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FLANDRIAN SEA-LEVEL CHANGES AND IMPACTS OF PROJECTED SEA-LEVEL RISE ON THE COASTAL LOWLANDS OF MORECAMBE BAY AND THE THAMES ESTUARY, U.K.

VOLUME TWO
Figures and Appendices

by

YONGQIANG ZONG

A Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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Department of Geography
The University of Durham



February 1993

12 MAY 1993

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博士毕业论文

宗永强

都林大学地理系
英国

FLANDRIAN SEA-LEVEL CHANGES AND IMPACTS OF PROJECTED SEA-LEVEL RISE ON THE COASTAL LOWLANDS OF MORECAMBE BAY AND THE THAMES ESTUARY, U.K.

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FIGURE 1.1.

The framework of the Thesis.

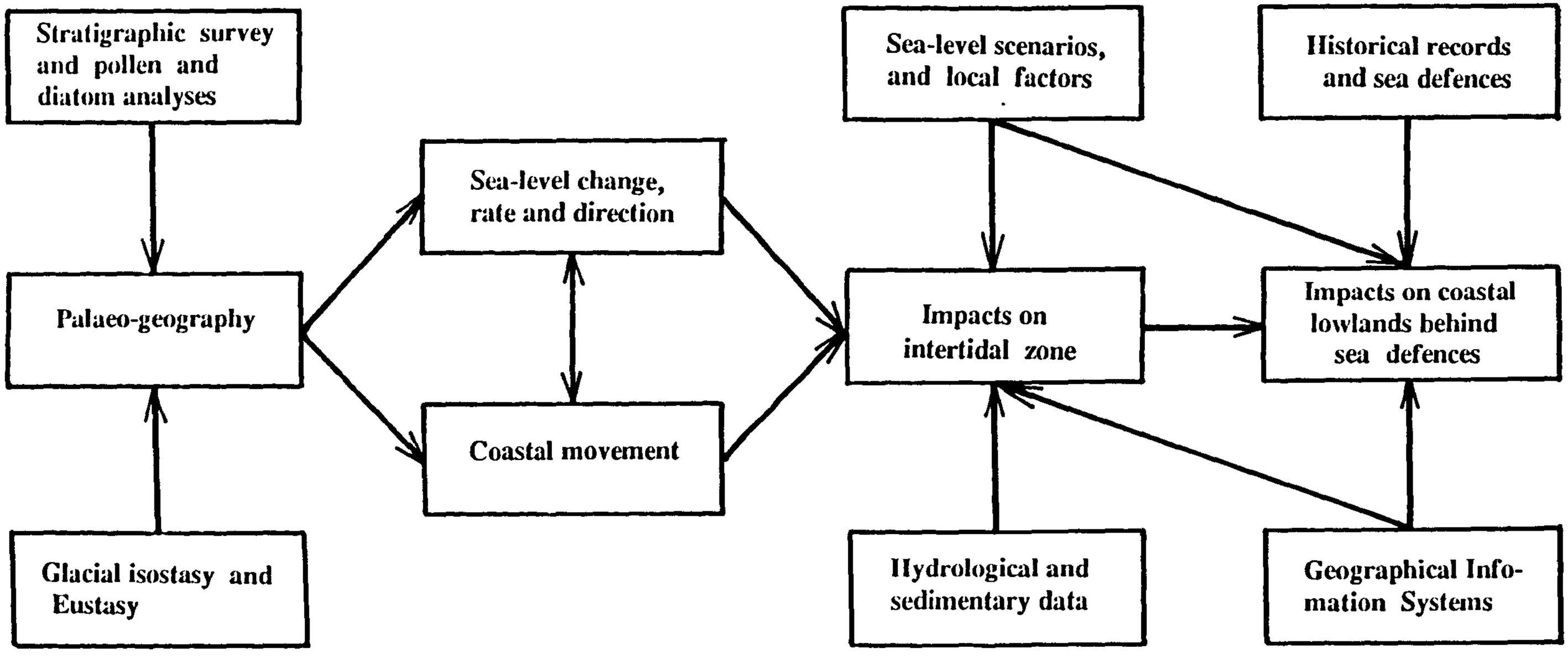

Stratigraphic survey and pollen and diatom analyses
Sea-level scenarios, and local factors
Historical records and sea defences
Sea-level change, rate and direction
Palaeo-geography
Impacts on intertidal zone
Impacts on coastal lowlands behind sea defences
Coastal movement
Glacial isostasy and Eustasy
Hydrological and sedimentary data
Geographical Info-mation Systems

FIGURE 1.2.

Two diagrams showing contrast stratigraphies resulted from different sea-level histories.

A: Sea level rose and fell alternatively,
B: Sea level rose rapidly and slowly alternatively.

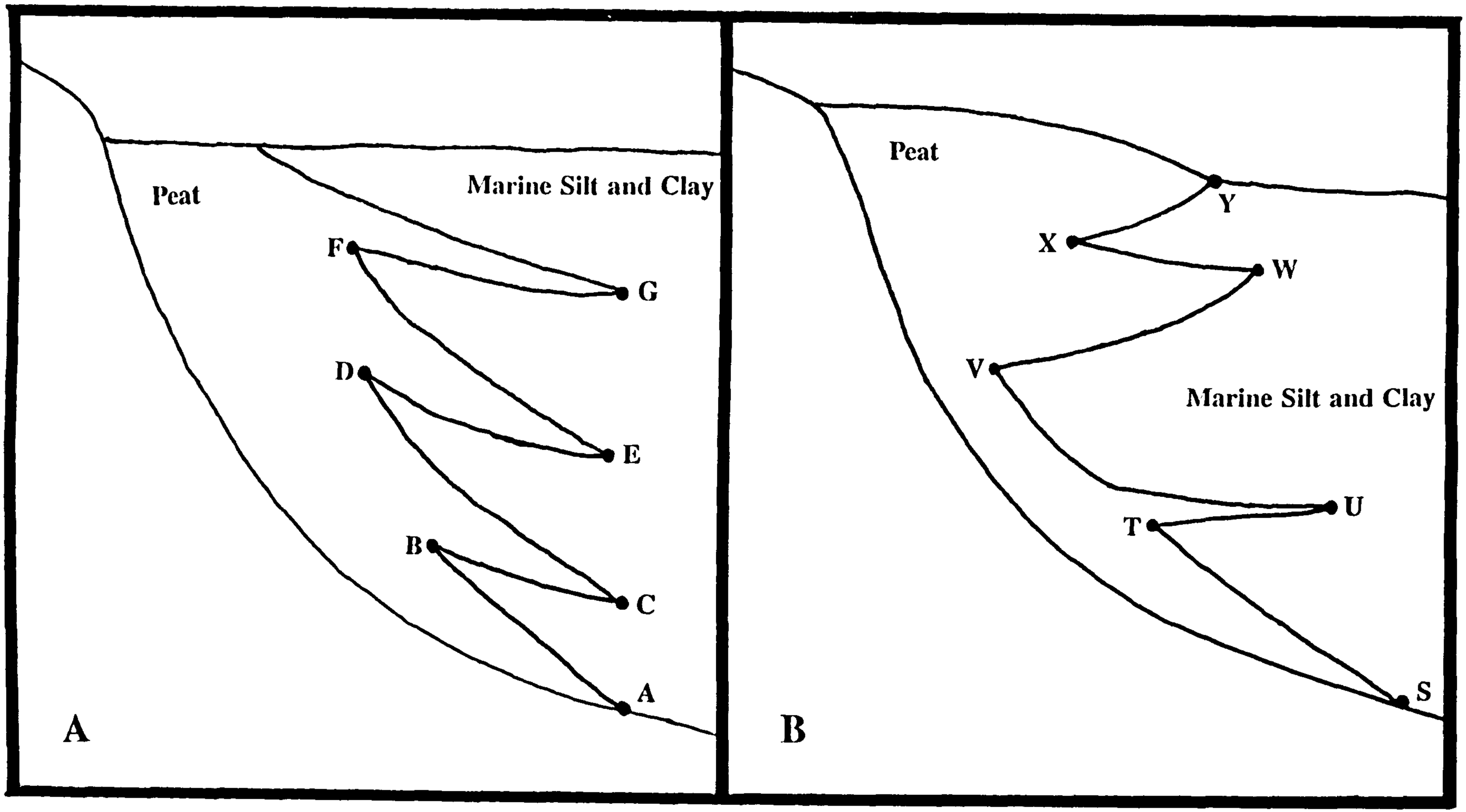

Peat
Marine Silt and Clay
F
G
D
E
B
C
A
A
Peat
Y
X
W
V
Marine Silt and Clay
U
T
S
B

FIGURE 1.3.

A map of the British Isles, showing the areas investigated.

1: Morecambe Bay, Northwest England
2: The Thames Estuary, Southeast England.

THE BRITISH ISLES

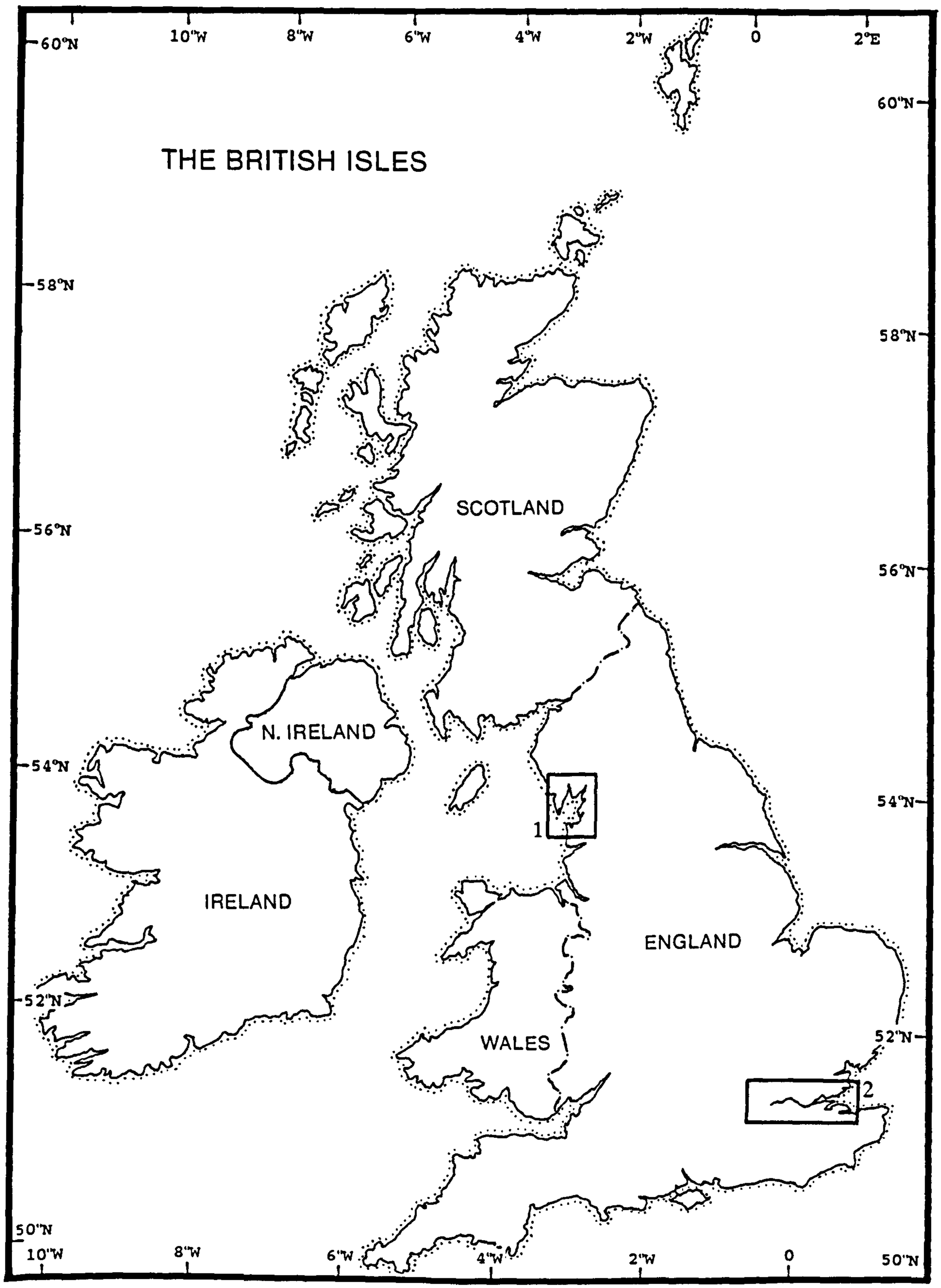


FIGURE 1.4.

Morecambe Bay --- Study area 1.

with urban and industrial areas shaded and the +10 metre contour showing the lowlying areas.

source: see Table 3.1.

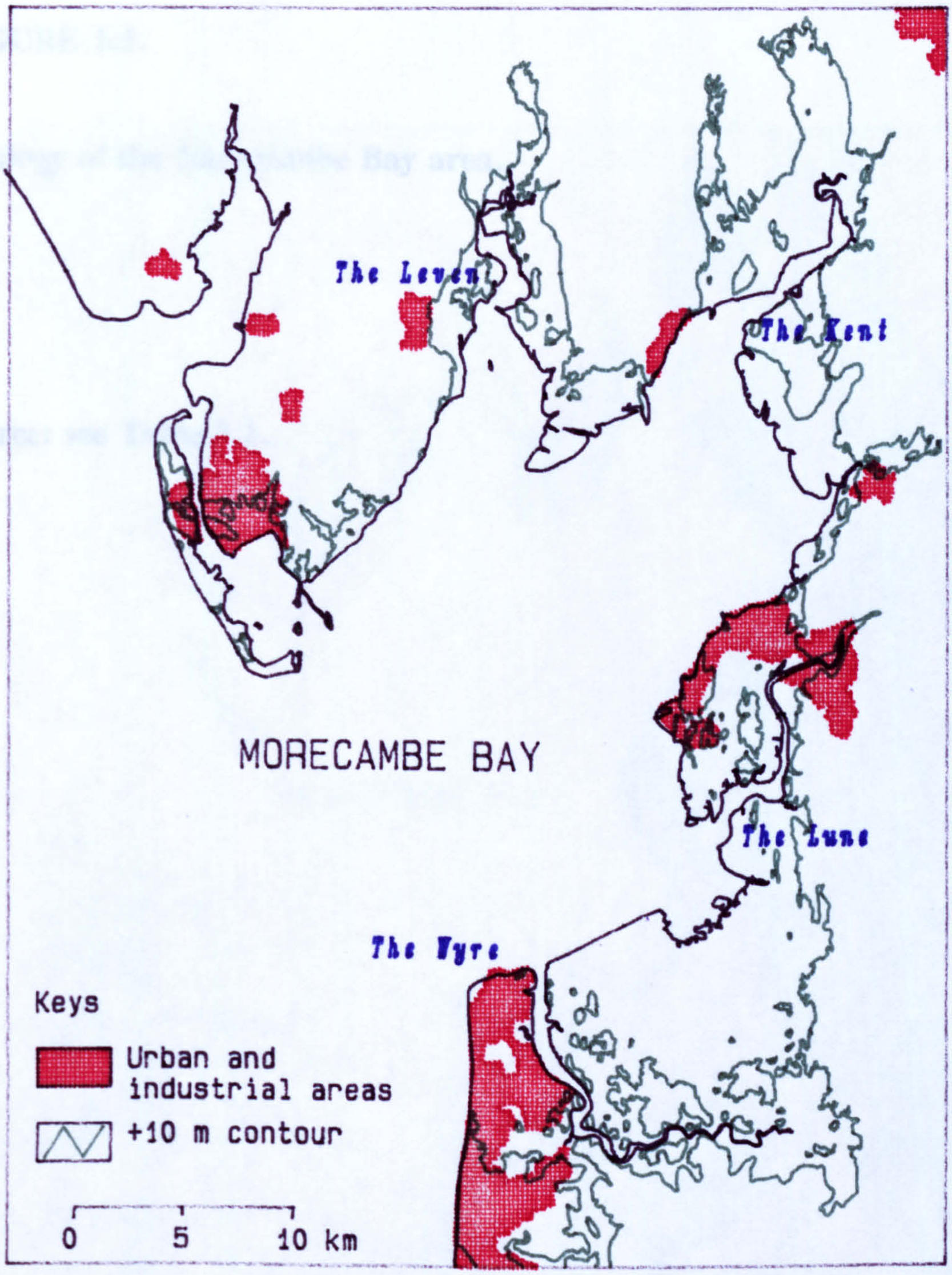


Fig. 1.4. Morecambe Bay --- investigated area 1, with urban and industrial areas and +10 m contour (source: see Table 3.1.)

FIGURE 1.5.

Geology of the Morecambe Bay area.

source: see Table 3.1.

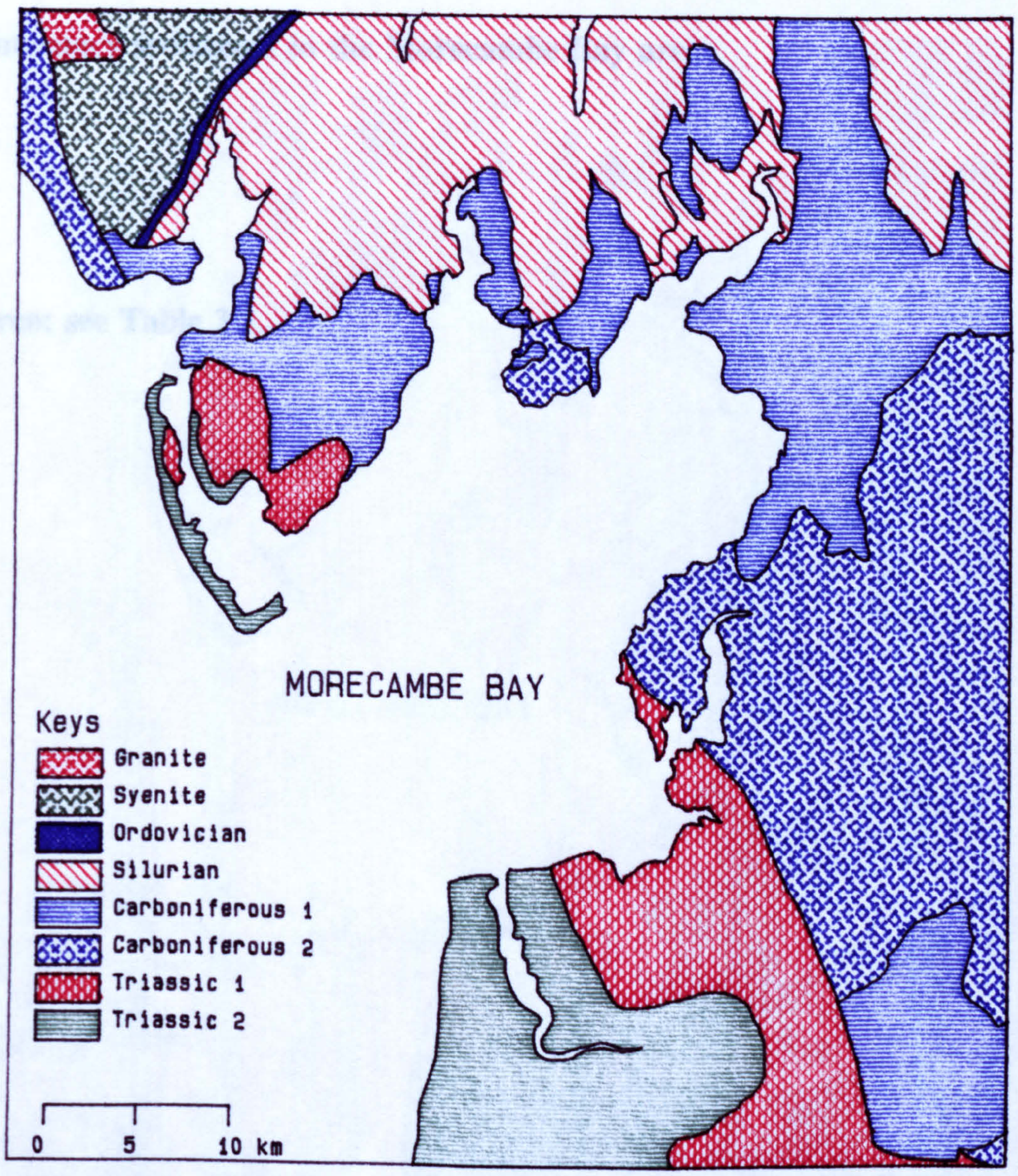


Fig. **1.5.** Geology of the Morecambe Bay area

(source: see Table 3.1.)

FIGURE 1.6.

Quaternary sediments in the Morecambe Bay area.

source: see Table 3.1.

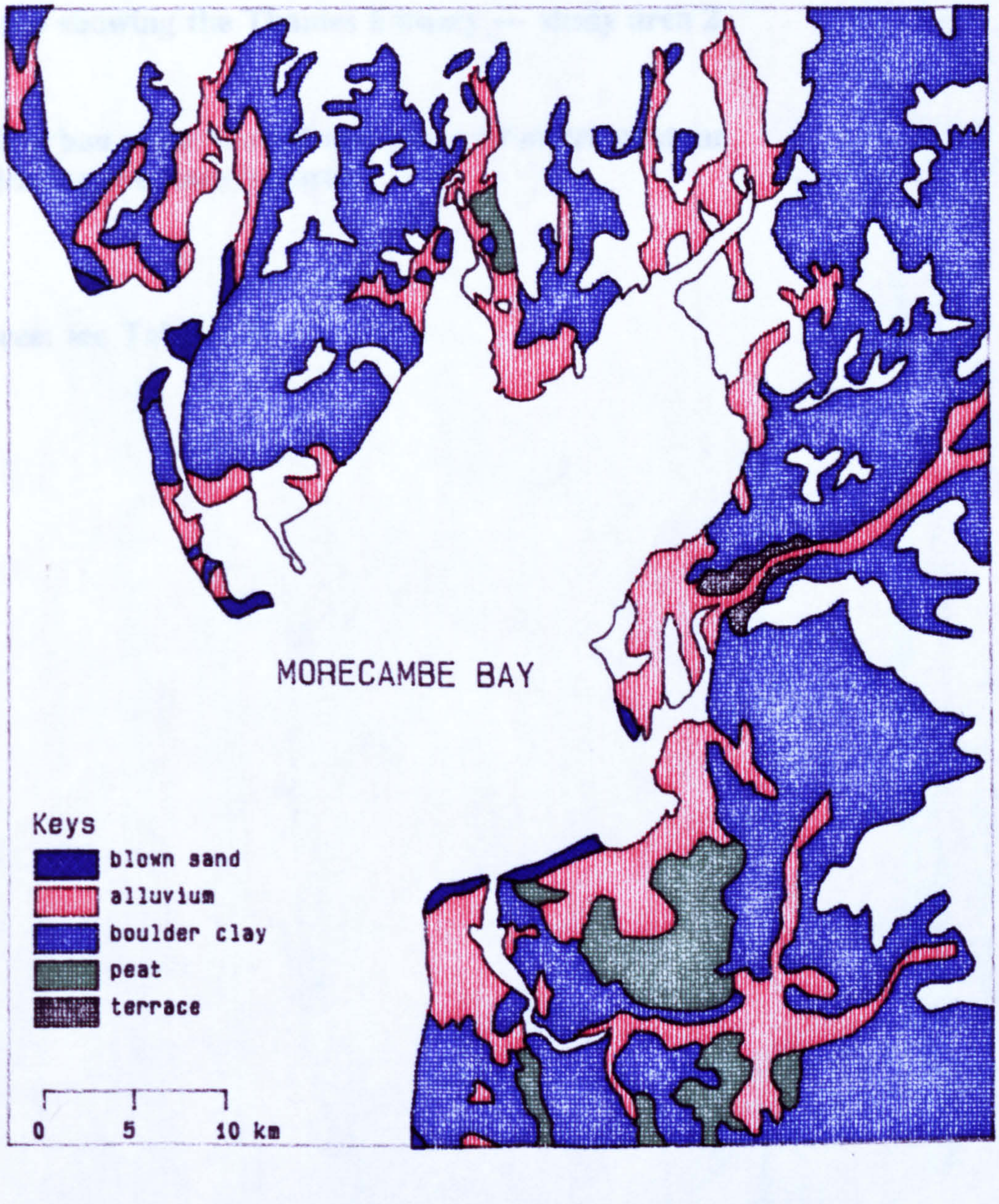


Fig. **1.6.** Quaternary sediments in the Morecambe Bay area

(source: see Table 3.1.)

FIGURE 1.7.

A map showing the Thames Estuary --- study area 2. with urban areas shaded and the +10 metre contour indicating the lowlying areas.

source: see Table 3.1.

THE THAMES LOWLANDS

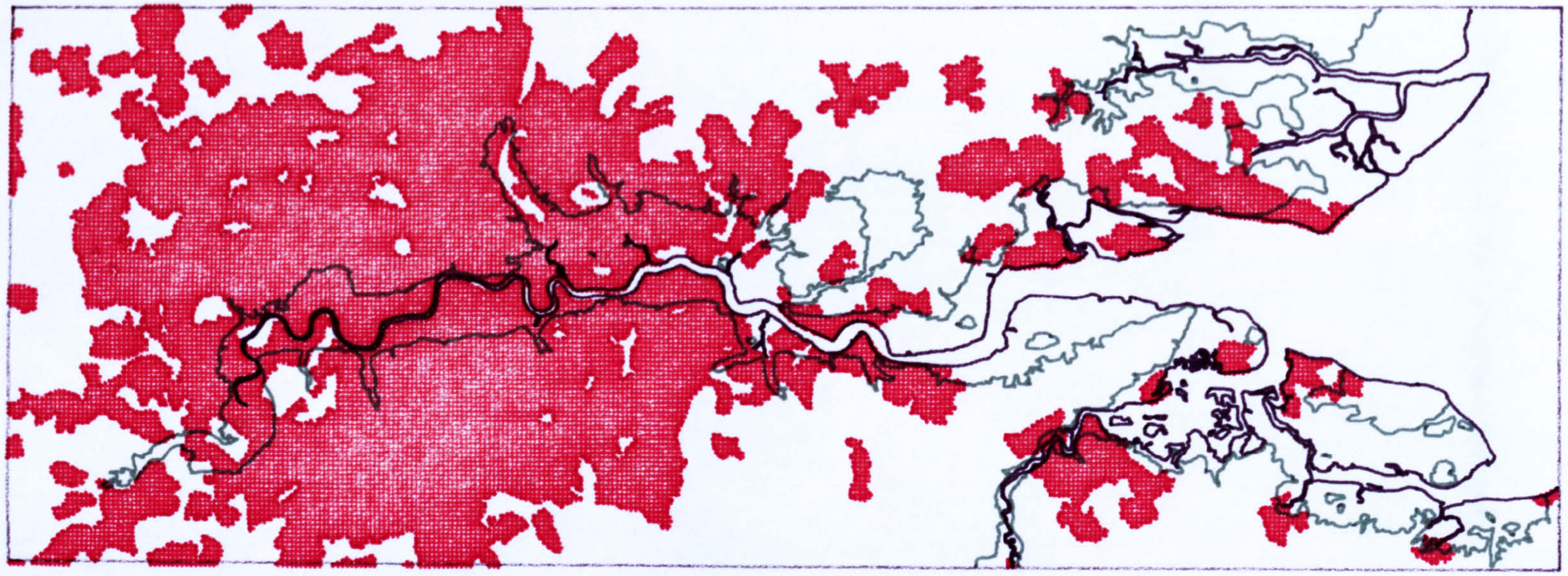


Fig. 1.7. A map showing the Thames Estuary --- investigated area 2, with urban and industrial areas and +10 m contour line.
(source: see Table 3.1.)

FIGURE 1.8.

A geological map of the Thames Estuary.

source: see Table 3.1.

