3 Methods

Information search

In order to achieve the aims and objectives a full and thorough audit was taken of published and unpublished reports, papers and field notes held both in the Heritage and Environmental Records (HER) for Northamptonshire and by the individual units and organisations that have all worked in the Nene Valley. These units and organisations included: University of Leicester Archaeological Services (ULAS), Northamptonshire Archaeology (NA), University of Exeter, Hertfordshire Archaeological Trust (HAT), Oxford Archaeology (OA), Birmingham University Archaeological Field Unit (BUFAU), Cotswold Archaeological Trust (CAT) and English Heritage.

The review of these data identified and catalogued all contexts of environmental value and also the contexts that will add knowledge to the archaeological and hydrological aspects of the project. The comprehensive review and collation of the data allowed for the identification of common themes, clusters and also notable gaps in the record either geographically or chronologically.

Physical material review

Concurrent with the literature review, a physical inspection and audit of stored cores, monoliths and pollen vials was undertaken. Due to the extensive quarrying of the project sites, stored material is all that remains of many excavations. Once the audit was completed, material that had been preserved well and came from sites with notable detailed environmental records, or notable absences of environmental data, was selected for further analysis and re-sampling for pollen analysis, macrofossil analysis and, where applicable, radiocarbon dating.

Database design and development

The range of data generated from the Nene Valley is extensive, and needed to be stored in a manageable and usable format. For convenience of multiple user access and future new user access, a database was specifically created for this project using Microsoft ACCESS. The criteria for the fields of information were developed via discussion between University of Exeter and Northamptonshire Archaeology. The final criteria lead to the use of four connected tables, these were: Location, Archaeology, Environmental, Hydrology and Chronology. Additional tables were added at a later date, but this will be commented on later.

All sites were unique in respect to the range of information they contained, and it was apparent from the data search that many site records consisted of a combination of archaeological, environmental and chronological information. In order to allow multiple data files from numerous sources to be attributed to a singular site, it was essential to sort the data from a common entry point. This common entry point was the site name, and once the site had been named/recorded all associated data files were linked to it. The information recorded in the location table fields, as seen in Figure 3.1, is relatively general, but it is searchable and enables a quick assessment of the site with brief details describing what kind of analysis was undertaken at that location.

The fields for the location table are:

- Site ID Code
- Site Name
- SMR (Sites and Monuments Record) Number
- Parish
- Map Sheet Letters
- Eastings
- Northings
- Site description
- Environmental Analysis (Yes/No)
- Archaeological Analysis (Yes/No)
- Dating Technique Applied (Yes/No)
- References
- Notes

SiteID Code	Site Name	SMR Number	Parish	Sheet Letters	Eastings	Northings	Site description
1	Wollaston I		Wollaston	SP	489800	264600	Iron Age and Roman Farmstead(s)
2	Wollaston II		Wollaston	SP	489810	264470	
3	Grendon		Grendon	SP	487300	261700	Neolithic, Bronze Age
4	Turnells Mill Lane (TML)		Wellingborough	SP	489700	265900	Roman, Saxon Settlements, Palaeochanne
5	Irchester (95) (96)		Wellingborough	SP	491100	267100	Section across Old river course (Near Bron
6	Little Irchester		Wellingborough	SP	491200	267200	
7	Stanwick		Raunds	SP	497500	271000	Late prehistoric, Roman and Post Roman
8	Irthingborough		Irthingborough	SP	496700	271400	Upstanding round barrow. Palaeochannels
9	West Cotton		Raunds	SP	497600	272500	Prehistoric and Saxon. Medieval village (de
10	Redlands Farm		Stanwick	SU	496400	270800	Neolithic barrow complex including mill
11	Little Houghton		Little Houghton	SP	258200	459800	Approximately 2 km downstream of Northa
12	Ditchford		Wellingborough	SP	492900	268000	Palaeochannel associated with Roman roa
13	Raunds (Upstream)		Raunds	SP	496500	272000	long section across floodplain with 2 palae
14	Raunds (downstream)		Raunds	SP	497200	272500	2 exposures.
15	Higham Ferrers		Higham Ferrers	SP	494700	268500	Large sections exposed by gravel extractio
16	Ringstead		Ringstead	SP	498100	275400	
17	Thrapston		Thrapston	TL	499900	279100	
18							
19	Tansor crossroads	MNN2671	Tansor	TL	505700	291010	Excavation
20							
21	Titchmarsh		Titchmarsh	TL	499000	279000	Roman includes possible palaeochannel w
22	Ecton		Ecton	SP	508400	293900	Late Neolithic Barrow
23	Warmington		Warmington	TL	508300	292300	Pit alignment above floodplain
24							
25	Aldwince 1	2288/1/2	Aldwince	SP	401100	280300	Neolithic mortuary enclosure
26	Aldwincle 11		Aldwincle	SP	401000	280400	2 round barrows and beaker graves
27	Little Billing		Billing	SP	480300	261600	Early mammal finds spot
28	Ecton -South of sewage w		Ecton	SP	502200	291400	Pleistocene remains and artifacts
29	Great Houghton		Great Houghtor	SP	479000	260100	Pleistocene mammal finds spot
30	Little Houghton II		Little Houghton	SP	480000	260500	Pleistocene mammal fins spot
31	Duston Mils Reservoir		Northampton	SP	473500	259800	Watching brief at site of glacial lake
32	Weedon road ,Duston		Northampton	SP	473400	260200	Pleistocene mammal finds spot
33	Barnes Meadow		Northampton	SP	477000	259650	Test pits.

