within it
- Software packages allow the acquisition, processing analysis and presentation for data of many kinds

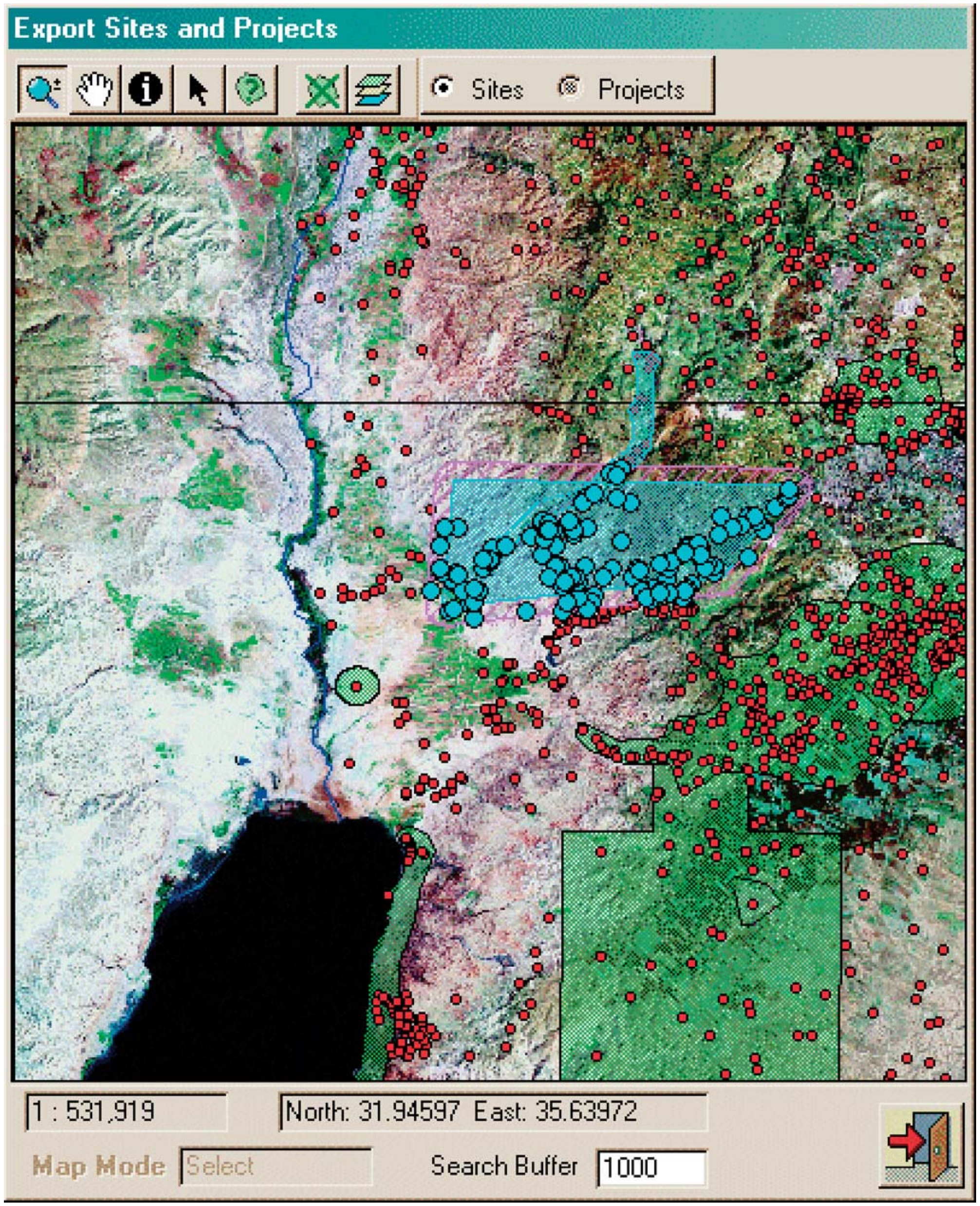


Geographical Information System (GIS)

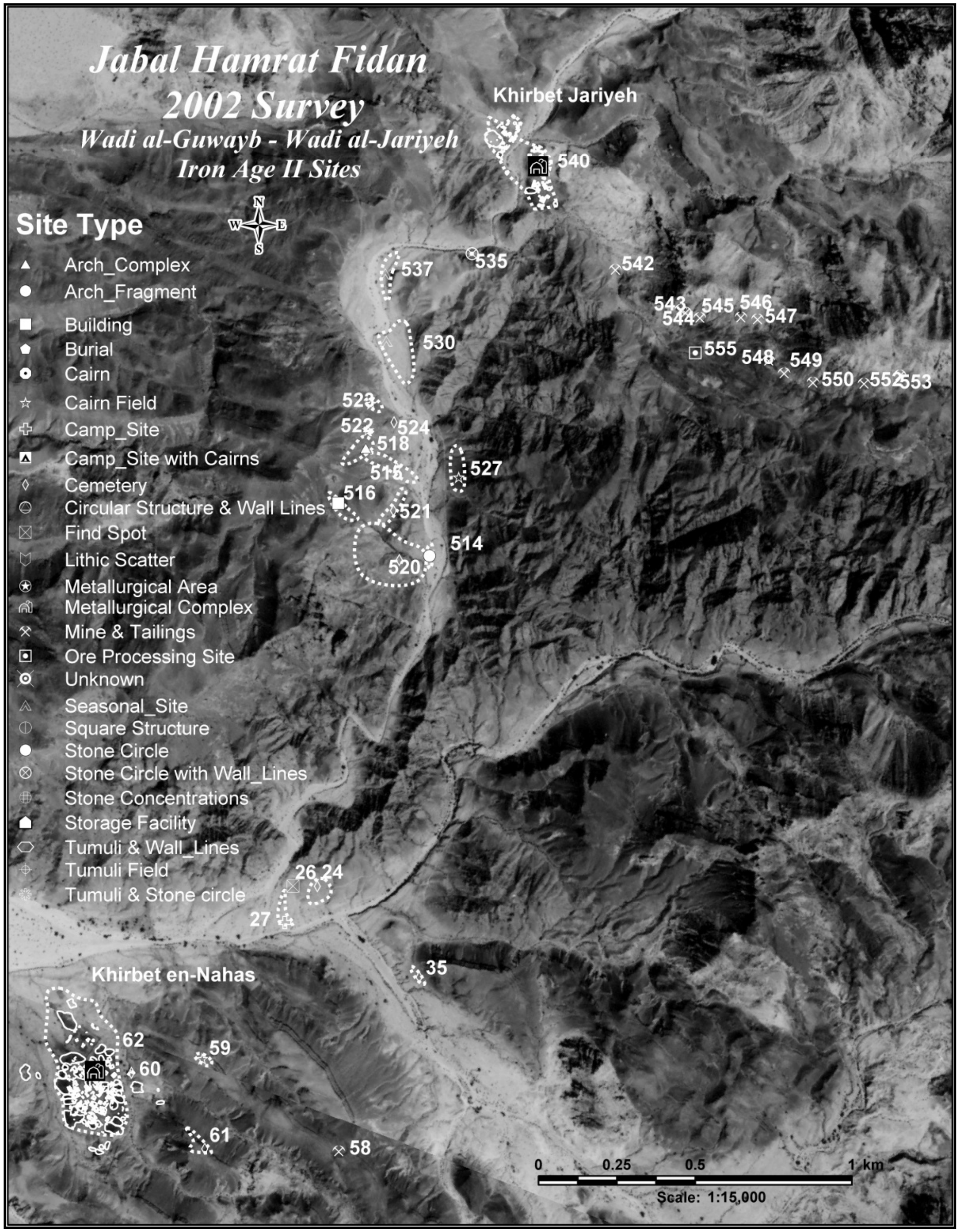
Advantages of using GIS

- Allows the manipulation of large amounts of data, especially useful for solving complex settlement analysis problems
- Satellites acquire environmental and topographic information
- The archaeological data can be added to the same data base
- Data in the GIS is **multi-layered**, allowing the incorporation, display and manipulation of all layers of data, either separately or together
- Analyses that once took years can be done in minutes, even seconds

- Used to inventory, analyze and manage complex data sets
- Particularly useful for visually displaying **patterns in data** which may not otherwise be obvious



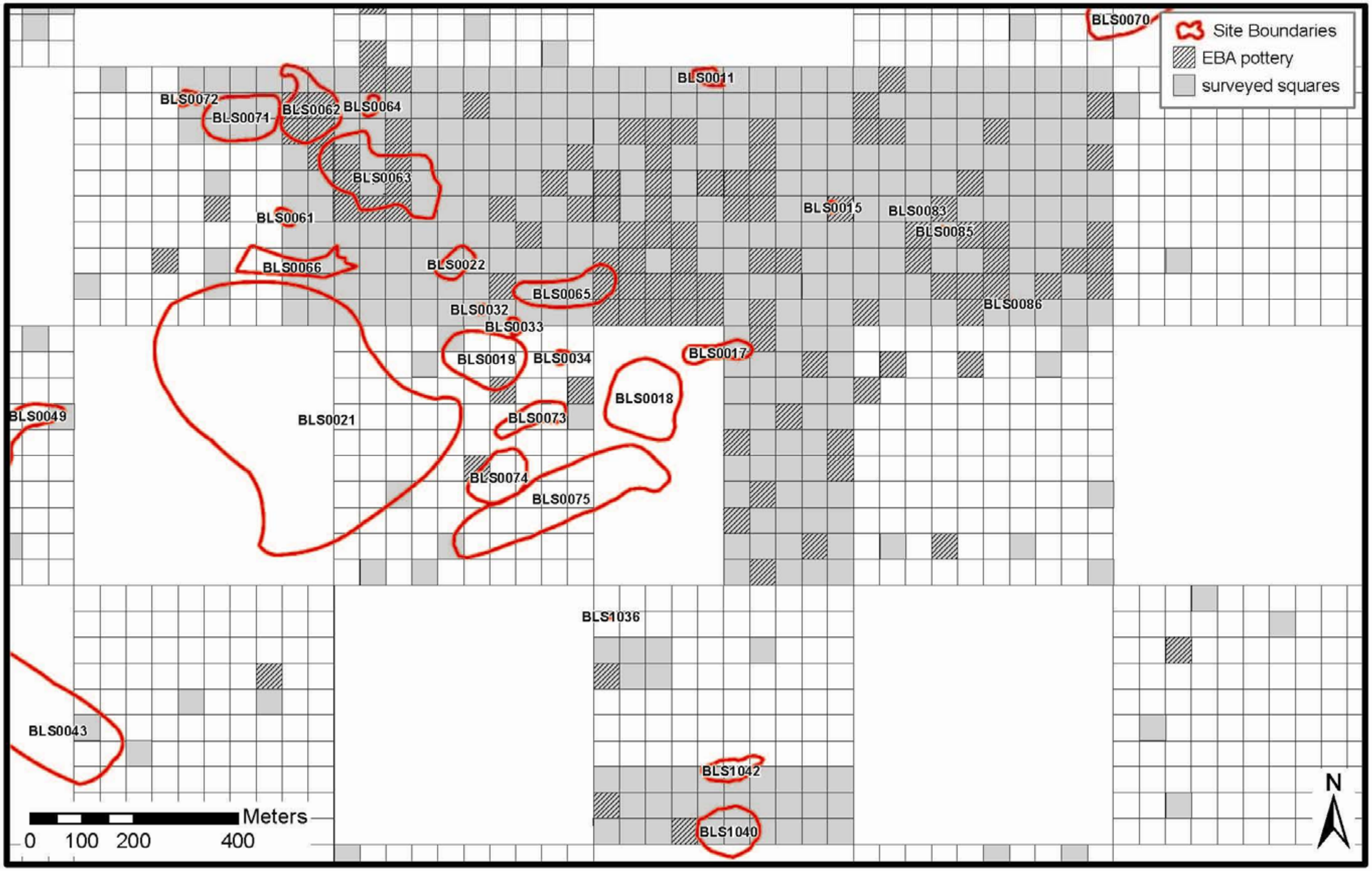
Jordan Archaeological Database Information System (JADIS)


Jabal Hamrat Fidan
2002 Survey
Wadi al-Guwayb - Wadi al-Jariyeh
Iron Age II Sites
Site Type
Arch_Complex
Arch_Fragment
Building
Burial
Cairn
Cairn Field
Camp_Site
Camp_Site with Cairns
Cemetery
Circular Structure & Wall Lines
Find Spot
Lithic Scatter
Metallurgical Area
Metallurgical Complex
Mine & Tailings
Ore Processing Site
Unknown
Seasonal_Site
Square Structure
Stone Circle
Stone Circle with Wall_Lines
Stone Concentrations
Storage Facility
Tumuli & Wall_Lines
Tumuli Field
Tumuli & Stone circle
Khirbet Jariyeh
Khirbet en-Nahas
0
0.25
0.5
1 km
Scale: 1:15,000

