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BOURNE ROAD/HORSESHOE ROAD, SPALDING, SOUTH HOLLAND, LINCOLNSHIRE: NOTE - GEOLOGICAL CONTEXTS

Background

1. Pre-determination evaluation, comprising a desk-top assessment (Cope-Faulkner 1997) and the cutting of 22 trial trenches (Herbert 1997), have been conducted by Archaeological Project Services. The exact locations of trenches were reported. APS have been kind enough to supply OAA with additional records of stratigraphic sequences observed in their trenches (cf. Figs. 2-3).

2. On the 12th. December, a further 9 testpits were cut, primarily for geotechnical purposes; SNC was present at this time and was able to observe the sequences exposed (and to guide the pitting away from the known archaeological material). The testpits were machine-cut to a depth of c.3 m below the modern surface (thus, to a level approximating to Ordnance Datum, the modern surface lying at altitudes of 2.59-3.27 m AOD); the watertable was encountered at this depth and the deposits ran freely, precluding deeper excavation. The testpits were located only approximately, with reference to the clearly visible traces of the refilled trial trenches; these approximate TP locations have been added to APS fig.4 (reproduced here as Fig.1).

3. APS report that local soils are of the Wisbech Association, coarse silty calcareous alluvial gley soils developed in stoneless marine alluvium (young marine alluvium or former estuarine deposits). The Fenland Project, covering the South-West Lincolnshire Fens (Hayes & Lane 1992) does not quite reach sufficiently eastwards to take in the Permitted Site. Nevertheless, a major roddon complex, over a kilometre wide, was recorded only c.2 km to the westsouthwest, heading straight for Spalding, apparently via the Permitted Site. APS have indicated to SNC that their assessment included only existing plots of suspected archaeological feature from aerial photographs; it is likely that much more detail on the gross geological morphology (i.e. the main structures of the roddon complex) could be retrieved from original photographs (if any) pre-dating the recent glasshouses. This roddon complex is part of the deep Flandrian Transgression sequence, known to be over 9 m deep in this vicinity; the general Fenland sequence is described by Zalasiewicz (1986). The geological basement is Oxford Clay.

4. The present note is a reinterpretation and synthesis of the various observations made to date on the geological contexts of the Permitted Site, as they may have a bearing upon archaeological potential.

The Roddon Complex

5. The deepest deposits encountered in the testpits (at c.0-1 m AOD) were clean, very well sorted, finest medium to fine sands, with laminar bedding and shell fragments. These sediments are interpreted as estuarine deposits, probably laid down under moderate current conditions and probably beyond the reach of (deeper than) constant tidal reworking (judging from the rarity of marked textural fluctuation, although closer observation of cross-structures, not possible from the deep testpit exposures, would be necessary to reach a more accurate estimate of water depth); an alternative, but rather less likely, interpretation would be sand flats, somewhat off-shore of landward mudflats, in a less incised littoral zone.

6. All observed testpit sequences then showed a general fining upward trend, with fine sands (with rare isolated granules and, sometimes, clayey pellets/lithorelics and tiny shell fragments, and also very lightly carbonate-cemented zones) giving way to coarse silts and then to clayey silts with floating sand grains and rare minor clay linsen/drapes, although there was considerable variability in fine detail in each sequence. There was

a tendency for finer-grained material to take on greyer (more reduced) colours, whilst the coarser material was more usually better oxidised (yellow browns). Some sequences (e.g. TP2, TP4) showed cyclic development, with renewed coarser material; some of the greyer beds (e.g. TP5, TP6), richer in silt/clay, also showed minor peat/detritus (well humified) near their base (often underlain by blue-grey silty clay), sometimes associated with water-rolled wood fragments, clay or peat lithorelics, and, in one case, a bone fragment of a large (but indeterminate) mammal. These finer beds (and to some extent the sands below) show strong but not particularly dense ichnofossils, consisting of long vertical unbranching tubes, of diameters mostly in the range 2-10 mm, sometimes with a slightly clayier core and with strong Fe-enriched haloes; the most likely cause of these traces would be *Phragmites* rhizomes (although the exact level(s) of origin could only be identified through further detailed study). These sediments are most readily interpreted as the normal facies progression, probably largely conformable with the cleaner sands below, in a prograding estuarine sequence. The upper deposits show greater current fluctuation and the effects of reworking of older, coherent beds, presumably at channel banks; water depth was probably decreasing and smaller-scale, locationally relatively stable, salt marsh creeks were probably present (neither low-angle cross-bedding, e.g. epsilon cross-bedding, nor slumping could be observed in the restricted testpits; if this apparent absence is real, marsh creeks, rather than laterally shifting tidal mudflat creeks, would be indicated, as suggested here).