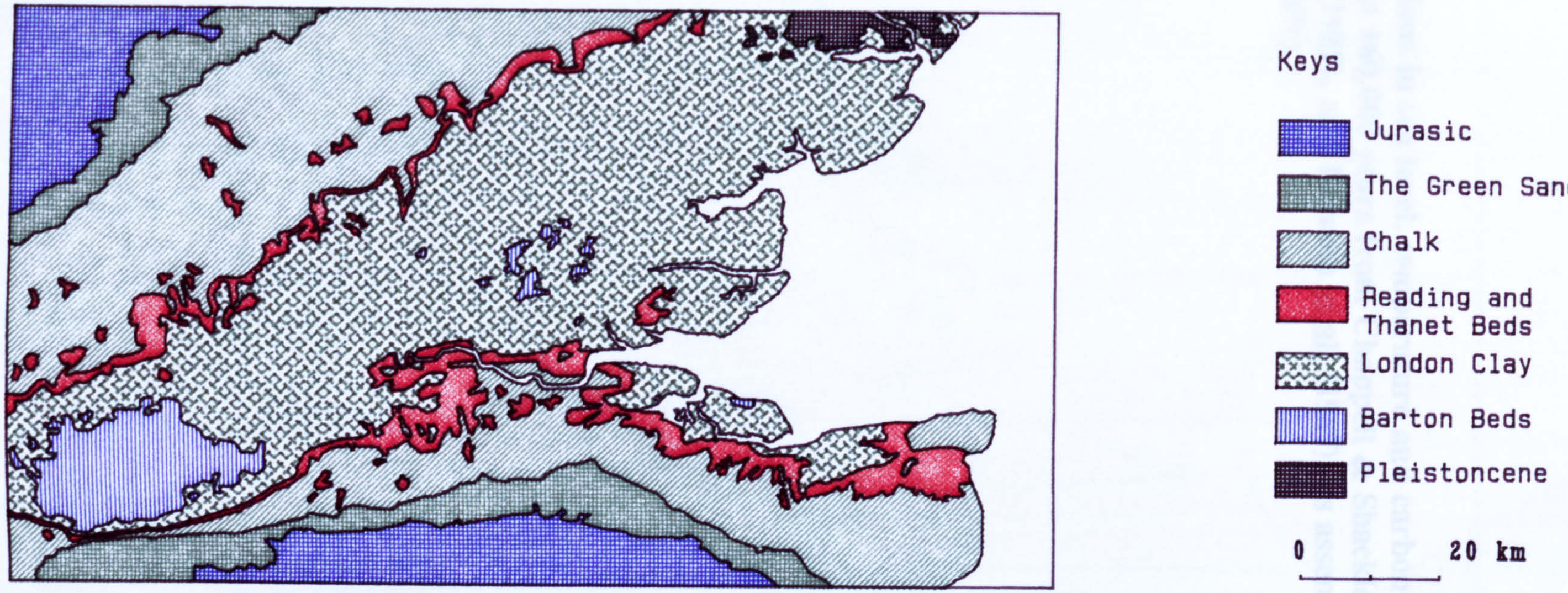


Fig. **1.8.** A geological map showing the London Basin.
(source: see Table 3.1.)

FIGURE 2.1.

Global variations in sea level, temperature and carbon dioxide during the last 160,000 years from Chappell & Shackleton (1986), Jouzel et al. (1987), and Barnola et al. (1987), as assembled in Tooley (1987c).

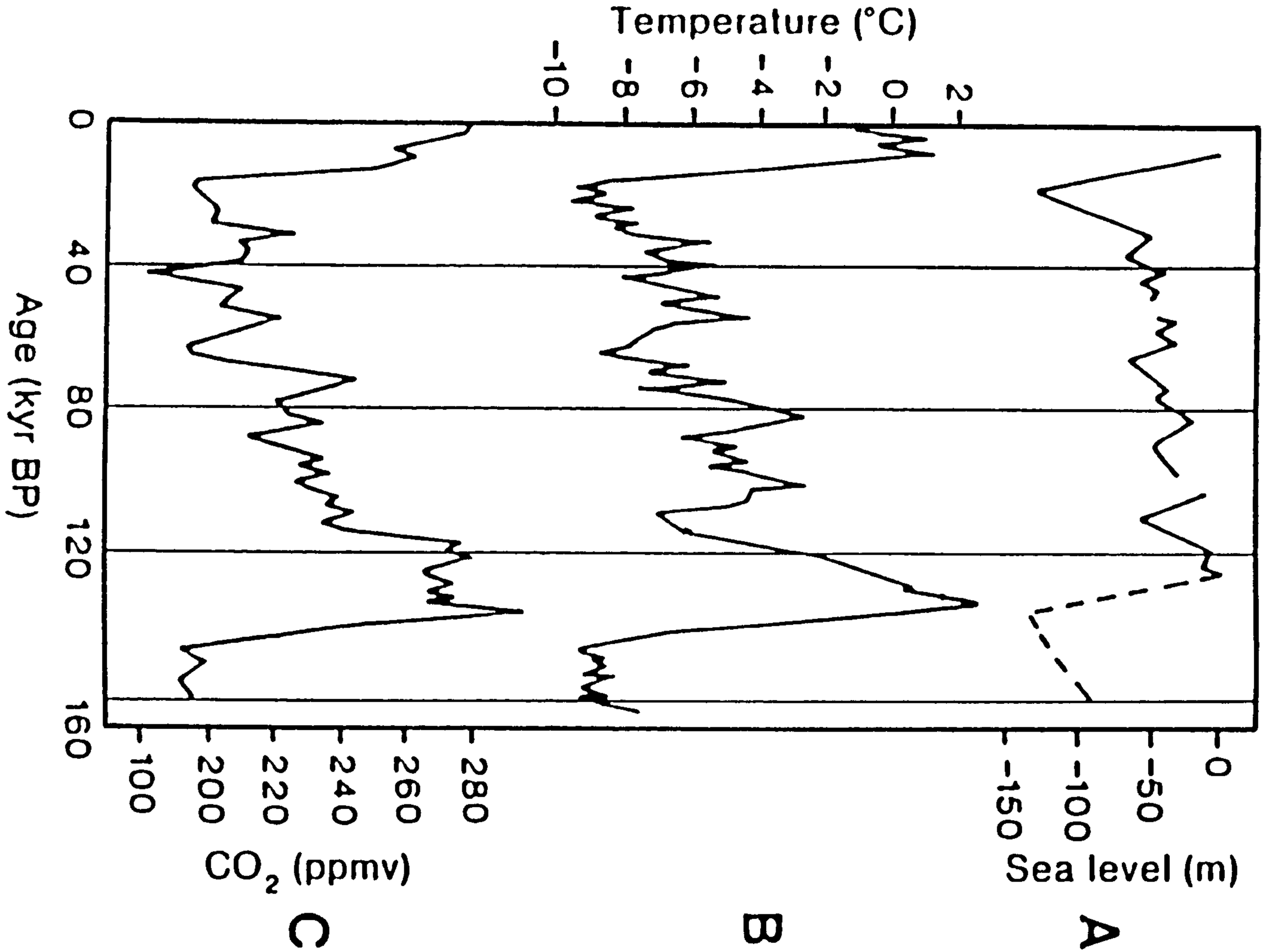

Temperature (°C)
-10
-8
-6
-4
-2
0
2
Age (kyr BP)
0
40
80
120
160
100
200
220
240
260
280
CO_2 (ppmv)
C
B
-150
-100
-50
0
Sea level (m)
A

FIGURE 4.1.

Locations of the previous investigation on Flandrian stratigraphy and relative sea-level changes.

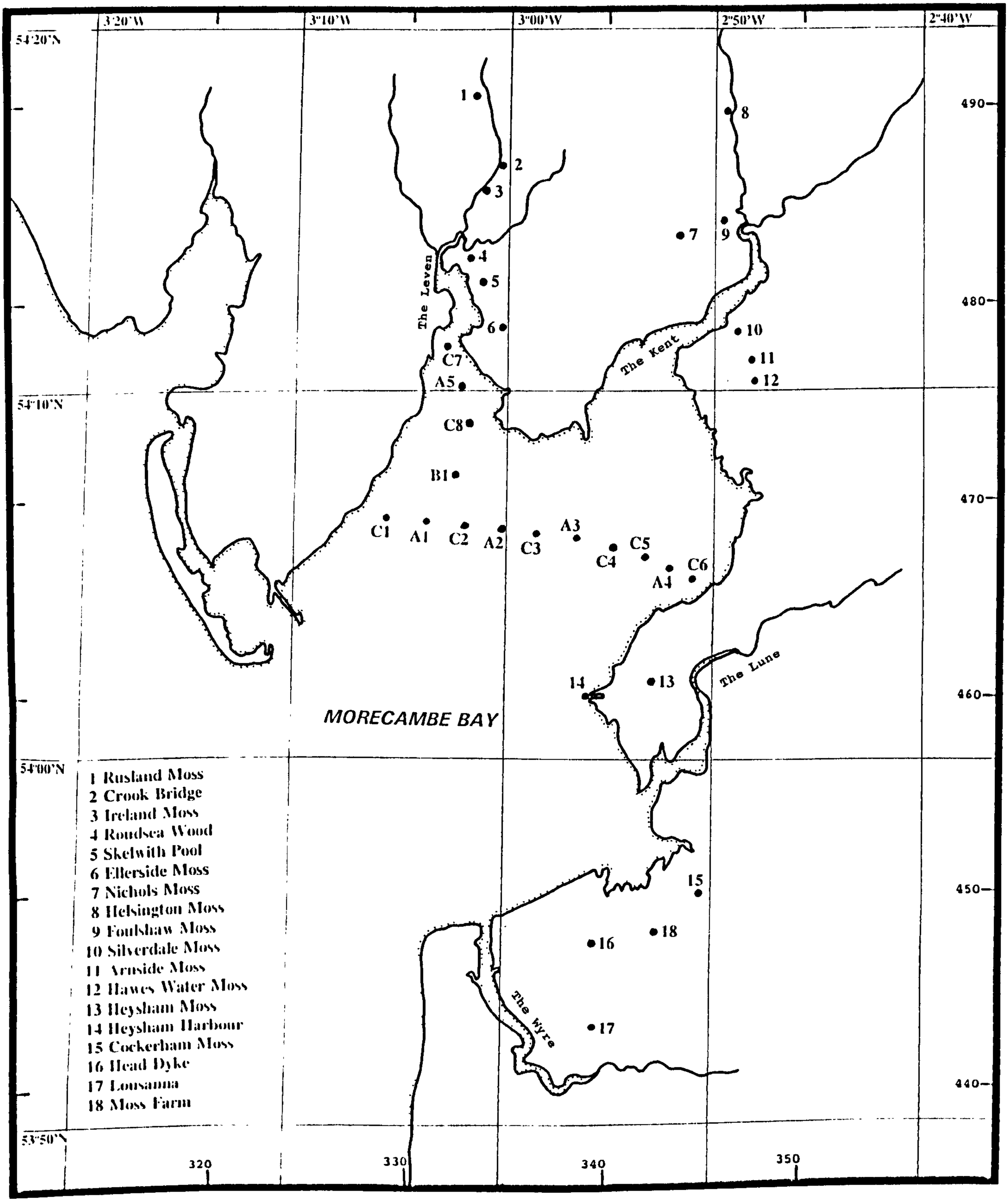

3°20'W
3°10'W
3°00'W
2°50'W
2°40'W
54°20'N
54°10'N
54°00'N
53°50'N
490
480
470
460
450
440
320
330
340
350
The Leven
The Kent
The Lune
The Wyre
MORECAMBE BAY
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
C1
A1
C2
A2
C3
A3
C4
C5
A4
C6
C7
A5
C8
B1
1 Rusland Moss
2 Crook Bridge
3 Ireland Moss
4 Roudsea Wood
5 Skelwith Pool
6 Ellerside Moss
7 Nichols Moss
8 Helsington Moss
9 Foulshaw Moss
10 Silverdale Moss
11 Arnside Moss
12 Hawes Water Moss
13 Heysham Moss
14 Heysham Harbour
15 Cockerham Moss
16 Head Dyke
17 Lousanna
18 Moss Farm

FIGURE 4.2.

A stratigraphic transect running cross Morecambe Bay from the west to the east coasts, showing the relief of the sub-surfaces of solid rocks, tills, post-glacial alluvial and lake deposits, and suggesting the lower boundary of Flandrian transgressive deposits.

(after Knight 1977)

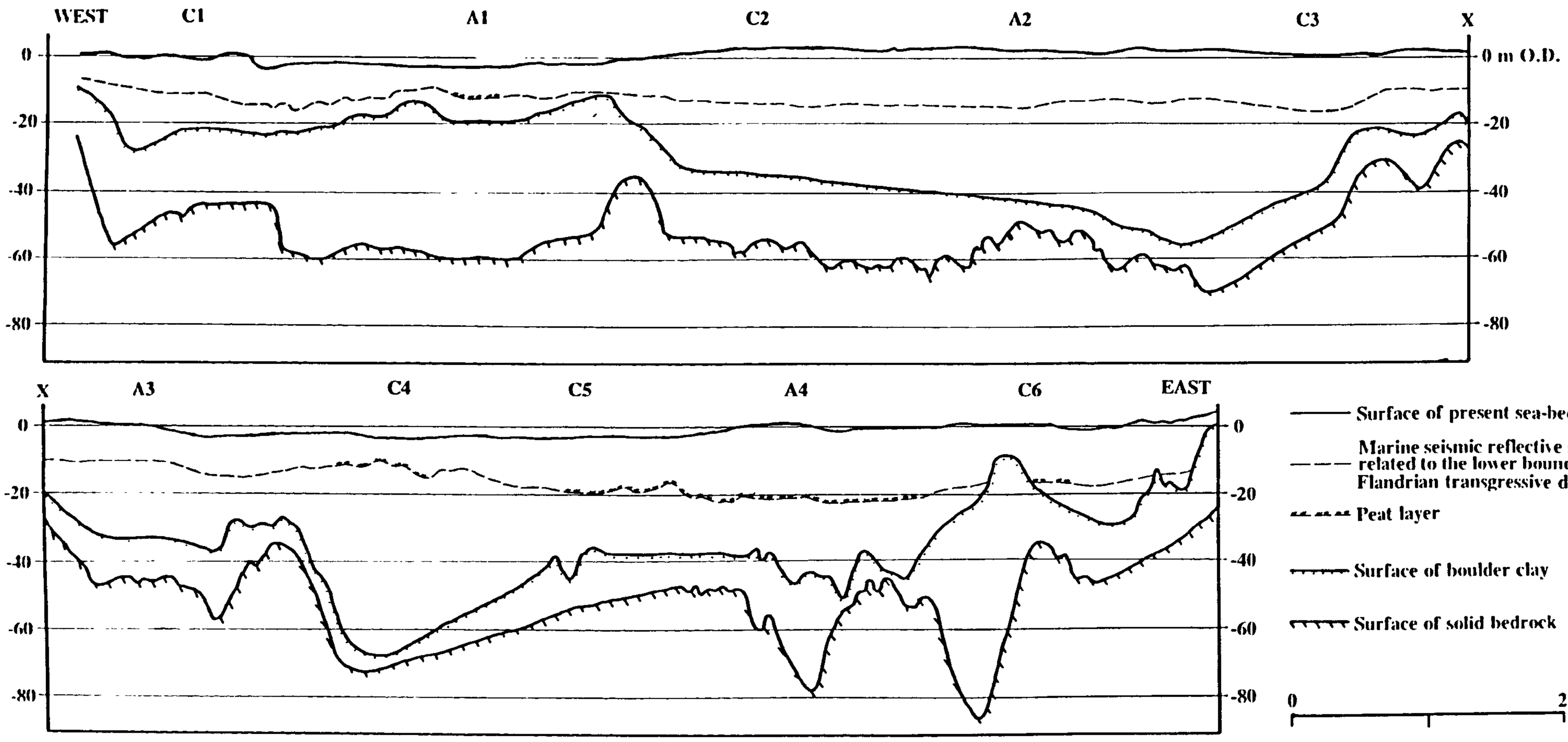

WEST
C1
A1
C2
A2
C3
X
0
-20
-40
-60
-80
0 m O.D.
X
A3
C4
C5
A4
C6
EAST
Surface of present sea-bed
Marine seismic reflective surface related to the lower boundary of Flandrian transgressive deposition
Peat layer
Surface of boulder clay
Surface of solid bedrock
0
2 km

FIGURE 4.3.

A map showing the sites investigated in the Leven Estuary and the Rusland Valley.

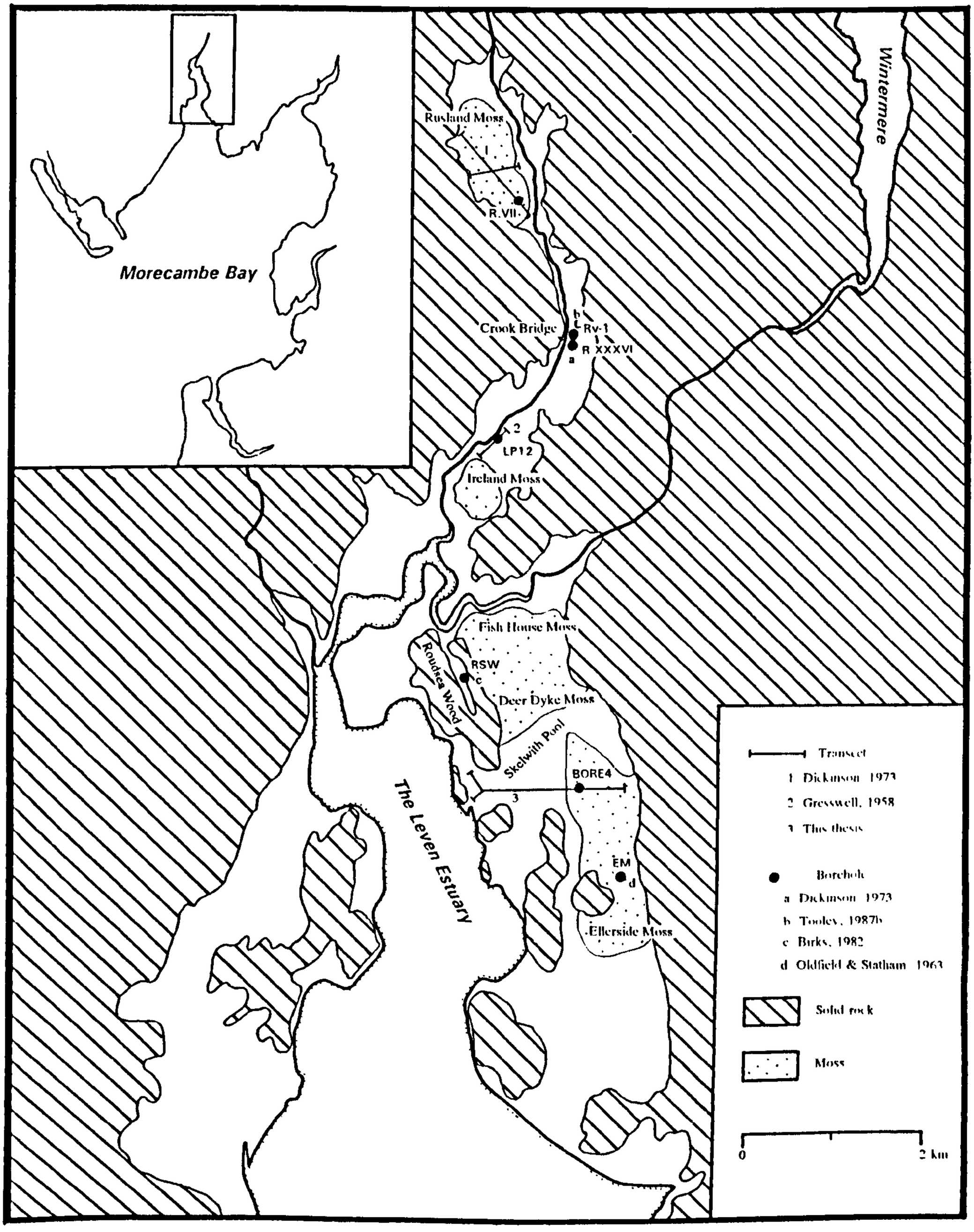

Morecambe Bay
Rusland Moss
R.VII
Wintermere
Crook Bridge
b
c
Rv-1
R XXXVI
a
2
LP12
Ireland Moss
Fish House Moss
RSW
c
Roudsea Wood
Deer Dyke Moss
Skelwith Pool
BORE4
1
3
The Leven Estuary
EM
d
Ellerside Moss
Transect
1 Dickinson 1973
2 Gresswell, 1958
3 This thesis
Borehole
a Dickinson 1973
b Tooley, 1987b
c Burks, 1982
d Oldfield & Statham 1963
Solid rock
Moss
0
2 km

FIGURE 4.4.

A stratigraphic transect along the Rusland Valley and the Leven Estuary, Morecambe Bay.

(after Dickinson 1973, Gresswell 1958, Oldfield and Statham 1963, and Tooley 1987b)

THE LEVEN VALLEY - ESTUARY

R. VII
Dickinson (1973)

R. XXXVI
Rv-1
Tooley (1987b)

LP12
Gresswell (1958)

RSW
Birks (1982)

BORE4
This thesis

EM
Oldfield *et al.* (1963)

8
7
6
5
4
3
2
1
m O D
-1

5435 +/-105 (Hv.3844)

6690 +/-65 (Q-2098, Q-2093)

(Har.3709)
7750 +/-100

PROGRAM BY R. J. C. EVERETT 1986

FIGURE 4.5.

A stratigraphic transect along the lower Leven Estuary, Morecambe Bay.

(after Tooley 1987b, locations shown in Figure 4.1.)

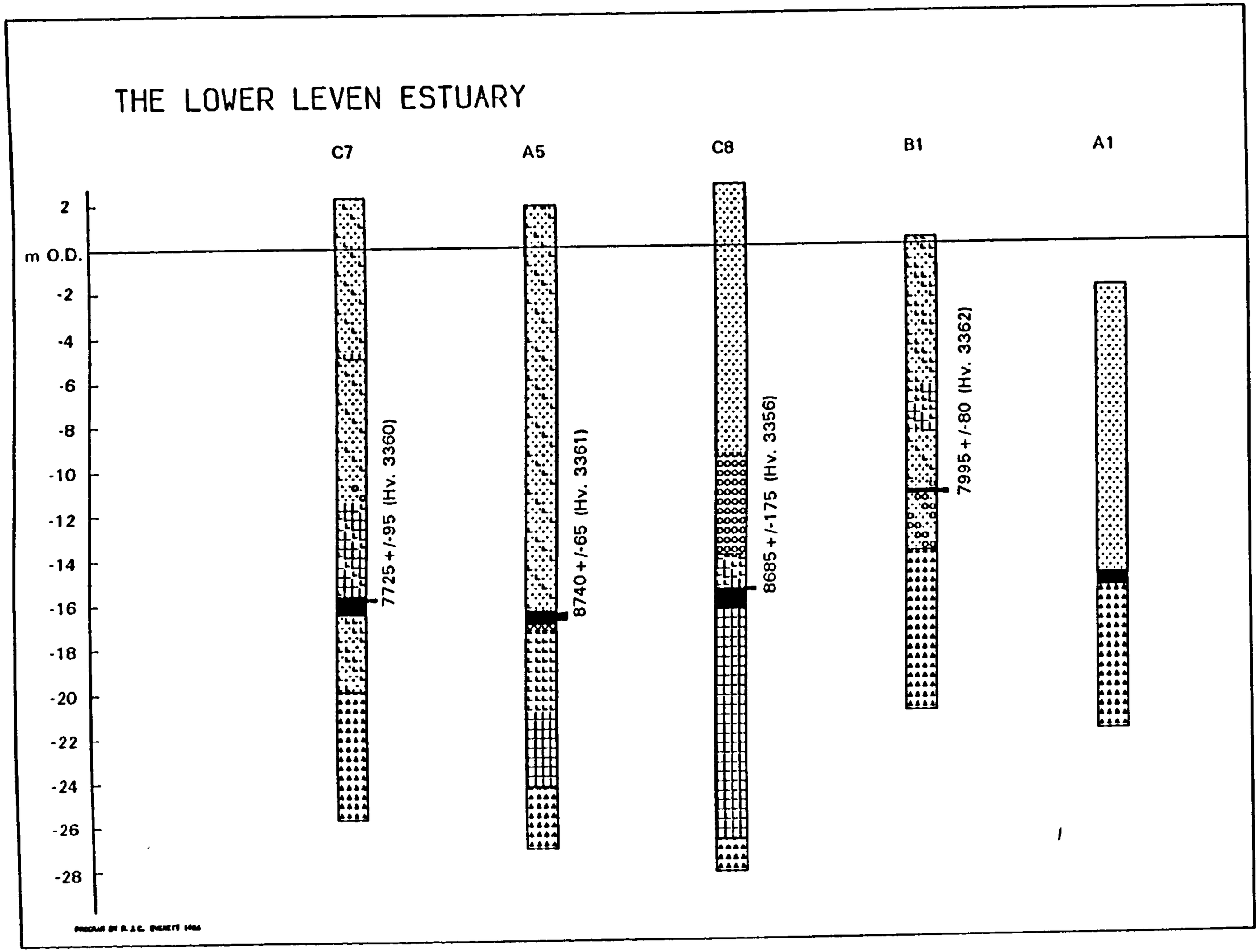
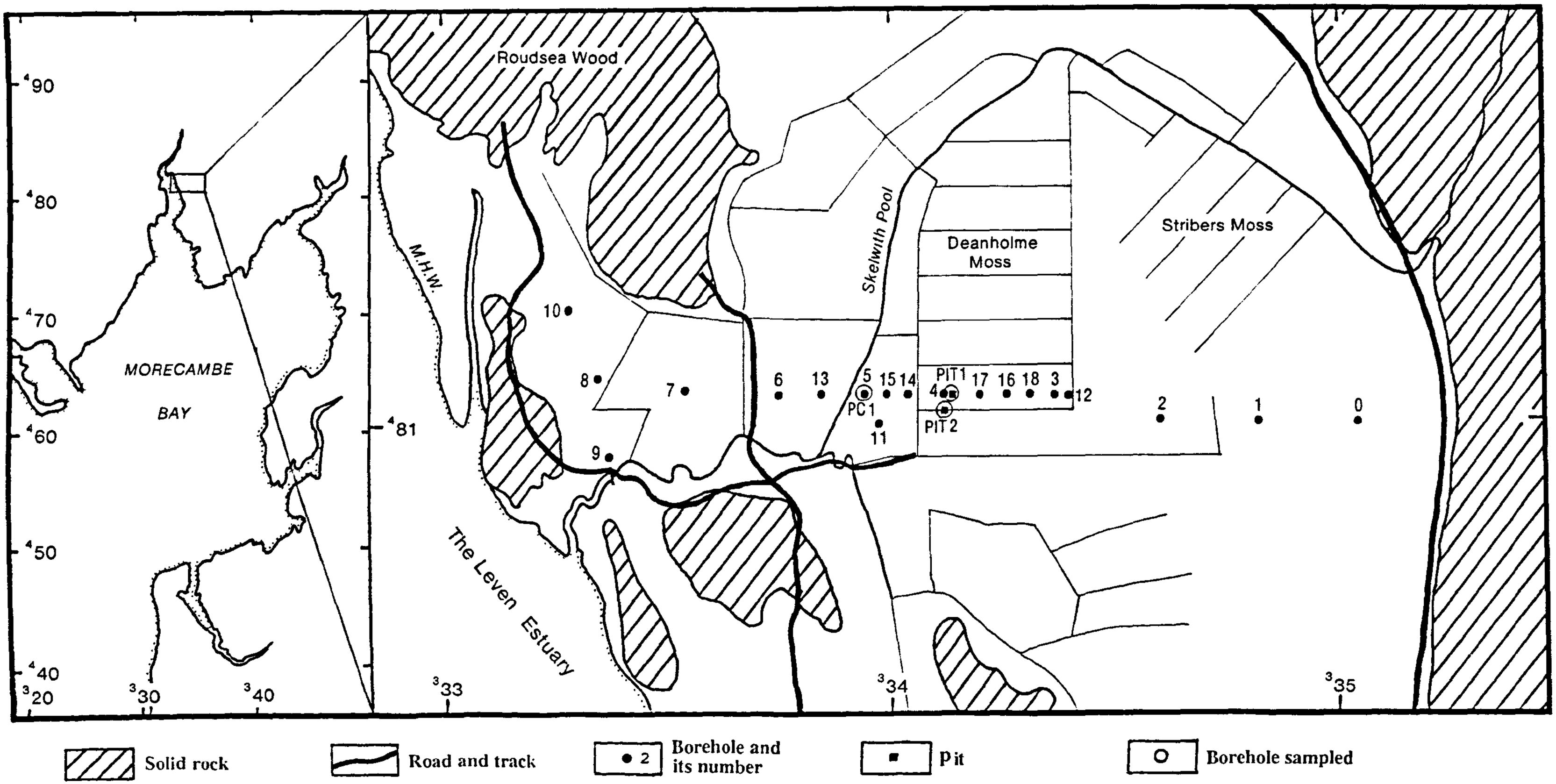

THE LOWER LEVEN ESTUARY
C7
A5
C8
B1
A1
2
m O.D.
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
7725 +/-95 (Hv. 3360)
8740 +/-65 (Hv. 3361)
8685 +/-175 (Hv. 3356)
7995 +/-80 (Hv. 3362)

FIGURE 4.6.

A location map of the boreholes sunk at Skelwith Pool, Morecambe Bay.



Solid rock

Road and track

• 2 Borehole and its number

Pit

O Borehole sampled

FIGURE 4.7.

A stratigraphic transect across Skelwith Pool from the landward to the seaward sides.