Transect walking

Surface Collection

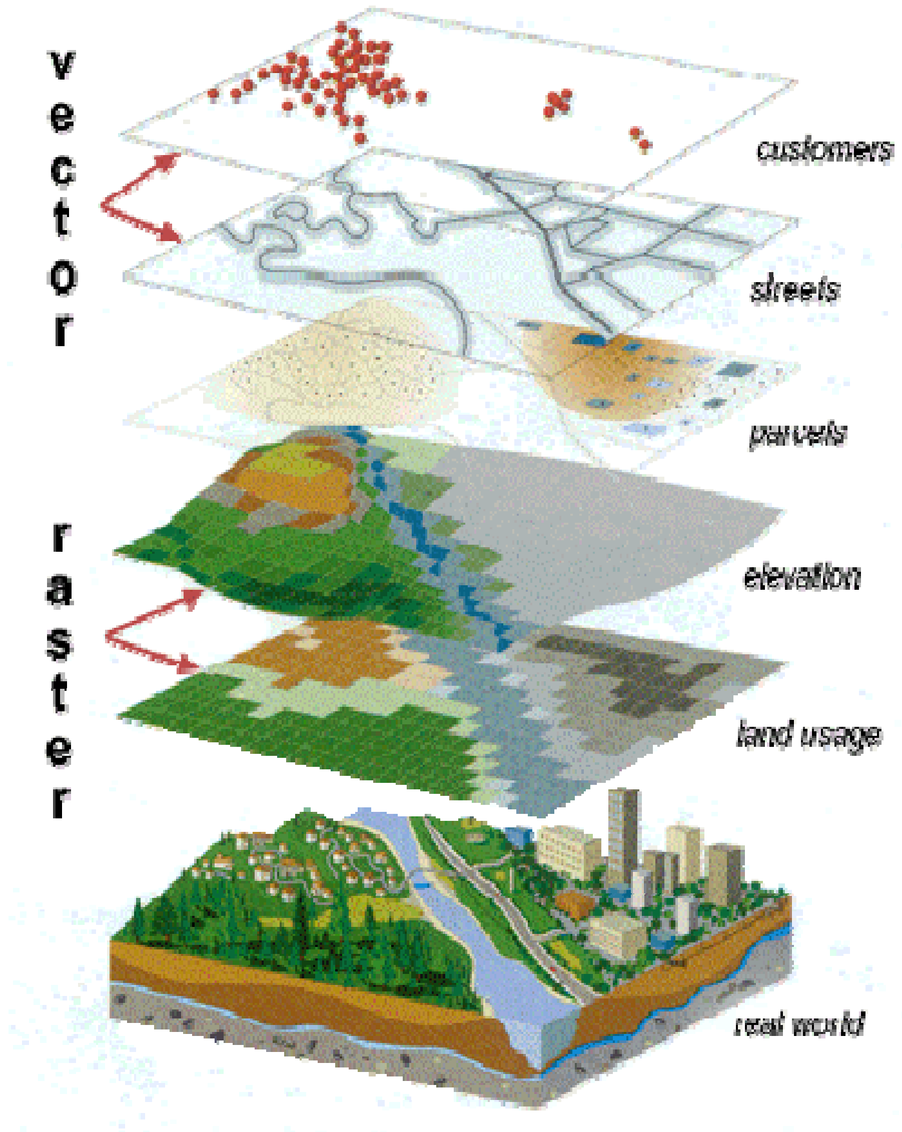
- controlled surface collection is a vital part of site assessment
- representative samples of artifacts from the modern ground surface can provide vital information on the age of the site and the various periods of occupation
- samples can be used to establish chronologies, as well as what activities took place on the site
- the areas of lesser/greater densities, and therefore the most productive if excavated



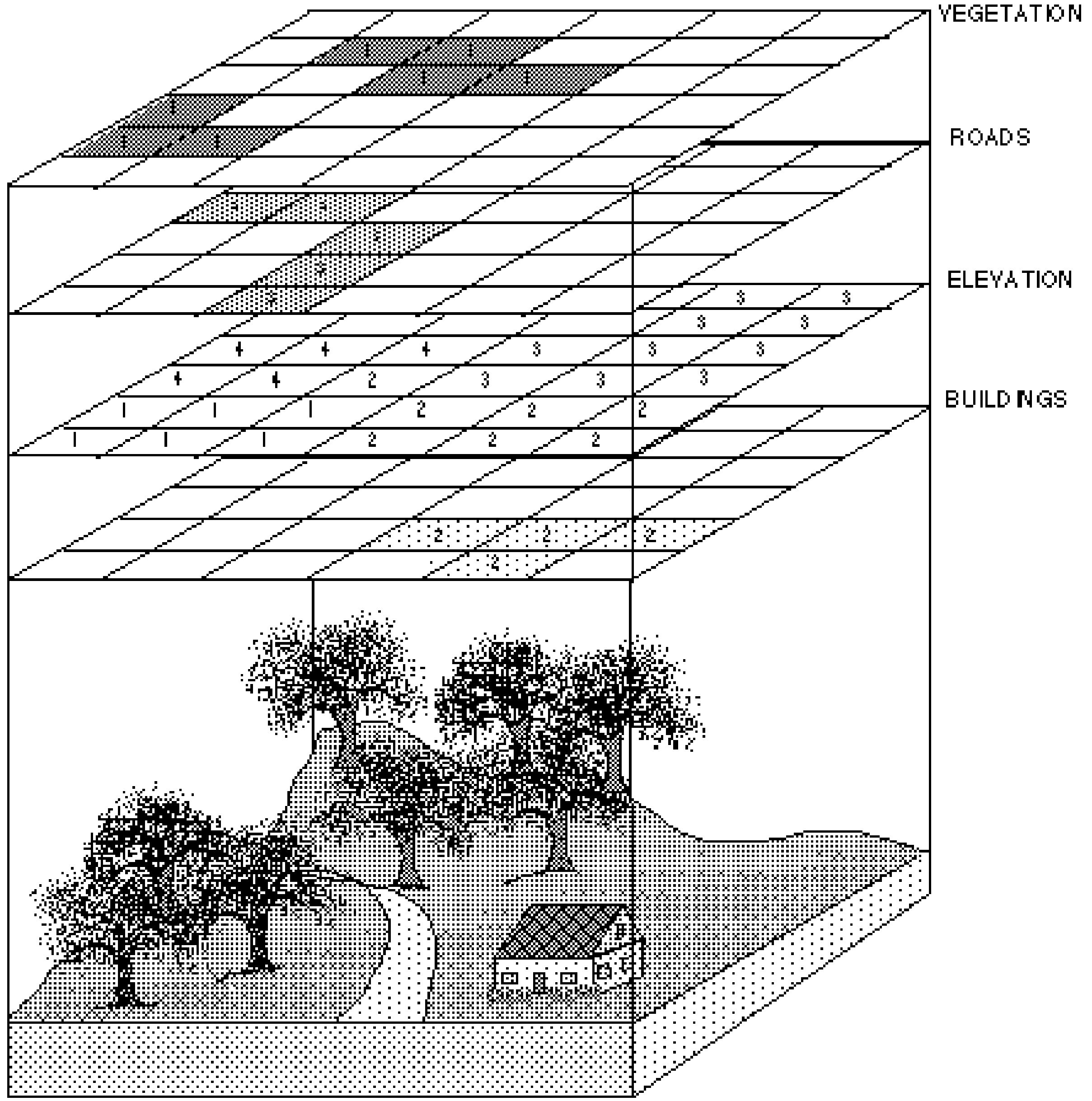
Early Bronze Age pottery distribution in the Barqa Landscape Survey

- each map, or layer, may comprise a combination of points, lines, and polygons, along with their non-spatial attributes
- can accommodate many different types of data: site plans, satellite images, aerial photographs, geophysical survey, as well as maps
- Incorporates collection data which can be added as layers in the GIS to show distribution of artifacts

The data in a GIS can be both *vector* (points, lines and polygons), or *raster* (for example a grid where each cell contains information)



raster datasets are composed of rectangular arrays of regularly spaced square grid cells. Each cell has a value, representing a property or attribute of interest.



There are three main types of *vector* data:

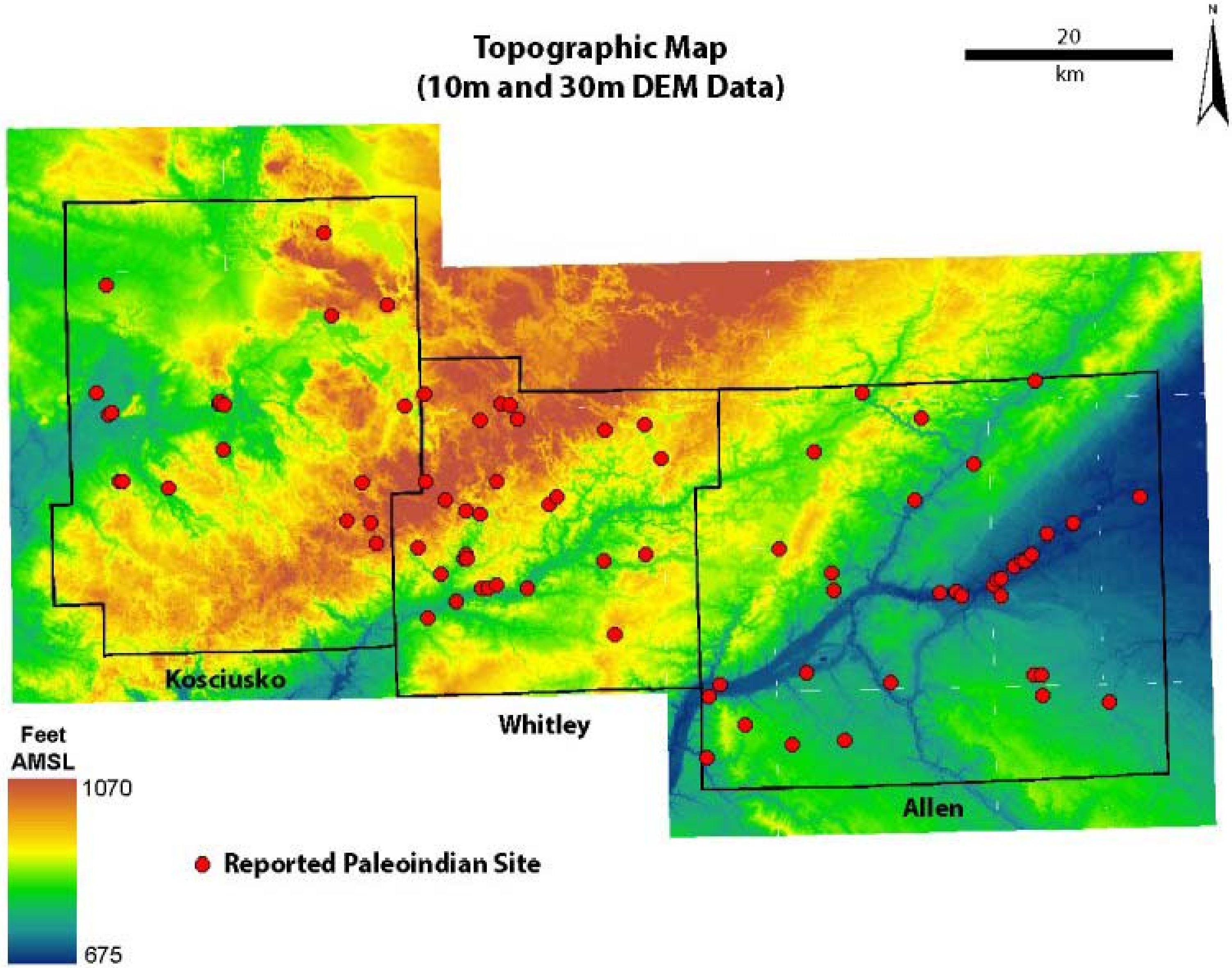
Points:
- have no length or area at the given scale
- have a single X, Y coordinate
- represent a feature that is too small to be displayed as a line or area

Lines:
- have length but too narrow for width to be shown, e.g. a creek, small road
- a set of linked coordinates as nodes and vertices

Areas (polygons):
- have an area that is given by the lines (arcs) that make the boundary.
- are used to represent features that have area (e.g. lakes, large cities, islands)

A GIS layer does NOT combine points, lines and polygons
each type requires a separate layer

Combined *raster* and *vector* data

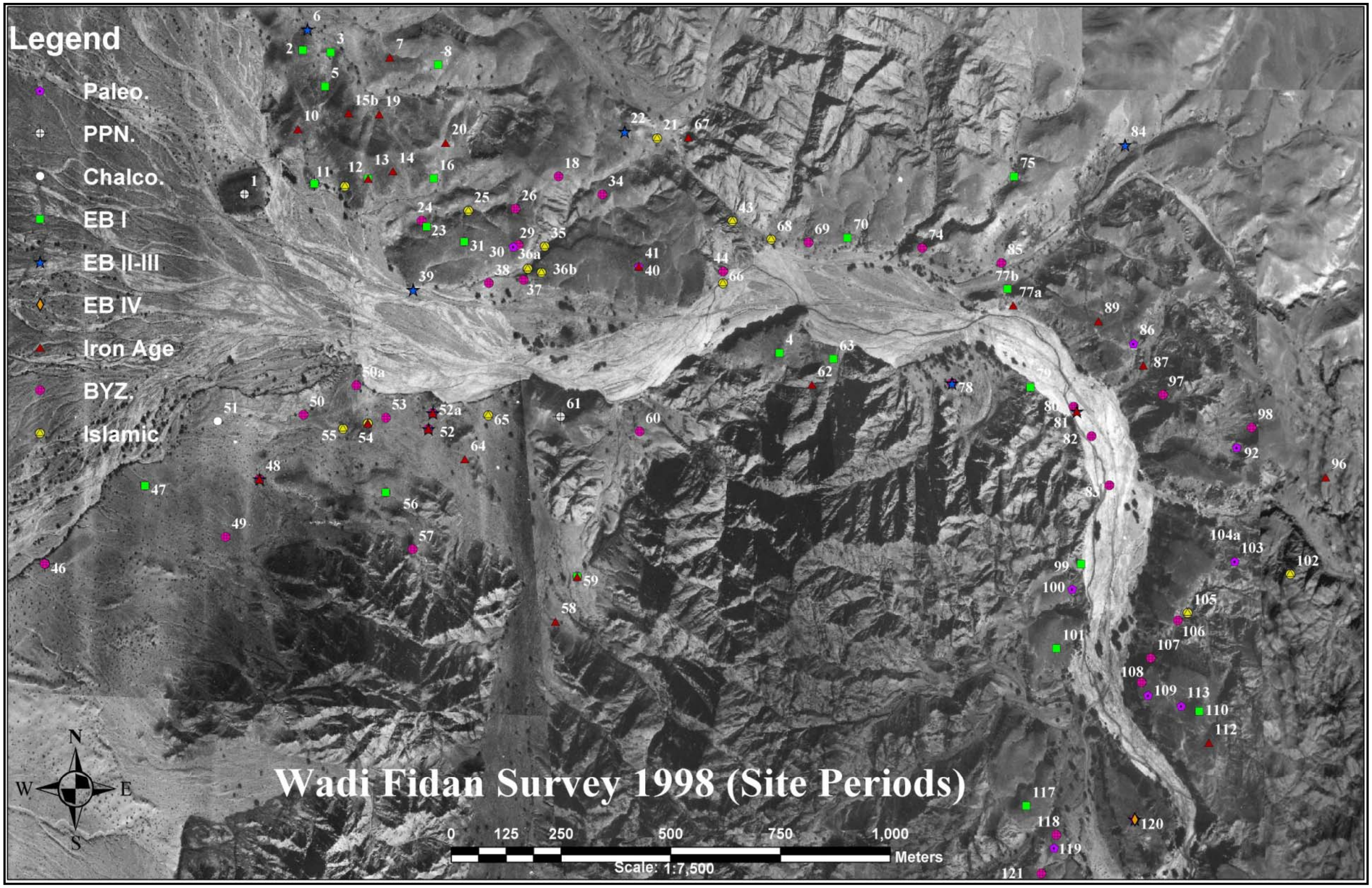


Procedure

- spatial data (point, line, and polygon) can be stored along with an identifying label and a number of non-spatial attributes, such as name, date, or material
- a single archaeological find might therefore be represented by an easting and northing and a find number, while an ancient road would be recorded as a string of coordinate pairs and its name
- a field system could be defined as strings of coordinates following each field boundary, along with reference names or numbers