7. The upper (surviving) surface of the roddon complex can be plausibly equated with context 039 (reported as present in all trial trenches in the APS text, although only in T20 in the context list) or with context 129 (reported as present in all trial trenches in the APS text, although not shown in this position in the report section drawings, but shown at or near the base of all schematic field sections of all trenches). APS record this material as either "a friable orangish-brown clayey sandy silt" (context 039) or "a light grey clayey silt" (context 129); it is not clear whether the difference is lateral, vertical (with finer grey above coarser browner material) or both. Nevertheless, accurate records of the maximum altitudes of these silts were taken in each trial trench, allowing a rough reconstruction of the apparent 'palaeosurface' (leaving aside for the moment the possibility of later erosion).

The 'Palaeosurface' and Intermediate Deposits

8. The 'palaeosurface' shows some relief, only c.0.70 m, but nevertheless significant in the estuarine/marsh context. In Fig.4, some key spot-heights are shown, together with interpolated contours in red. The general configuration is one of low, intermittent swells, generally elongated along the axis expected for a major roddon from the work of Hayes & Lane (1992), noted above. Significant swells occupy the western part of the Permitted Site and the extreme eastern side, with a broad shallow trough passing obliquely between. This reconstructed 'palaeosurface' is entirely plausible as broadly approximating to a real surface, given all the available geological information. Such shallow elongate swells, often placed along dominant axes like beads on a string and with several 'strings' forming sub-parallel sets, are a common phenomenon in the context envisaged, resulting from a combination of differential settlement of deeper elongate deposits, persistence of broad bounding thalwegs with slightly greater erosion and/or less sedimentation, vegetational trapping on swells, and 'overbank' or 'levée' sedimentation; it is not necessary to discover the exact combination of causes in the present case.

9. Although testpits are not optimal for the observation of sedimentary structures, it may be noted that no channel-forms were recognised in the body of the roddon complex itself. A channel-form is here defined as a localised elongate erosive feature, both 'banks' of which are present. However, several palaeochannels were indeed recognised by APS, cutting into (originating from) the 'palaeosurface' capping the roddon complex and mostly located on and around the swells. Orientations were not recorded in all cases but, where this information is available, the angles are broadly concordant with the 'palaeoslopes' and general morphology.

This is an added element in the argument that the reconstructed 'palaeosurface' indeed approximates to a true surface. Persistent smaller-scale (say, 1-5 m across) channel-forms are often a sign of at least intermittent emergence. In those cases where APS give details, the fill of these features appears to be dominated by concordant beds, that is, roughly concentric geometries, deposited from the outside inwards until the channels were completely filled; there is little sign of major recutting events significantly after the onset of sedimentation. Again, this is often a sign of regression and emergence.

10. At no point in the testpits was any macroscopic pedological effect (e.g. total homogenisation by bioturbation, curing effects producing peds, translocation of iron compounds or other horizon formation, terrestrial animal burrows, tree-throw phenomena) noted at the stratigraphic level of the reconstructed 'palaeosurface'. It is very unlikely, therefore, that the higher points of the 'palaeosurface' became well drained or even that emergence persisted for any great length of time. The environment would merely have consisted of low banks of damp ground, surrounded by shallow tidal marsh.

11. This is precisely the type of environment in which salt production would be most efficient, when there would have been ample access to shallow salt water, without any great risk of destructive tidal inundation. The remains of Late Iron Age and Early Roman period salterns identified by APS lie in a slight 'col' (itself possibly at least enhanced by human activity) across the eastnortheastern 'nose' of the western 'palaeosurface' swell, in a position where it might have been possible to derive water of slightly different chemical and thermal characteristics from either north or south. The very slightly raised (only c.0.20 m) zones immediately to the east and west would have provided drier working areas as necessary. Thus, the salterns are actually in a predictable location, given knowledge of the palaeogeography. Conversely, one can be reasonably sure that primary remains will not occur further east, in the broad trough. The swell on the next 'string' to the east is only just apparent at the very eastern edge of the Permitted Site; no traces of archaeological material were noted by APS at this point, any additional salterns perhaps lying beyond the Permitted Site further along the swell. It is noteworthy that the remains of another possible saltern (small derived briquetage fragments) have recently been noted (Tann 1997) during a watching brief centred at TF 2315 2200, at Horse Fayre Fields only some 200 m distant and probably on or near the next swell of the same 'string' occupied by the salterns within the Permitted Site; no certain dating material was present but Tann concluded that a (possibly early) "Romano-British date" would not be inconsistent with the available evidence.