Location of these boreholes shown on Figure 4.6.

SKELWITH POOL TRANSECT 2 (LANDWARD SIDE) (SEAWARD SIDE)

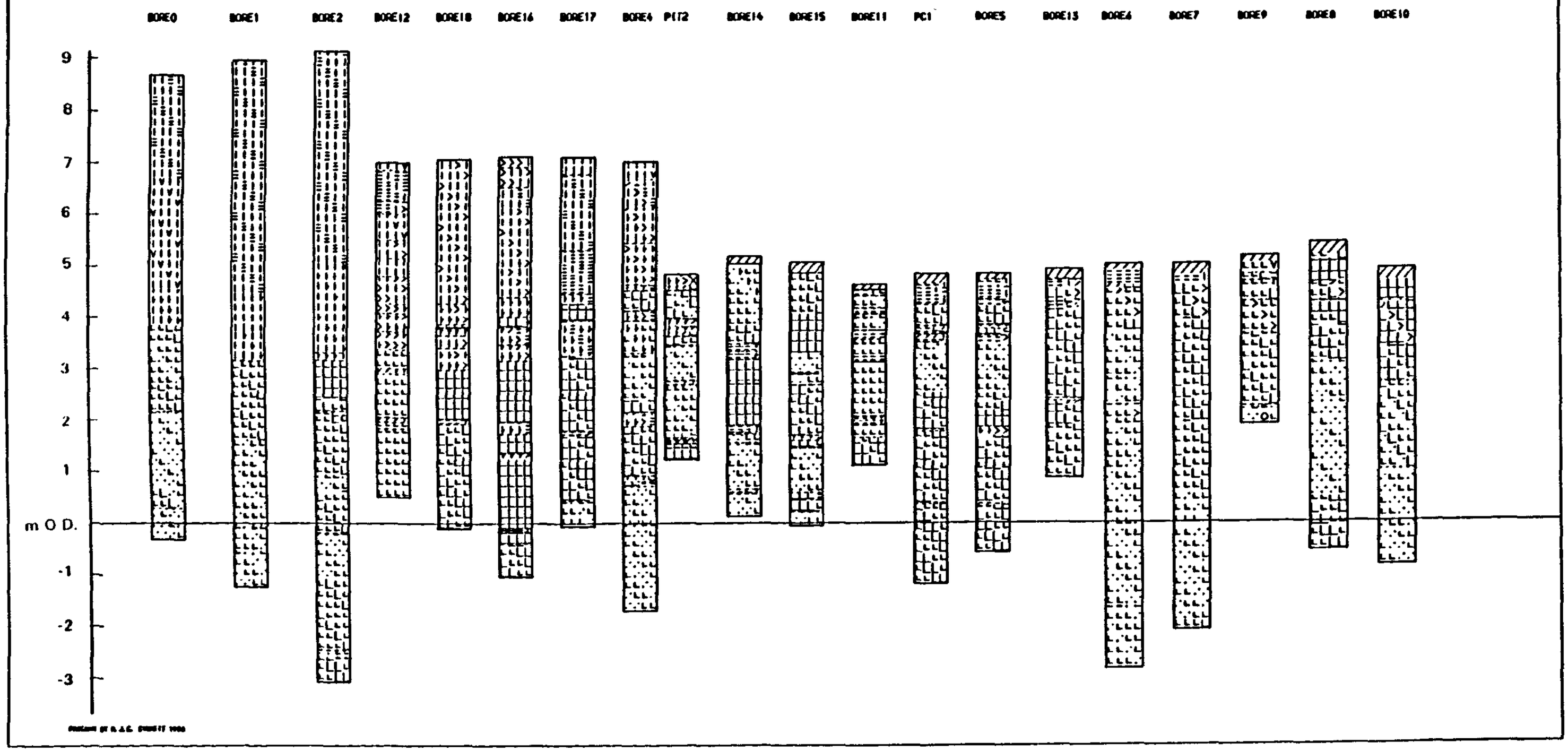


FIGURE 4.8.

Sedimentary sequences discovered from the key boreholes and pits at Skelwith Pool from the landward to the seaward sides.

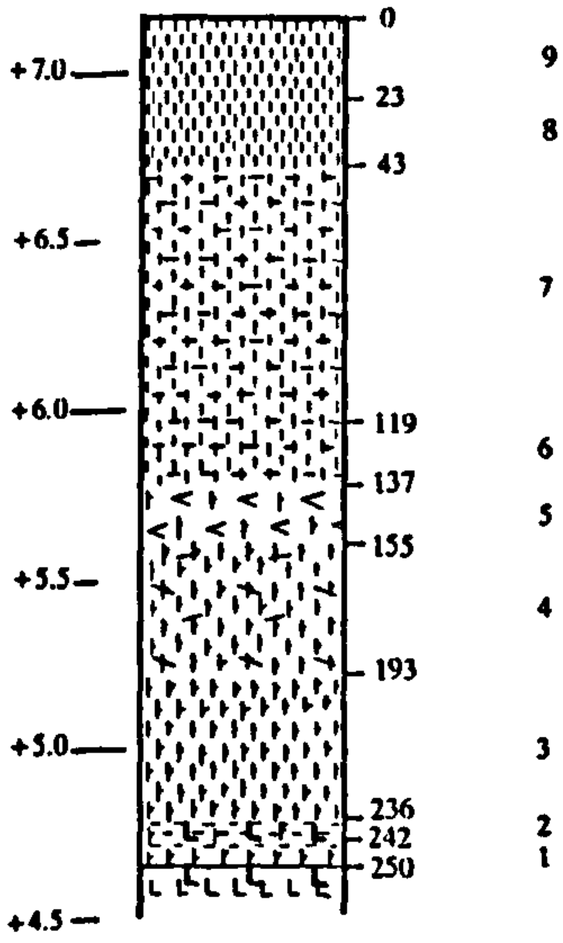
Location of these boreholes shown on Figure 4.6.

Skelwith Pool, Morecambe Bay

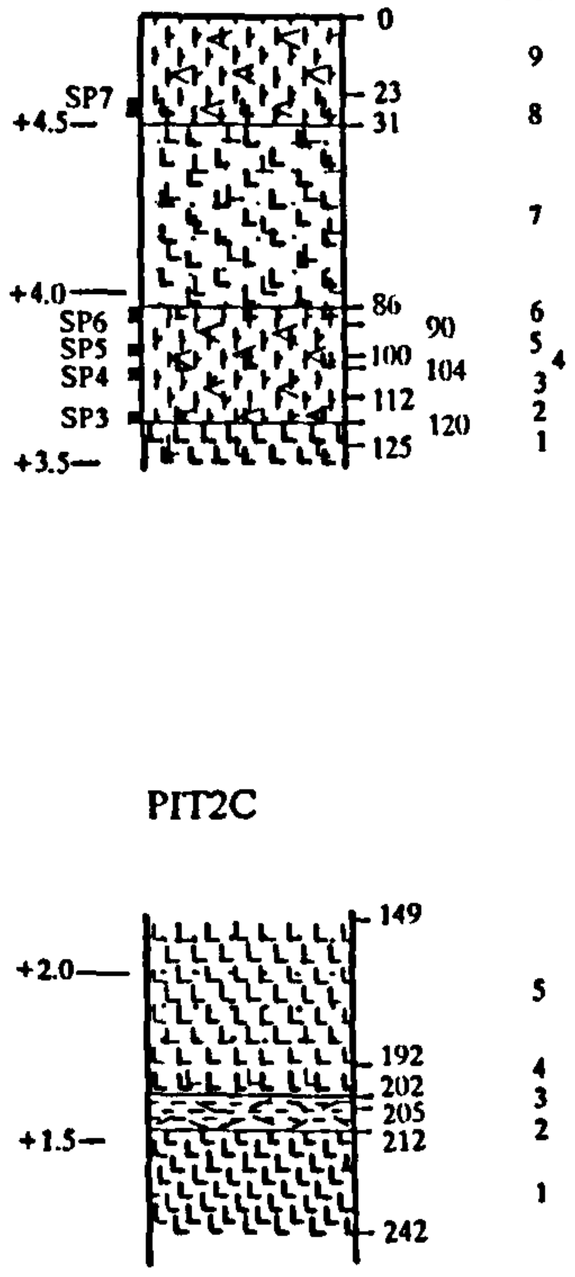
Natinal Grid Ref:

PIT1	34155	81040	(08 11 87)
PIT2	34120	81030	(08 11 87)
PIT2C	34120	81030	(09 03 88)
PC-1	33940	81040	(26 02 88)

PIT1

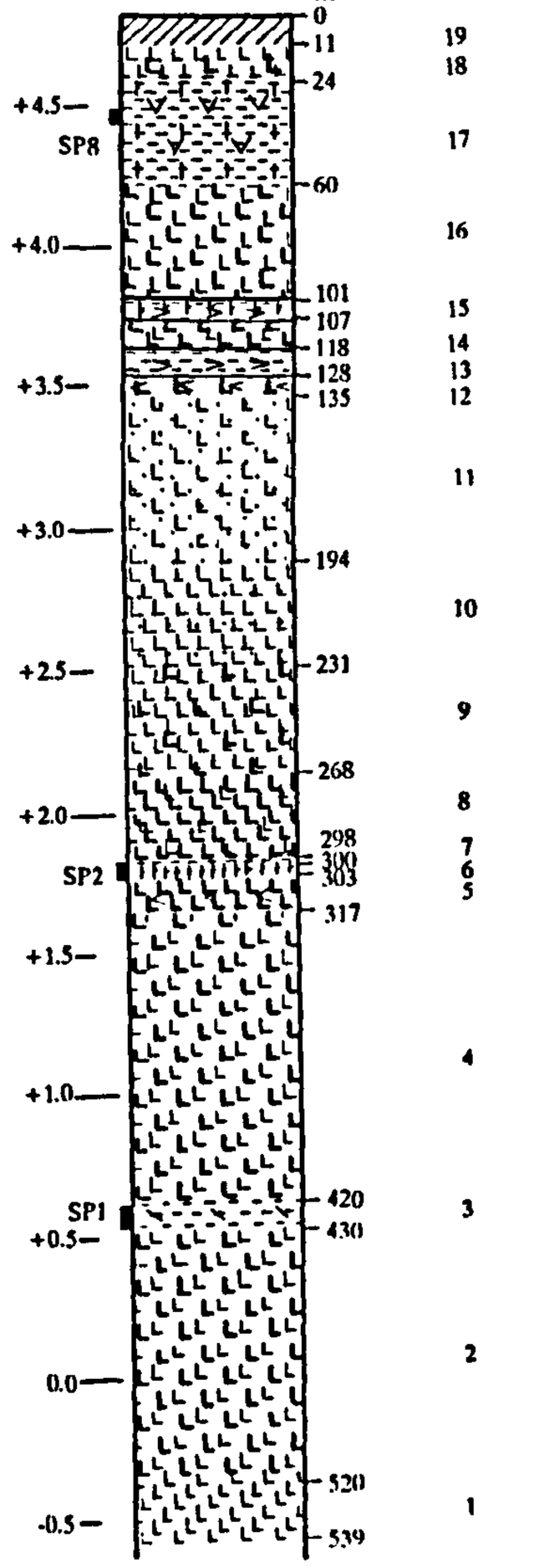


PIT2



PIT2C

PC-1



Samples for Radiocarbon Dationg

	O.D. m	Year B.P.	Lab. code
SP1	0.624-0.524	7875+/-85	Q-2782
SP2	1.824-1.774	7150+/-80	Q-2783
SP3	3.644-3.624	5660+/-55	Q-2784
SP4	3.784-3.764	5430+/-50	Q-2785
SP5	3.844-3.824	5130+/-65	Q-2786
SP6	3.954-3.924	4980+/-55	Q-2787
SP7	4.584-4.564	4710+/-75	Q-2788
SP8	4.484-4.424	3945+/-75	Q-2789

FIGURE 4.9.

Diatom counts in species from borehole PC-1.

Expressed as percentages of total diatom species.

Diatoms (species) counted from PC-1

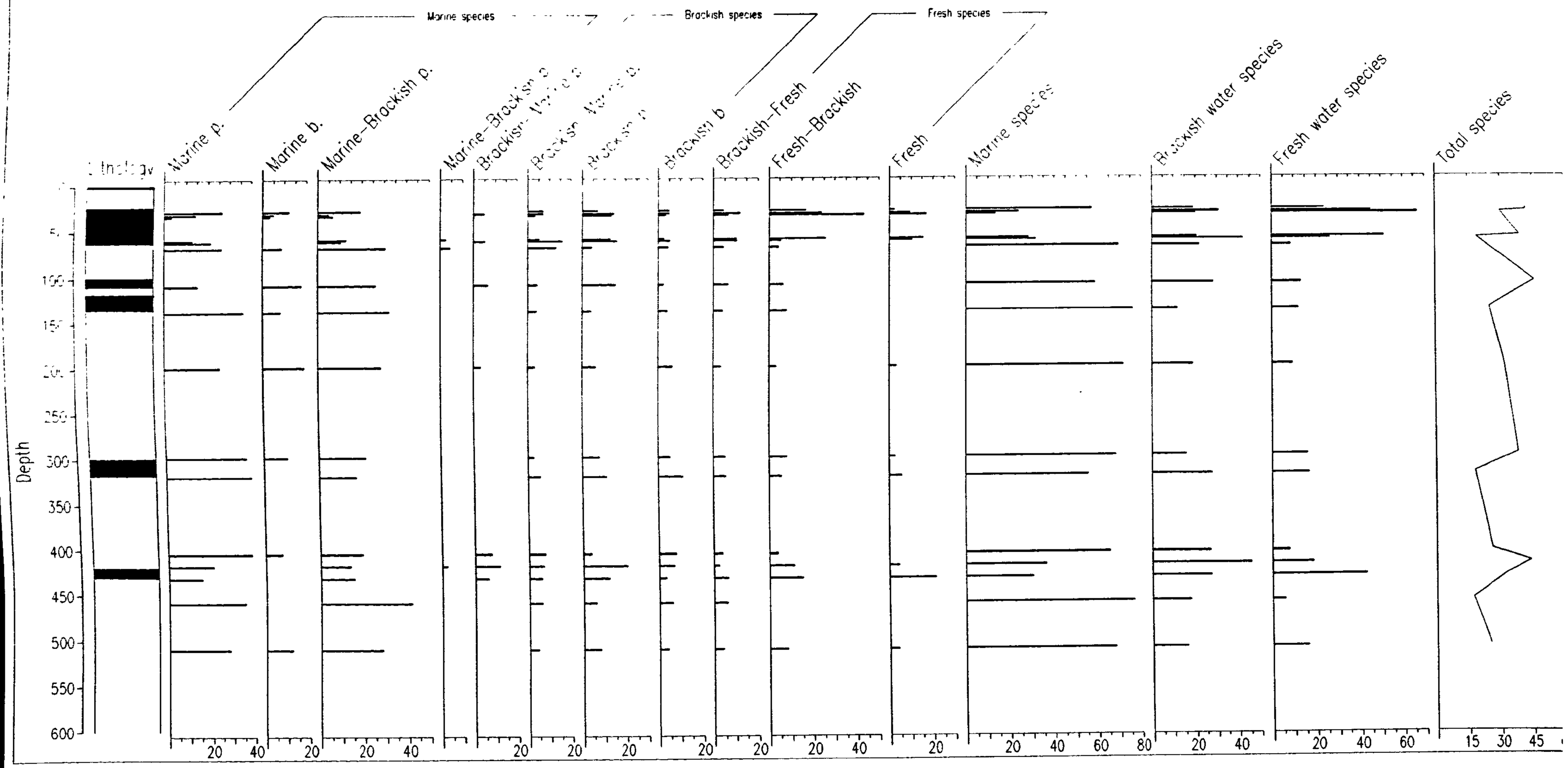


FIGURE 4.10.

Diatom counts in valves from borehole PC-1.

Expressed as percentages of total diatom valves.

Diatoms (valves) counted from PC-1

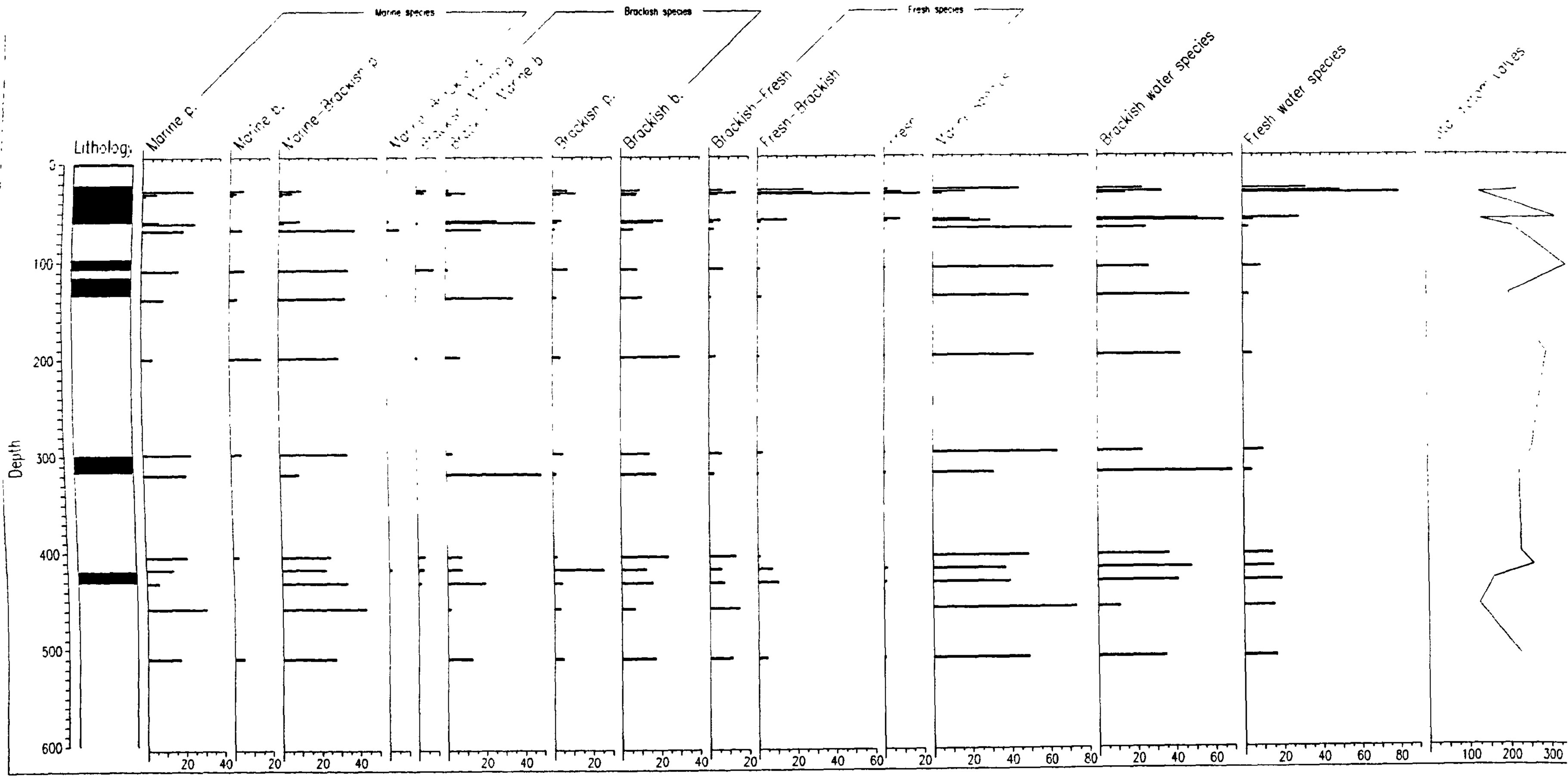


FIGURE 4.11.

Diatom counts in species from pit PIT2.

Expressed as percentages of total diatom species.

Diatoms (species) counted from PIT2

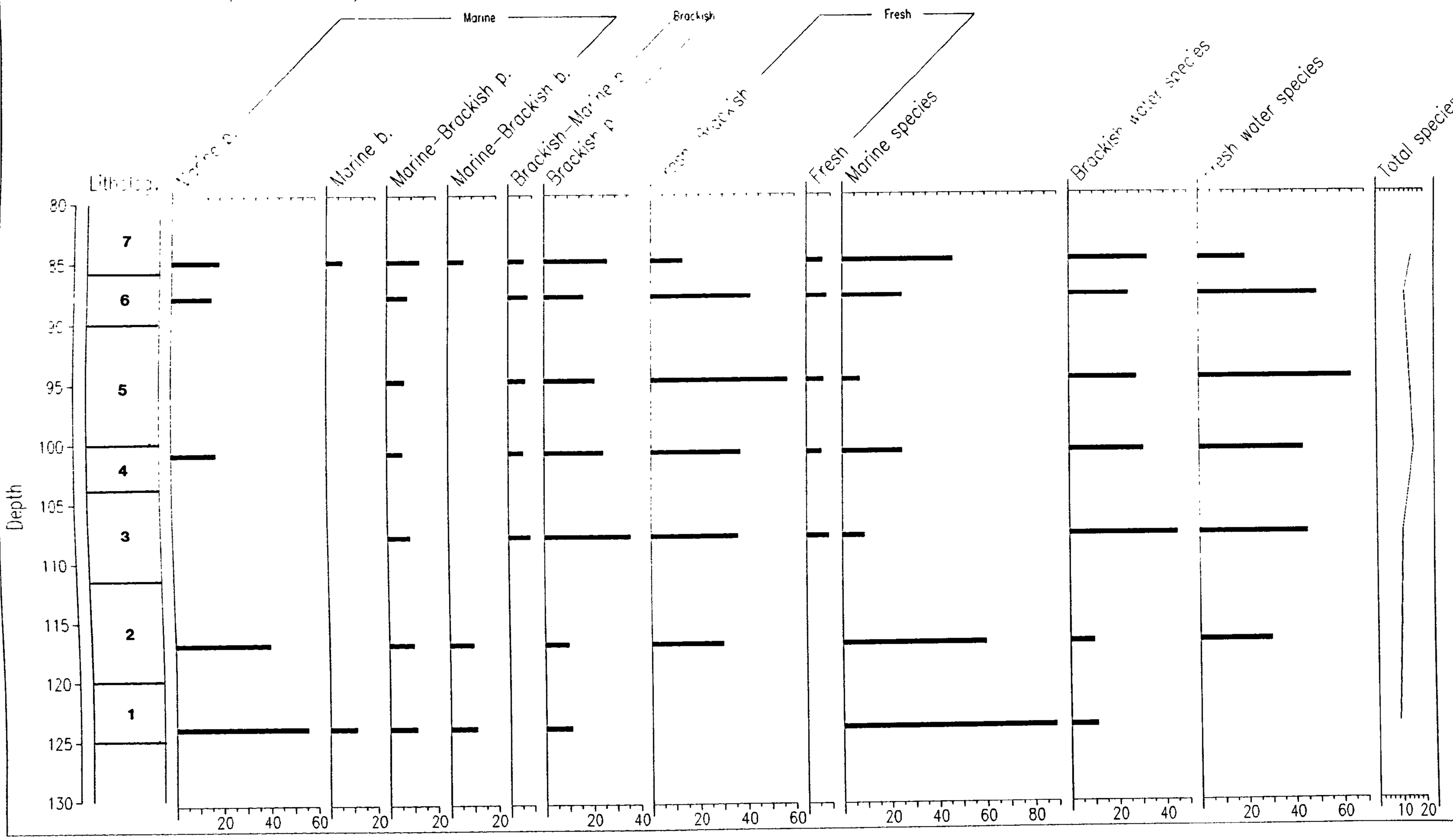


FIGURE 4.12.

Diatom counts in valves from pit PIT2.

Expressed as percentages of total diatom valves.

Diatoms (valves) counted from PIT2

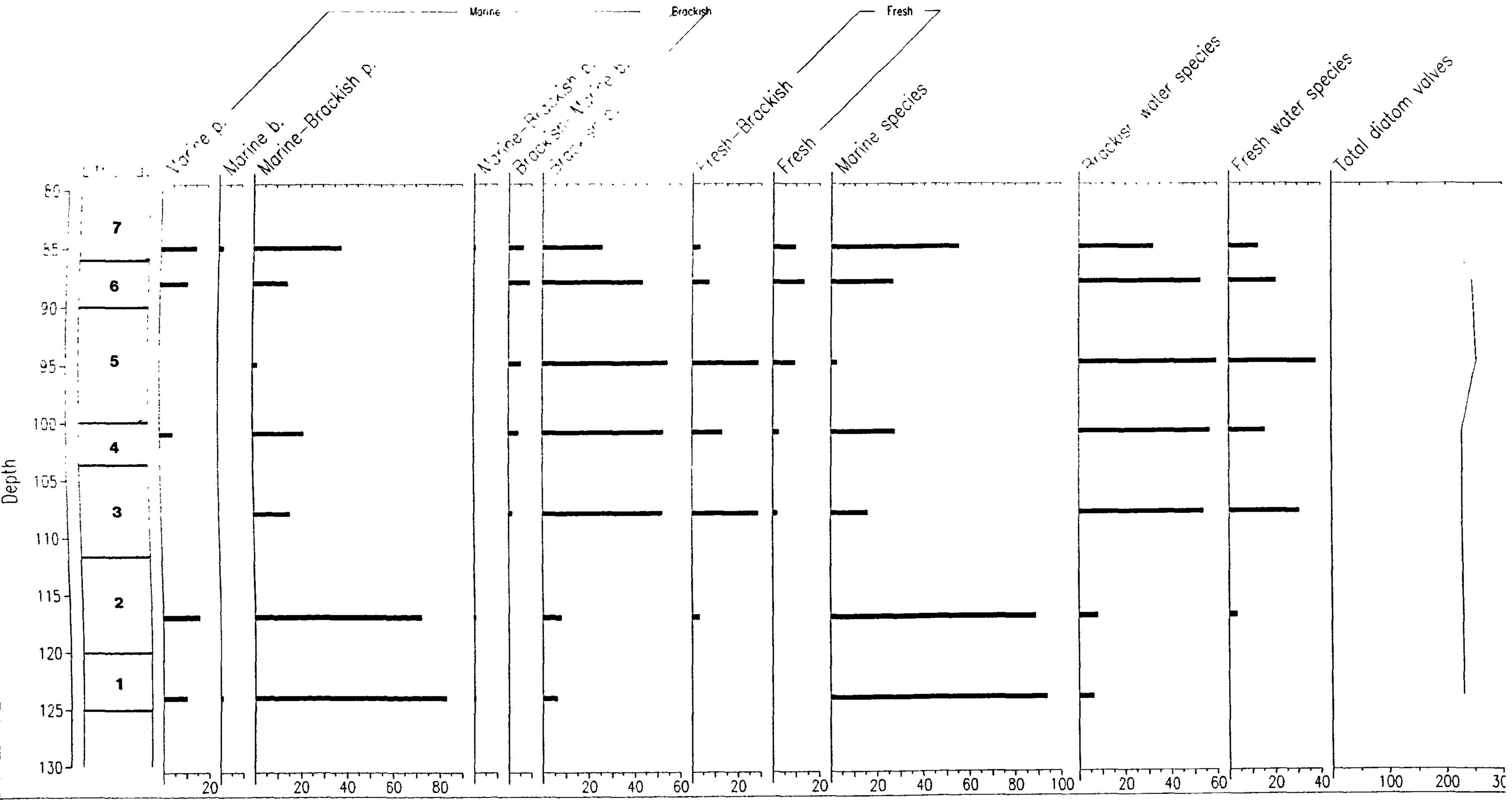
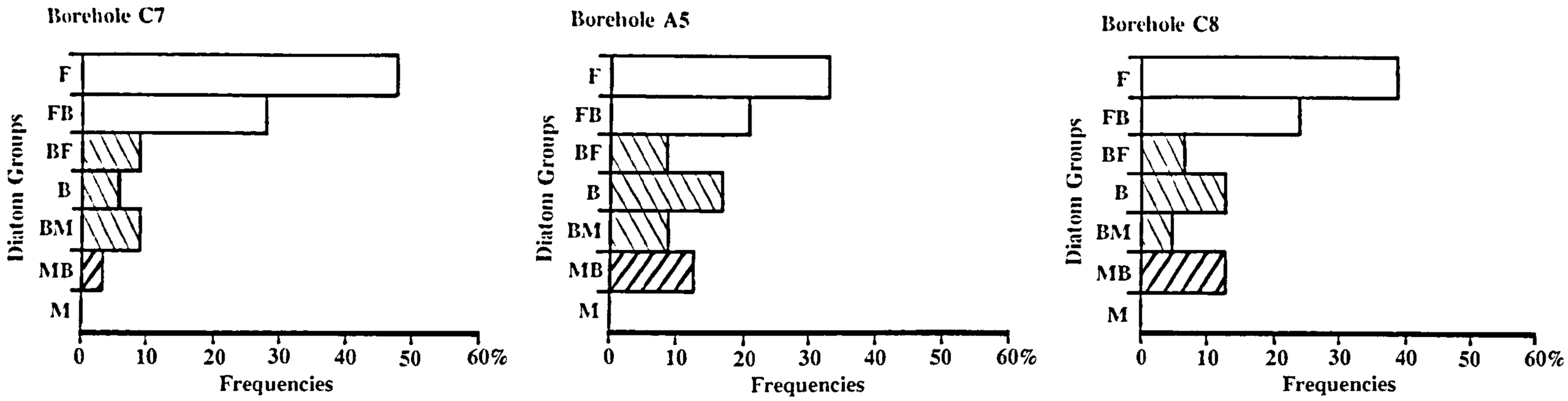


FIGURE 4.13.