Survey of the Wadi Fidan, Jordan

Sites, by chronological period located in a GIS, using an aerial photograph



Survey of the Wadi Fidan, Jordan

Site perimeter

Types of queries a GIS can Answer

Location

WHAT exists here

what is at a particular location?

Condition

WHERE are specific conditions-

Example: rainfall patterns

Trends

WHAT HAS CHANGED (over time)

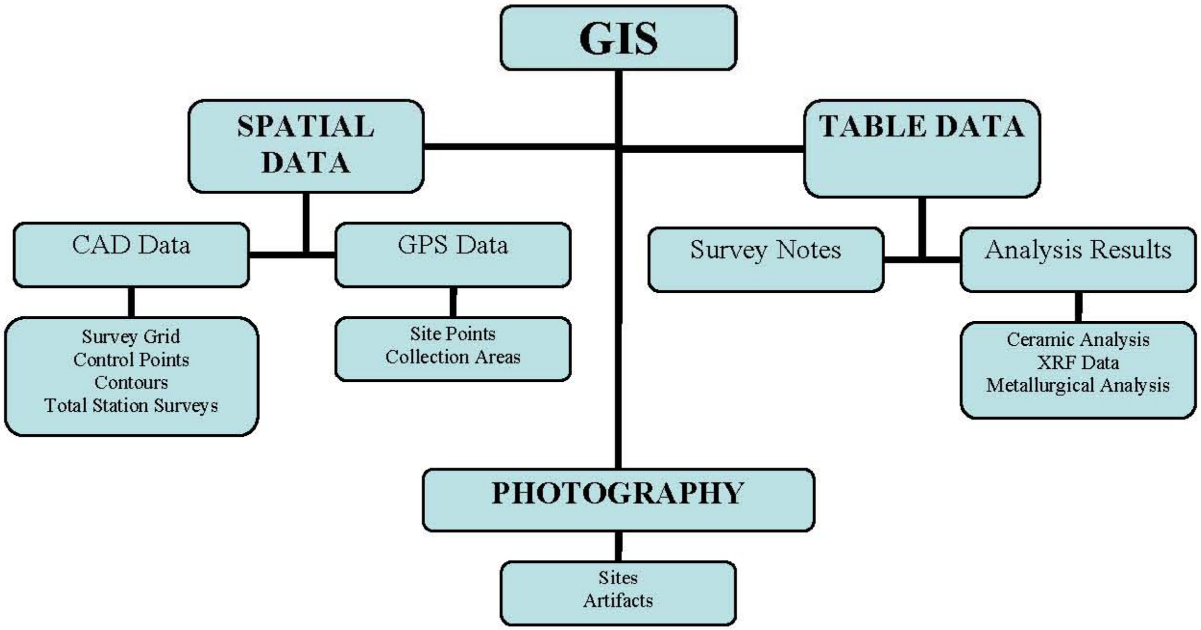
Patterns

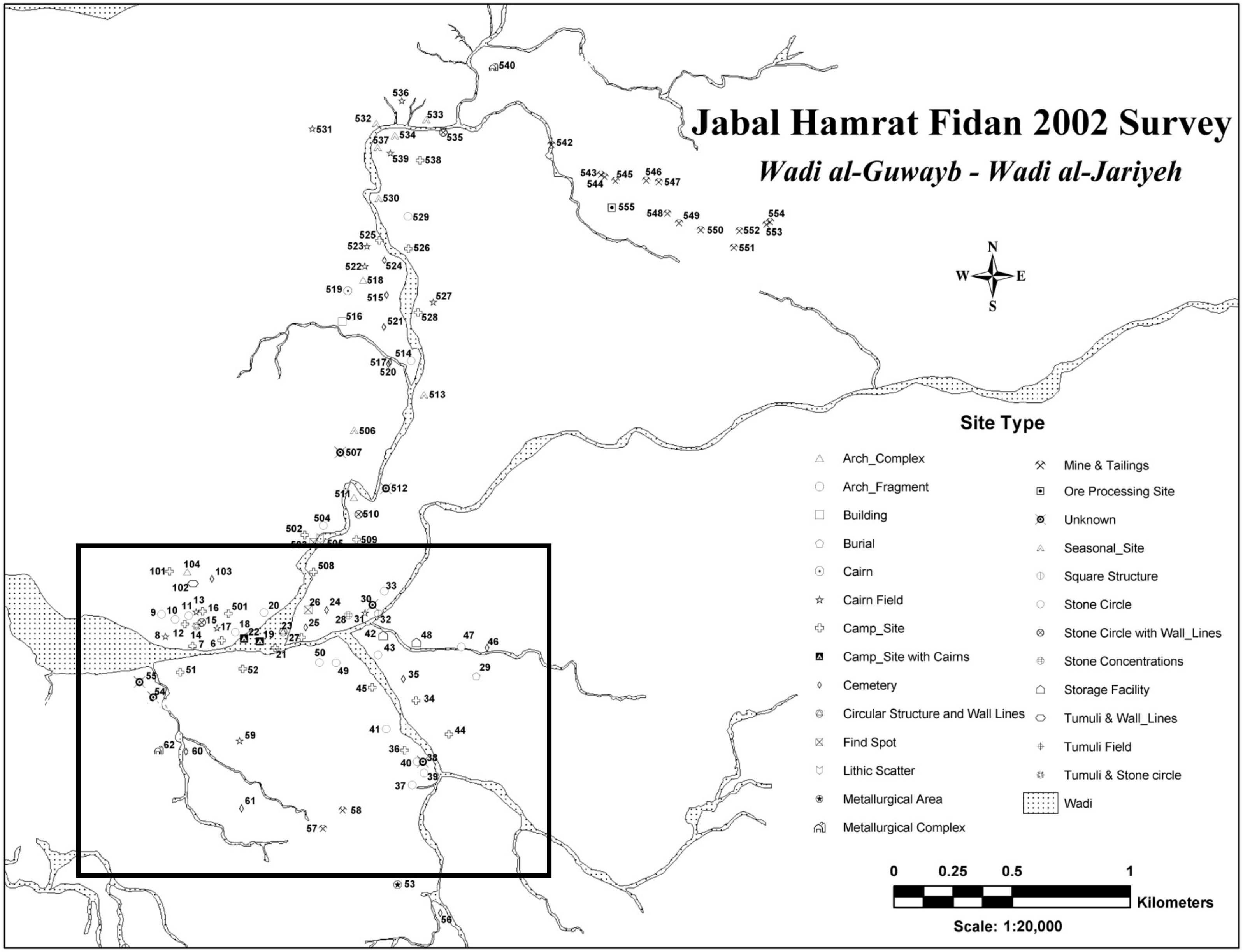
HOW are patterns related

Modelling

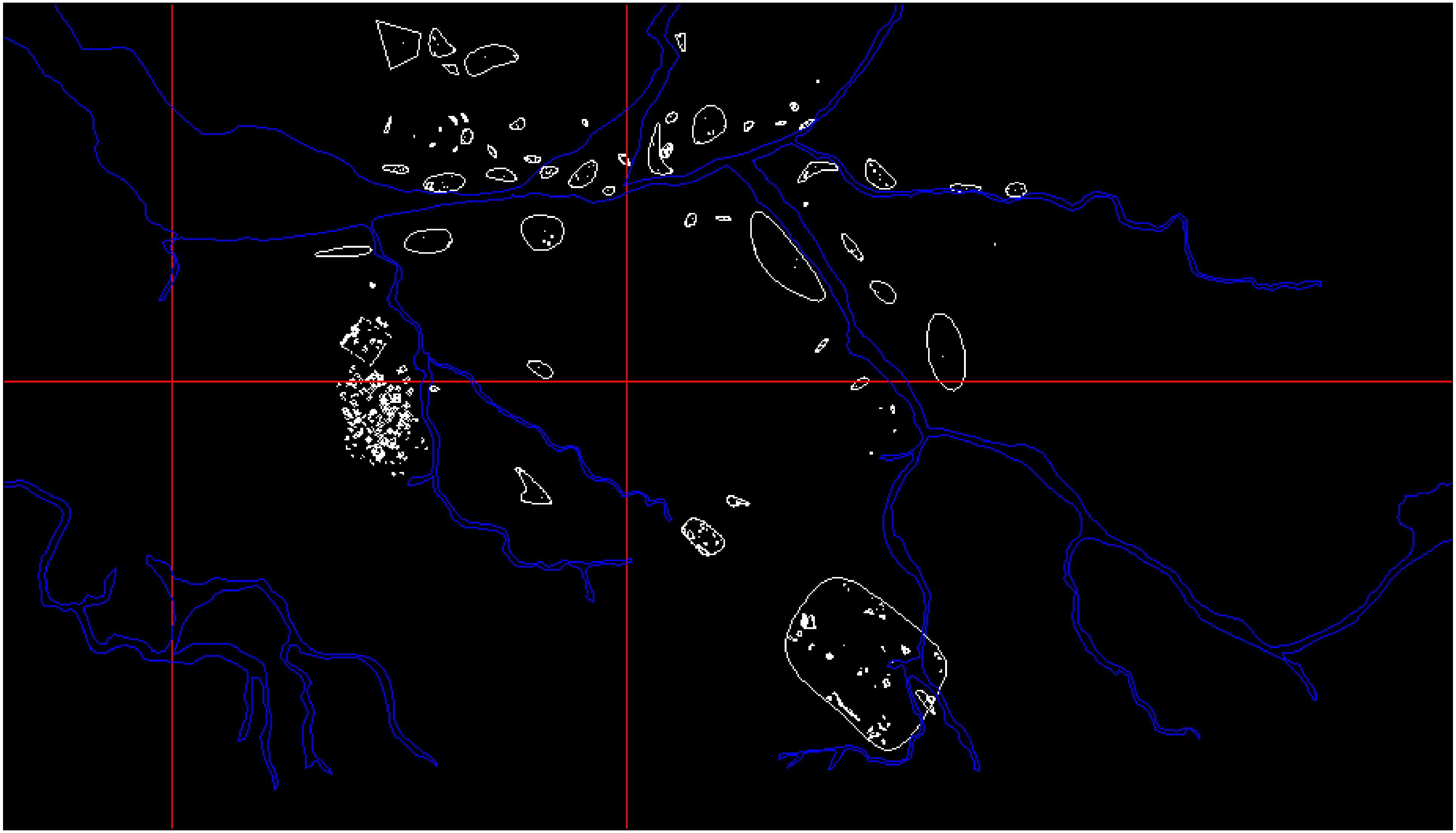
WHAT IF ..?