Record: 1 of 78

Fig 3.1: Fields in the Location Table

The site name was the first piece of information entered into the Location Table on the database. Following this a unique number was generated for each site, known as the Site ID Code. In terms of database management, the Site ID Code is the key piece of information. Each site was given a unique Site ID Code, which would be used to identify subsequent entries to that specific site in different tables. For example, Wollaston was given the Site ID Code of 1 in the Location Table, and this embedded into all subsequent tables (environmental, archaeological and hydrological) that contained data associated with Wollaston.

Development of Forms

In order to maintain good database management, the data should not be entered directly into a table, as a mistake in the table format can corrupt the database. Instead, information should be entered via a purpose-built interface, known as a ‘Form’. Each table in the Nene Valley database had a specific form developed to assist with the data entry, to produce a user-friendly format for the current and future project user. Each field had a specific data entry point, and the form was constructed to lead the user through systematically. An example of the location form can be seen in Figure 3.2.

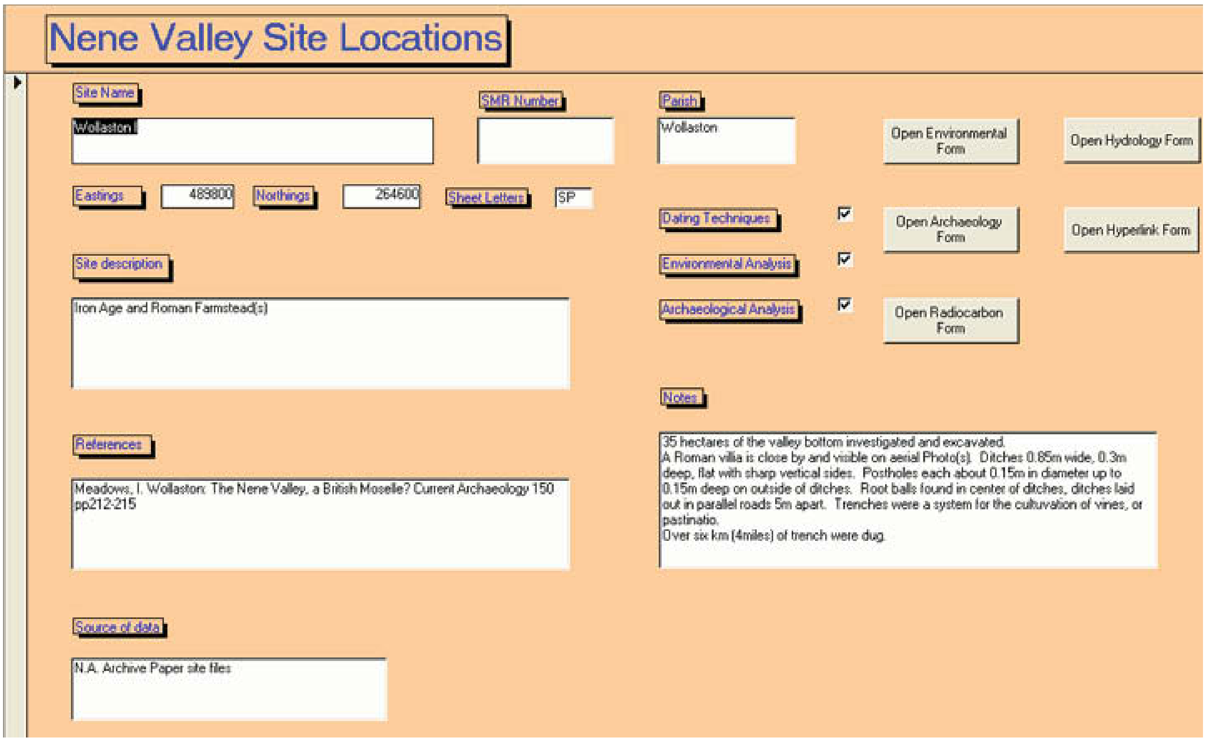

Fig 3.2: Nene Valley Site Locations Form

Environmental data

Following the initial site location data entry, specific information: environmental, archaeological and hydrological, was filtered into the relevant and individual tables. The tables were designed to store specific details recording the extent of the investigation at each location. However, it was apparent that in some cases more than one environmental investigation had been conducted at each location, therefore each investigation would need a unique Env data ID code to store the data sensibly. The number of fields increased in these tables to accommodate the increased level of detail pertaining to each investigation. The fields for the environmental table are:

Env data ID
Site ID Code (from Location Table)
Site Name
Sample Type
Sample Name
Height OD
Context Number
Context Description
Sample Description

Preservation
Pollen (Yes/No)
Macrofossils (Yes/No)
Insects (Yes/No)
Molluscs (Yes/No)
Waterlogged (Yes/No)
Charcoal (Yes/No)
Other (Yes/No)
14C Date (Radiocarbon dates) (Yes/No)
Site Images (Yes/No)
Section Images (Yes/No)
Sample Images (Yes/No)
Environmental Data Notes
Sample Storage location
Source of data

A form for each individual table was created, for the reasons outlined in section 3.2.1. An example of the environmental form can be seen in Figure 3.3. The design of individual forms allowed concurrent data entry between University of Exeter and Northamptonshire Archaeology team members. The master database was held at the University of Exeter and was updated bi-monthly.

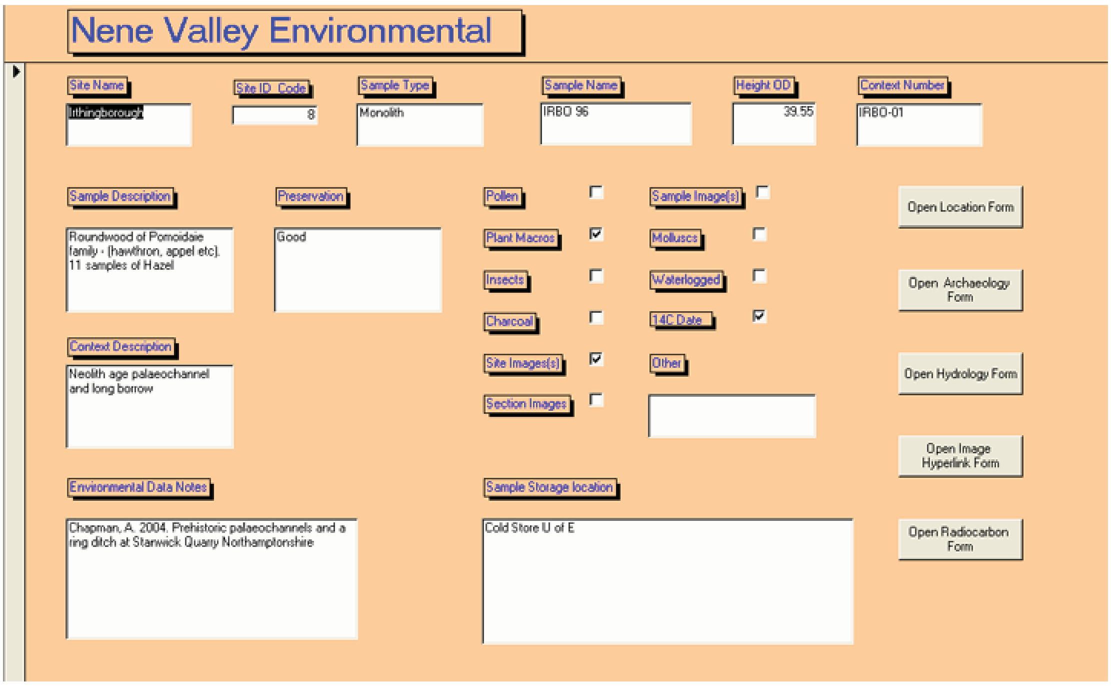

Fig 3.3: Nene Valley Environmental Form

Radiocarbon dates

From the literature review it became apparent that a large number of radiocarbon dates had been produced from the Nene Valley in the last twenty years. One potential problem was that individual radiocarbon dates were often attributed to both environmental and archaeological reports, and it soon became apparent that entering the dates into two tables, environmental and archaeological, would cause a replication of data. In order to remove the problem of data replication, radiocarbon dates found in environmental and archaeological reports would be placed into a specific radiocarbon date table. In order to keep track of the origin of the date the unique site ID code was used to allow the radiocarbon date to be attributed to the site and context from whence it came.