Diatom counts in species from the basal peat.

Expressed as percentages of total diatom species.


Borehole C7
Borehole A5
Borehole C8
Diatom Groups
F
FB
BF
B
BM
MB
M
0
10
20
30
40
50
60%
Frequencies

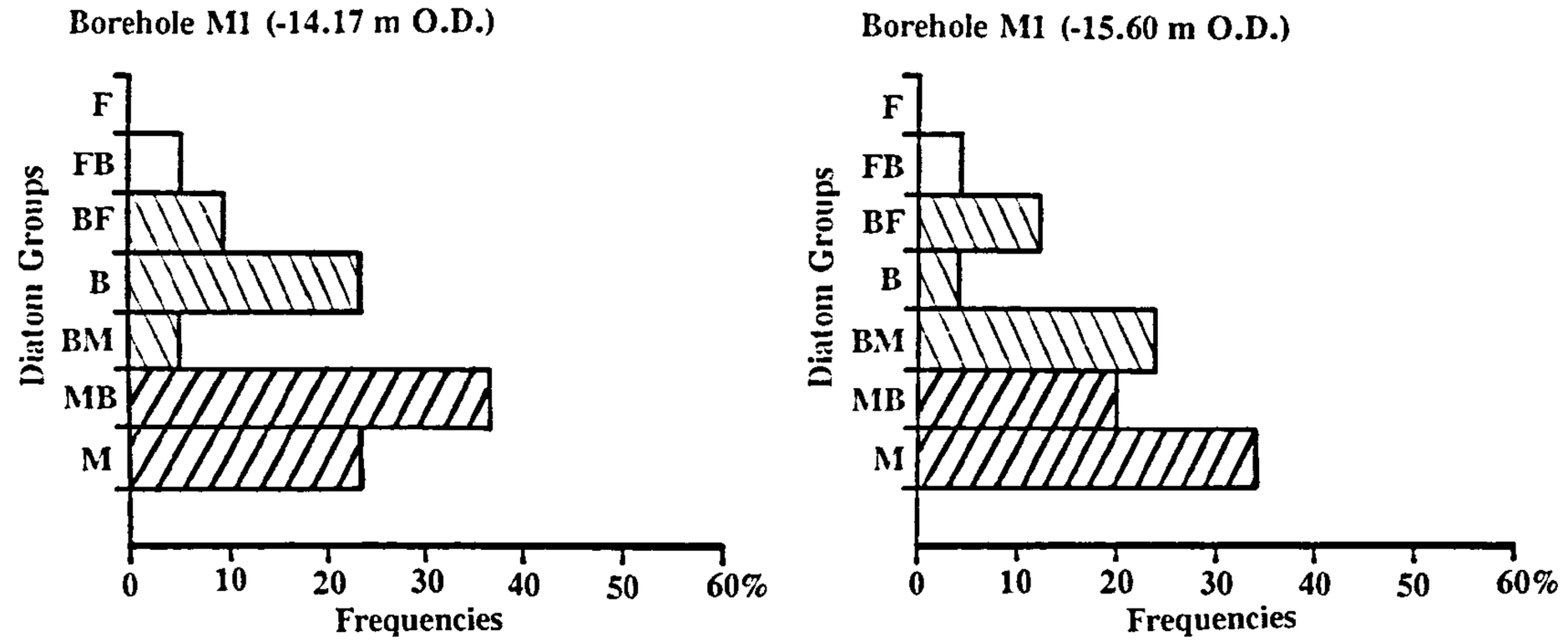
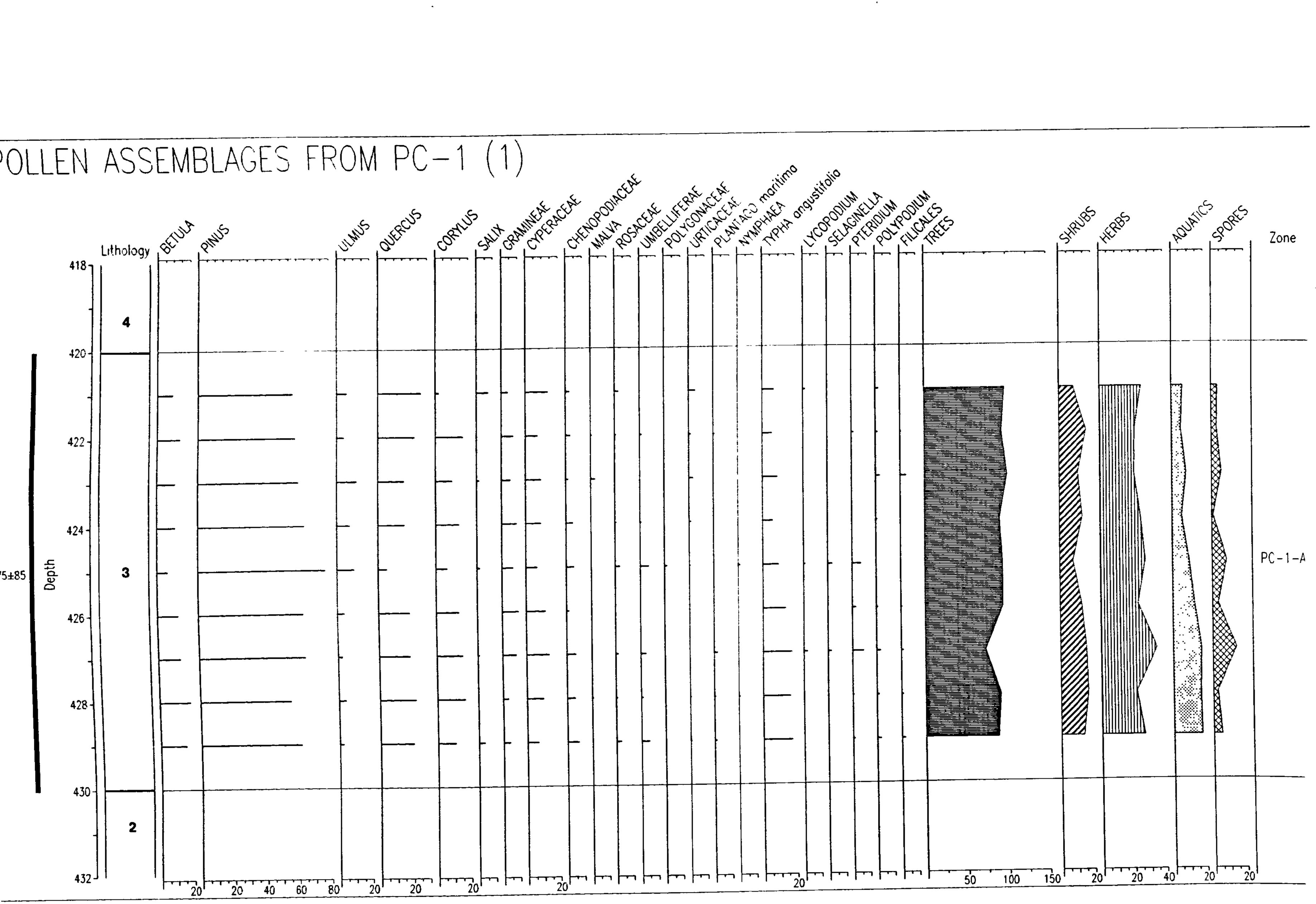

Borehole M1 (-14.17 m O.D.)
Borehole M1 (-15.60 m O.D.)
Diatom Groups
F
FB
BF
B
BM
MB
M
0
10
20
30
40
50
60%
Frequencies

FIGURE 4.14.

Pollen assemblages counted from borehole PC-1 (1).

Tree pollen are expressed as percentages of total tree pollen, shrub and herb pollen are expressed as percentages of total land pollen, and aquatic pollen and spores are expressed as percentages of total pollen.

POLLEN ASSEMBLAGES FROM PC-1 (1)



75±85

FIGURE 4.15.

Pollen assemblages counted from borehole PC-1 (2).

Tree pollen are expressed as percentages of total tree pollen, shrub and herb pollen are expressed as percentages of total land pollen, and aquatic pollen and spores are expressed as percentages of total pollen.

POLLEN ASSEMBLAGES FROM PC-1 (2)

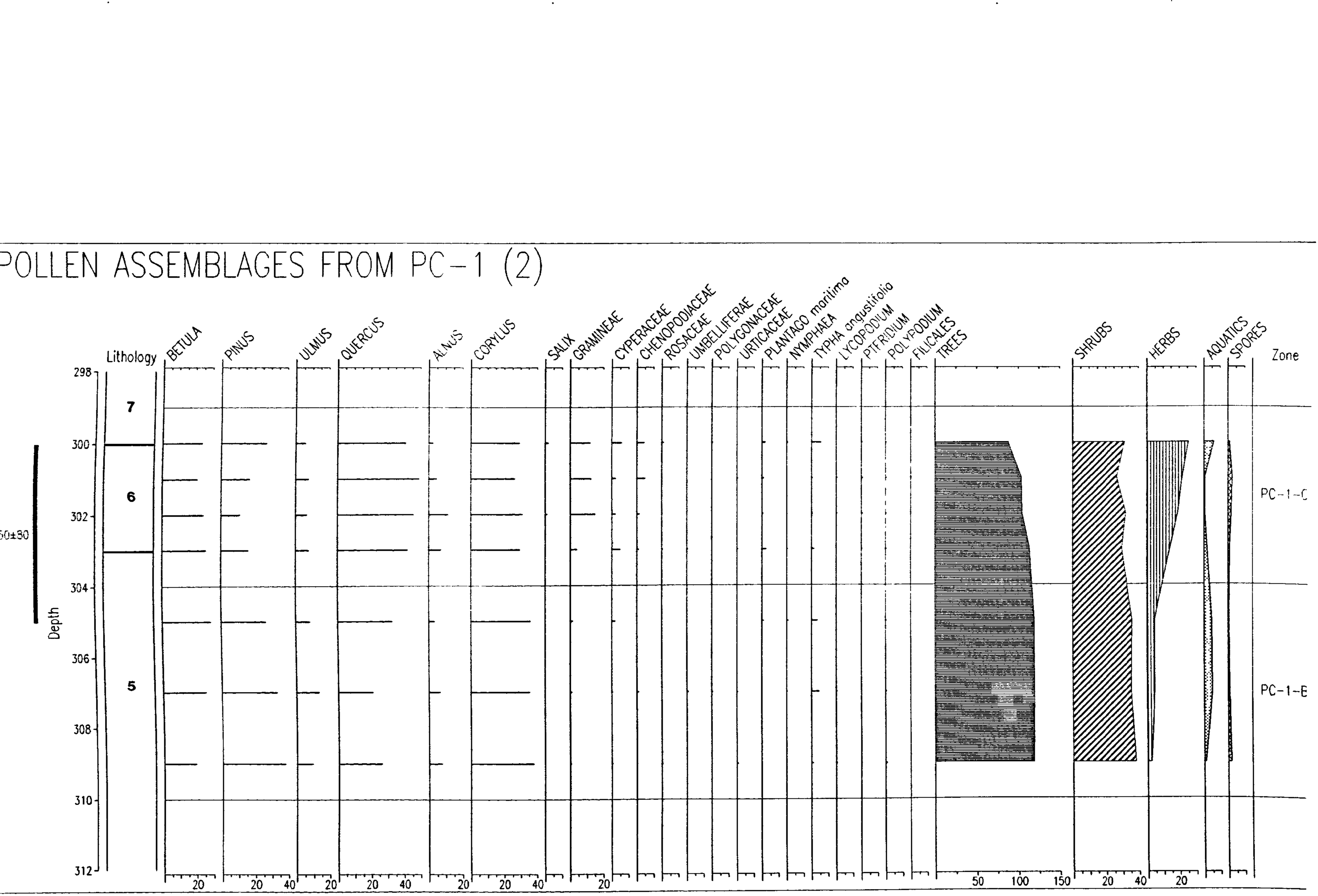


FIGURE 4.16.

Pollen assemblages counted from borehole PC-1 (3).

Tree pollen are expressed as percentages of total tree pollen, shrub and herb pollen are expressed as percentages of total land pollen, and aquatic pollen and spores are expressed as percentages of total pollen.

POLLEN ASSEMBLAGES FROM PC-1 (3)

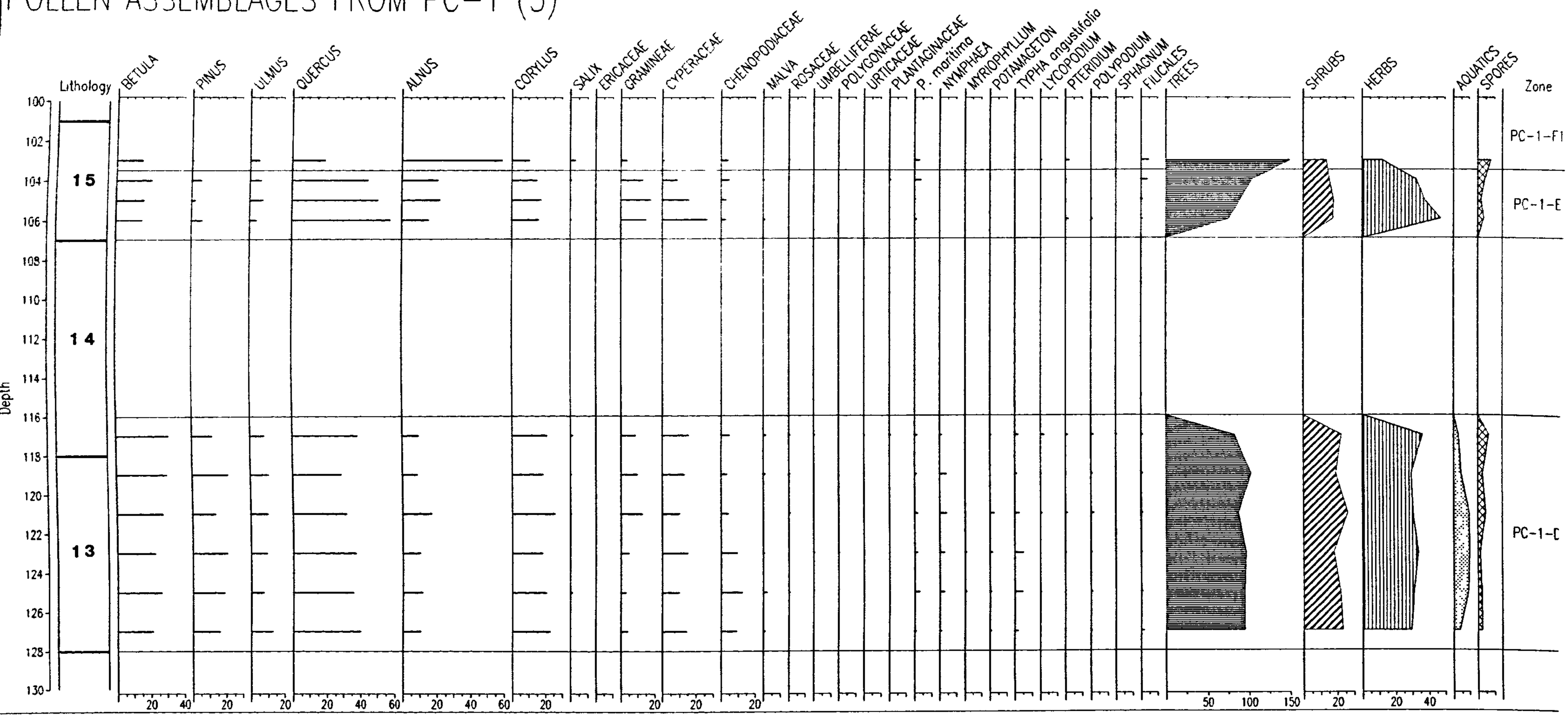


FIGURE 4.17.

Pollen assemblages counted from borehole PC-1 (4).

Tree pollen are expressed as percentages of total tree pollen, shrub and herb pollen are expressed as percentages of total land pollen, and aquatic pollen and spores are expressed as percentages of total pollen.

POLLEN ASSEMBLAGES FROM PC-1 (4)

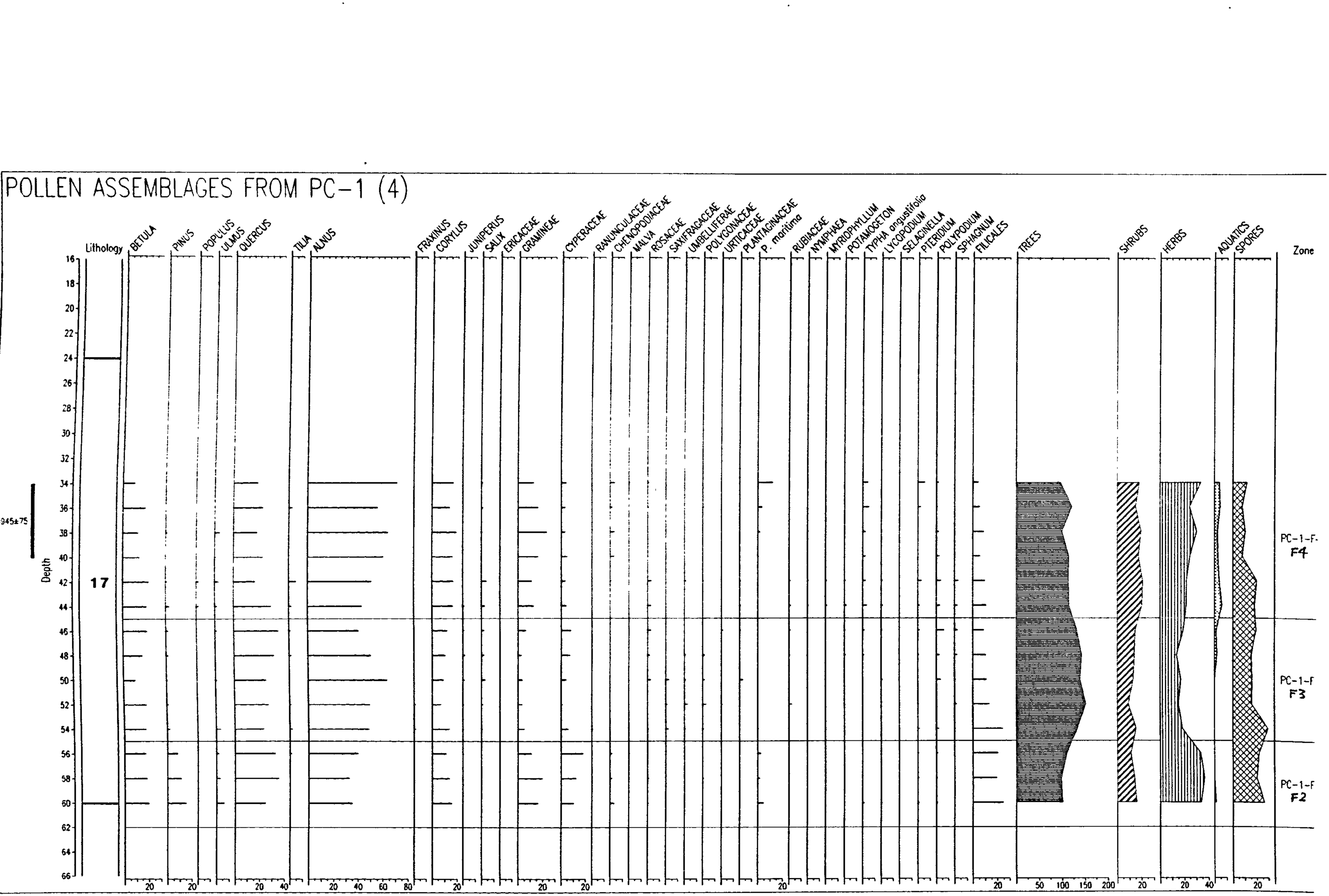


FIGURE 4.18.

Pollen assemblages counted from borehole PIT2C.

Tree pollen are expressed as percentages of total tree pollen, shrub and herb pollen are expressed as percentages of total land pollen, and aquatic pollen and spores are expressed as percentages of total pollen.

POLLEN ASSEMBLAGES FROM PIT2C

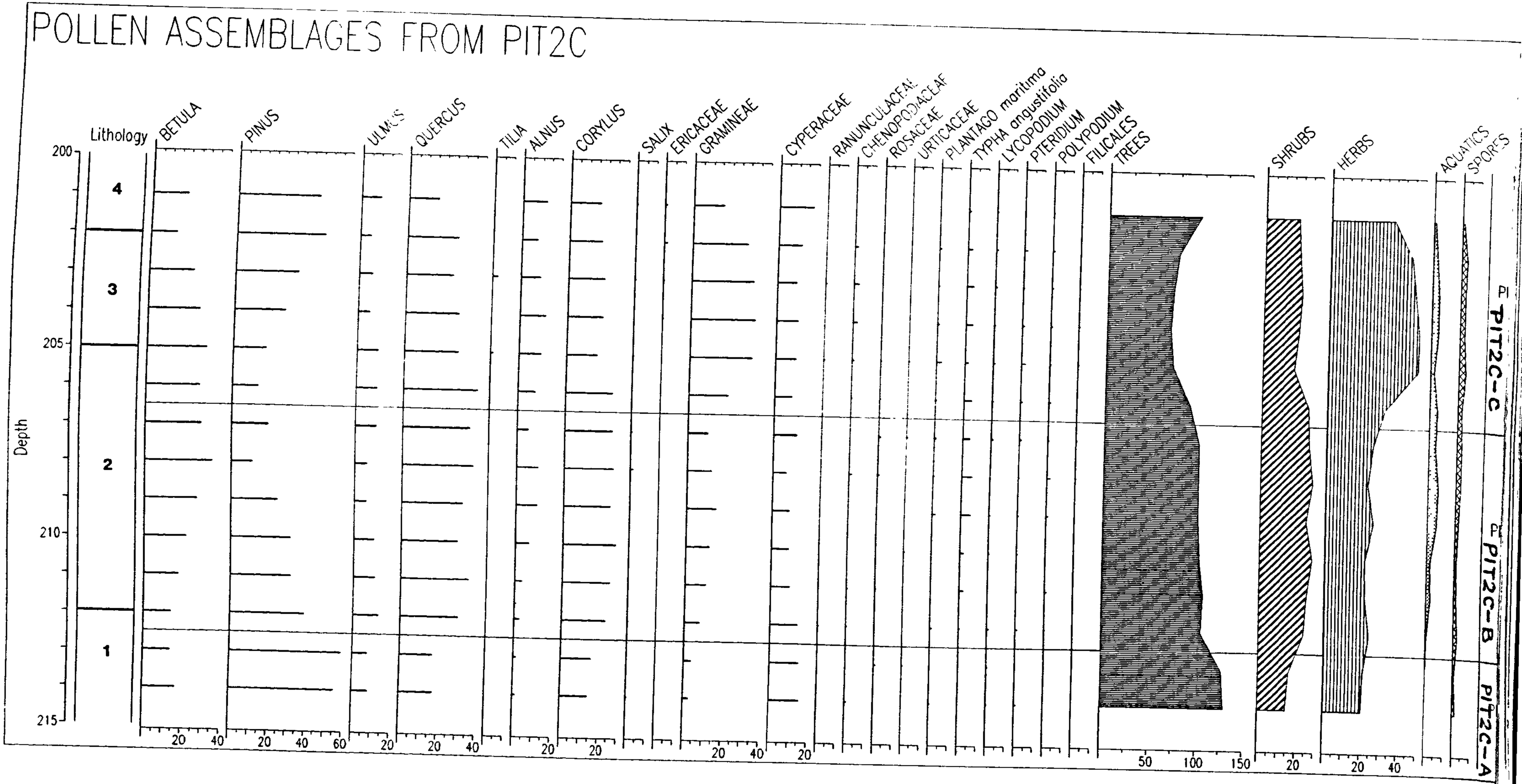


FIGURE 4.19.

Pollen assemblages counted from pit PIT2.

Tree pollen are expressed as percentages of total tree pollen, shrub and herb pollen are expressed as percentages of total land pollen, and aquatic pollen and spores are expressed as percentages of total pollen.

POLLEN ASSEMBLAGES FROM PIT2

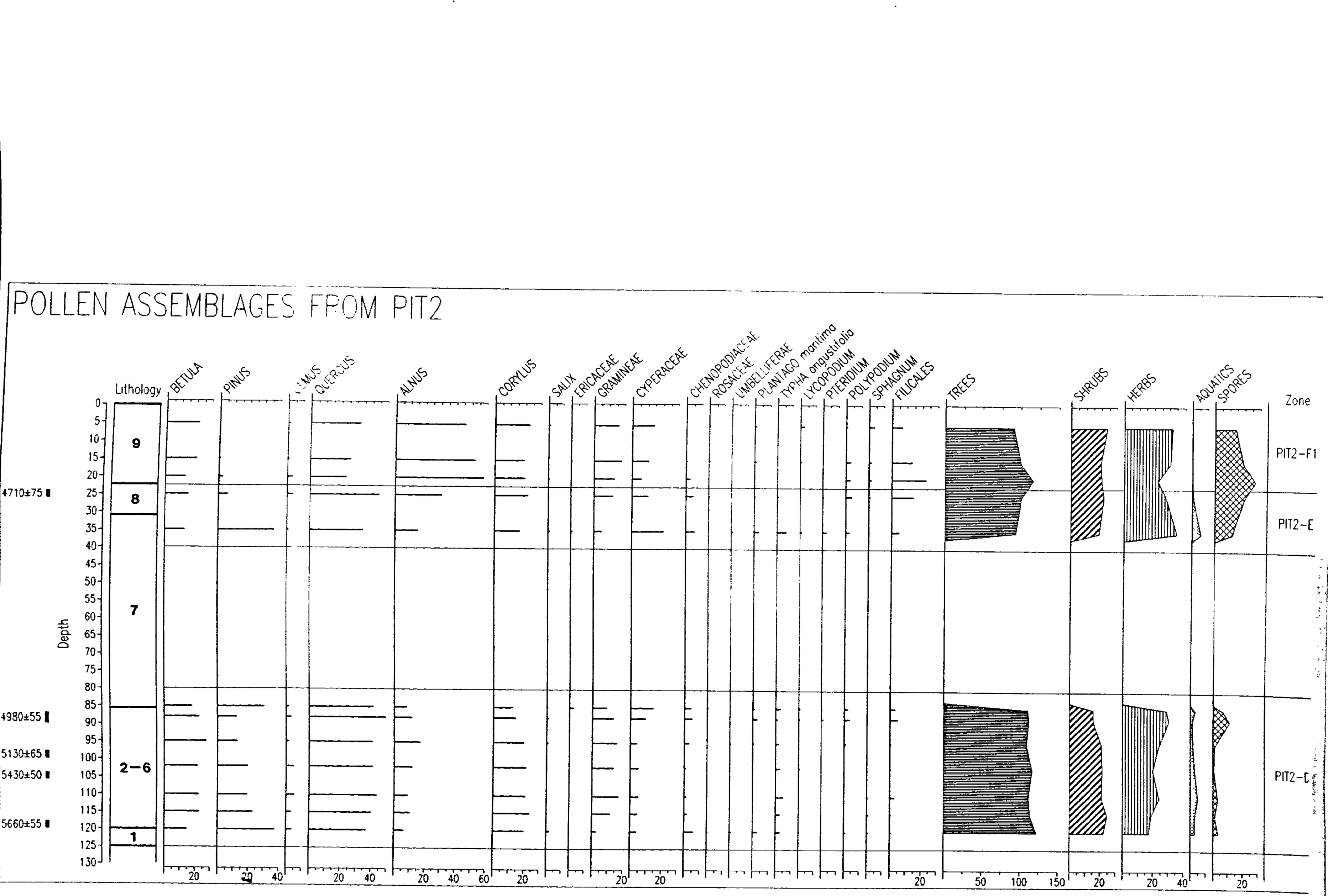


FIGURE 4.20.

Pollen assemblages counted from pit PIT1.

Tree pollen are expressed as percentages of total tree pollen, shrub and herb pollen are expressed as percentages of total land pollen, and aquatic pollen and spores are expressed as percentages of total pollen.

