

OR/15/064 Cross section interpretation

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[Jump to navigation](#) [Jump to search](#)

Ford, J R, Hughes, L, Burke H F and Lee, J R. 2015. The Vale of Pickering: an initial summary of the Quaternary/superficial geology and data holdings. *British Geological Survey Internal Report, OR/15/064*.

Borehole data, a DEM and 1:50 000 scale surface geological linework have been used to construct an interim set of schematic cross-sections through the Vale for the Quaternary succession (the software and methodology used in this study are described by Mathers & Kessler 2008)^[1]. These cross-sections (located on Figure 11) are largely interpretative and should be considered as schematic representations of the superficial geology for the purpose of developing a conceptual (hydro-) geological understanding of the area for the Vale of Pickering environmental baseline monitoring project. Ongoing work will further increase the level of constraint and confidence in these sections and assess the viability of progressing to a 3D geological framework model.

For the purpose of constructing the schematic cross-sections, the borehole logs have been hung from the DEM. In some cases, this has superseded the start height recorded on the log or shown in SOBI. Hence, the elevation of the Quaternary succession shown in the sections may differ slightly from that derived directly from the logs. A key to the interpreted Quaternary succession and corresponding lithological descriptions for the logs included in the cross-sections is shown in Figure 12.

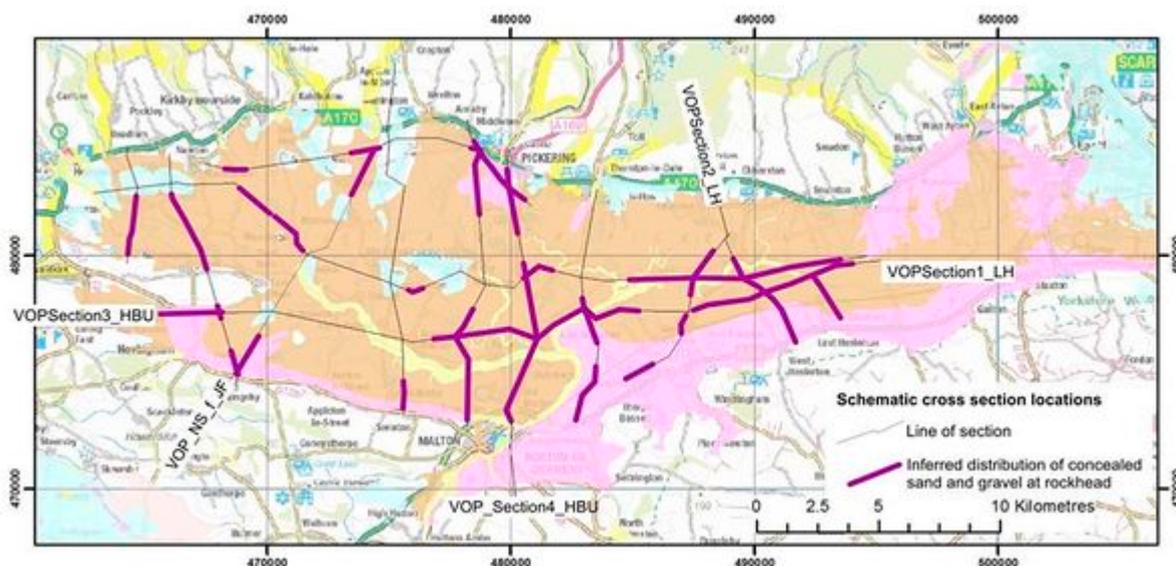


Figure 11 Map showing inferred distribution of concealed sand and gravel deposits at rockhead based on the schematic cross sections.

Interpreted Quaternary succession shown on cross-sections:

- Alluvium (mostly fine-grained unconsolidated sediment)
- Lacustrine deposits (upper unit with common sand and gravel)
- Sand and gravel (within and above lacustrine deposits)
- Lacustrine deposits (mostly clay & silt with some coarse-grained sediment)
- Sand and gravel (basal deposit)
- Till ('boulder clay')
- Bedrock (mostly mudstone)

Primary lithology in borehole log:

- Soil / peat
- Gravel
- Sand
- Silt
- Clay
- Mudstone / bedrock
- Redaction of confidential log

Ground surface (based on NextMap)

ASTM Rockhead (described in text)

Figure 12 Key to the schematic cross-sections.