Upper Deposits

12. APS show mid-brown or orange-brown silts (e.g. Context 130 in their schematic field sections), occurring intermittently in the trial trenches, especially at locations upon or on the flanks of the underlying roddon swells; in the report text, at least some of these are interpreted as alluvium. Traces of similar material were also noted in a few of the testpits (e.g. TP5). The topographic position and more oxidised colours of these silts indeed suggest generally fluvially derived floodloams, deposited at a time when marine influence had receded somewhat further northeast. In Fig.4, some key spot-heights are shown, together with interpolated contours of uppermost occurrence in blue, although it should be remembered that these deposits are not continuous. The general impression is that the alluvium is draped over and against the 'palaeosurface' swells, again confirming the reality of the latter. There does not seem to have been widespread erosion of the old swells at this time.

13. In their schematic field sections, APS consistently show Context 127 as being the topmost deposit in all their trenches; the sections are labelled "topsoil". The context list in the report notes the presence of Context 127, a "mid grey-brown clayey silt", interpreted as "topsoil" in all trenches (with apparent correlation with Context 091 in T5); the list also includes Context 128, a "dark-grey silt", interpreted as "subsoil", in all

trenches (but not shown in this position in the report section drawings). In the report text, these and other localised Contexts, usually present in thicknesses of up to 0.40 m, are said to be associated with the modern development of the site as a garden centre. Some obvious modern made ground (in one case with asphalt) was also noted at a few locations.

14. Observation during the testpitting showed deposits assumed to be those recorded by APS as Contexts 128 and 127. However, the interpretation of these deposits as recent 'soils' is incorrect. The true soils on this site (as seen in the more peripheral testpits TP2, TP6 and TP7) are very shallow (no more than 10 cm) undifferentiated humic horizons, almost certainly developed under turf (not arable cultivation); Cope-Faulkner (1997) reports an undated (but presumably early 19th. century) map, *A Plan of the Parish of Spalding in the County of Lincoln* by George Clarke, which shows the Permitted Site as "commons". The layout of the garden centre (greenhouses) is known (mapped). Concrete foundations are present which held the walls of the greenhouses and ancillary structures, and there are minor surface spreads of asphalt and disturbed rubble. Within former greenhouse areas, the turf has been removed, thin (0.5 cm) expanded polystyrene sheets have been laid and a consistent 10 cm thick layer of fluvial coarse sand/grit (the horticultural medium) has been spread. The remaining silts are neither tilth nor made ground but well structured natural (sedimentary) deposits.

15. As observed in all the testpits, these uppermost natural deposits consist of brown-grey to grey silts and silty clays, usually showing quite good laminar bedding (with good textural differentiation and low amplitude waviness) but with patches of fluid injection and plastic deformation in places nearer the base. Clayier beds often contain floating sand grains and even isolated pebbles. There are very common tiny dark flecks of organic matter, which give the deposits their generally grey reduced colours (usually darkening downwards). Very dark silts, with slightly fibrous peat lenses (up to 5 cm thick) and common marine shell fragments (very fragile but probably including *Mytilus* sp.), occur at the base of these deposits in TP3, TP4, TP5 and TP6; small peaty relicts and wood fragments occur even in the upper portions of TP3 and TP4. Blue-grey clayey silt occurs below the peat in TP5 and TP6. Minor ichnofossils, consisting of thin unbranching vertical Fe-stained tubes (often clumped), are quite common, and probably represent sparse marine grass vegetation; rare and small J-tubes are characteristic of marine worms. A slightly unusual sequence occurs at TP7, with light ginger silty sand, representing a stronger current episode, lying between upper silts and lower peat. The term 'peat' is used here in a general sense; rather than true peat (*in situ* growth), further study might well show this material to be partially fibrous organic detritus. At TP4, TP8 and TP9 tiny fragments of reworked red fired material (probably from briquetage) and charcoal are present near the base, often concentrated along partings; APS report a similar situation in Context 019 of T20.