POLLEN ASSEMBLAGES FROM PIT1

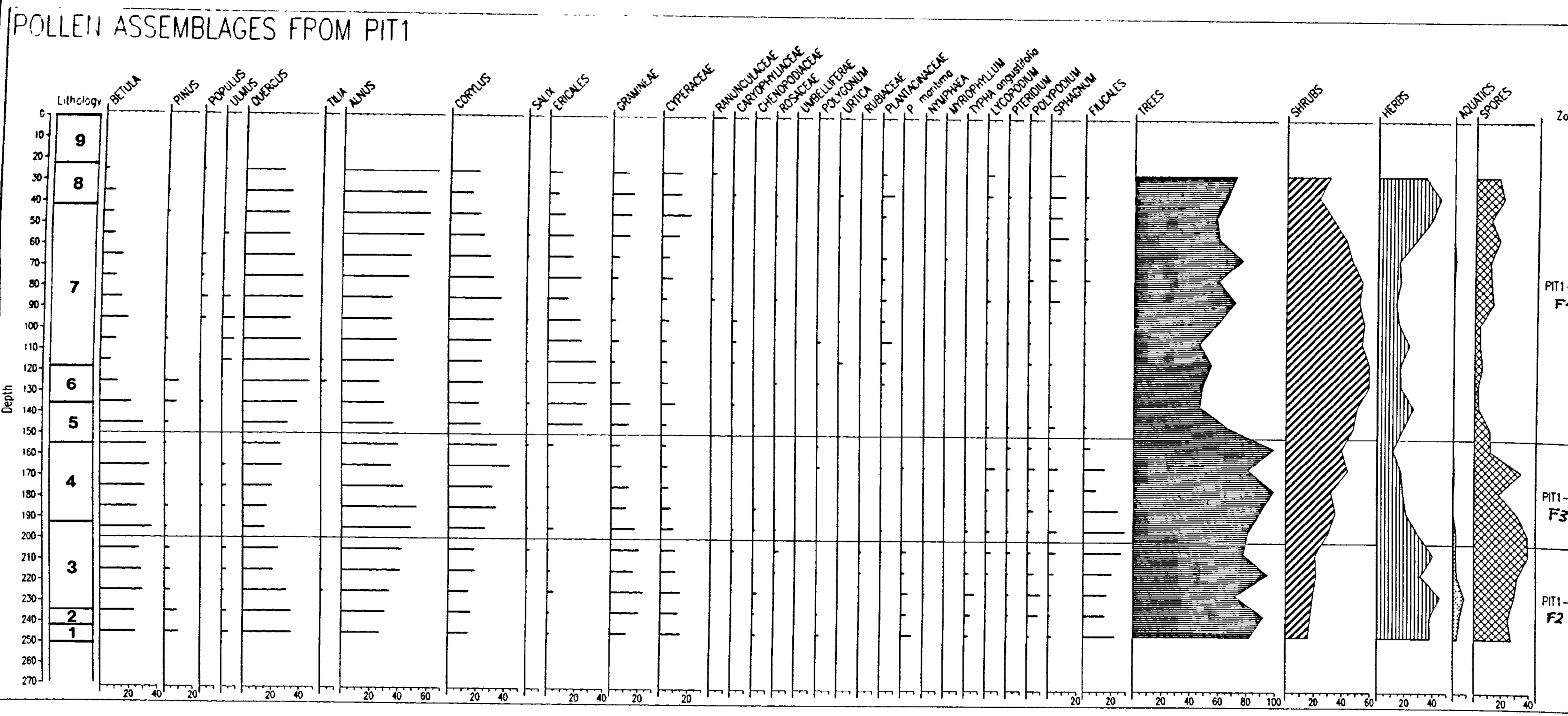


FIGURE 4.21.

Stratigraphic correlation at Skelwith Pool on the basis of pollen analyses and stratigraphic survey.

Skelwith Pool

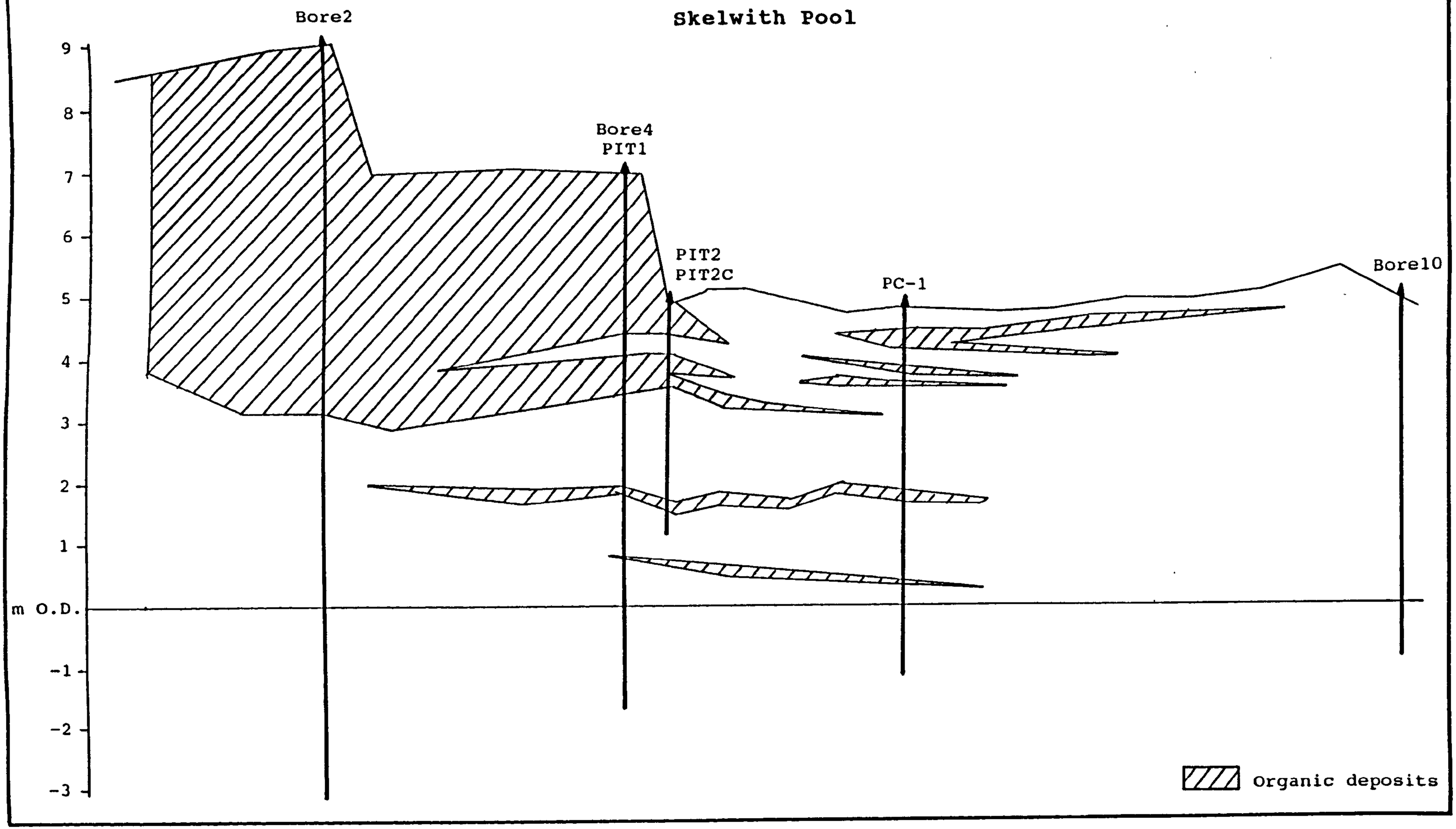


FIGURE 4.22.

A model of stratigraphic sequences in the Leven Estuary suggested by this study.

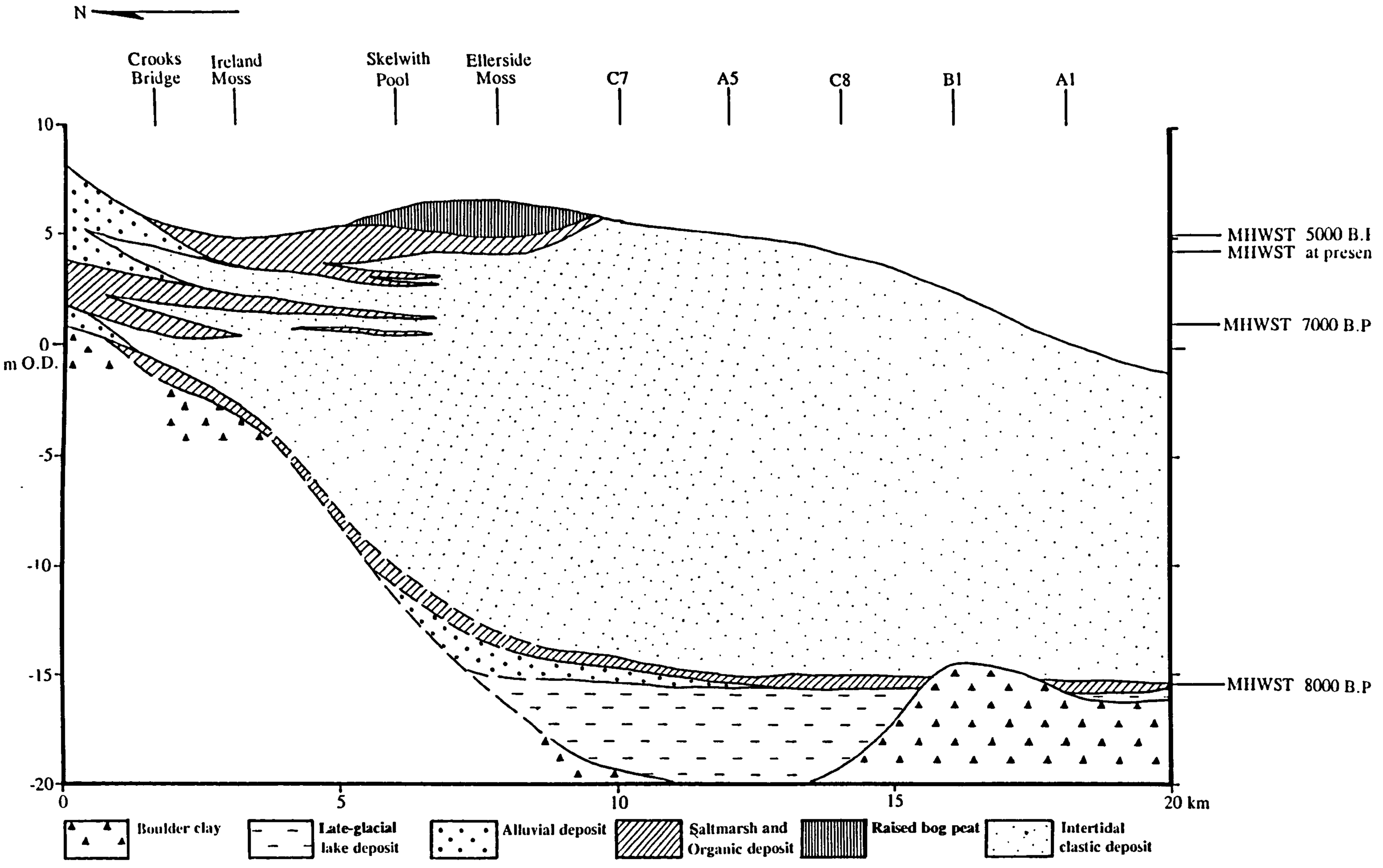

N
Crooks Bridge
Ireland Moss
Skelwith Pool
Ellerside Moss
C7
A5
C8
B1
A1
10
5
0
m O.D.
-5
-10
-15
-20
0
5
10
15
20 km
MHWST 5000 B.P
MHWST at present
MHWST 7000 B.P
MHWST 8000 B.P
Boulder clay
Late-glacial lake deposit
Alluvial deposit
Saltmarsh and Organic deposit
Raised bog peat
Intertidal clastic deposit

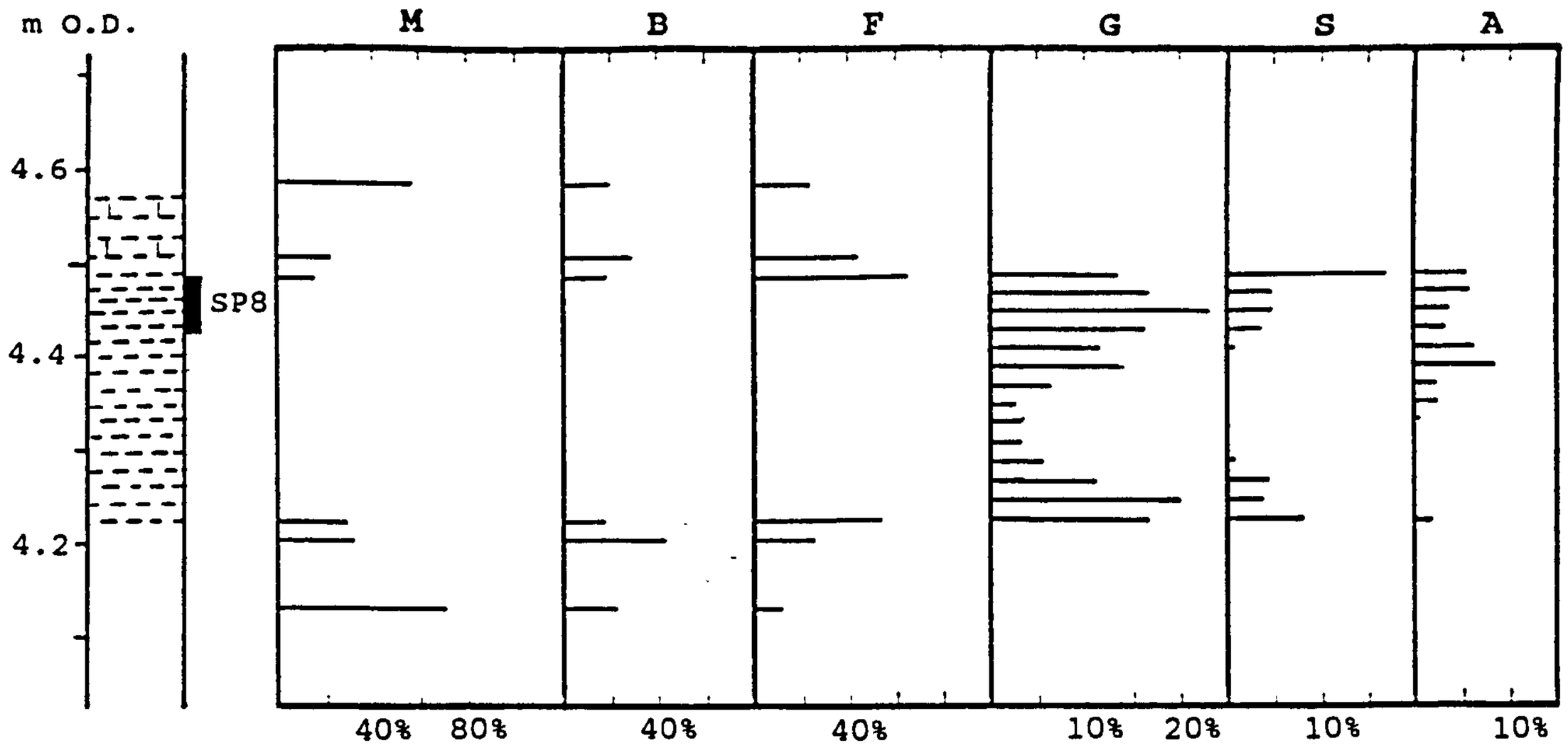
FIGURE 5.1.

A diagram showing the changing water level or salinity around the stratigraphic contacts suggested by diatom and pollen analyses.

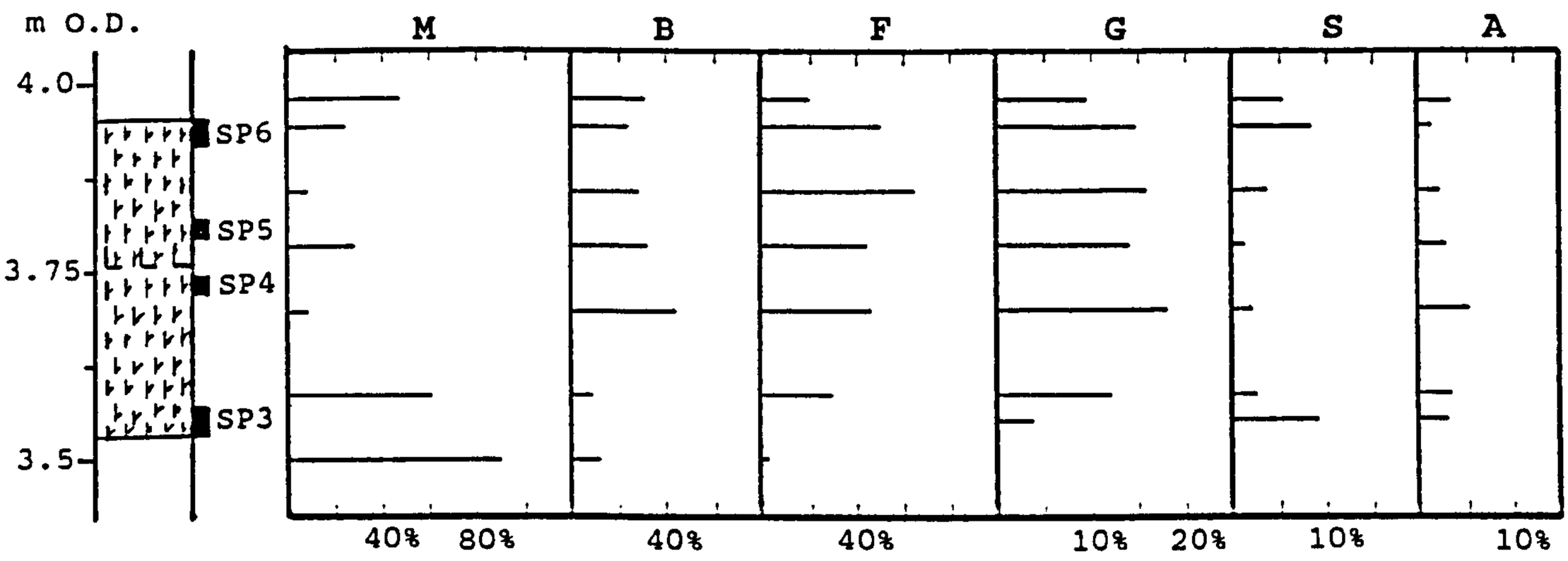
M: marine and marine-brackish diatoms,
B: brackish-marine and brackish diatoms,
F: brackish-fresh and fresh water diatoms.
Diatoms are expressed as percentages of total species.

G: Gramineae, percentages of total land pollen,
S: saltmarshes including Chenopodiaceae and Plantago maritima, percentages of total land pollen,
A: aquatic pollen, percentages of total pollen.

Borehole PC-1



Pit PIT2



Borehole PC-1

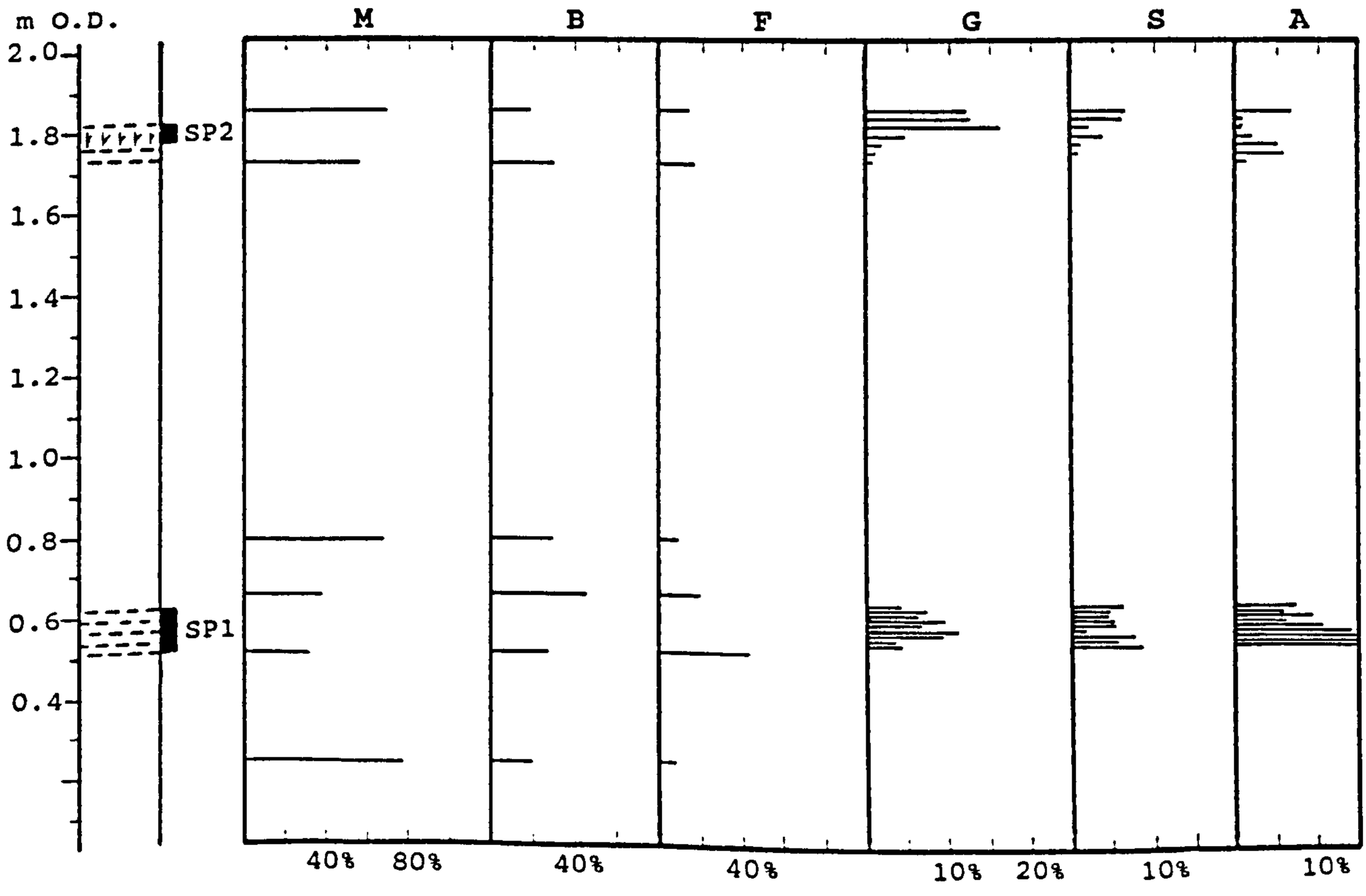


FIGURE 5.2.

A diagram showing a combined frequency histogram of transgressive and regressive overlaps with a certain 50 years interval given in Table 5.3.

A Combined Frequency Histogram

Overlaps from Morecambe Bay

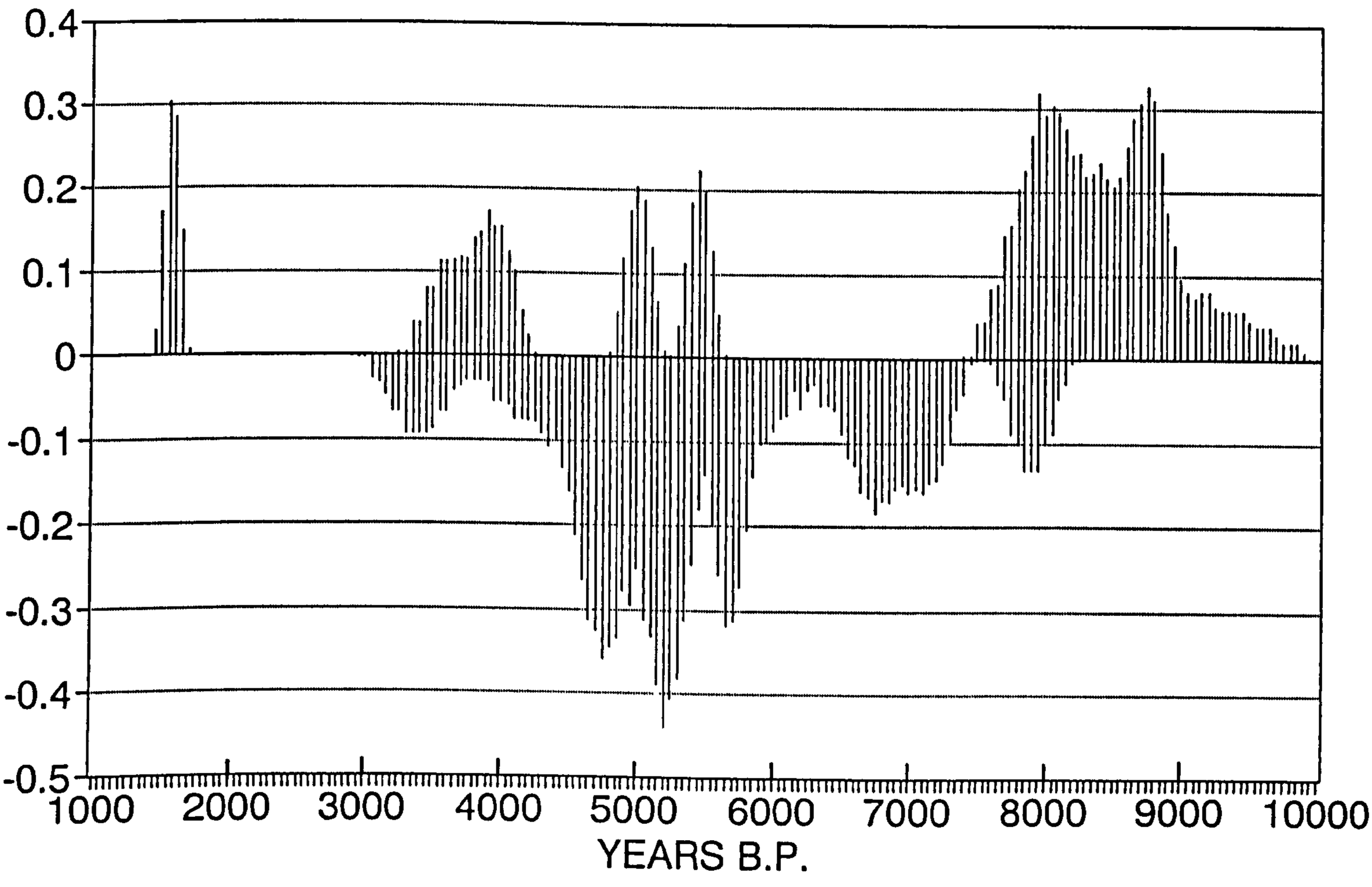


FIGURE 5.3.

A diagram showing a combined frequency histogram of regressive overlaps with a certain 50 years interval given in Table 5.3.

Those considered as regressive overlaps relative to a rising water table are plotted in positive values.