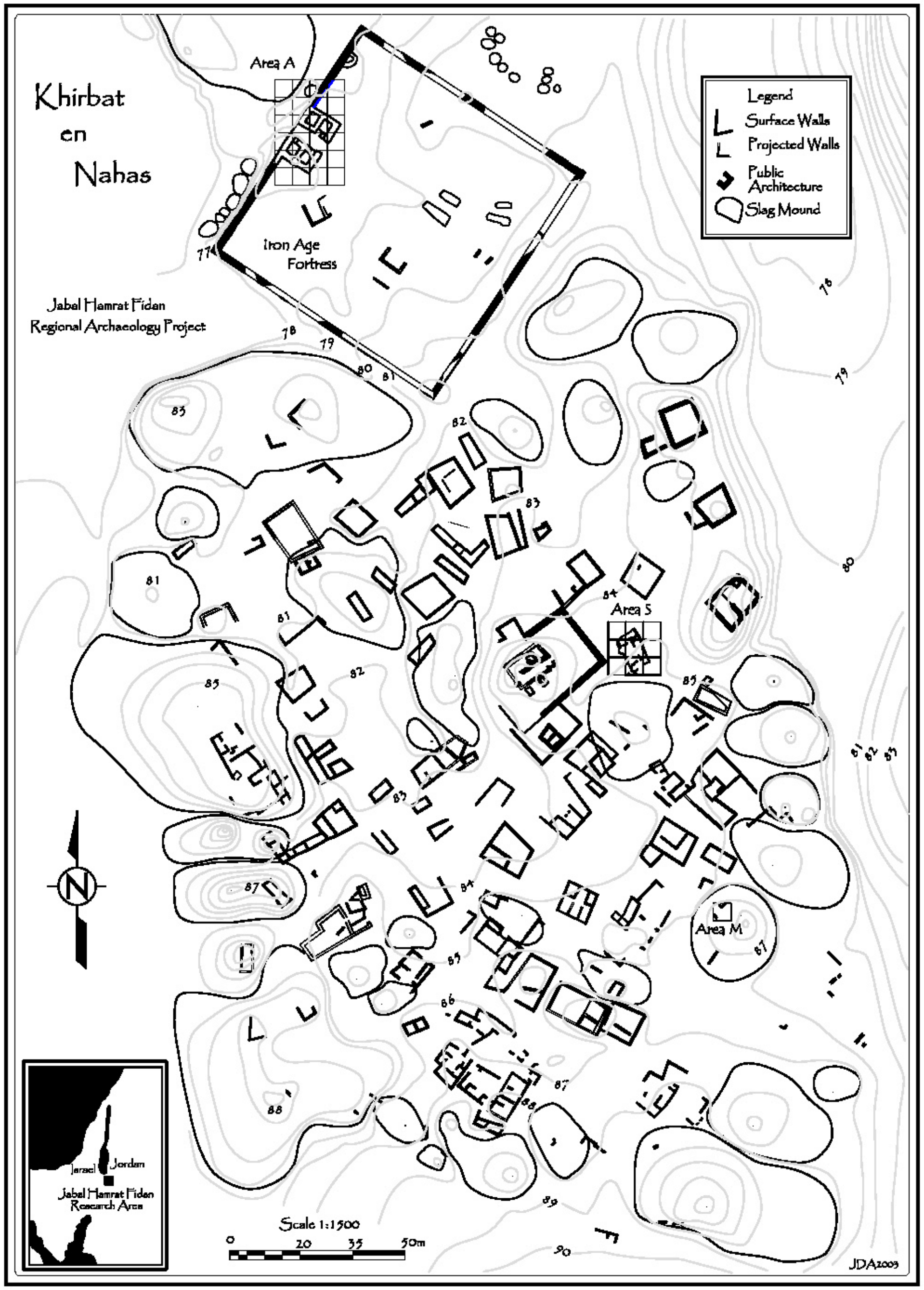
Typical data flow in a GIS

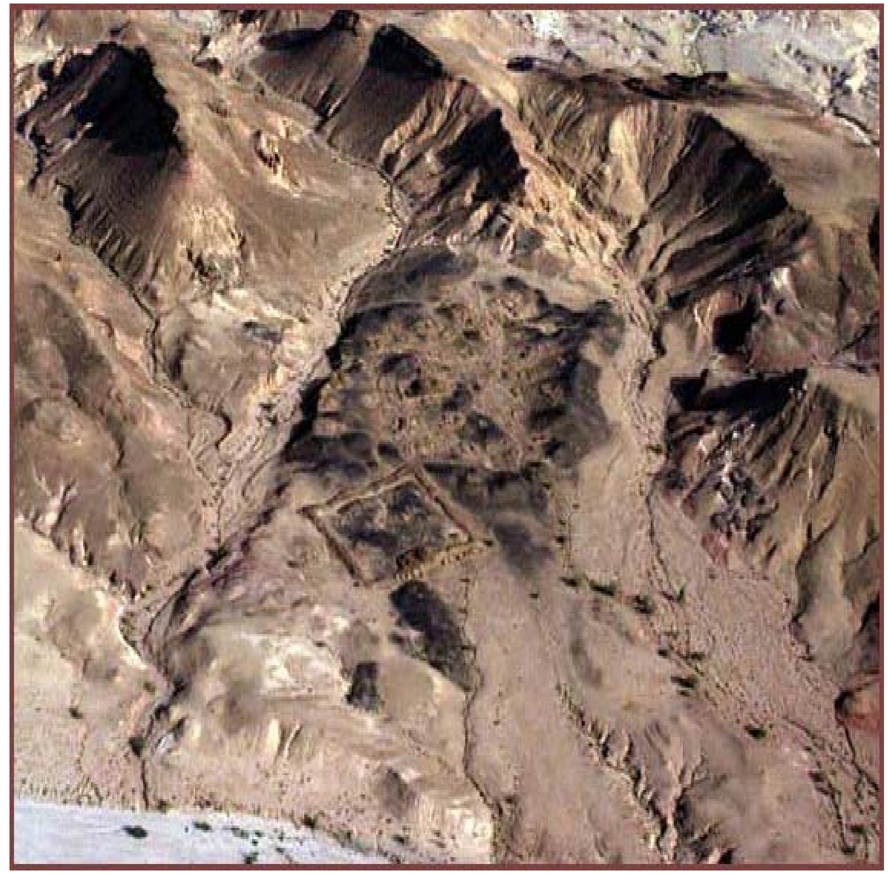




Jabal Hamrat Fidan 2002 Survey
Wadi al-Guwayb - Wadi al-Jariyeh
N
W
E
S
Site Type
Arch_Complex
Arch_Fragment
Building
Burial
Cairn
Cairn Field
Camp_Site
Camp_Site with Cairns
Cemetery
Circular Structure and Wall Lines
Find Spot
Lithic Scatter
Metallurgical Area
Metallurgical Complex
Mine & Tailings
Ore Processing Site
Unknown
Seasonal_Site
Square Structure
Stone Circle
Stone Circle with Wall_Lines
Stone Concentrations
Storage Facility
Tumuli & Wall_Lines
Tumuli Field
Tumuli & Stone circle
Wadi
0 0.25 0.5 1
Kilometers
Scale: 1:20,000




Khirbat en Nahas
Area A
Iron Age Fortress
Jabal Hamrat Fidan Regional Archaeology Project
Legend
Surface Walls
Projected Walls
Public Architecture
Slag Mound
Area S
Area M
Israel
Jordan
Jabal Hamrat Fidan Research Area
Scale 1:1500
0 20 35 50m
JDA2003



Assessing Archaeological Sites

Processes

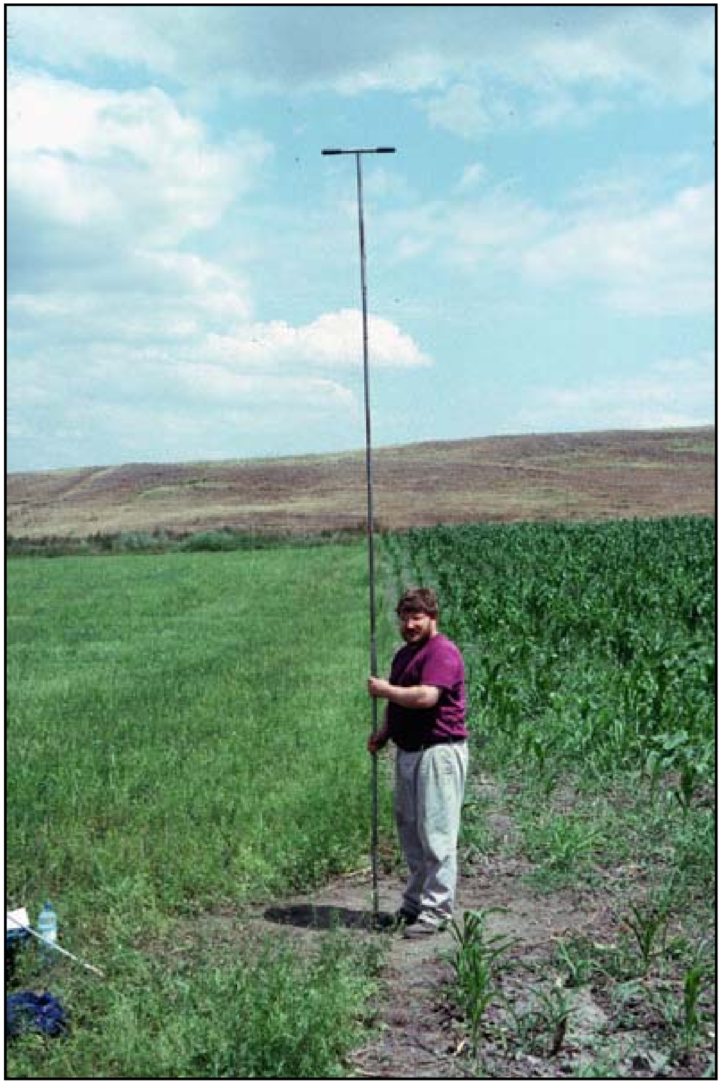
Accurate mapping

- mapping of the site and recording its precise geographic location
- it is not enough just to record a site on a map, even if this is a GIS record with background environmental data
- special forms are used to record location, features and other information on surface features, landowner, etc.
- the site is given a name and number and any potential threats to the resource are noted

Subsurface Detection Methods

Probes

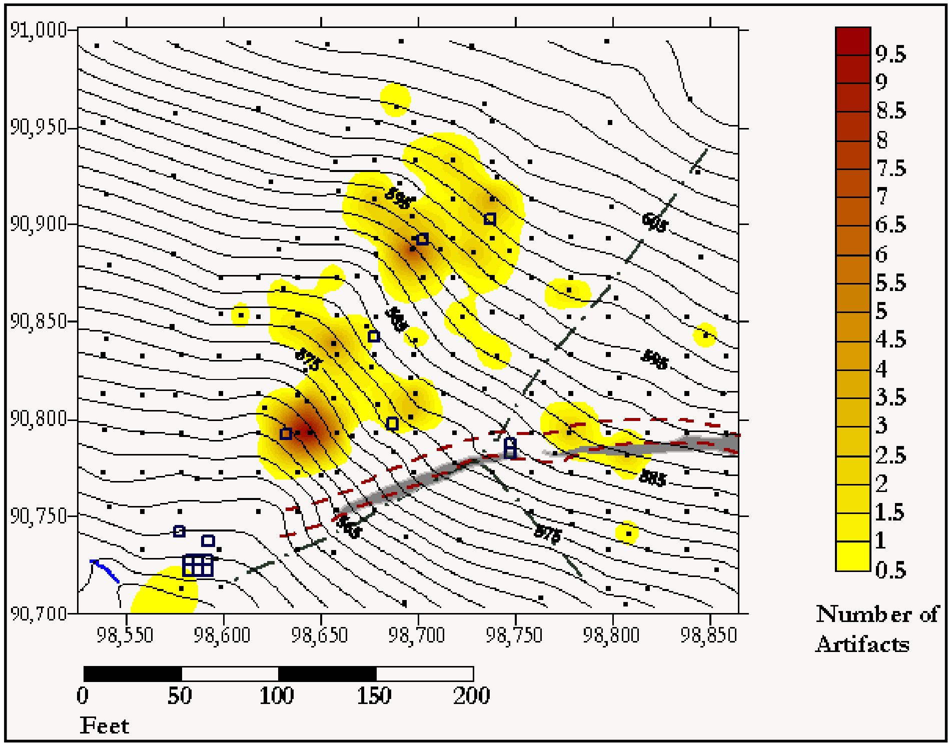
- One of the oldest techniques for probing the soil
- Uses rods or borers
- notes the positions where they strike solids or hollows
- Used more often these days for environmental and archaeological coring to retrieve samples at specified depths