16. This body of silty sediment represents the onlap of marsh (rather ephemeral) and then intertidal mudflat conditions during a broadly post-Roman marine transgression. Whilst the presence of reworked archaeological material in some sequences indicates a little erosion of saltern debris, the modern ground surface (shown in Fig.4 by the dashed black contours) still parallels the underlying swell topography of the old roddon complex; the larger lithorelics and wood fragments in TP4 and TP5 suggest that stronger tidal currents were maintained along the old trough still passing obliquely across the Permitted Site.

17 Tann (1997), at the Horse Fayre Fields site noted above, recorded a similar sequence of deposits above the traces of saltern activity. He recognised "inundation" silts, re-organising finer debris from the saltern, then a thin peat (interpreted by him as due to a short period of drier conditions with *in situ* vegetation, followed by waterlogged decay), the whole capped by (disturbed) silts, interpreted by Tann as probably from a marine transgression.

18. Within the Permitted Site, there are no deposits referable to a post-transgression period, merely the minimal humic soils, noted above, at points undisturbed by the garden centre.

References

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Figure Captions

Figure 1. Trial Trench locations (based upon Herbert 1997: fig.4) with Testpit (12.12.97) locations added.

Figure 2. Schematic field sections for Trenches 1-10 (kindly supplied by APS).

Figure 3. Schematic field sections for Trenches 11-18 and 21-22 (kindly supplied by APS).

Figure 4. Selected spot-heights and interpolated contours (from APS data) at various stratigraphic levels (based upon Herbert 1997: fig.4)

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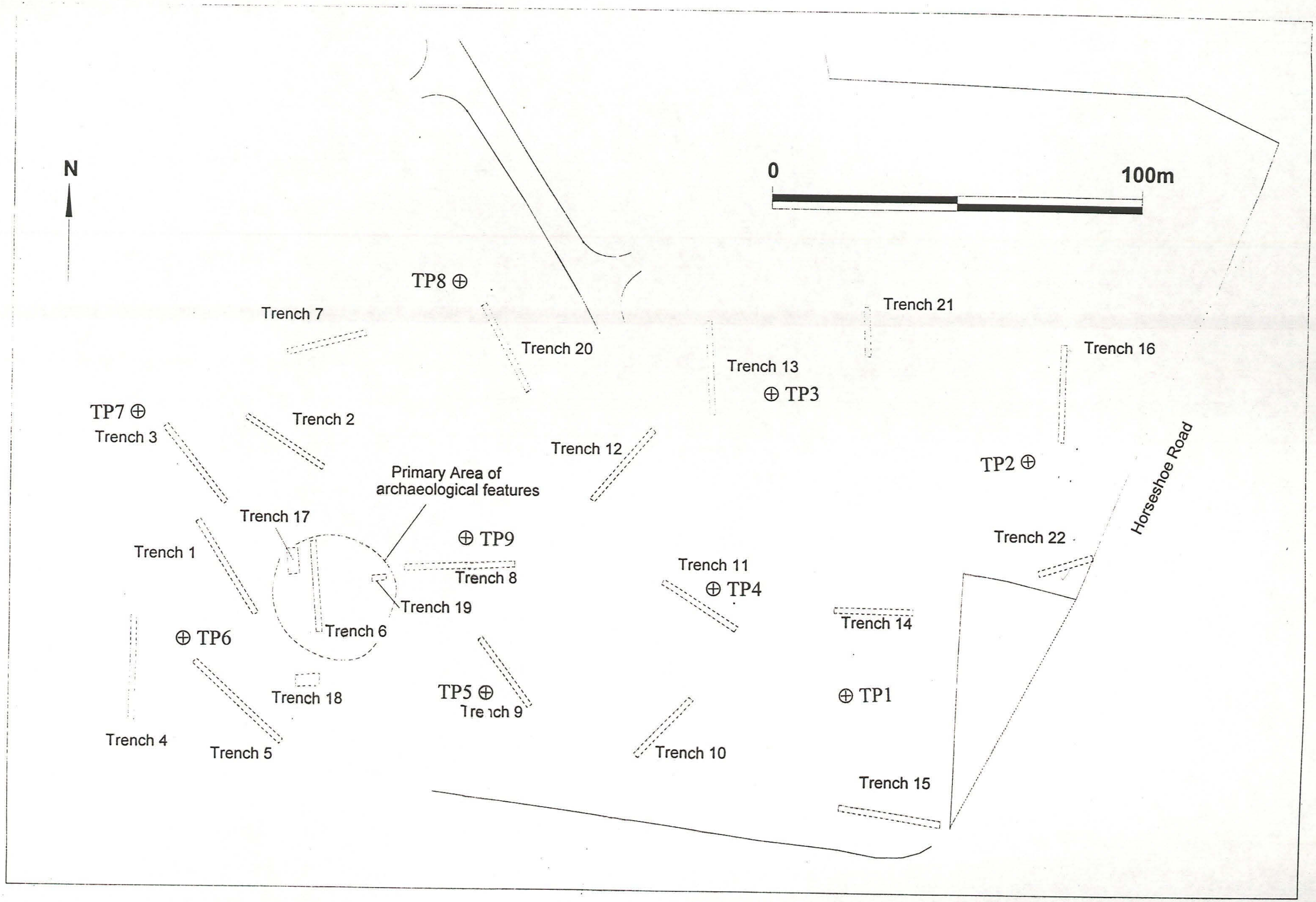