A Combined Frequency Histogram

Overlaps from Morecambe Bay

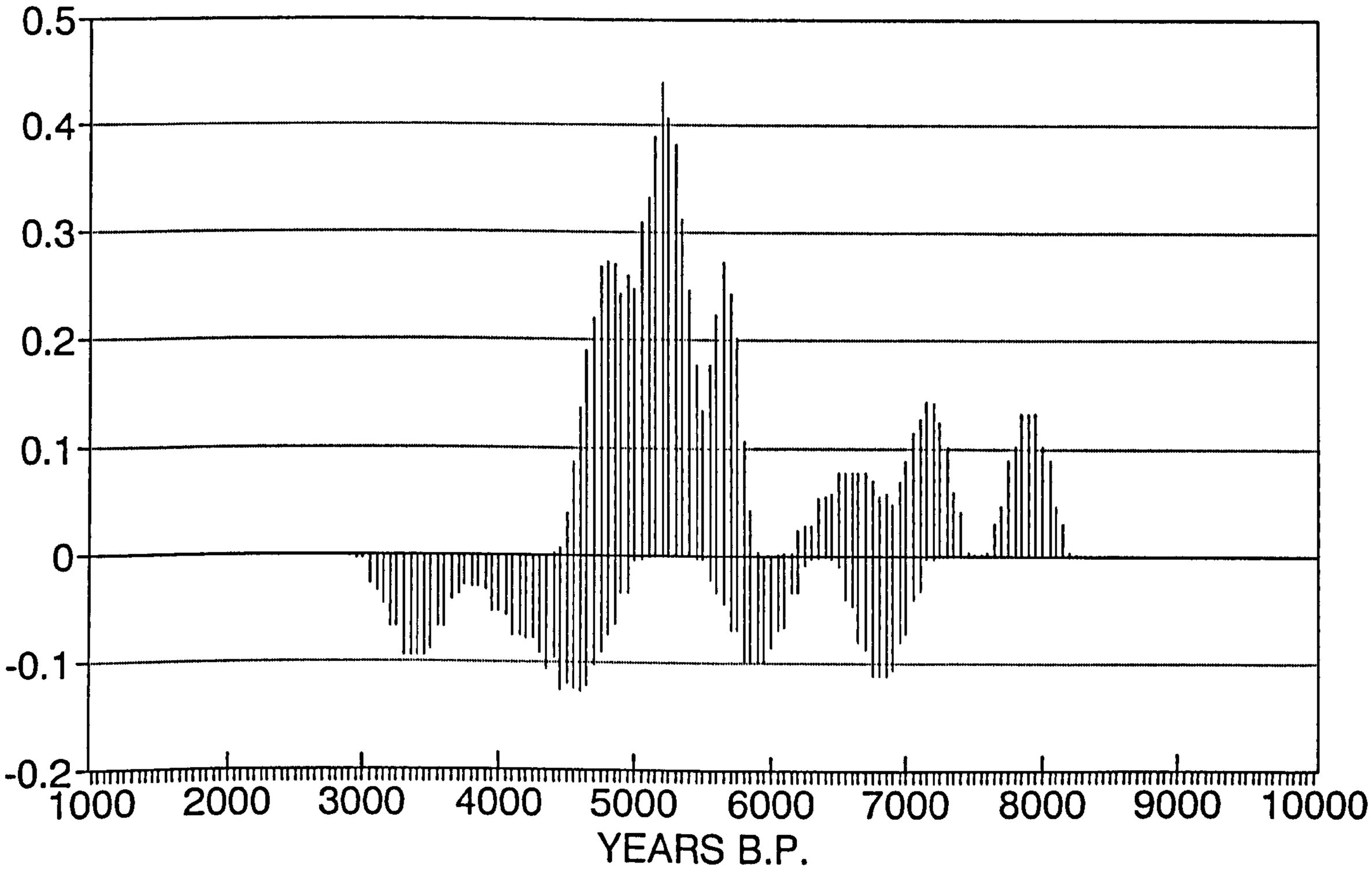


FIGURE 5.4.

A combined frequency histogram of the transgressive and regressive overlaps with a certain 50 years interval given in Table 5.3.

Those regressive overlaps relative to a rising water table (see Figure 5.3.) are plotted in this diagram with positive values.

This histogram is used to define the tendencies of sea-level movement which are plotted in Figure 5.5.

A Combined Frequency Histogram

Overlaps from Morecambe Bay

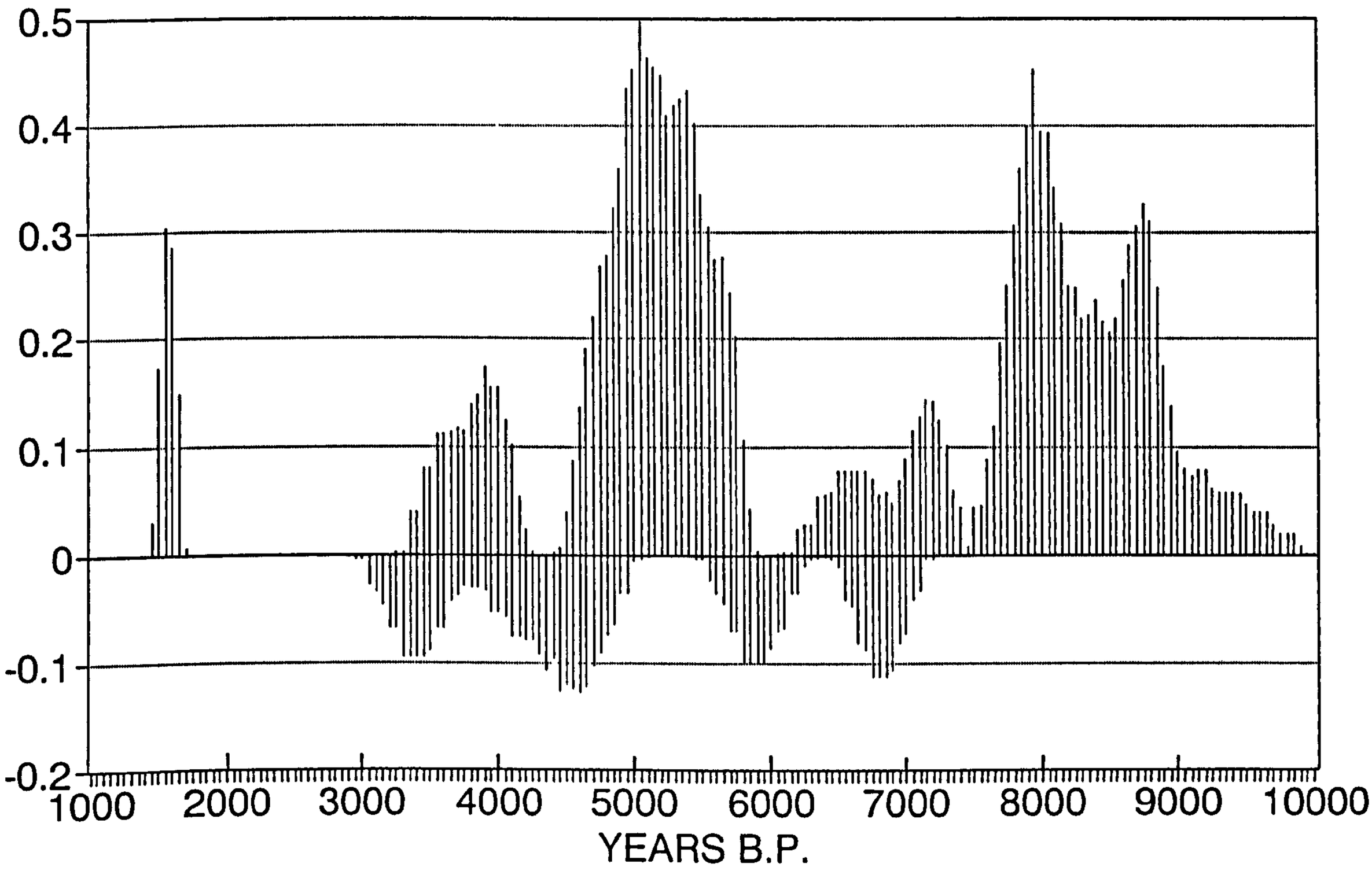


FIGURE 5.5.

A tendency model for Morecambe Bay of Flandrian sea-level movement derived from the histogram of Figure 5.4.

A Sea-Level Tendency Model
For Morecambe Bay

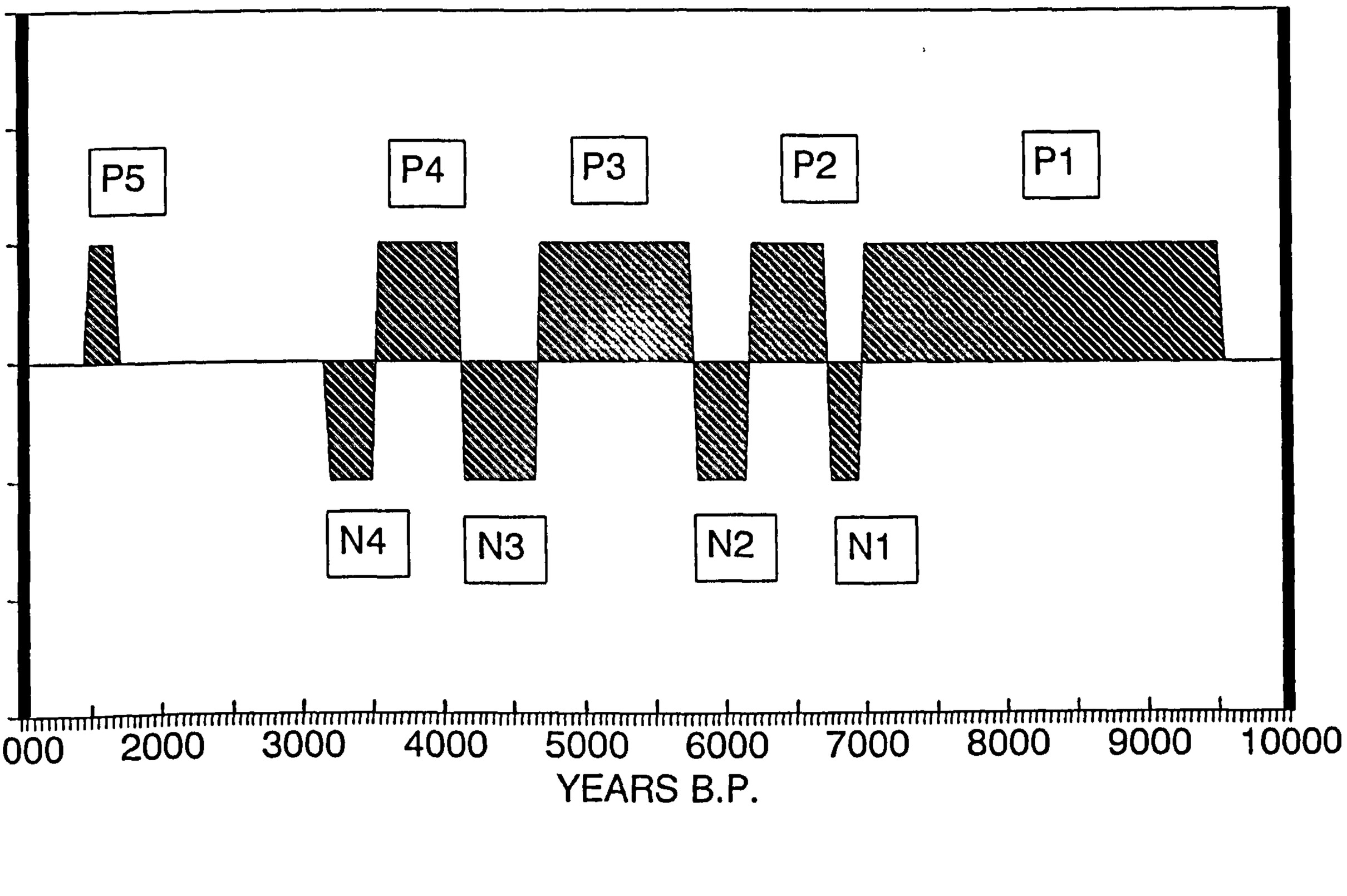


FIGURE 5.6.

A time-altitude plot of the sea-level index points showing the fluctuating rises of Flandrian sea-level in Morecambe Bay.

Each point has an error box indicating two deviations of the range of the radiocarbon dates and the error range of the reconstructed altitude of the local MHWST associated.

The two sections of sea-level curve are not linked together because a differential crustal movement may have happened in Morecambe Bay. This crustal movement may have distorted the altitudes between the two groups of sea-level index points.

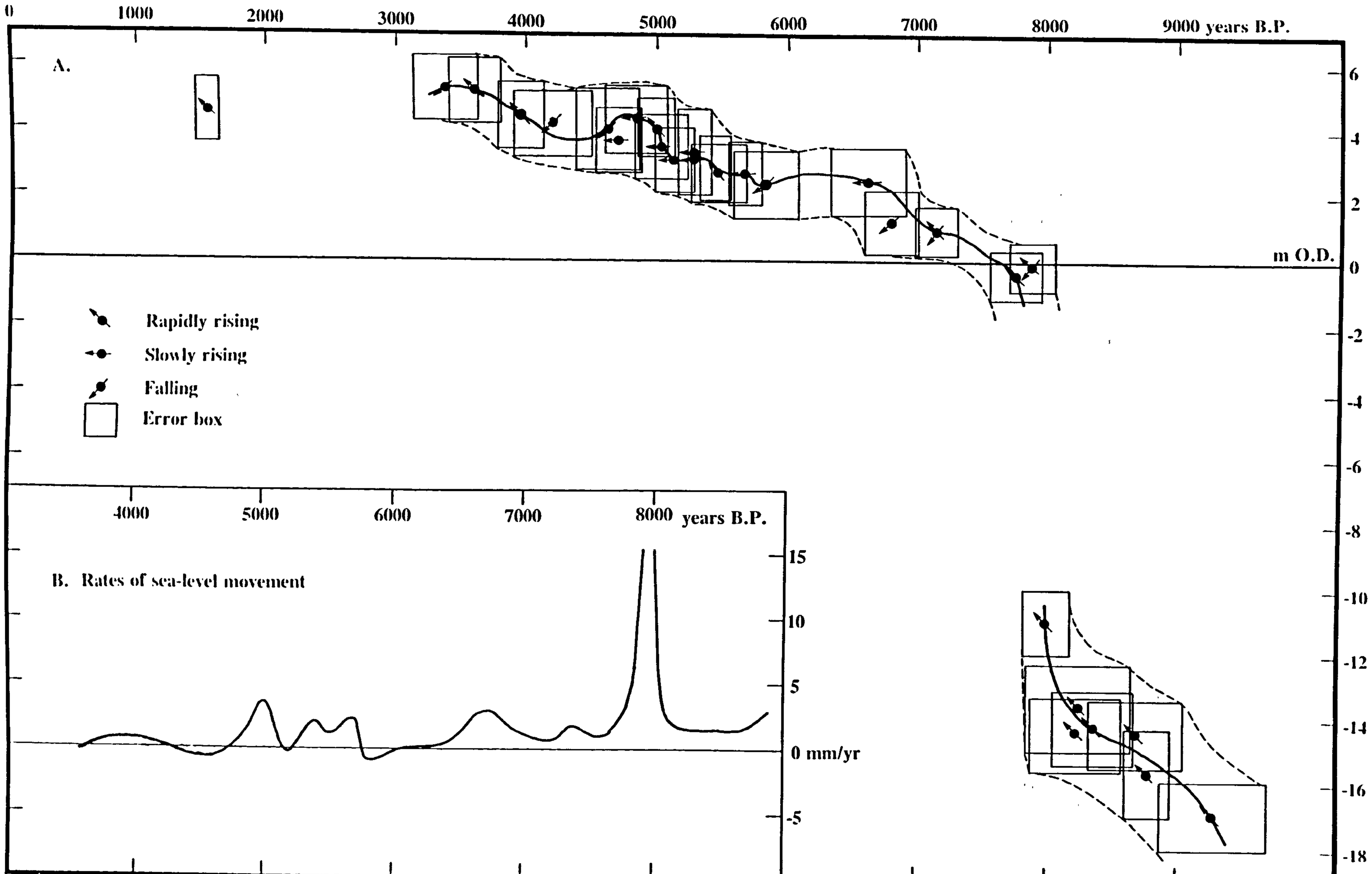

0
1000
2000
3000
4000
5000
6000
7000
8000
9000 years B.P.
A.
6
4
2
m O.D.
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
Rapidly rising
Slowly rising
Falling
Error box
4000
5000
6000
7000
8000 years B.P.
B. Rates of sea-level movement
15
10
5
0 mm/yr
-5

FIGURE 5.7.

A summary diagram showing the Flandrian sea-level history in Morecambe Bay, and comparisons among the sea-level tendency model, the fluctuating curve of sea level, the rates of sea-level movement and the periods of organic deposition in Skelwith Pool.

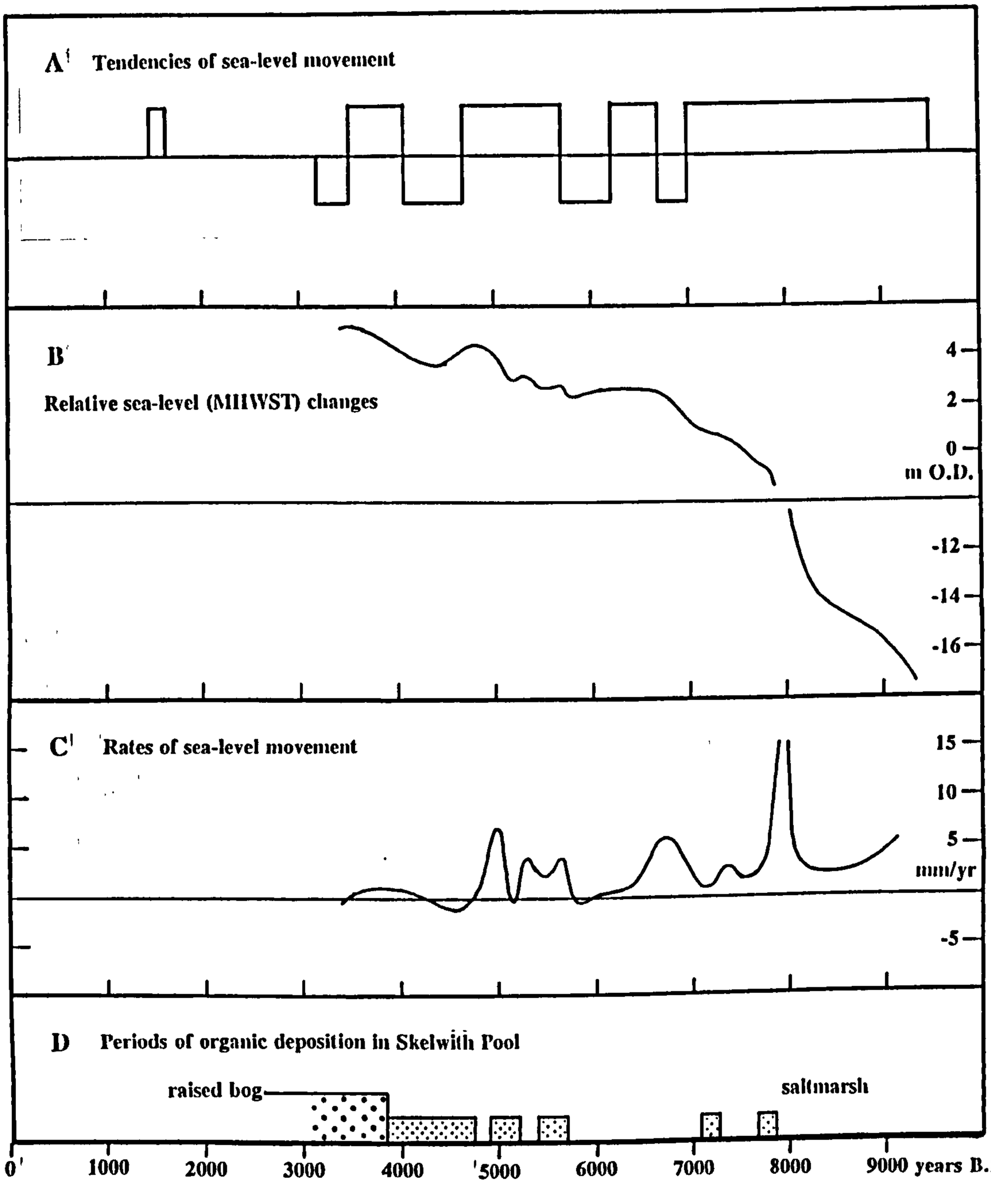

A Tendencies of sea-level movement
B
Relative sea-level (MHWST) changes
4
2
0
m O.D.
-12
-14
-16
C Rates of sea-level movement
15
10
5
mm/yr
-5
D Periods of organic deposition in Skelwith Pool
raised bog
saltmarsh
0
1000
2000
3000
4000
5000
6000
7000
8000
9000 years B.P.

FIGURE 5.8.

Plot A shows the eustatic curve from Morner (1984) and the sea-level index points from Morecambe Bay.

These index points are adjusted to mean tide level by reducing a constant value of 4.5 m, the mean high water spring tides above O.D. at Heysham.

Plot B shows the residuals between the index points and the eustatic curve.

A curvilinear line suggests the general trend of crustal movement. The crustal uplift curves from the western Forth Valley (Sissons and Brooks, 1971) and from Solway Firth (Shennan, 1989) are also plotted for comparison.

Those index points older than 7995 B.P. drop down about 8 to 10 m from the curvilinear line, suggesting that a differential crustal movement may have happened in the area concerned.

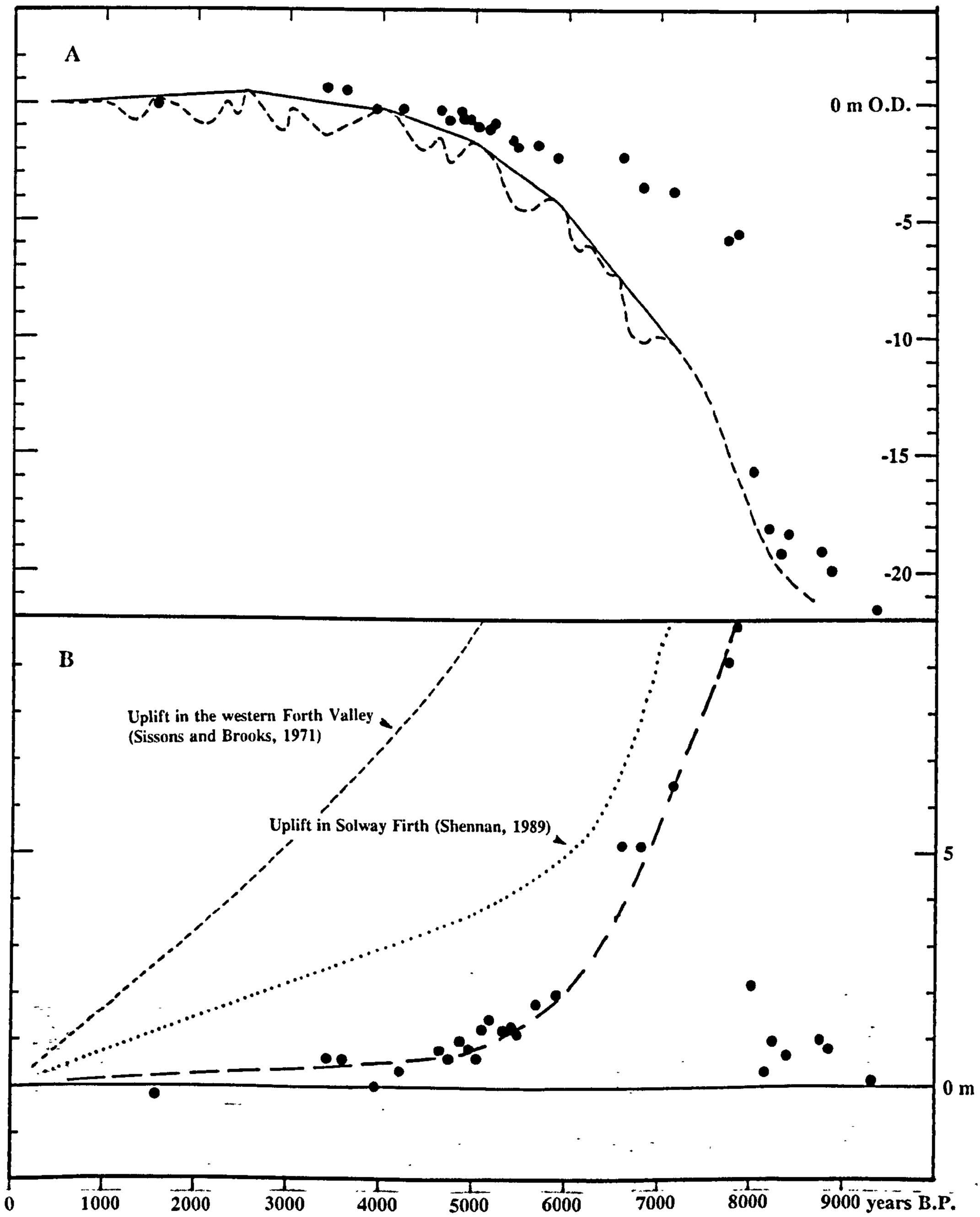

A
0 m O.D.
-5
-10
-15
-20
B
Uplift in the western Forth Valley
(Sissons and Brooks, 1971)
Uplift in Solway Firth (Shennan, 1989)
5
0 m
0
1000
2000
3000
4000
5000
6000
7000
8000
9000 years B.P.

FIGURE 5.9.

A plot showing the relationship between uplift and distance for the four sites selected.

Along the X axis:

0 km means the uplift centre in the western Forth Valley;
68 km is the Solway Firth area;
120 km is the Morecambe Bay area; and
155 km is the south Lancashire.

The cross marks mean the sea-level index points which are in age of about 7000 years B.P. and come from the four sites.

The solid boxes are the sea-level index points which are in age of about 4000 years B.P.

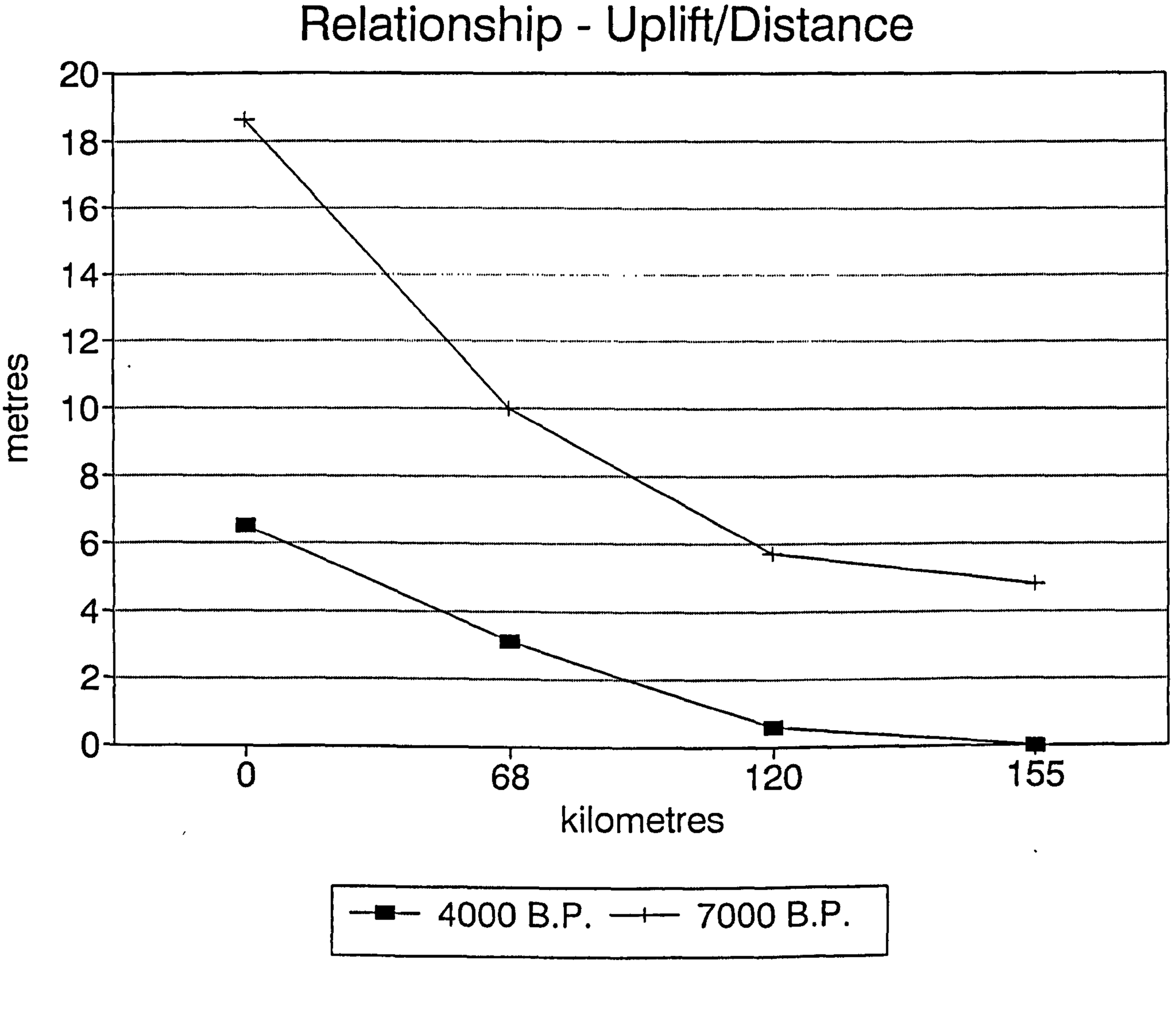

Relationship - Uplift/Distance
metres
20
18
16
14
12
10
8
6
4
2
0
0
68
120
155
kilometres
4000 B.P.
7000 B.P.

FIGURE 5.10.

Altitudes of the sea-level index points from Morecambe Bay and the south Lancashire, suggesting the subsidence in the central and southern parts of Morecambe Bay.

North Shore | Morecambe Bay | South Shore | Southwest Lancashire

Rusland Valley | Skilwith Pool | Arnside Moss A5 C8 B1 | C6 | Heysham | Pilling Moss | Skippool Valley | Lytham | Formby

2820 1545 4760 4616 5277 4710 5015 4980 5660 5435 7150 6590 7160 6790 7875 7750 3000 5000 6000 7000

4190

4830 5005 4895 4800 2270 3090 4960 5775 5945 6056 6535 6885 7605 2335 4090 4545 5615 5565 6050 6760 6750 6980 3000 5000 6000 7000

7820 8300 7995 8685 8330 8240 8364 8390 8740 8300

5 0 -5 -10 -15 m O.D.