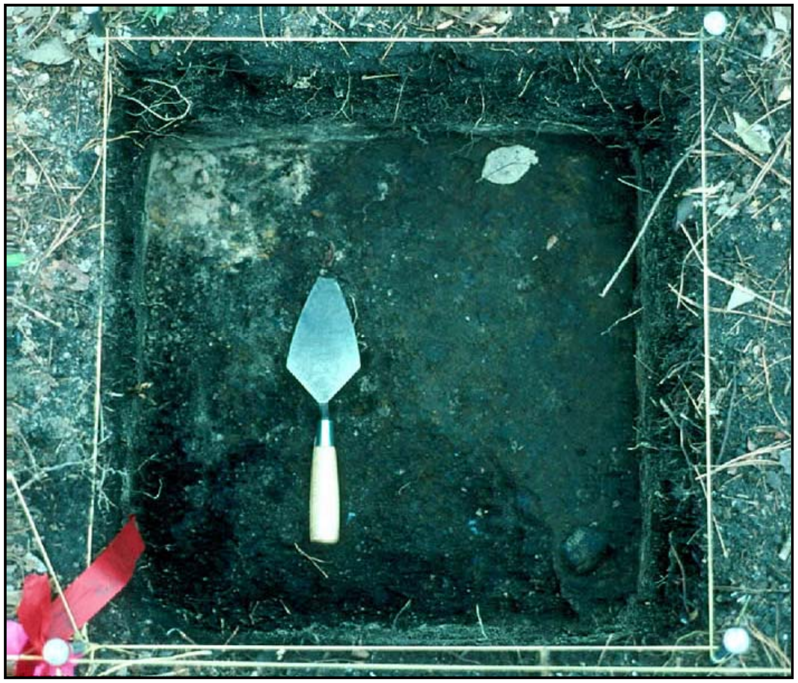
Hand Coring

Mechanical Coring

Shovel Testing/Test pits

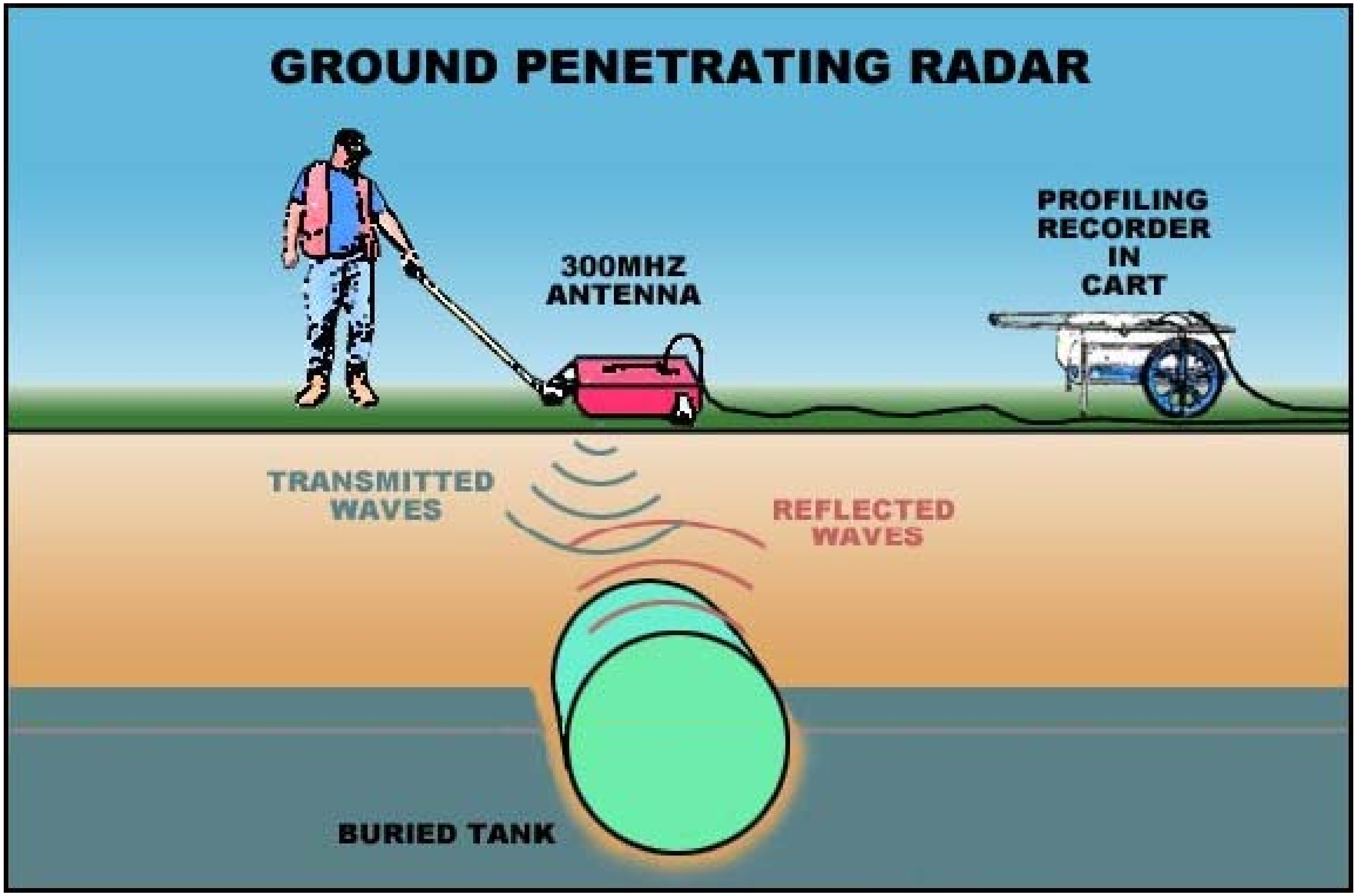


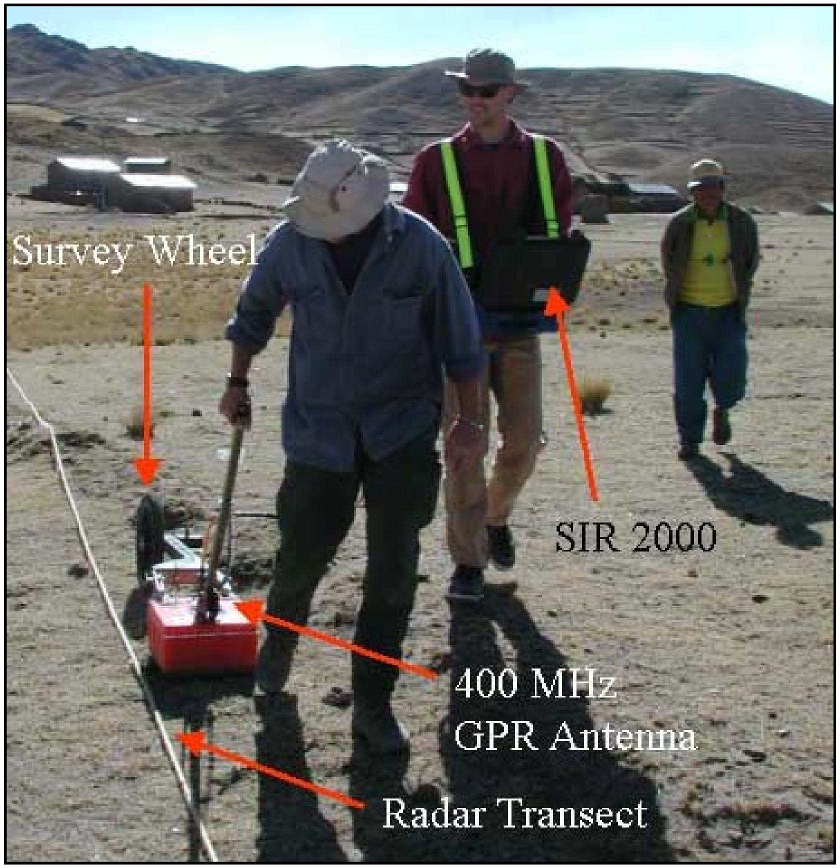
Shovel test pits reveal density of artifacts at Site 6, Monticello

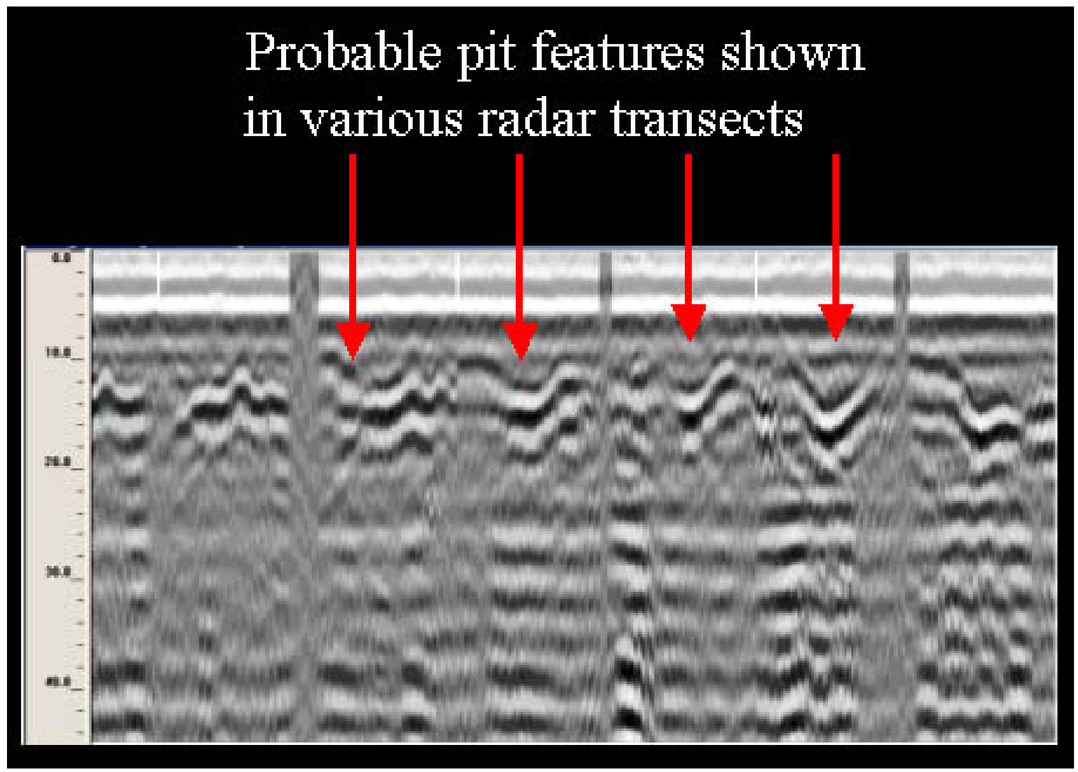


Ground Penetrating Radar

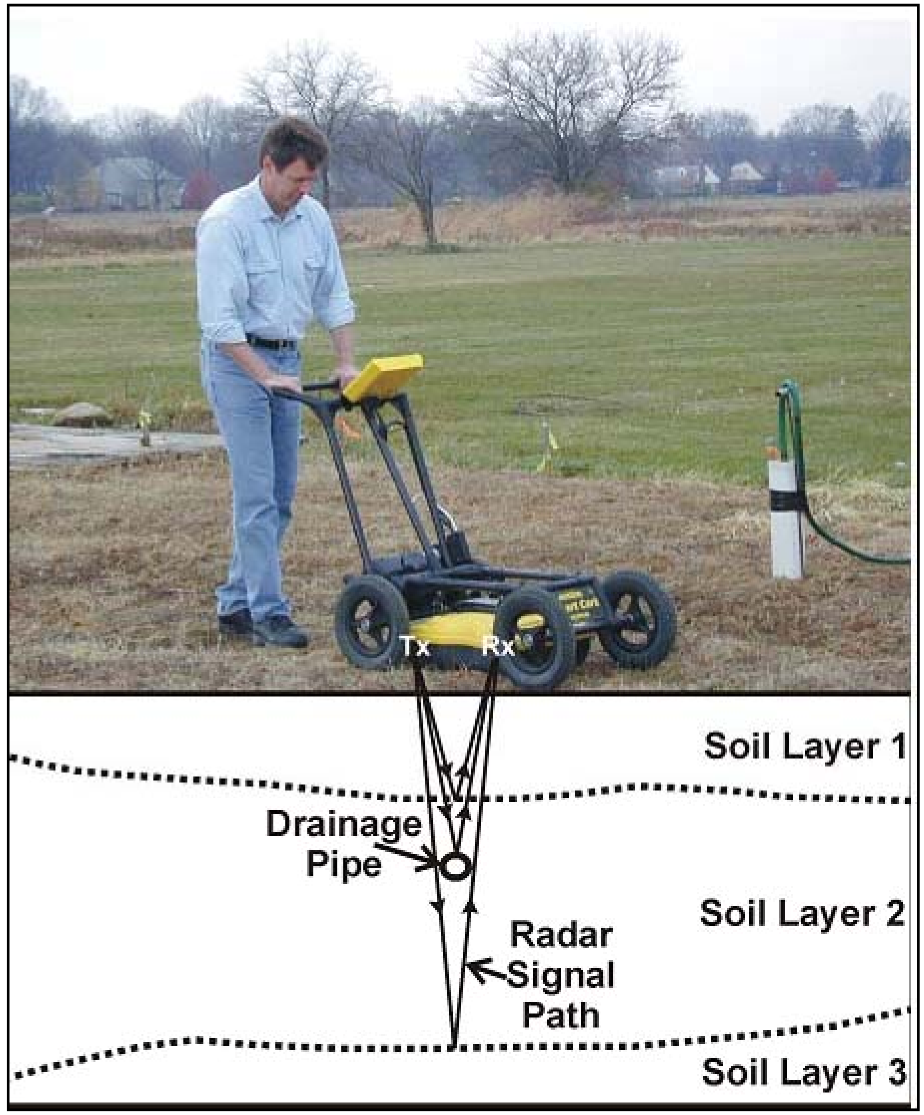
- early versions were mounted on a ‘sled’ and dragged across a site, emiting radio waves into the earth and then measuring the response
- fairly large and awkward to use, although the results were very good




Survey Wheel
SIR 2000
400 MHz
GPR Antenna
Radar Transect


Probable pit features shown
in various radar transects

Small, portable and easy to use

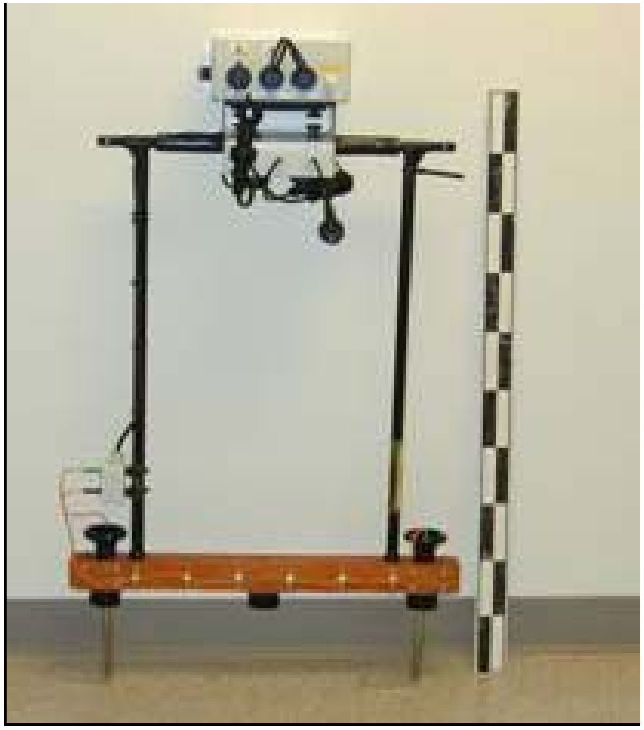


Ground Penetrating Radar (GPR)