Data from the Nene Valley has been generated for over 20 years, and changes in the calibration of radiocarbon dates have been ongoing during this time. To remove potential error between dates that were generated via different calibration programs, all the radiocarbon dates entered into this database were recalibrated using the calibration programme Calib 5 (Stuiver *et al* 2005) which is compatible with OxCal 3.10, both using InCal 04 data (Reimer *et al* 2004). This was used as the standard calibration programme, to recalibrate all the dates to allow confident comparison and interpretation of all dates produced from the Nene Valley. The raw uncalibrated dates were also entered to allow future recalibration.

The fields for the radiocarbon table are:

- Radiocarbon ID code
- Site Name
- Site Number (ID Code)
- Lab Number/Ref
- Material Type
- Calibration Program
- Dating Method
- Uncalibrated Date (radiocarbon age BP)
- Error years +
- Error Years -
- Re-calibrated One Sigma Age Range
- Re-calibrated Two Sigma Age Range
- References
- Notes
- Source of Data
- Source of Material
- δ^{13}C (‰)
- δ^{15} N (‰)(where known)
- C:N ratio (where known)

A form for the radiocarbon table was created, for the reasons outlined in section 3.2.1. An example of the radiocarbon form can be seen in Figure 3.4.

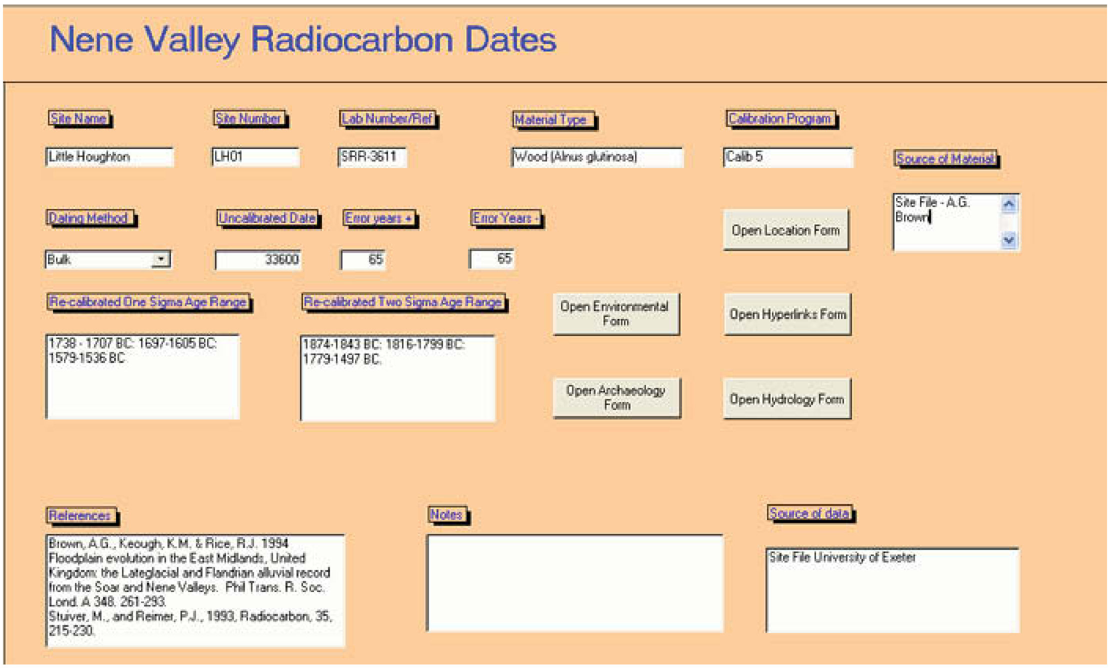

Fig 3.4: Nene Valley Radiocarbon Dates Form

Additional Radiocarbon Dating

During the review of the physical material it was decided that material from monoliths RAP (Raunds Area Project) C, D, E and Wollaston S1013 was suitable for submission for a suite of new radiocarbon dates. Organic material intercalated with inorganic sediment was chosen for radiocarbon dating, as this change in stratigraphy can be dated and used to constrain a chronology for periods of geomorphic activity.