90 km 80 70 60 50 40 30 20 10 0

Northing

FIGURE 6.1.

Sea-level Scenarios 1 and 2 for the next century for Morecambe Bay and the Thames Estuary, adopted from the IPCC report (Warrick and Oerlemans, 1990) and EPA report (1983, also Hoffman, 1984), with comparison to other predictions.

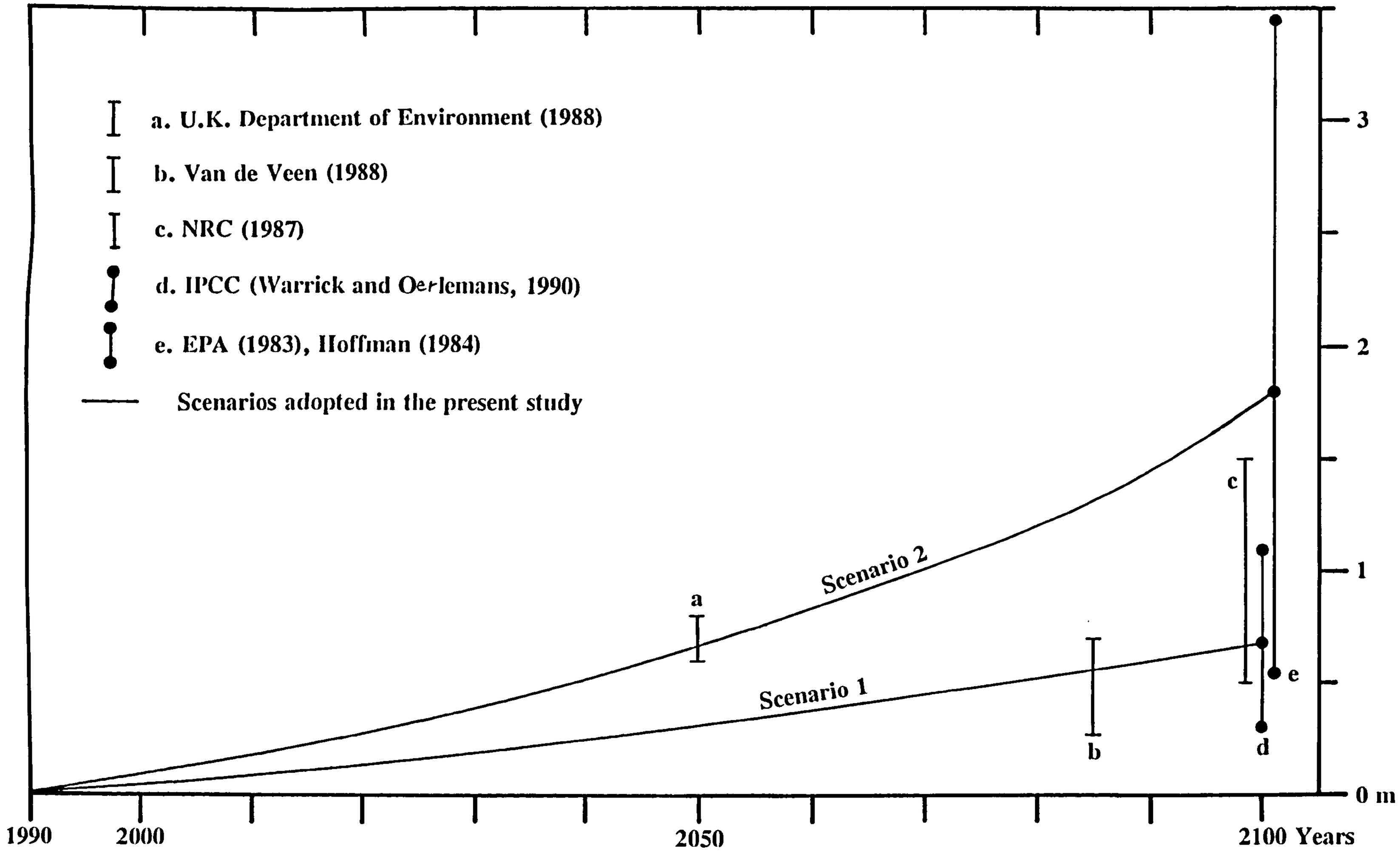

a. U.K. Department of Environment (1988)
b. Van de Veen (1988)
c. NRC (1987)
d. IPCC (Warrick and Oerlemans, 1990)
e. EPA (1983), Hoffman (1984)
Scenarios adopted in the present study
Scenario 2
Scenario 1
a
b
c
d
e
3
2
1
0 m
1990
2000
2050
2100 Years

FIGURE 7.1.

A theoretical model showing the likely coastal responses to the rising sea-level.

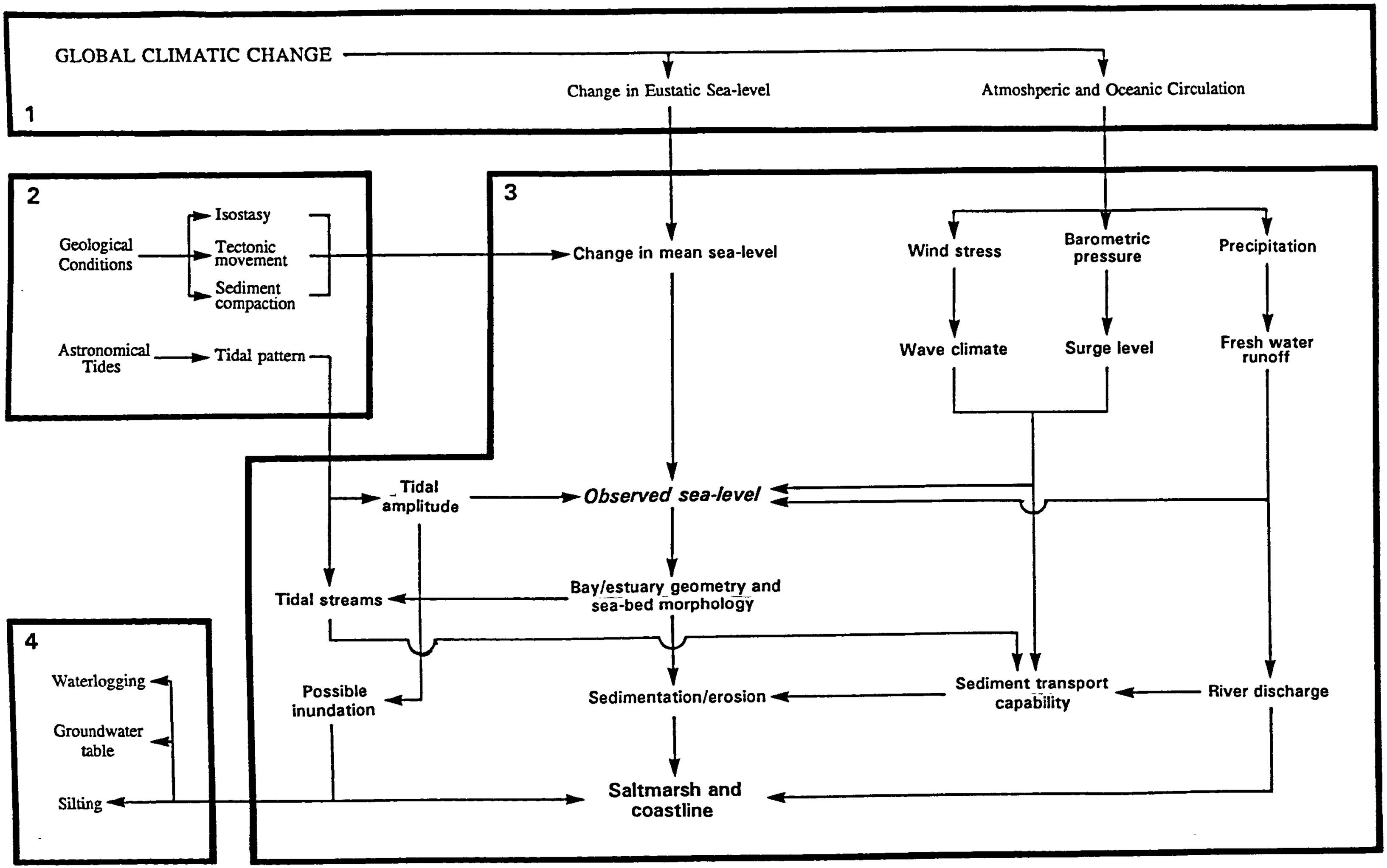

GLOBAL CLIMATIC CHANGE
Change in Eustatic Sea-level
Atmoshperic and Oceanic Circulation
1
2
Geological Conditions
Isostasy
Tectonic movement
Sediment compaction
Astronomical Tides
Tidal pattern
3
Change in mean sea-level
Wind stress
Barometric pressure
Precipitation
Wave climate
Surge level
Fresh water runoff
Tidal amplitude
Observed sea-level
Tidal streams
Bay/estuary geometry and sea-bed morphology
Possible inundation
Sedimentation/erosion
Sediment transport capability
River discharge
4
Waterlogging
Groundwater table
Silting
Saltmarsh and coastline

FIGURE 7.2.

A map showing the location of the tidal gauges in Morecambe Bay.

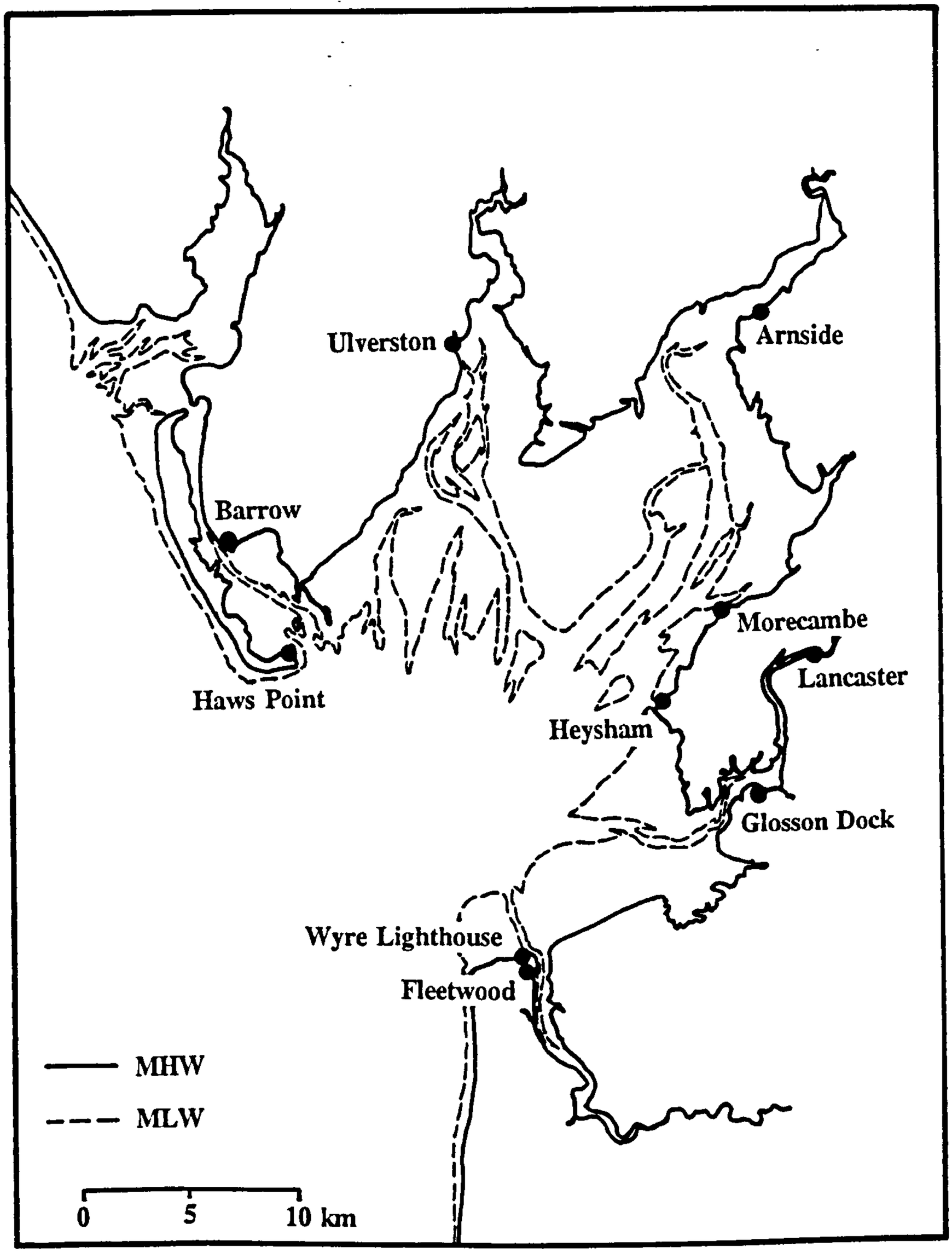

Ulverston
Arnside
Barrow
Haws Point
Morecambe
Lancaster
Heysham
Glosson Dock
Wyre Lighthouse
Fleetwood
MHW
MLW
0
5
10 km

FIGURE 7.3.

Directions of the maximum flood streams in the Irish Sea.

(from Bowden, 1955)

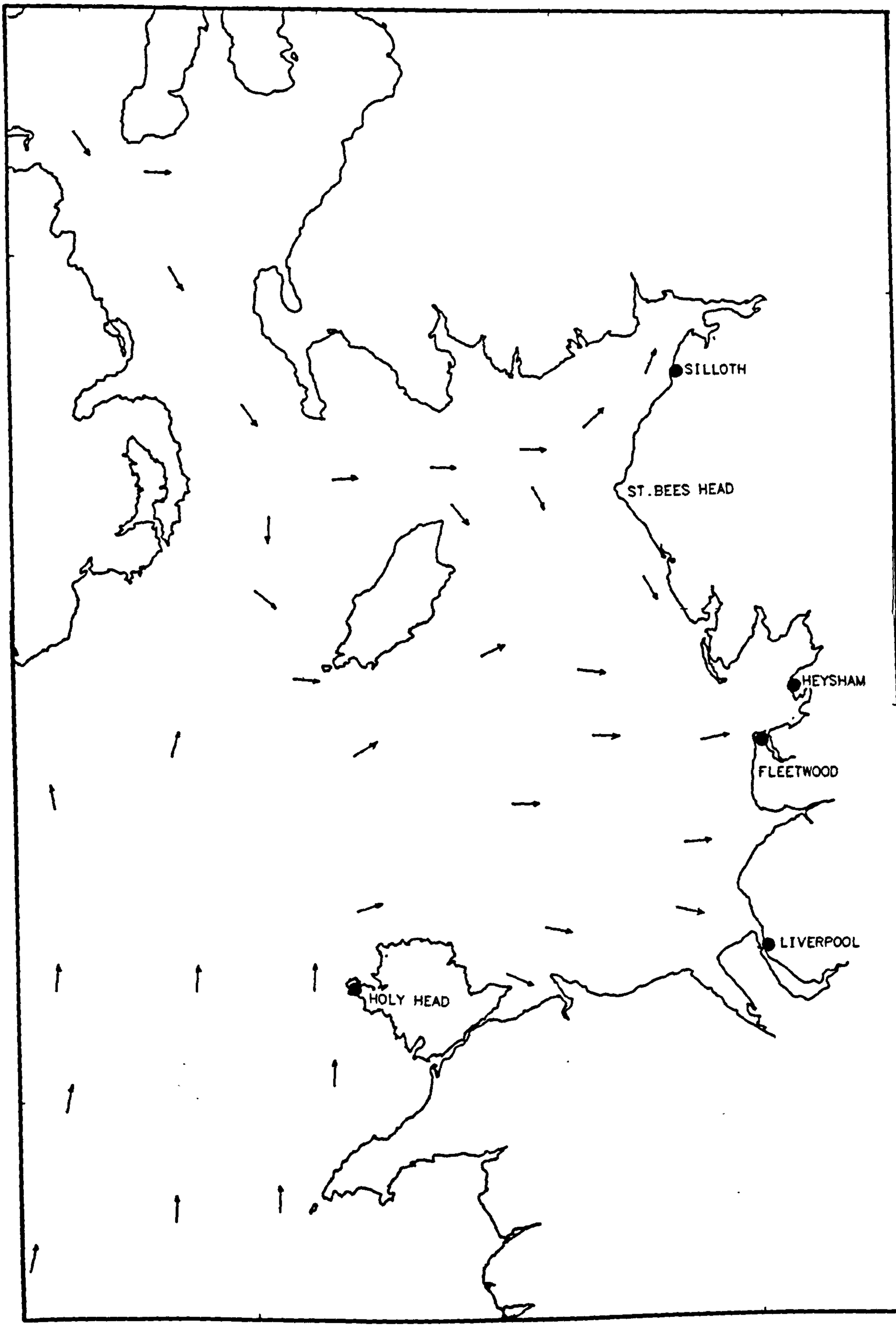

SILLOTH
ST.BEES HEAD
HEYSHAM
FLEETWOOD
LIVERPOOL
HOLY HEAD

FIGURE 7.4.

Co-tidal amplitude lines in the Irish Sea.

(from Bowden, 1955)

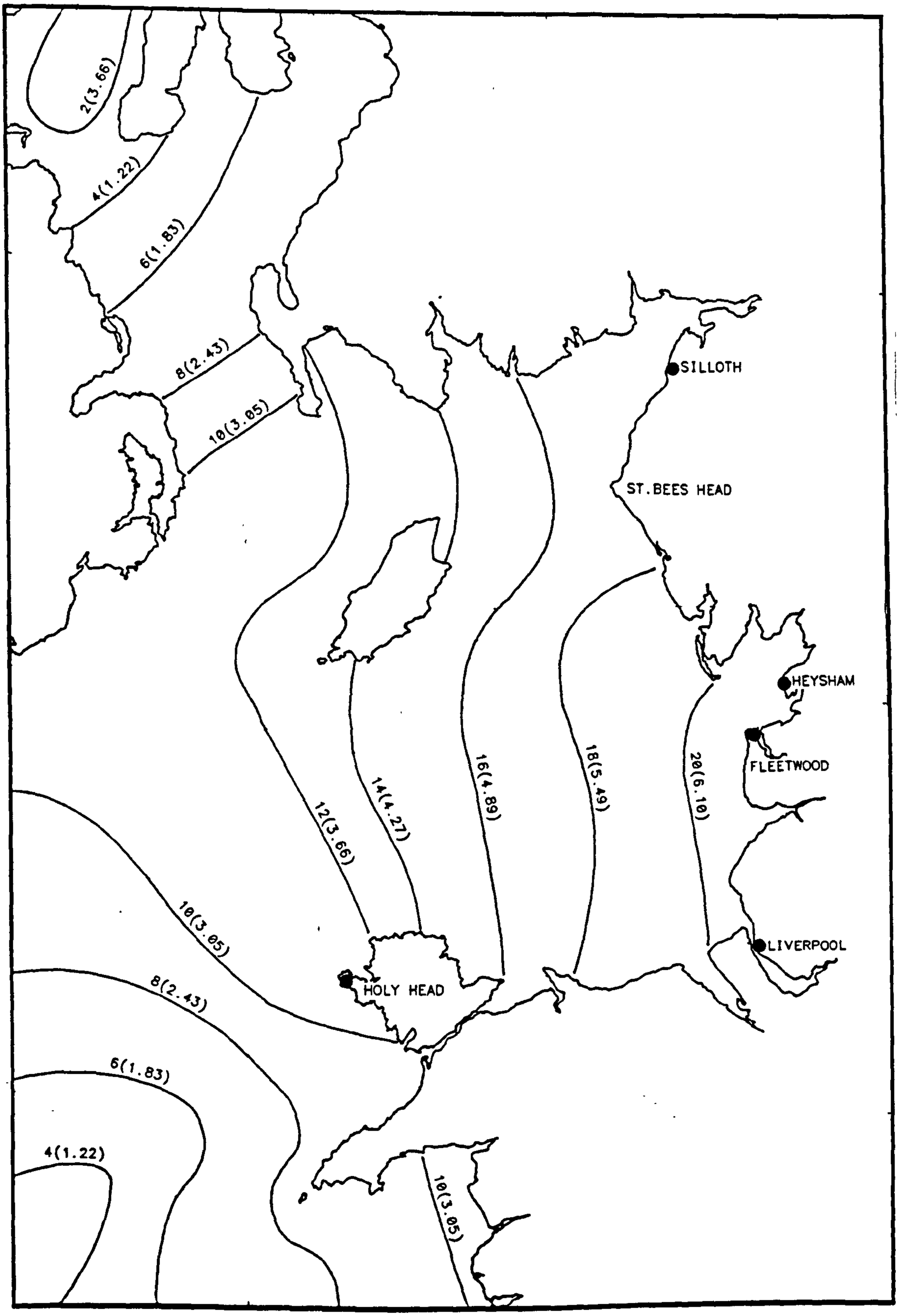

2(3.66)
4(1.22)
6(1.83)
8(2.43)
10(3.05)
12(3.66)
14(4.27)
16(4.89)
18(5.49)
20(6.10)
SILLOTH
ST.BEES HEAD
HEYSHAM
FLEETWOOD
LIVERPOOL
HOLY HEAD
10(3.05)
8(2.43)
6(1.83)
4(1.22)
10(3.05)

FIGURE 7.5.

Surfacial sea-bed sediments in Morecambe Bay.

The symbols are: 1, clay; 2, silt; 3, fine sand; 4, coarse sand; 5, fine gravel; 6, till; 7, saltmarsh.

(from Nijhof and Tooley, 1990)

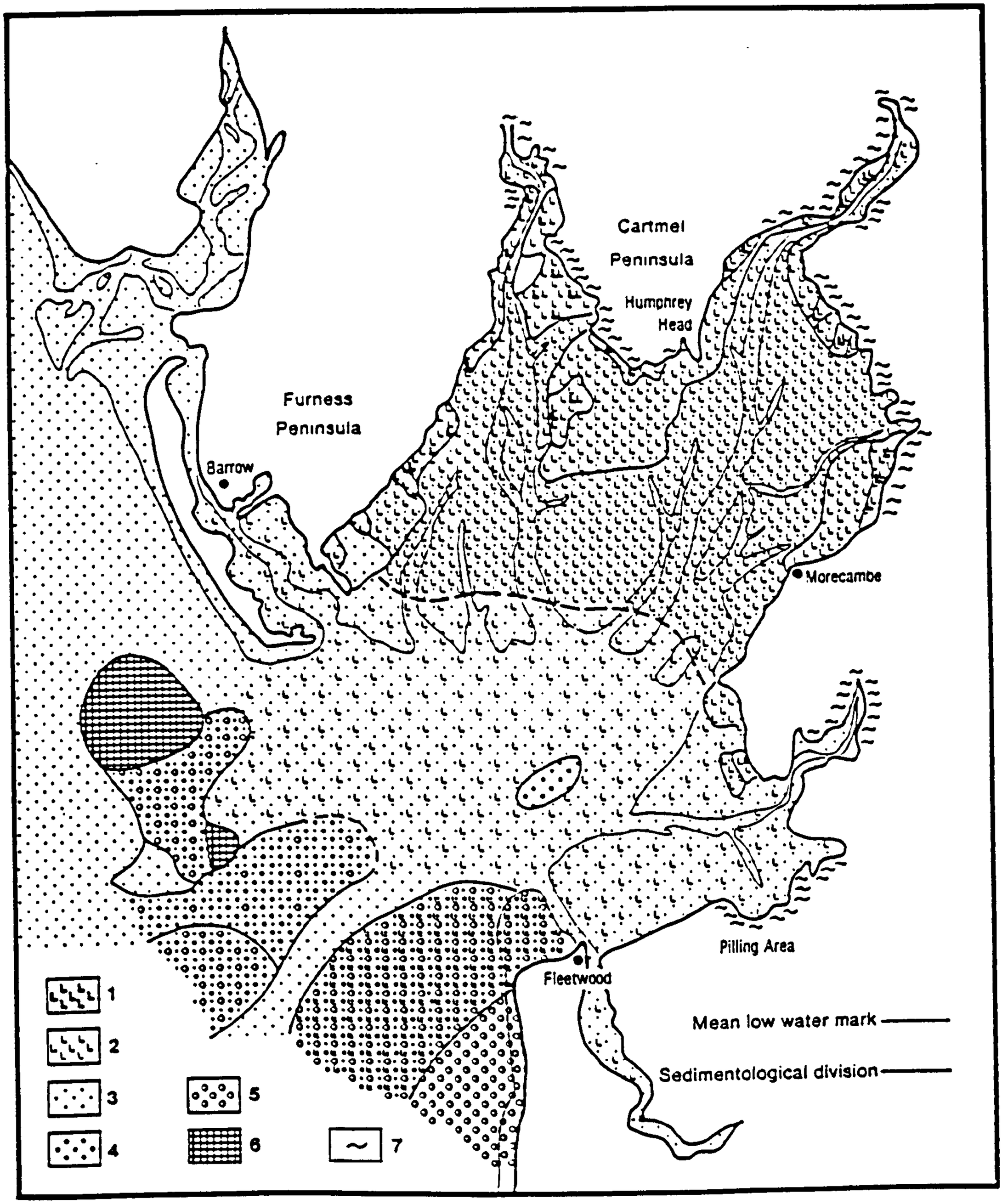

Cartmel
Peninsula
Humphrey
Head
Furness
Peninsula
Barrow
Morecambe
Pilling Area
Fleetwood
1
2
3
4
5
6
7
Mean low water mark
Sedimentological division

FIGURE 7.6.

Types of coastline around Morecambe Bay interpreted from the 1:25,000 O.S. maps.

Features of these coastlines is described in text.

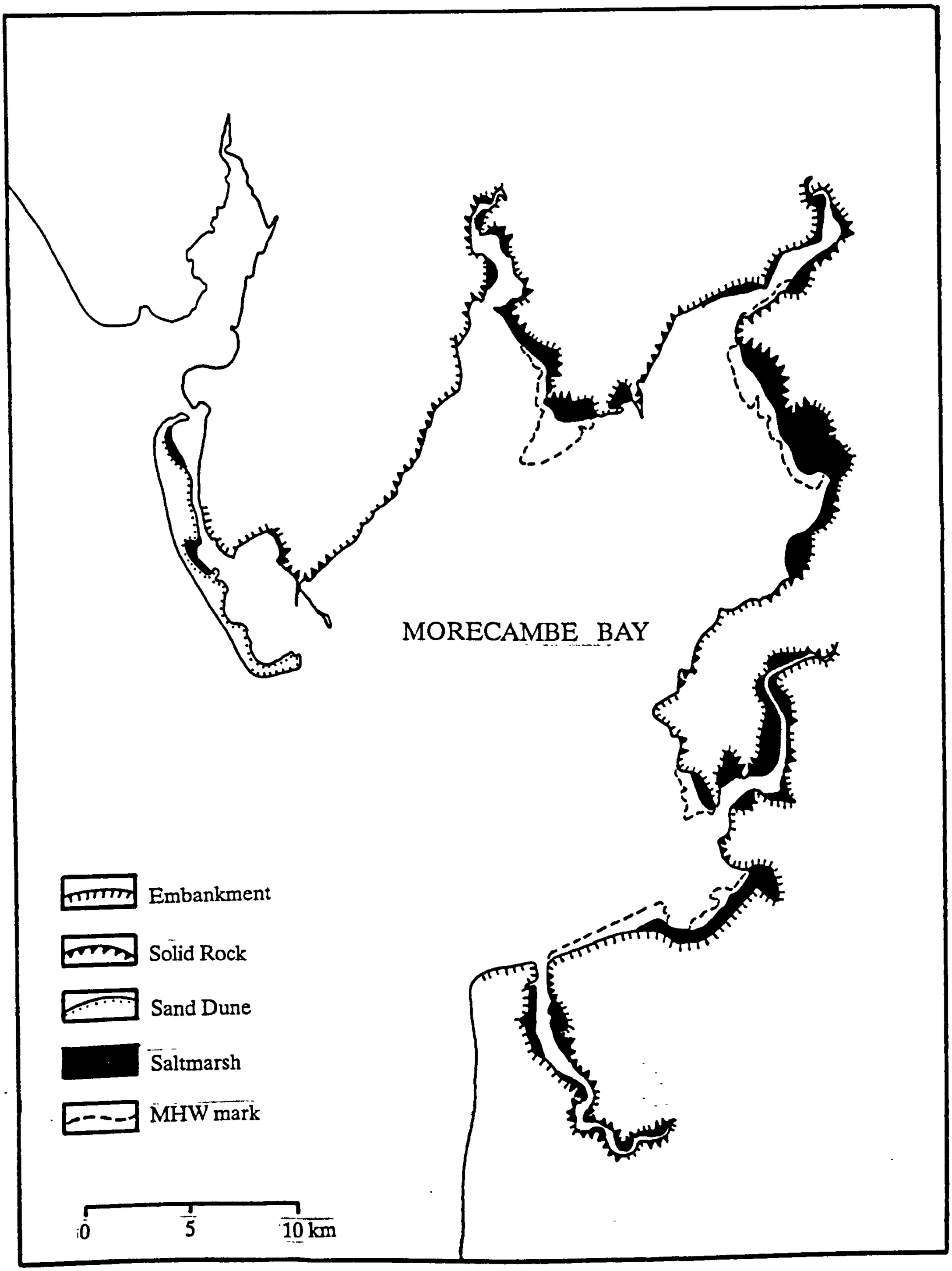

MORECAMBE BAY
Embankment
Solid Rock
Sand Dune
Saltmarsh
MHW mark
0
5
10 km

FIGURE 7.7.