Military application
- locating IEDs

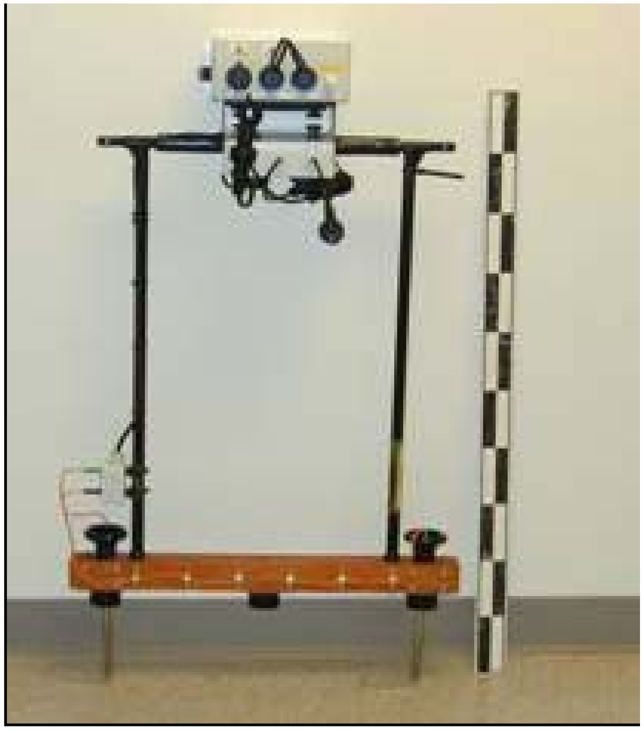
Resistivity surveys

- measures the variation on the resistance of the ground to electric current
- usually recorded by walking a set of ‘transects’ (lanes across a site)

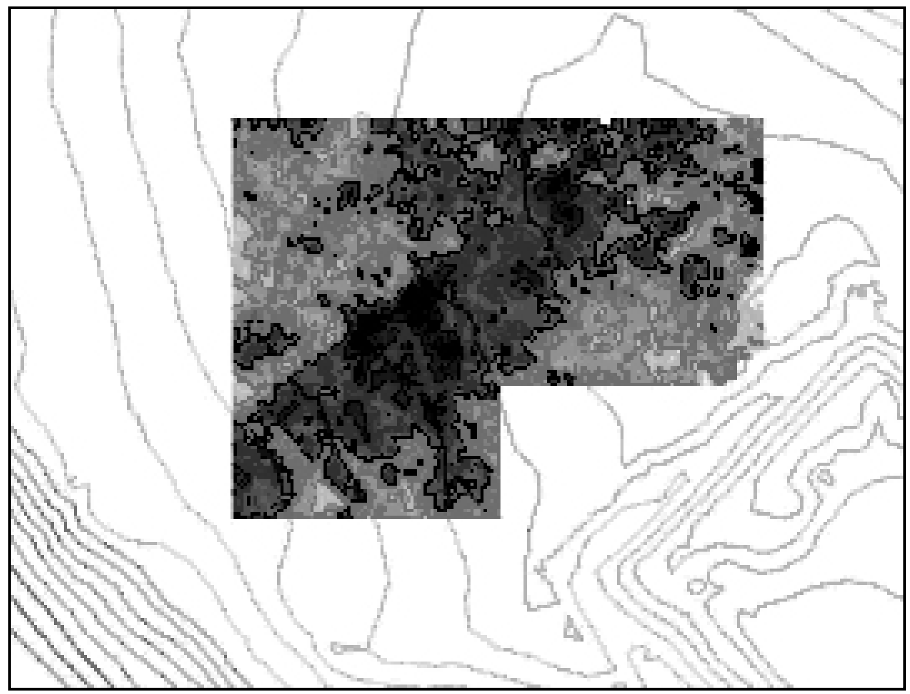


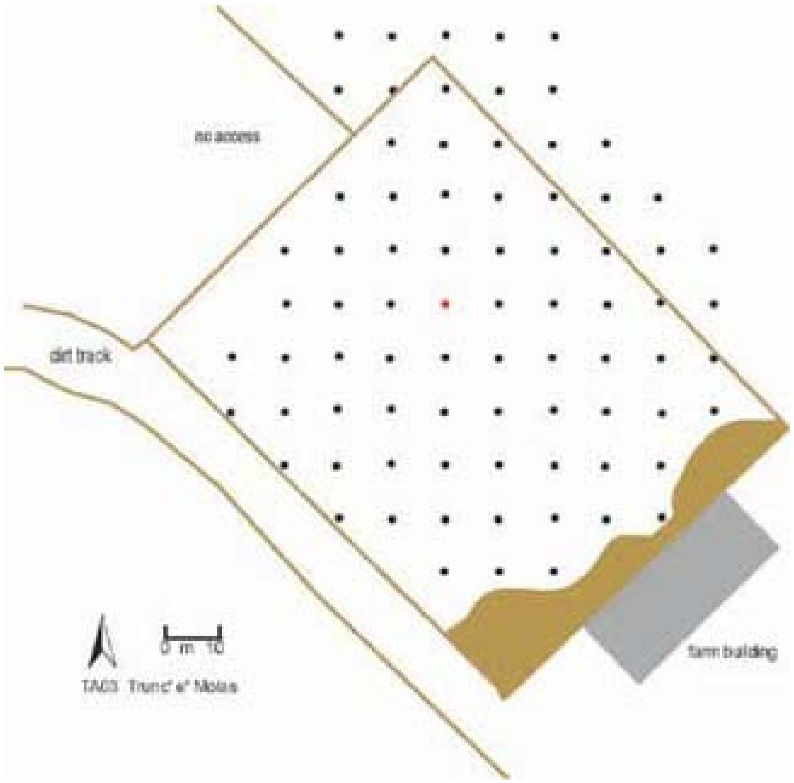
Resistivity surveys

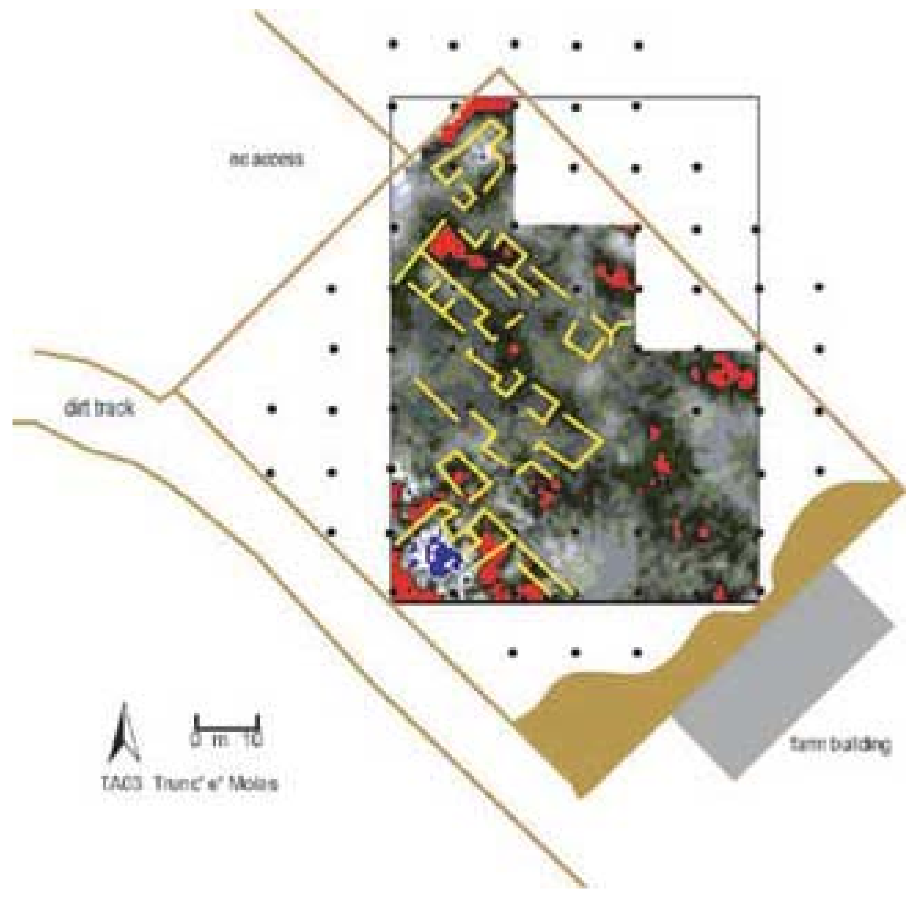
- measures the variation on the resistance of the ground to electric current
- stone walls or hard pavement retain less dampness than a deep pit filled with soft earth or a silt-filled ditch
- these differences an be measured accurately with a resistivity meter, which records the resistivity contours across a grid of squares laid out on the site
- works well for ditches and pits in chalk and gravel and masonry in clay
- Better in temperate climates than very dry ones, where ground moisture is minimal at the surface