Samples removed for radiocarbon analysis were cut from thoroughly cleaned sections of the monoliths in a clean sampling laboratory. Extreme care was taken to remove any possible contamination by modern root penetration. De-ionised water and repeatedly cleaned scalpels were used while sub-sampling in the laboratory. Twenty-two measurements were obtained from four uncarbonised macrofossils and nine samples of sediment from the Scottish Universities Environmental Research Centre (SUERC). They were all measured by AMS. The calibrations of these results, relating the radiocarbon measurements directly to calendar dates, have been calculated using the calibration curve of Reimer et al (2004) and the computer program OxCal (v3.10) (Bronk Ramsey 1995, 1998, 2001). Samples were, where appropriate, fraction dated using the macrofossil, humic and humin fractions. This was in order to evaluate possible contamination, the effects of storage and natural variation in the age of sample fractions. A list of the nine sediment samples, and the corresponding macrofossil dates are presented in Table 3.1 and Figure 3.1.

Table 3.1: Radiocarbon results from the Nene Valley Project

Lab ID	Sample ID	Material	$\delta^{13}C$ (‰)	Radiocarbon Age (BP)	Calibrated Date (95% confidence)
Beta-877442	WS1013 NV009	bulk sediment date		5000 ±70	3970–3640 cal BC
SUERC-10054	WS1013 NV009	sediment, humic acid	-28.7	5445 ±35	4360–4230 cal BC
SUERC-10055	WS1013 NV009	sediment, humin fraction	-28.9	5740 ±35	4690–4490 cal BC
SUERC-10062	RAP C NV002 A	unident. roundwood (cf *Salicaceae*)	-27.5	4180 ±35	2890–2630 cal BC
SUERC-10063	RAP C NV002 B	sediment, humic acid	-28.4	4625 ±35	3500–3360 cal BC
SUERC-10064	RAP C NV002 B	sediment, humin fraction	-27.2	5325 ±35	4320–4040 cal BC
SUERC-10056	RAP C NV001 A	unidentified twig	-26.3	4185 ±45	2900–2620 cal BC
SUERC-10057	RAP C NV001 B	sediment, humic acid	-28.7	4645 ±35	3520–3350 cal BC
SUERC-10058	RAP C NV001 B	sediment, humin fraction	-28.4	5380 ±35	4340–4060 cal BC
SUERC-10065	RAP C NV008 A	unidentified roundwood	-26.4	4225 ±35	2910–2690 cal BC
SUERC-10066	RAP C NV008 B	sediment, humic acid	-27.5	4625 ±35	3520–3340 cal BC
SUERC-10067	RAP C NV008 B	sediment, humin fraction	-27.7	5055 ±35	3960–3710 cal BC
SUERC-10046	RAP D NV003 A	unidentified bark fragment	-28.8	1005 ±35	cal AD 980–1150
SUERC-10047	RAP D NV003 B	sediment, humic acid	-29.3	1680 ±35	cal AD 250–430
SUERC-10048	RAP D NV003 B	sediment, humin fraction	-28.3	2755 ±35	1000–810 cal BC
SUERC-10052	RAP D NV004	sediment, humic acid	-31.3	1355 ±35	cal AD 630–770
SUERC-10053	RAP D NV004	sediment, humin fraction	-30.3	1740 ±35	cal AD 220–400
SUERC-10042	RAP E NV006	sediment, humic acid	-29.4	4745 ±35	3640–3370 cal BC
SUERC-10043	RAP E NV006	sediment, humin fraction	-29.0	5030 ±35	3960–3700 cal BC
SUERC-10044	RAP E NV007	sediment, humic acid	-28.4	6760 ±35	5730–5620 cal BC
SUERC-10045	RAP E NV007	sediment, humin fraction	-28.7	7075 ±35	6020–5890 cal BC
SUERC-10037	RAP E NV005	sediment, humic acid	-28.8	8445 ±40	7580–7470 cal BC
SUERC-10038	RAP E NV005	sediment, humin fraction	-29.3	8575 ±35	7610–7570 cal BC