Brief explanation of the superficial geology based on the borehole review and schematic cross sections

Alluvium — Mostly fine-grained poorly consolidated sediment associated with the modern-day drainage network, the precursor for which was established following the draining of ‘Lake Pickering’. Due to the flat-lying nature of the Vale and the low-permeability substrate it is likely that the alluvium will locally contain organic deposits and although no isolated peat deposits are shown on the Pickering 1:50 000 scale map, it is likely that bodies of peat will be present. Close to the higher ground flanking the Vale, coarser-grained alluvial deposits should be expected.

A confident differentiation between alluvium and (the older) lacustrine deposits can be problematic in low-lying areas due to limited contrast in lithology and surface morphology. The Vale of Pickering shares many similarities with the Vale of York (Ford *et al.*, 2008)^[2], where observations indicate a continuum between alluvium and lacustrine deposits in some areas.

Blown sand (postulated occurrence, not shown on the cross-sections) — Although no blown sand deposits are shown on the published data, observations from the Vale of York suggest that such deposits may be present in the Vale of Pickering, having developed following the draining of Lake Pickering. If so, these deposits are likely to occur at surface as a thin (1–2 m max) veneer of fine-grained, well-sorted sand.

Lacustrine deposits — During the Late Devensian, North Sea ice and corresponding glaciogenic deposits in the east, and similar restrictions in the west, impounded drainage within the Vale. This resulted in the inundation of the area and the formation of (Glacial) Lake Pickering. This lake was fed by corresponding meltwaters in the east and west and by active drainage from the Wolds to the south and the Tabular Hills to the north.

The lacustrine deposits are shown on the map as “clay and sand, locally with peat”. Borehole data confirms that these deposits are predominantly fine-grained, composed of clay and silt. It is likely that the clay and silt are thinly interlaminated. The lower lacustrine unit shown in the sections represents this fine-grained ‘facies’ of the lacustrine deposits.

The lacustrine succession shows a coarsening of sediment in the upper part. This is most pronounced in the south and east of the area, where in the cross-sections, a body of interbedded clay, sand and gravel has been correlated over a large part of the Vale. The upper lacustrine unit shown on the cross-sections represents this interbedded fine- and coarse-grained facies of the lacustrine deposits. Borehole evidence suggests that several sand or gravel horizons within this unit may be correlated over distances in the order of several kilometres (e.g. as shown in the eastern-most part of the sections illustrated in Figure 13). This facies is thought to pass laterally into the fine-grained facies with smaller, discreet and possibly less continuous beds or lenses of sand and gravel.

In addition to the broadly defined facies described above, more localised lithological variation within the lake succession should be expected. It is likely that coarser-grained (silt- or sand- dominated) horizons will be present, possibly emanating from the contemporaneous drainage systems that fed the lake. These horizons may occur at several levels within the lake deposits and may be laterally persistent. Equivalent clay-dominated lacustrine deposits in the Vale of York contain saturated silty sand horizons up to 2.5 m in thickness that extend laterally in the subsurface for more than 10 km. In the present study, several ‘lenses’ of sand or gravel that have been inferred from borehole

evidence and included in the cross sections (e.g. Figure 15).

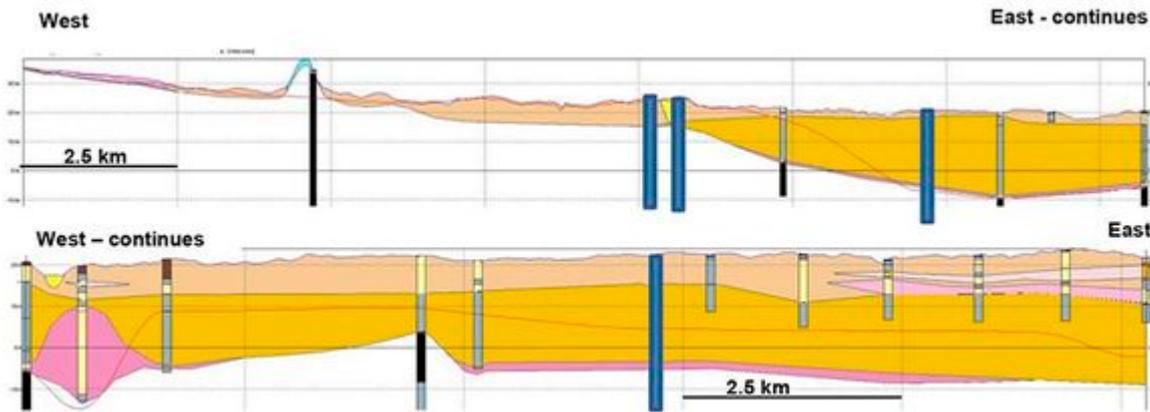


Figure 13 West-east oriented schematic cross section, split into two parts (VOPSection3_HBU and VOPSection1_LH; about 50 times vertical exaggeration; for section location and key see Figure 11 and Figure 12).