Figure 1. **Trial Trenches & Testpits**

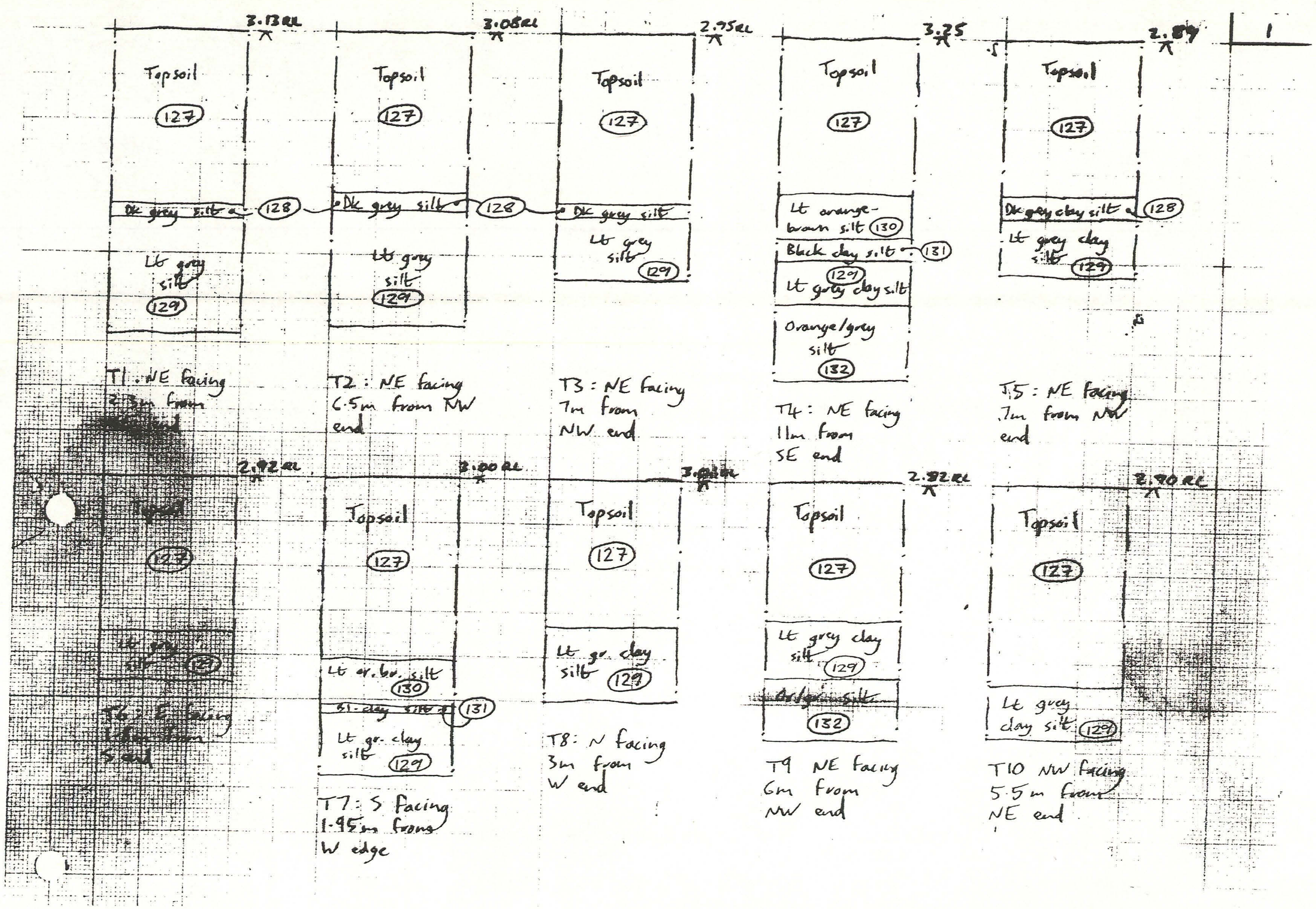