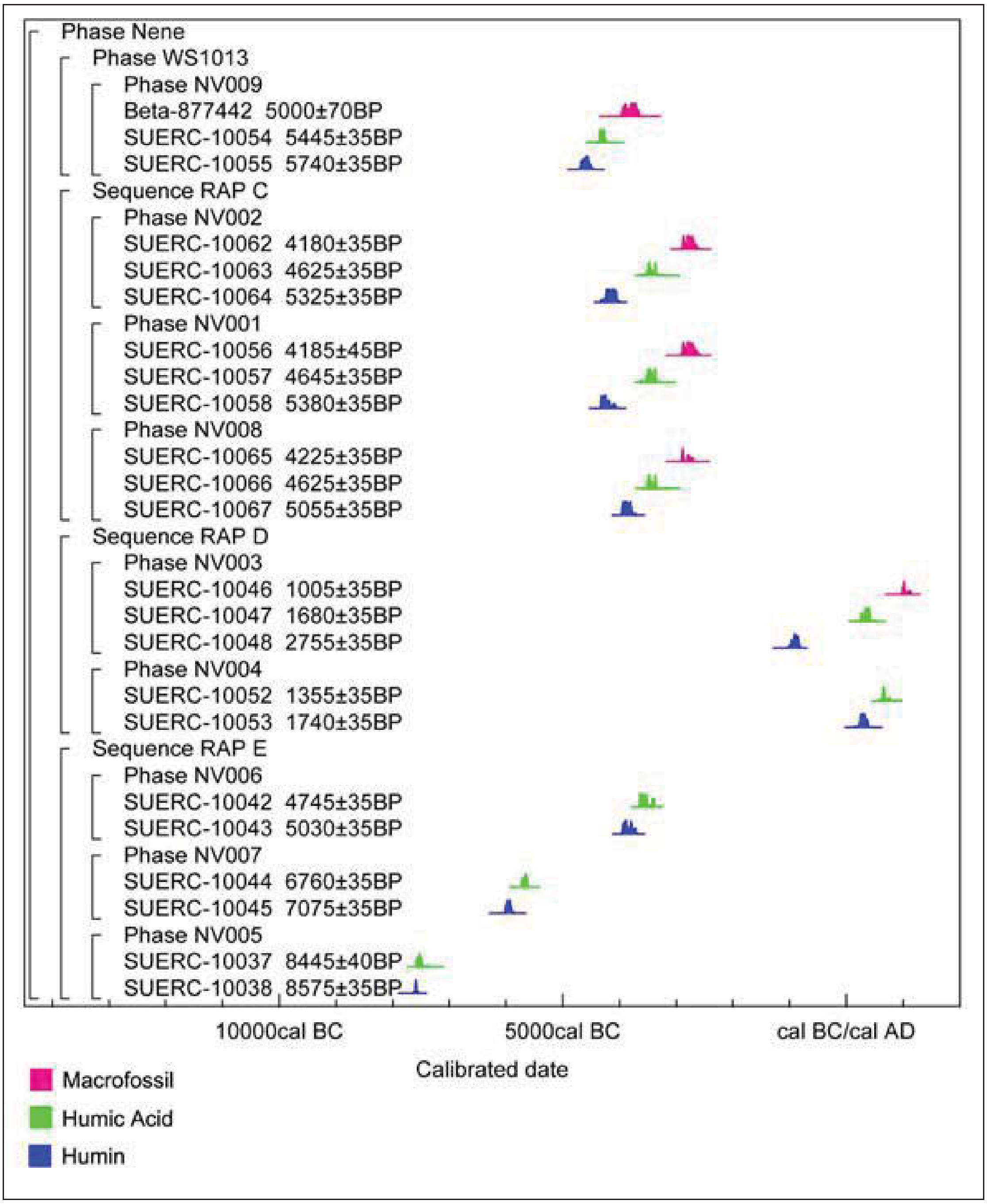

Fig 3.5: Radiocarbon dates from monoliths RAP (Raunds Area Project) C, D, E and Wollaston S1013

GIS design and development

The GIS database was developed in ArcView 8.0. Pre-existing GIS files at Northamptonshire Archaeology were in MapView format, and were converted at the University of Exeter. The GIS database was designed to display the sites throughout the Nene Valley in a spatial context, whilst having multi-period information attributed to each site location. The database was constructed using layers, allowing different information to be placed into a specific and relevant layer.

The multi-period data was placed into specific layers to allow easy access to different archaeological periods of data, eg Neolithic, Bronze Age and Roman periods would allow visual representations of landuse and settlement patterns to be viewed.

Linking ACCESS and ArcView databases

Access Database Manipulation

In order to produce a fully operational database, the problem of combining the different tables into one coherent database needed to be overcome. This was completed in a stepwise format, as outlined in Figure 3.6.