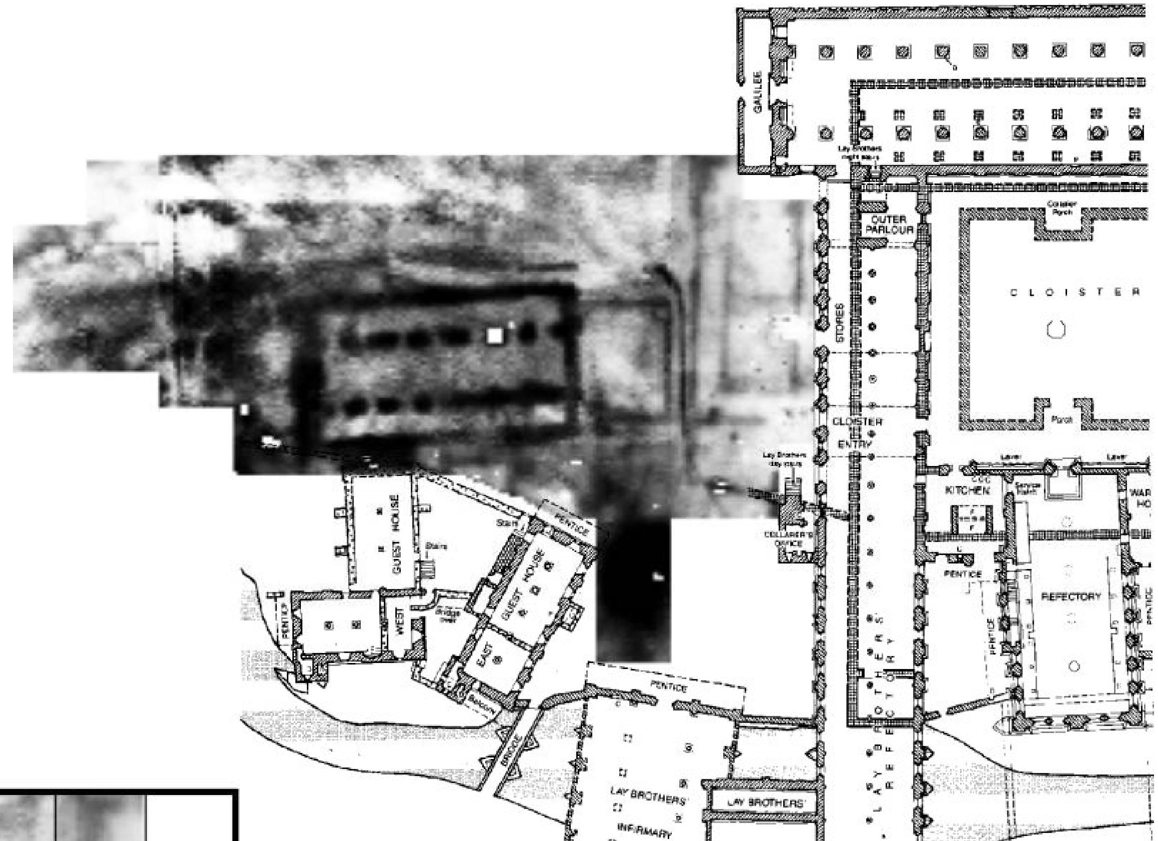


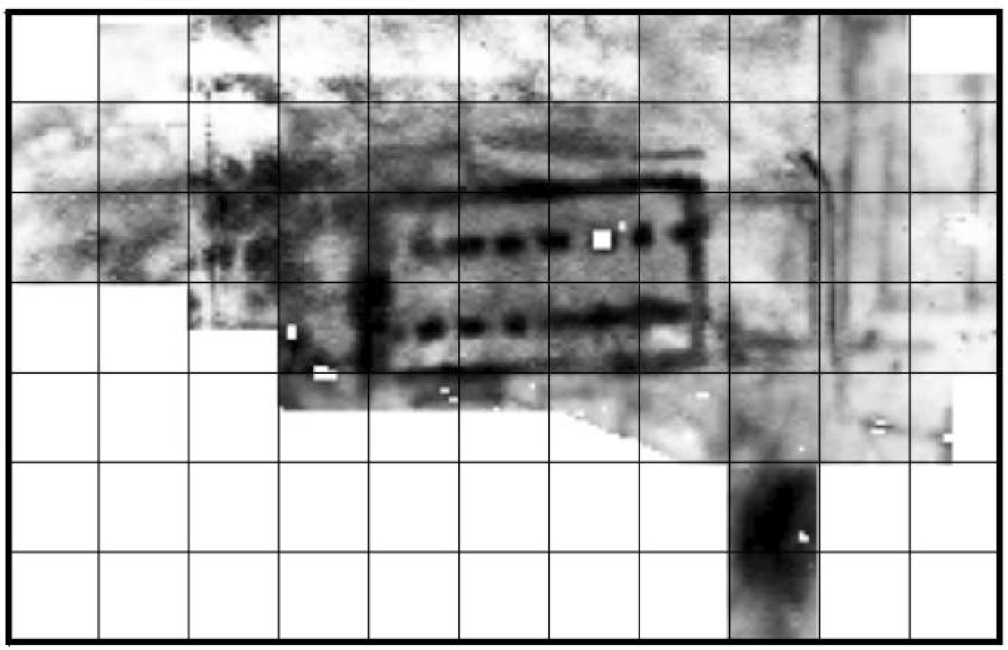
Resistivity surveys




no access
dirt track
0 m 10
TA03 Trunc' e' Molas
farm building


no access
dirt track
0 m 10
TA03 Trunc' e' Molas
farm building





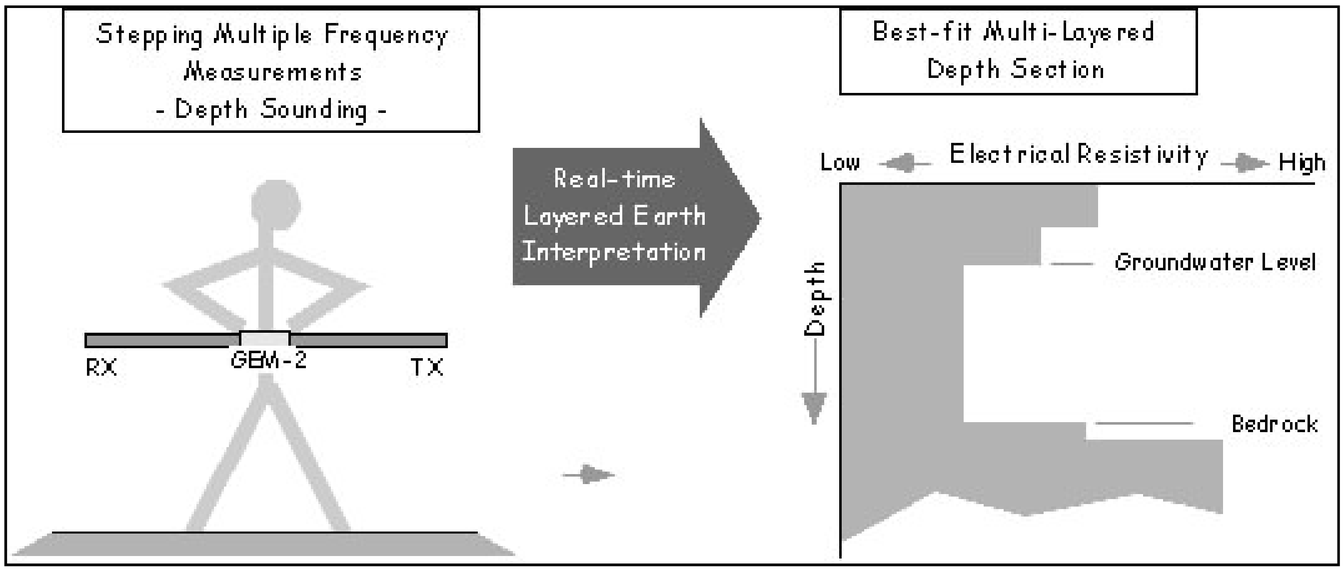
Resistivity survey

Electro-magnetic induction

emits electronic pulses into the earth and then measures the response

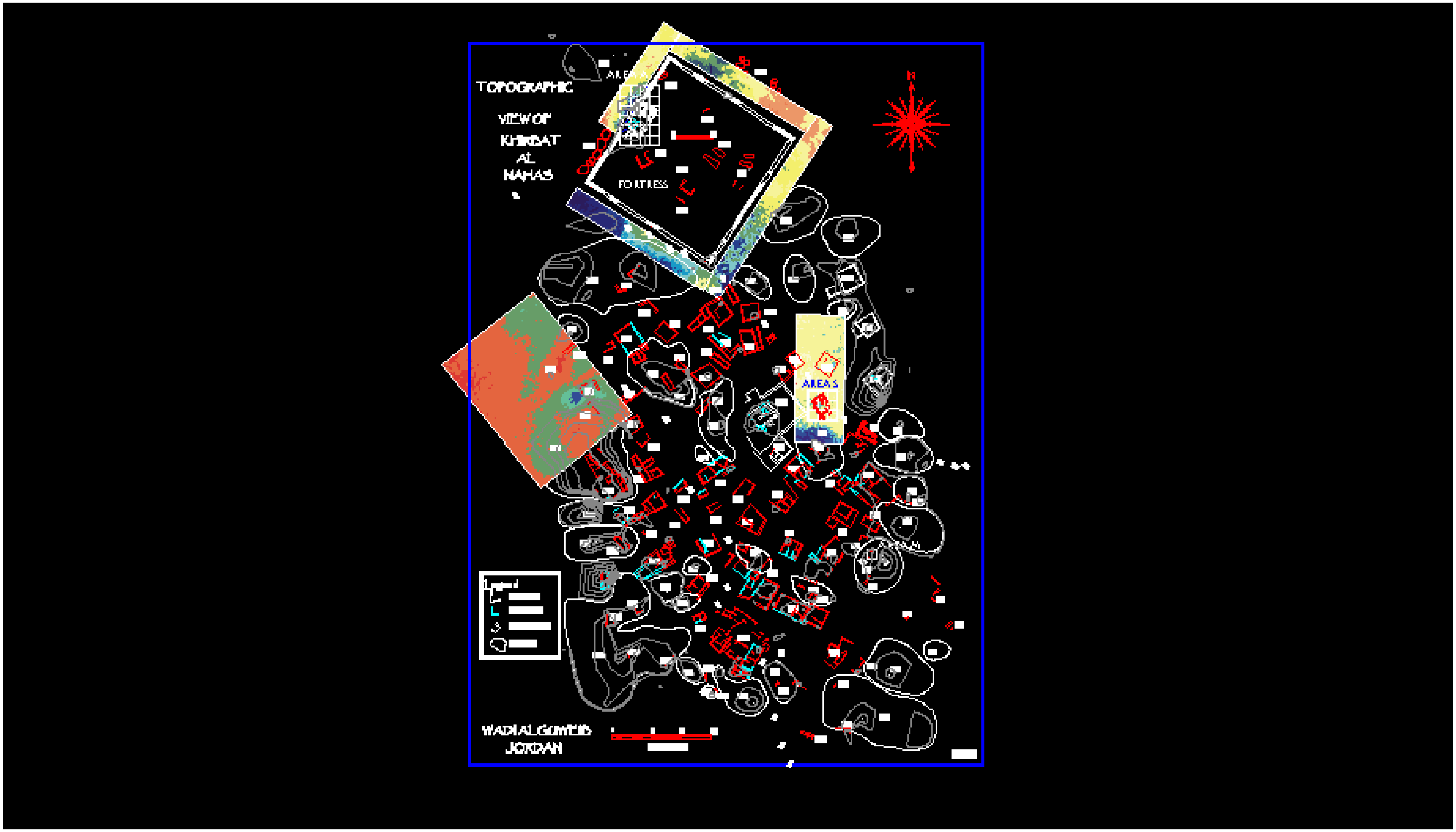
GEM 2:

- The sensor weighs only 9 pounds, operates in a frequency band between 90 Hz to about 24 kHz.
- Its built-in operating software allows a surveyor to cover about one acre per hour at line spacing of five feet.
- Along a survey line about 20,000 data points per acre per hour can be collected

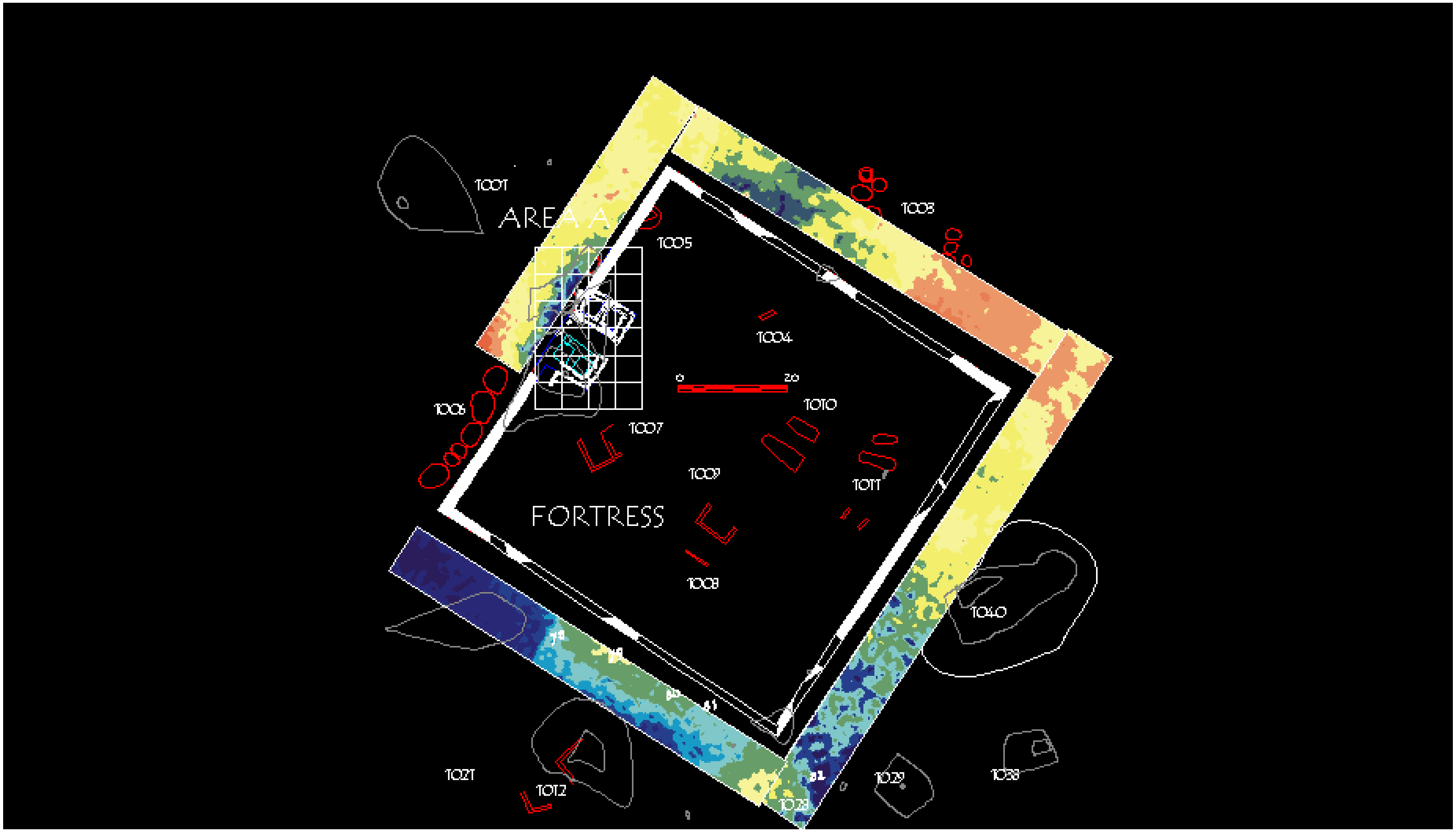


Electro-magnetic induction

GEM 2:



TOPOGRAPHIC
VIEW OF
KHIRBAT
AL
NAHAS
AREA A
FORTRESS
AREA S
N
Legend
WADI AL GUWEIB
JORDAN



AREA A
FORTRESS
1001
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1021
1028
1029
1038
1040
0
20

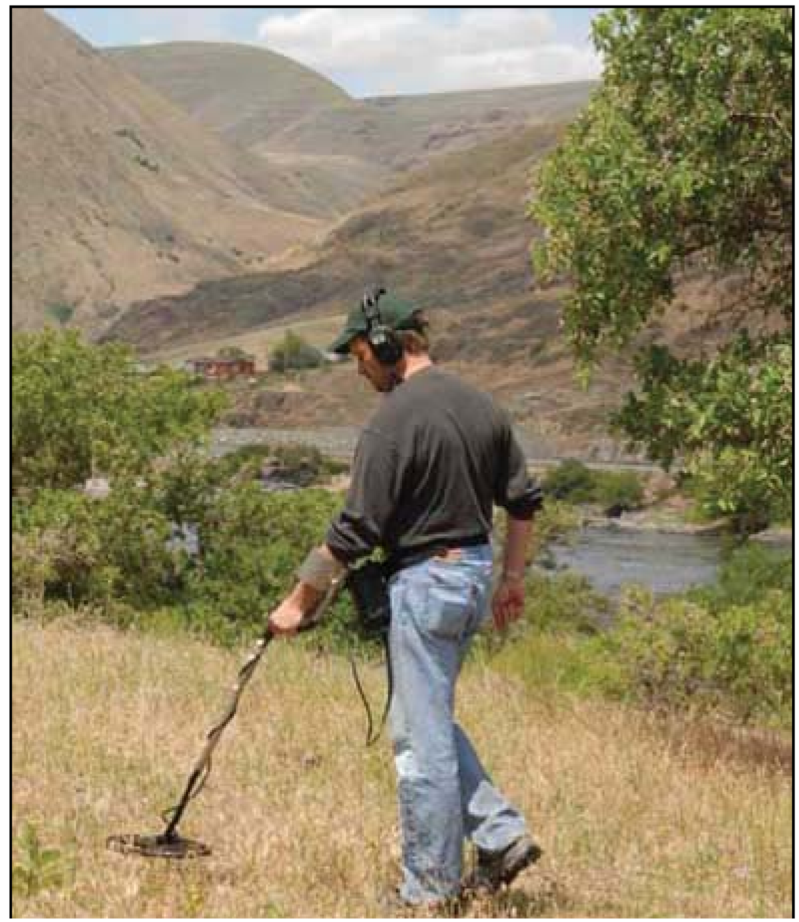
Magnetometry

- helpful in locating fired clay structures such as hearths and pottery kilns, iron objects, and pits and ditches
- such produce slight but measurable distortions in the earth's magnetic field
- based on the presence of iron, even if in minute amounts
- if clay is heated to about 700 C, iron within lines up to earth's magnetic field