Sand and gravel deposits — Several areas of sand and gravel coincide with the opening of confined river valleys on the Vale’s norther margin. These deposits are interpreted as delta/fan deposits (patches of sand and gravel shown on the northern edge of the Vale in Figure 3 and corresponding topographic features highlighted in Figure 2). It is likely that the rivers were active at times during the Late Devensian and that sand and gravel that is mapped at surface may extend into the lake succession at depth. Rivers that have little or no current expression at surface may have been active during the early stages of Lake Pickering. Such rivers may have deposited coarse-grained sediment that is now entirely concealed. Little is known about the lateral extent, continuity or orientation (i.e. if channel-like in form) of these rivers or any corresponding deposits.

The southern margin of the superficial deposits of the Vale is largely represented by “sand and gravel of uncertain age”. The relative distribution of these deposits appears similar to those observed on the eastern flank of the Vale of York, and may represent sheets of gravel and shoreline deposits that were sourced from the limestone and chalk bedrock to the south. If analogous to the marginal sand and gravel deposits in the Vale of York, these deposits may be expected to interdigitate with the lacustrine deposits and form laterally persistent horizons within or below the lake sediments (see above).

Borehole evidence indicates that sand and gravel deposits occur at depth in the Vale. These deposits can be identified in adjacent borehole logs (e.g. Figure 14). In the absence of additional borehole evidence, they are interpreted in the schematic sections as having lateral continuity with the sand and gravel mapped at surface (e.g. Figure 14).

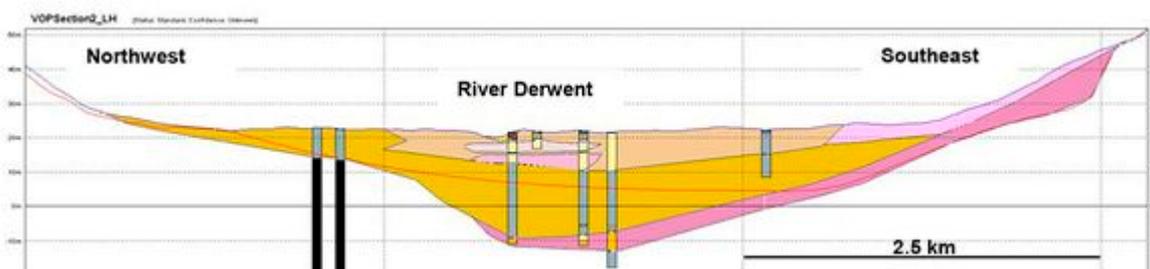


Figure 14 Northwest-southeast oriented schematic cross section (VOPSection2_LH; about 25 times vertical exaggeration; for section location and key see Figure 11 and Figure 12).

However, it should be noted that alternative interpretations could be made, for example to model the

sand and gravel that is encountered at depth as a separate body to that mapped at the surface. In Figure 14 this would be shown as deposit of sand and gravel occupying the rockhead depression in the centre of the Vale, isolated by fine-grained lacustrine deposits from that on the edge of the Vale (for example, as shown in Figure 15 where the concealed sand and gravel deposits at depth in the centre of the Vale are inferred to be contiguous with those mapped at surface in the south but isolated from equivalent deposits in the north).

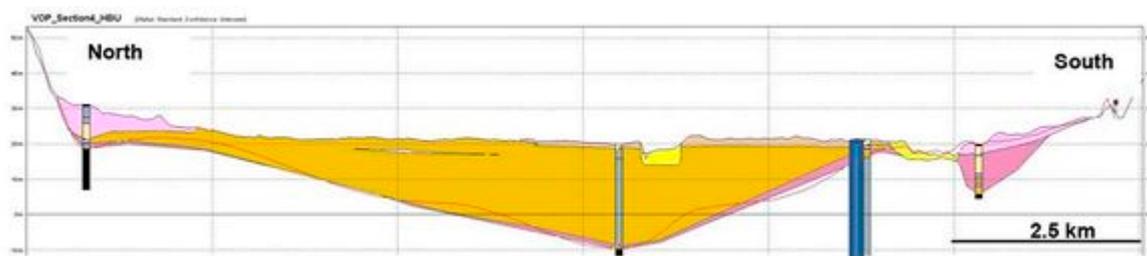


Figure 15 North-south oriented schematic cross section (VOP_Section4_HBU; about 50 times vertical exaggeration; for section location and key see Figure 11 and Figure 12).