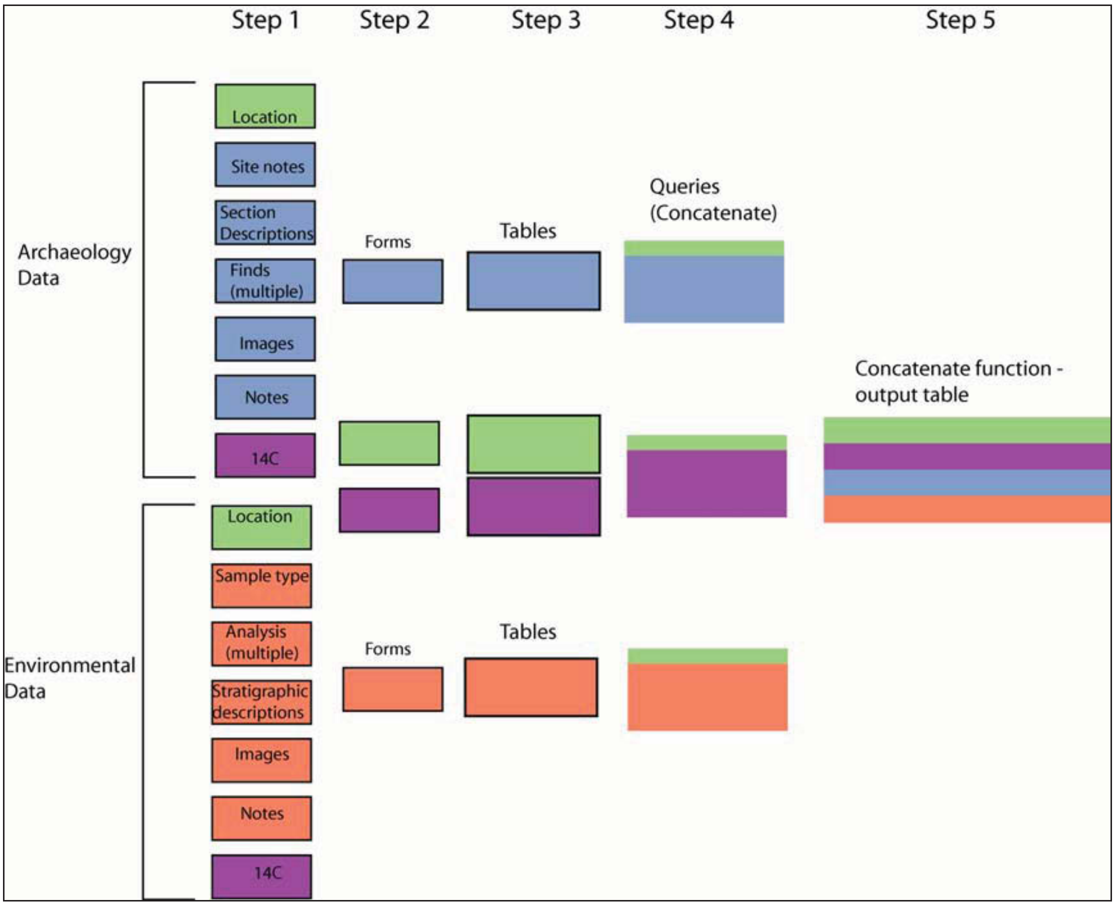

Fig 3.6: A schematic diagram of the combining steps for the ACCESS database

Step 1 Identification of the fields for the database, as described in section 3.2
Step 2 Development of the forms, as described in section 3.2.1
Step 3 Data entry into the tables
Step 4 Compression of the individual tables into one large table. All the information contained within the fields is connected to the site location data. Writing a unique and specific command function in SQL completed the compression of multiple entries of data to the specific site location, from whence it came. This produced a 'ghost table', one that the database could use, but the operators could not view, that had sorted all the data and used the Site ID code to organise each site with the correct data
Step 5 Using a custom SQL query, a concatinate command combined the data from all tables into one comprehensive output table. The output table allowed all the fields of data from each of the tables (location, environmental, archaeological, and hydrological) to be placed into a site-by-site format.

Entering data into the GIS

Once the comprehensive table (Step 5) had been generated it was entered into a GIS. The location details of each site (based on NGRs) were the key data that tied the varied information (environmental, archaeological and hydrological) to each site. Therefore the output table had all the related data sorted by site. Once the site information was entered into the GIS, all associated site data could be displayed in a spatial context.