Features a magnetometry survey can locate:

- Ferrous (iron rich) materials
- Fired materials such as brick, roof tiles, kilns, hearths, burned daube
- Middens, pits, trenches, activity areas and graves
- Structural features such as walls, floor surfaces, foundations
- Soil differences
- Modern utilities

Metal detectors



Metal detectors

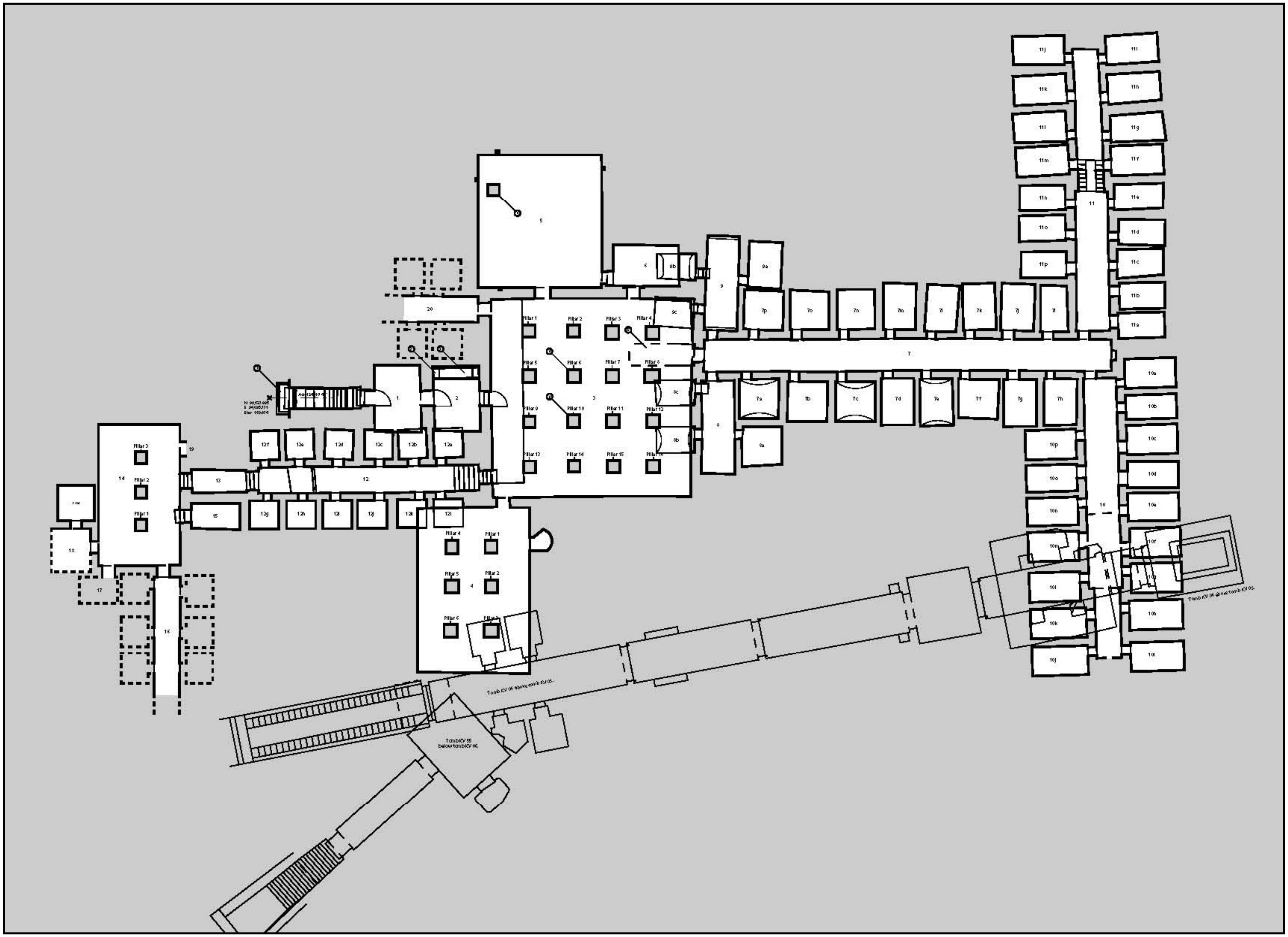
- Although quite helpful in some situations, they are rarely used by professional archaeologists.
- Extensively used by amateur 'treasure hunters' to look for buried objects
- This sets up a conflict with the main aim of archeology, since we are interested in the context of a find, rather than the find itself
- Lack of recording of finds by amateurs means that the find is lost to the archaeological record
- In Europe some countries, like England, have introduced the Portable Antiquity Scheme, to record artifacts found by the public. Check out the web site at: http://finds.org.uk/

Seismic and acoustic methods

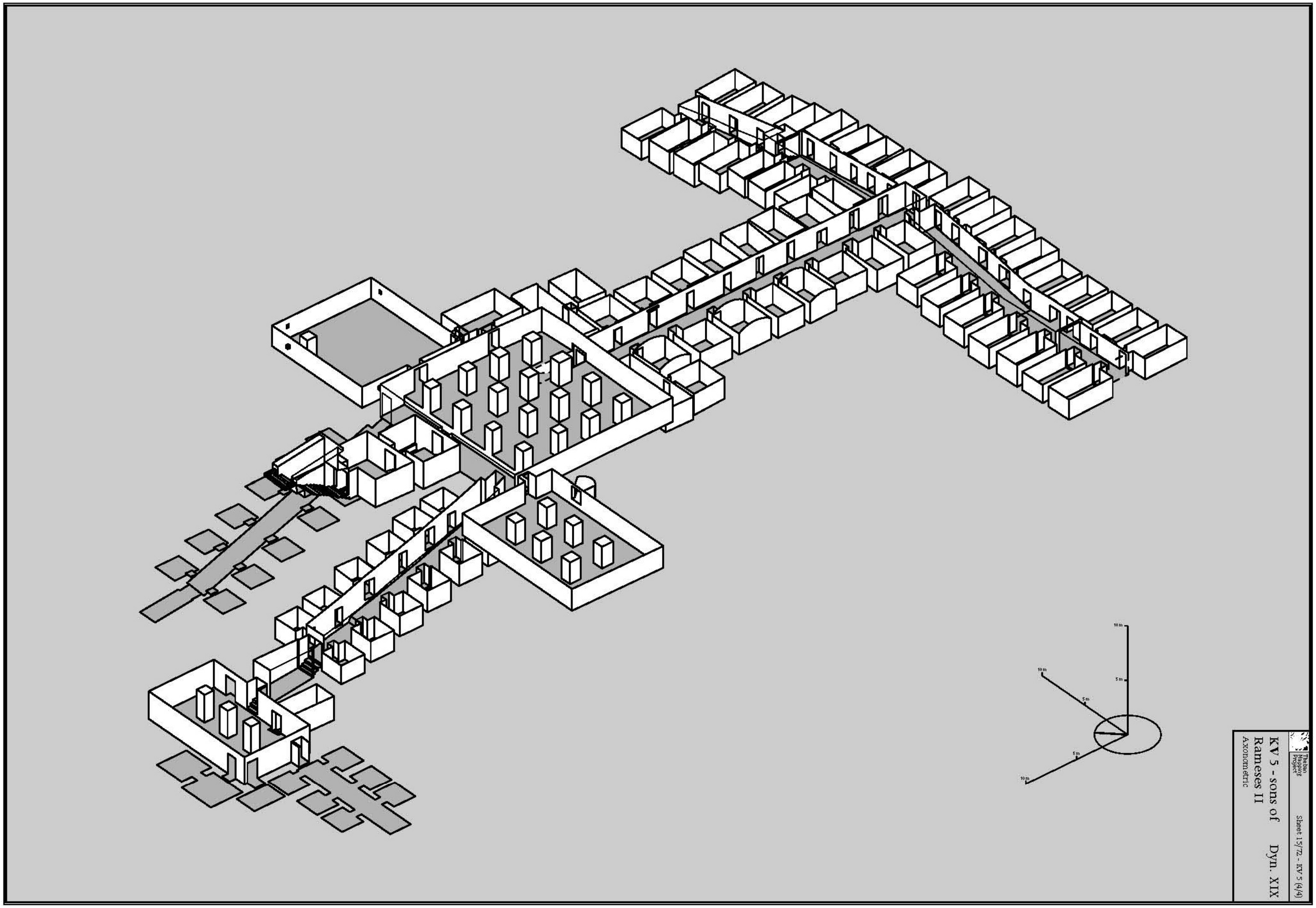
Example: Egypt, Valley of the Kings – KV5

- Kent Weeks used a combination of hot-air balloon, X-rays, and sonic detectors to map subterranean features and hidden chambers
- using this method they have discovered a long-lost tomb with 67 subterranean chambers built for the 50 sons of the the Pharaoh Ramesses II.

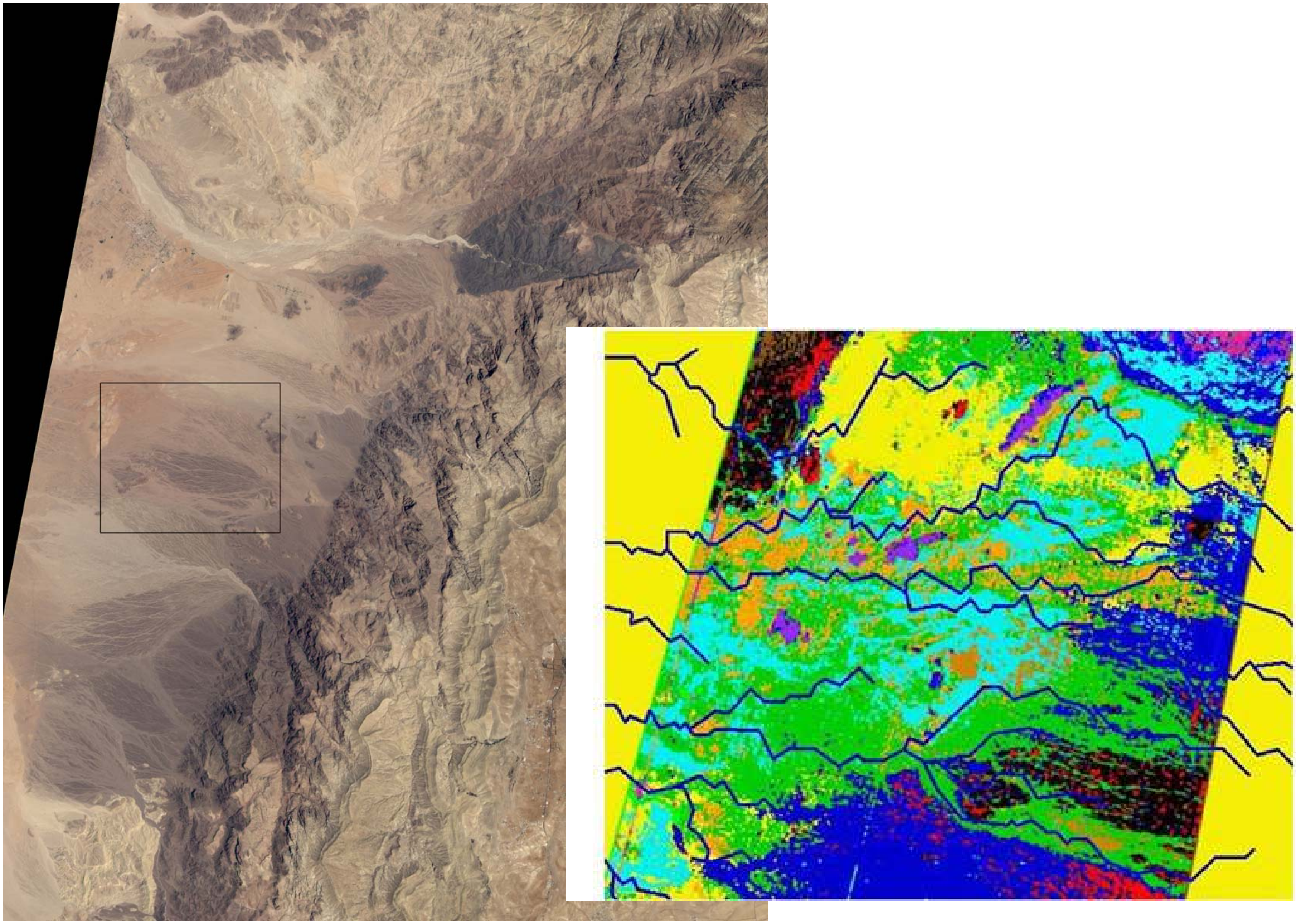
KV5 – Tomb of Ramesses II



KV5


Theban Mapping Project
Sheet 15/72 - KV 5 (4/4)
KV 5 - sons of Rameses II
Dyn. XIX
Axonometric

Space remote-sensing



Points to consider when choosing a geophysical survey method

Physical surface area of survey area:

- Topography
- Ground cover
- Surface structures, roads, fences
- Overhead powerlines
- Recent history of land use

Points to consider when choosing a geophysical survey method

Sub-surface of survey area:

- Soil type
- Underlying geology
- Drainage and soil saturation
- Conductivity of soil
- Tree root systems
- Bioturbation

Points to consider when choosing a geophysical survey method

Archeological characteristics of site:

- Suspected buried features (walls, pits, floor surfaces, graves, tombs, etc.)
- Expected depth to features
- Approximate dimension of features
- Physical properties of features (limestone foundations, humic-rich pit fill, 18th century burial with iron nails and possible grave goods, etc.)
- Site occupation history up to present land use