The cross-sections show a schematic/simplified representation of the concealed sand and gravel. The inferred distribution of concealed sand and gravel deposits at rockhead based on the schematic cross sections is shown in Figure 11. The actual extent of these deposits may differ from that shown and additional bodies may be present that have not been depicted by this study.

Till — Till is a poorly-sorted sediment composed of clay, silt, sand and gravel that was deposited by a glacier. Isolated patches of till are shown on the map, occupying topographic highs within or at the margin of the Vale (Figure 3). These deposits are inferred to pre-date the formation of Lake Pickering. It is suggested that the till is discontinuous at depth and may not extend any great distance away from the topographic highs where it is preserved. The borehole and cross-section studies support this premise: no firm evidence was found to suggest that the till extends for any significant distance at depth beneath or within the lacustrine deposits adjacent to the hills such as those at South Holme, Great Barugh and Kirby Misperton (e.g. Figure 16). The 3D geometry of the till shows that it caps and forms a drape on the flanks of these topographic highs — the material mapped as till on the flanks is likely to represent re-worked material (i.e. ‘head’, rather than insitu till). The till-capped topographic highs within the Vale may represent local sources of coarse-grained sediment within or beneath the lacustrine succession.

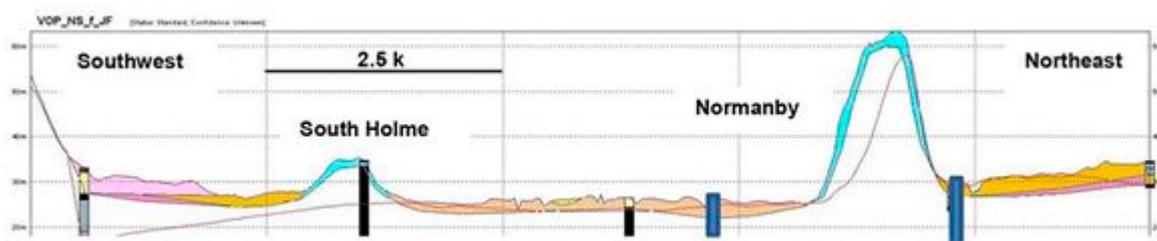


Figure 16 Southwest-northeast oriented schematic cross section (VOP_NS_f_JF; about 50 times vertical exaggeration; for section location and key see Figure 11 and Figure 12).

Borehole information in the north of the Vale, close to the limit of the lacustrine deposits and adjacent to an area where extensive areas of till have been mapped around Kirby Mills, indicate that till deposits may extend at depth in this area, concealed beneath the lacustrine succession. This suggestion is based on the recorded presence of boulders and gravelly clay at rockhead. Alternative genetic interpretations for these deposits also includes their classification as head deposits (i.e. soliflucted material), or an admixture of gravel and clay deposits, including weakened bedrock

(formed by weathering, permafrost, drilling or sampling).

The till of the Vale was targeted by BGS-led drilling in recent years as part of ongoing research into the glacial evolution of the area. Results and interpretations based on these boreholes, including schematic cross sections and the geological evolution outlined above forms the basis of a draft paper on the region's Quaternary geology (Powell and Ford, in prep.)^[3]

References

1. [↑](#) MATHERS, J and KESSLER, H. 2008. GSI3D: the software and methodology to build systematic near-surface 3-D geological models. Version 2.6
2. [↑](#) FORD, J, COOPER, A, PRICE, S, GIBSON, A, PHARAOH, T and KESSLER, H. 2008 Geology of the Selby district: a brief explanation of the geological map Sheet 71 Selby. Nottingham, UK, British Geological Survey, 34pp. (Explanation (England and Wales Sheet), 71).
3. [↑](#) POWELL, J H and FORD, J R. In Prep. Pre-Ipswichian tills from the Vale of Pickering and Tabular Hills, north-east Yorkshire.

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- [Discussion](#)

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- [View history](#)
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