Physical material preparation

Monolith preparation

On arrival at the laboratory the monoliths were cleaned to allow clear visual inspection of the sediment. Stratigraphic logs were recorded within the laboratory where the description of the monolith/core lithology was based on a technique developed by Eyles (1983), which detailed each distinct unit within the section. Colour characteristics of the sediments were recorded using a Munsell Colour chart. Levels for pollen analysis and radiocarbon dating were identified and samples removed.

Photography

The cleaned monoliths were placed on a mechanical stage underneath a fixed position digital camera, see Plate 3.1. The monoliths were advanced at 80mm intervals, with high-resolution images being taken. The images were then combined using ArcSoft Panorama 3.0 software, producing a continuous digital image of each monolith.

Plate 3.1: Digital photographic set-up

Pollen preparation laboratory procedure

Pollen analysis is the study of pollen and spore assemblages from sediments (Birks and Birks 1980, Faegri and Iversen 1989, Moore *et al* 1991) and is used to identify local and regional vegetation changes over time throughout the study areas. Although pollen analysis is still the most versatile method available for reconstructing past vegetation, a huge difference exists between the timescales considered by field ecologists (decades) and those considered by palynologists (centuries to millennia) (Green and Dolman 1988).

The fundamental difference between the two approaches is the sampling resolution. Fine resolution pollen analysis (FRPA) links pollen analysis and field ecology (Green and Dolman 1988). In theory FRPA should only be used when the depositional resolution of the sediment (ie degree of vertical mixing) is finer than the sampling interval. This criterion is satisfied in most alluvial sequences and indeed appears to be satisfied in most peatlands (Barber 2006). FRPA is advantageous as the time period represented by the interval between adjacent pollen samples is substantially less (5 mm) than those used in traditional Quaternary pollen analysis (2-4 cm). Traditional or non-FRPA is a versatile technique for reconstructing and displaying vegetation succession. Traditional pollen analysis is an appropriate technique for reconstructing past vegetation histories, however, the sampling range (2-4 cm) can represent a variety of time periods (decades to centuries) which can be too great to identify subtle changes in vegetation communities. Instead of attempting to document large-scale vegetational change, the role of FRPA, therefore, is to identify small-scale vegetational processes (Green and Dolman 1988). The data provided by FRPA can provide subtle evidence of landuse change (Fyfe *et al* 2004). Therefore, because of the advantages of pollen analysis and FRPA, both of these techniques were used in this research.

Standard preparation procedures were used on 1g of (wet) sediment. The sampling interval was not uniform but varied throughout the sedimentary sequence with a sample thickness of 5mm being employed. At each selected level, between 1.5g – 4g, (wet weight) of sediment were removed, and 1g used per sample. For the purposes of calculating pollen and charcoal concentrations as described by Stockmarr (1971) two *Lycopodium* (batch number 483216) tablets were added to each sample prior to chemical preparation. The chemical preparation of the samples followed the procedure as described by Barber (1976).

Pollen count and identification

All counts were undertaken using a Nikon Optiphot microscope at a magnification of x400, and x1000 when needed. For low resolution counting a pollen sum of 300 grains per level was set, excluding exotic grains, spores and aquatics to give a total land pollen (TLP) sum. For high resolution diagrams a TLP of 500 grains was used and in the case of Wollaston 1000+ TLP was used in order to quantify the frequency of rare types. Identification of pollen grains and spores was aided by the use of keys in pollen textbooks, including primarily Faegri and Iversen (1989) and Moore *et al* (1991) and by comparison with modern pollen reference material (type slides) at the Department of Geography University of Exeter.

Presentation of results and zonation criteria

The results of all the pollen analyses have been presented as percentage diagrams using Tilia 2.0 and TGView (Grimm 1991-1993). The final TGview images were converted into JPEG format using Adobe Illustrator 10.2. The pollen data has been presented as percentages of Total Land Pollen (TLP), excluding spores and aquatics, which have been expressed as percentages of TLP. Zonation of the pollen data was initially performed by a visual assessment of the information to identify Local Pollen Assemblage Zones. These were superseded by the use of the statistical technique of CONISS (stratigraphically constrained cluster analysis using sum squares and Euclidean squared distances).

Wood identification

Wood identification followed standard procedures, with radial and transverse sections being cut using a sharp razor, then stained and mounted before examination under a microscope at x100 to x400 magnification. Standard keys were used (eg Schweingruber 1978) and also a computer assisted key (North Carolina State University 1986) and reference material held in the Palaeoecology Laboratory at the University of Exeter.