Figure 2. APS Schematic Sections

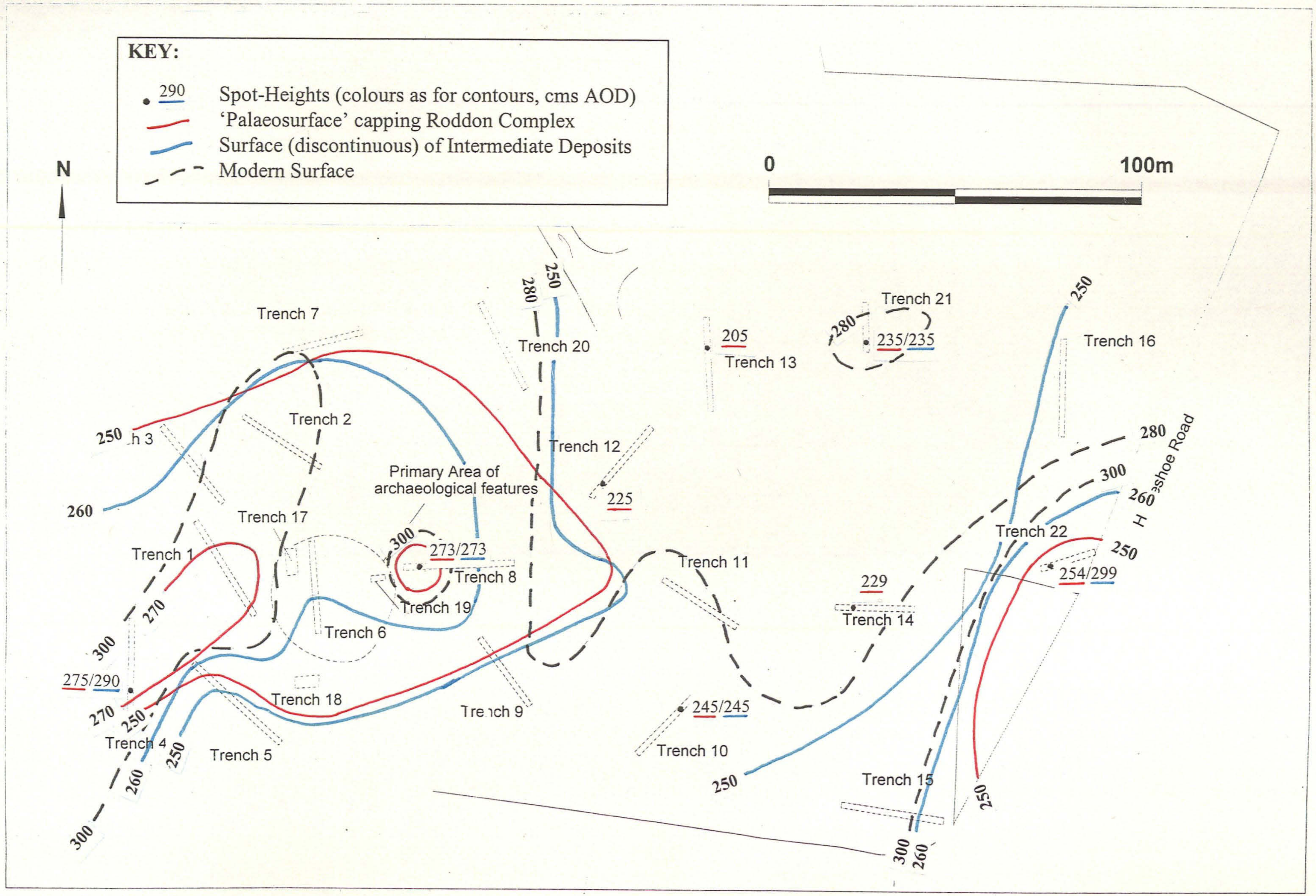

Figure 4. Altitudinal Data

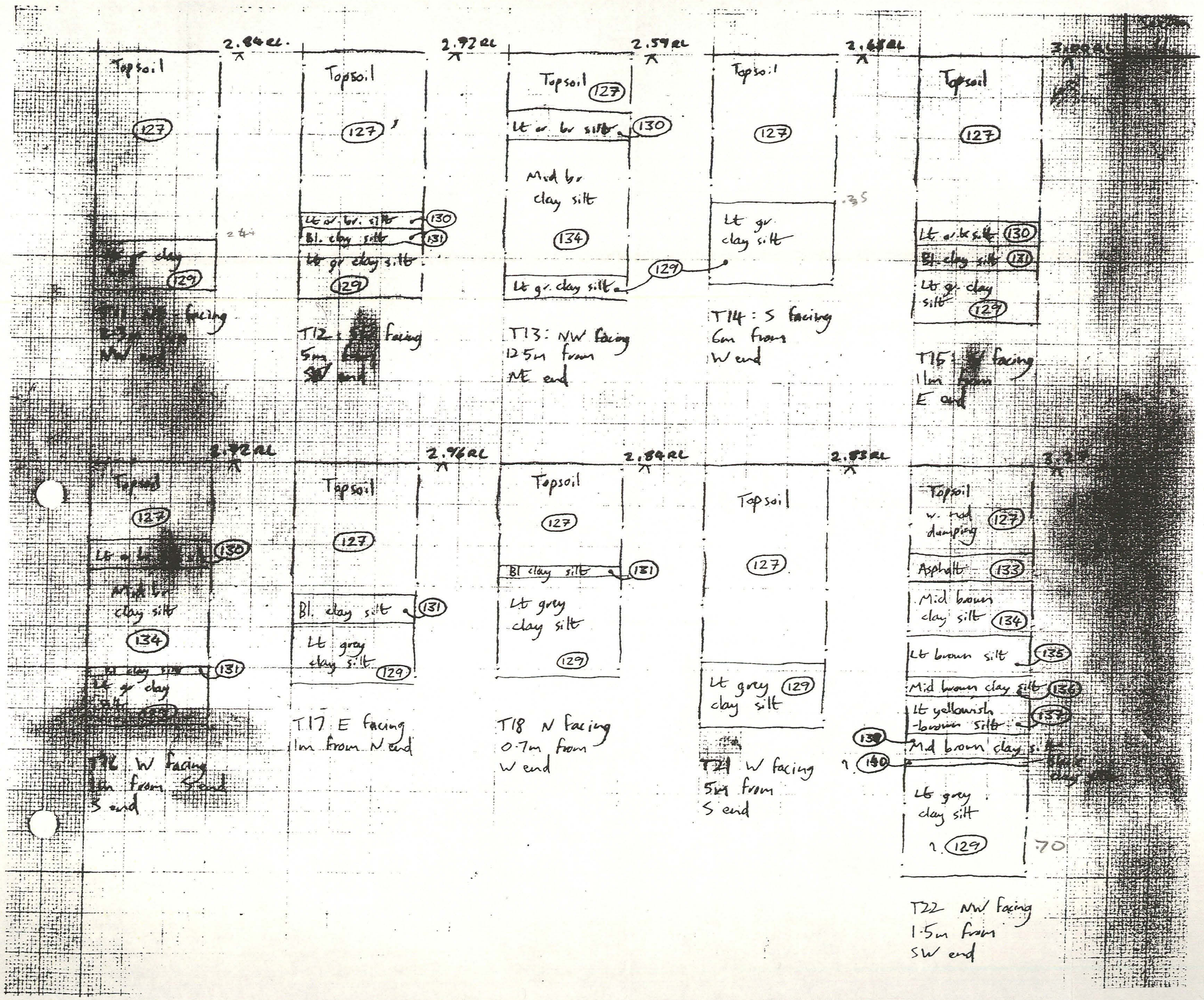

Figure 3. APS Schematic Sections