A profile of intertidal zone from Pilling to the Lune channel, showing the widening of the intertidal zone as a result of sea-level rise (Scenario 2).

The present MHW and MLW are measured from the 1:25,000 O.S. maps.

The dashed line shows the landward migration of saltmarshes, with detailed explanation in the text.

The Lune | Intertidal flat | Saltings | Mature marsh | Reclaimed land

N

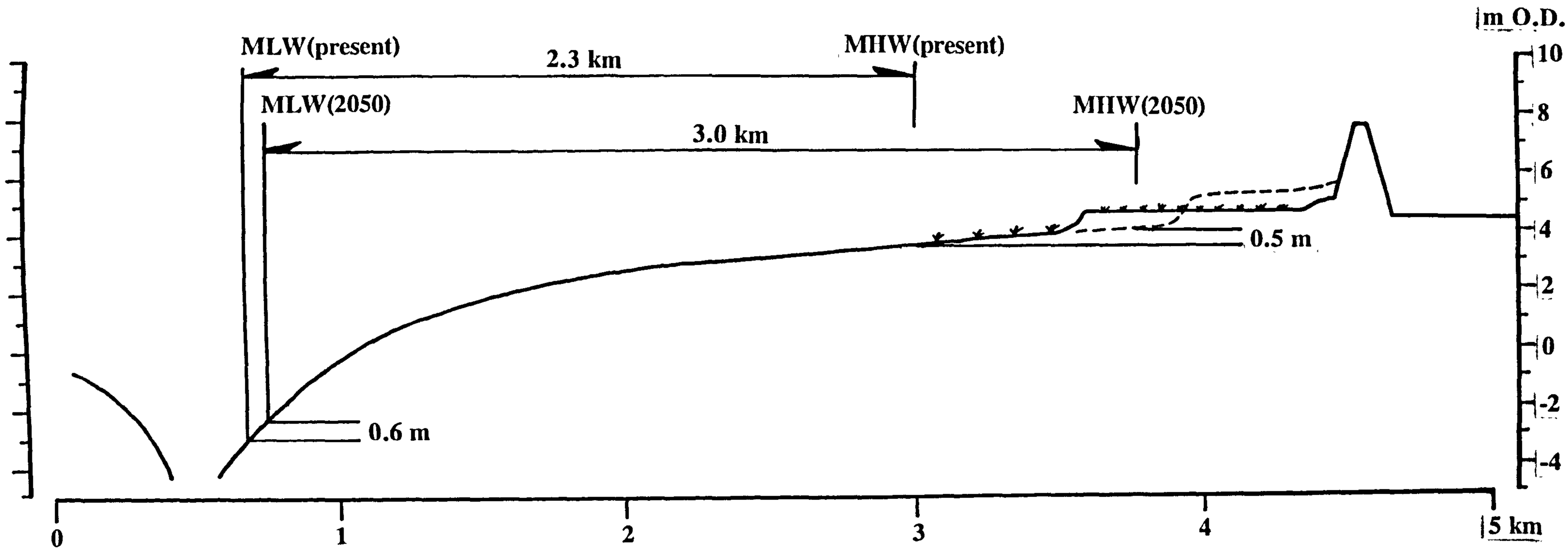


FIGURE 7.8.

A profile of intertidal and supertidal zones from Roudsea Wood, Morecambe Bay, suggesting the landward migration of the coastal vegetation zones as a result of sea-level rise (Scenario 2).

Zone A, salting; B, saltmarsh; C, Phragmites marsh; D, wetland wood; E, dry-land wood.

(after Kidson and Heyworth, 1979)

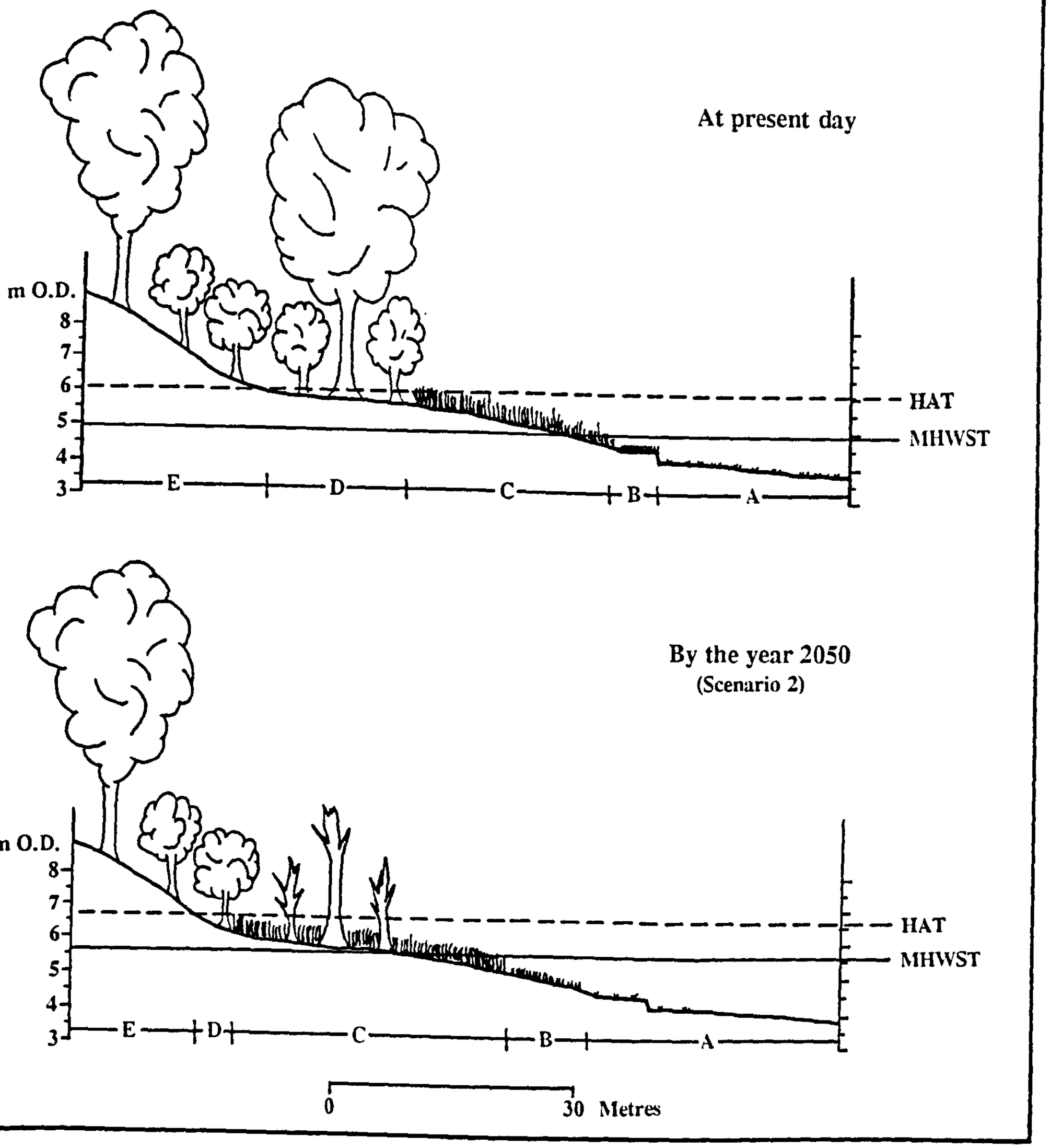

At present day
m O.D.
8
7
6
5
4
3
HAT
MHWST
E
D
C
B
A
By the year 2050
(Scenario 2)
m O.D.
8
7
6
5
4
3
HAT
MHWST
E
D
C
B
A
0
30 Metres

FIGURE 7.9.

Location of tidal gauges along the Thames Estuary.

UNIV DUNELM

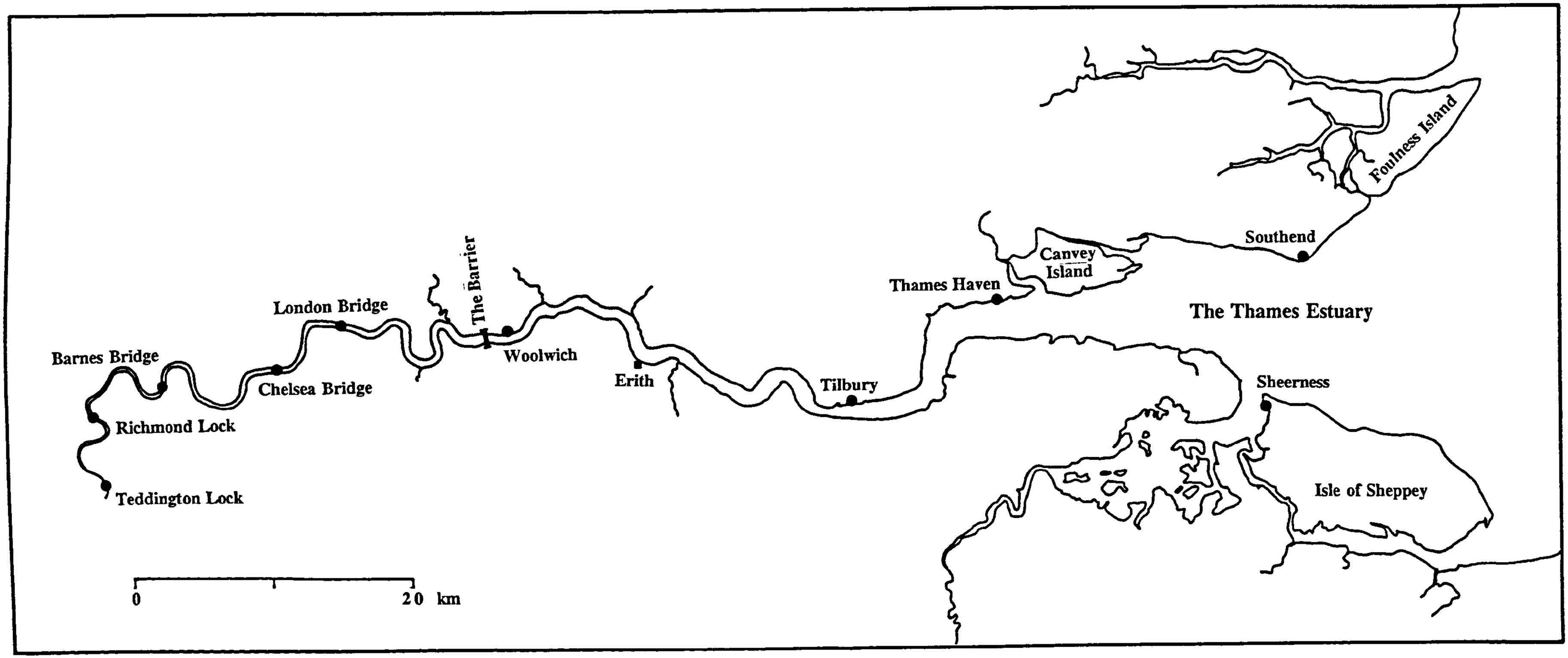

Foulness Island
Southend
Canvey Island
Thames Haven
The Thames Estuary
London Bridge
The Barrier
Woolwich
Barnes Bridge
Chelsea Bridge
Erith
Tilbury
Sheerness
Richmond Lock
Isle of Sheppey
Teddington Lock
0
20 km

FIGURE 7.10.

The rising of the extremely high water levels in London Bridge.

(from Gilbert and Horner, 1984)

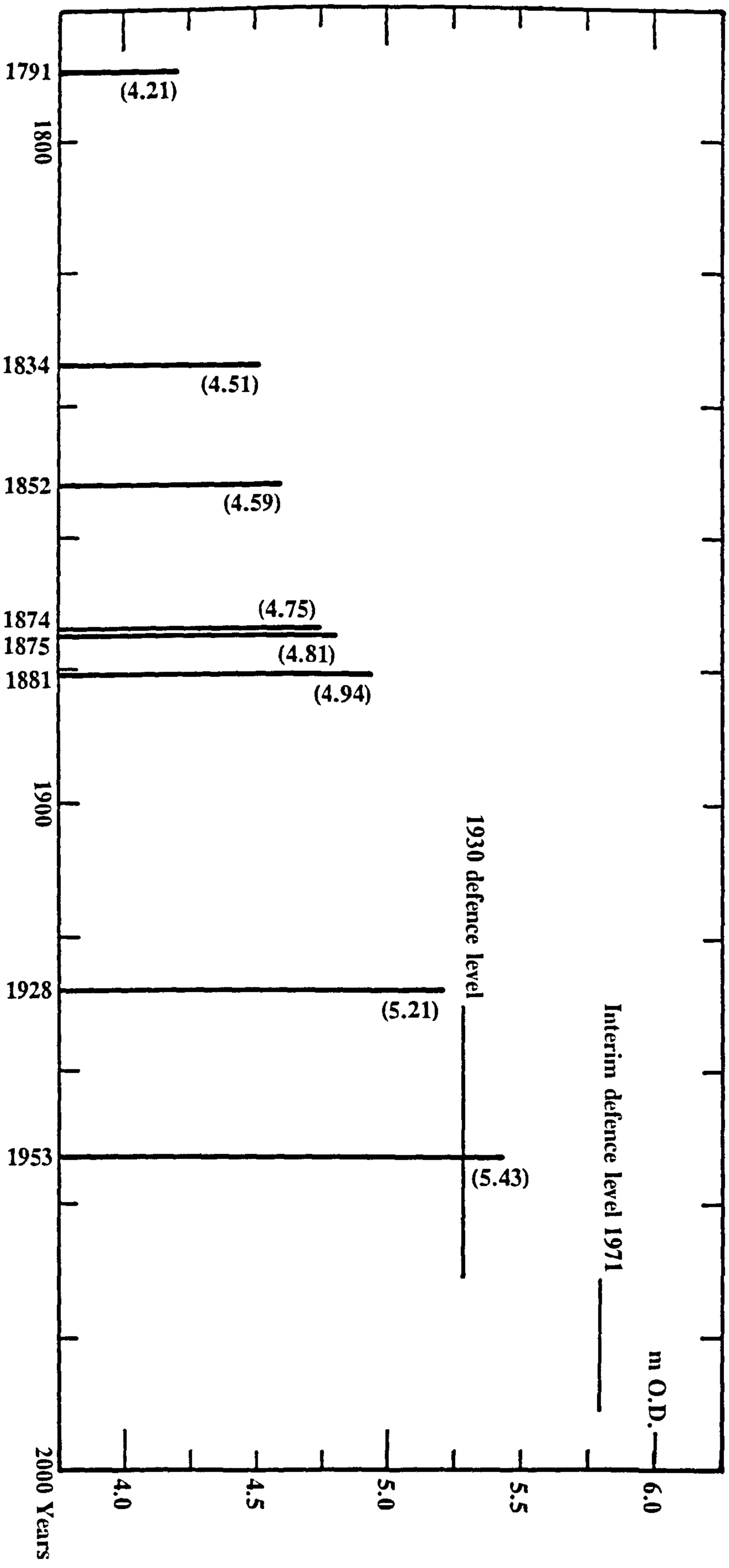
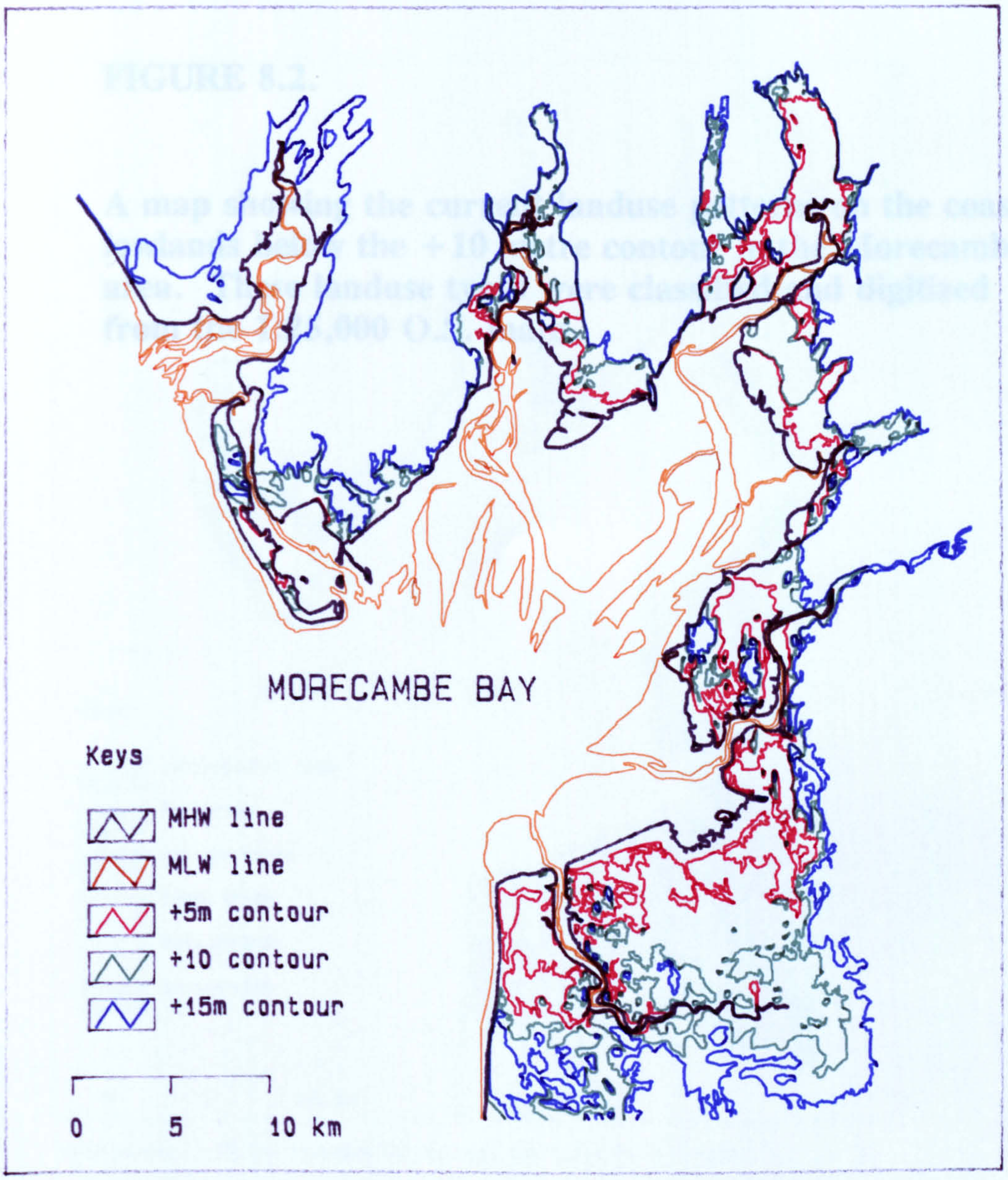

1791
(4.21)
1800
1834
(4.51)
1852
(4.59)
(4.75)
1874
1875
(4.81)
1881
(4.94)
1900
1928
(5.21)
1930 defence level
1953
(5.43)
Interim defence level 1971
m O.D.
2000 Years
4.0
4.5
5.0
5.5
6.0

FIGURE 8.1.

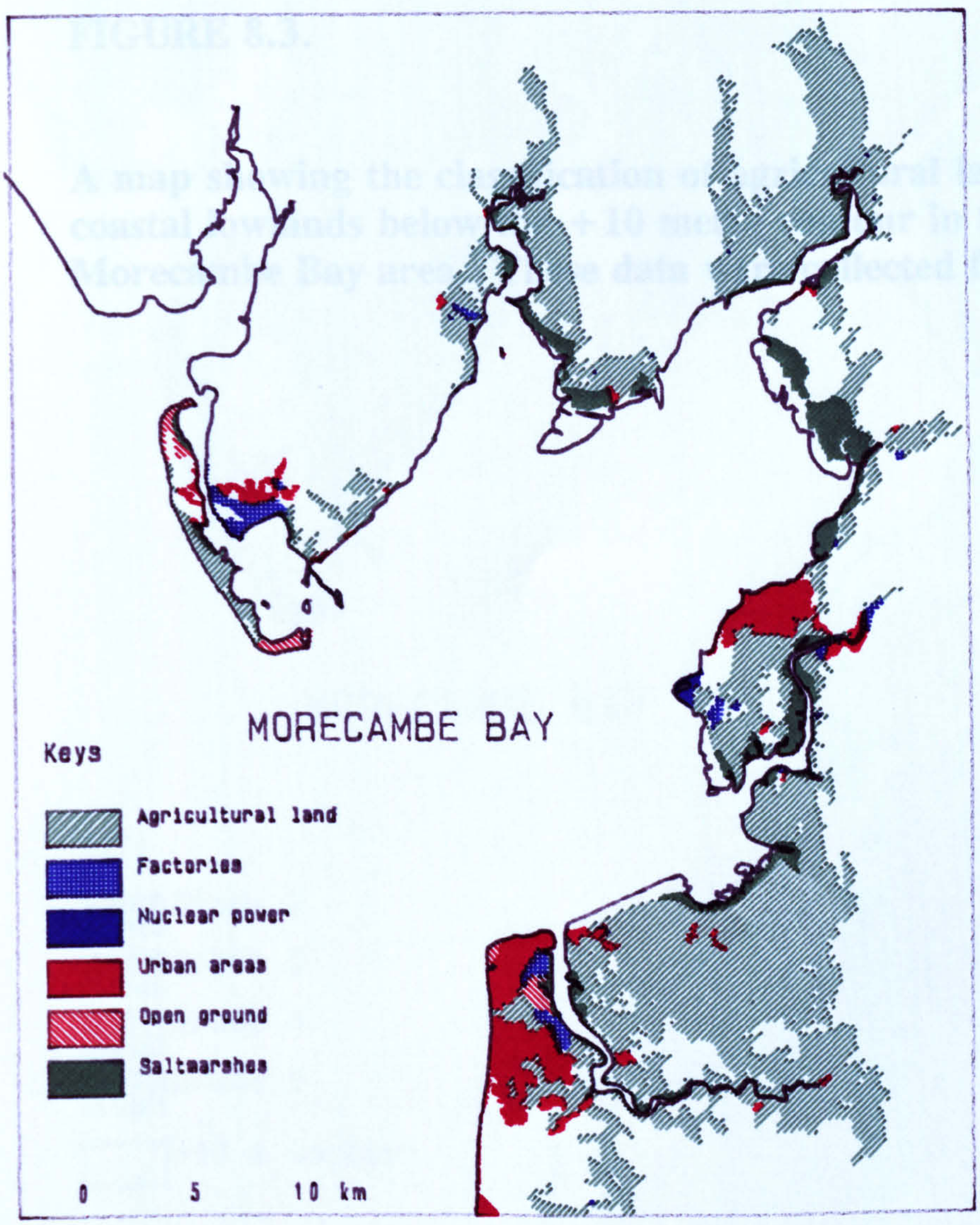
A map of Morecambe Bay showing the Mean High Water and Mean Low Water lines, associated with the +5, +10 and +15 metre contours. These lines were digitized from the 1:25,000 O.S. maps.



A map showing Mean High Water, Mean Low Water, +5m, +10m and +15m contour lines.

FIGURE 8.2.

A map showing the current landuse patterns on the coastal lowlands below the +10 metre contour in the Morecambe Bay area. These landuse types were classified and digitized from the 1:25,000 O.S. maps.

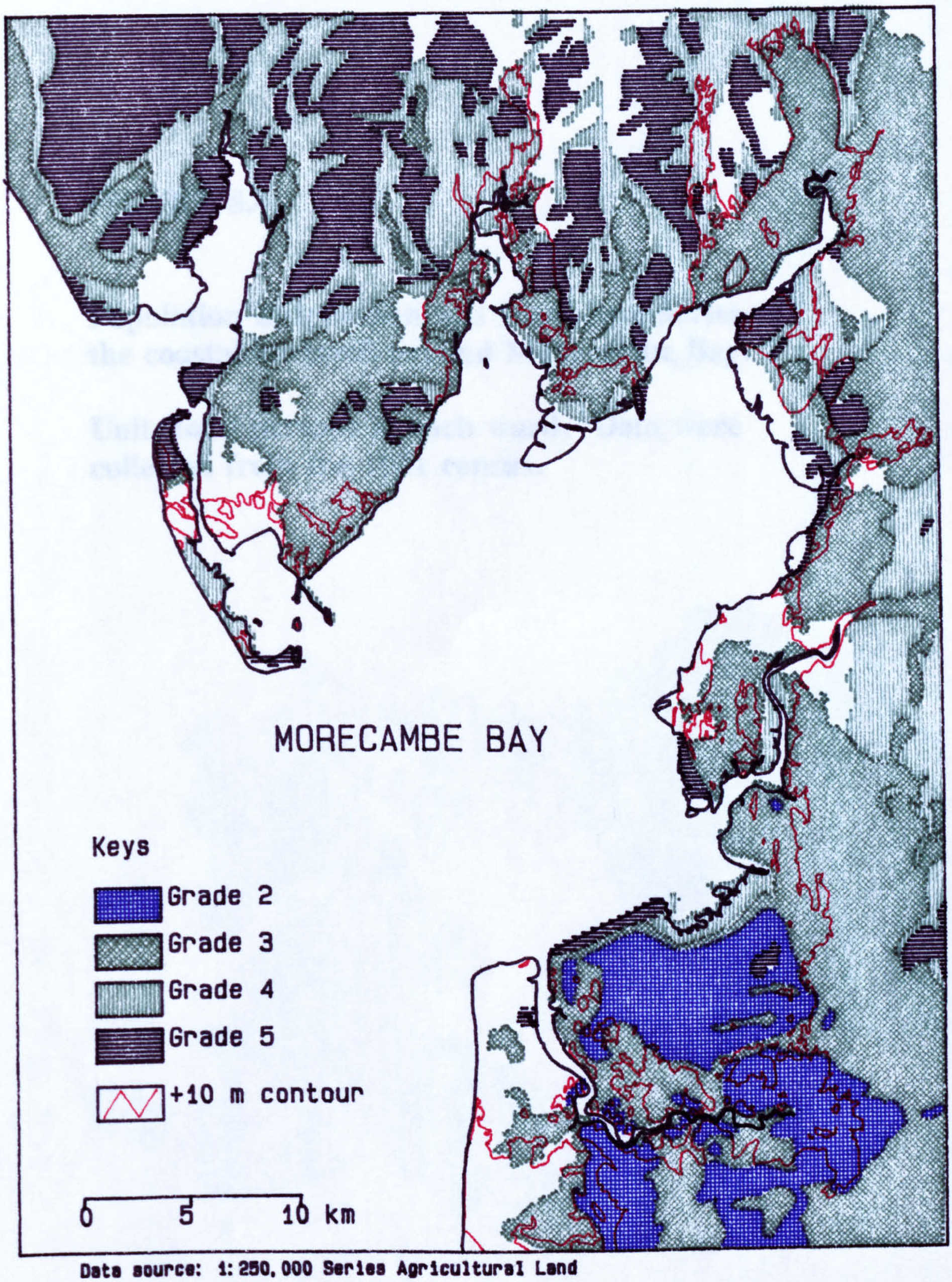


Data source: 1:25,000 Ordnance Survey maps published in 1977-1985

A map showing the current pattern of landuse on the coastal lowlands below 10 m contour line.

FIGURE 8.3.

A map showing the classification of agricultural land on coastal lowlands below the +10 metre contour in the Morecambe Bay area. These data were collected from MAFF.



Data source: 1:250,000 Series Agricultural Land Classification, MAFF, 1977

Fig. 6.1.

Agricultural land classification with the 10 m contour showing the lands below 10 m O.D.

FIGURE 8.4.

Population distribution and ward boundaries of the coastal lowlands around Morecambe Bay.

Unit: total persons in each ward. Data were collected from the 1981 census.

POPULATION DISTRIBUTION

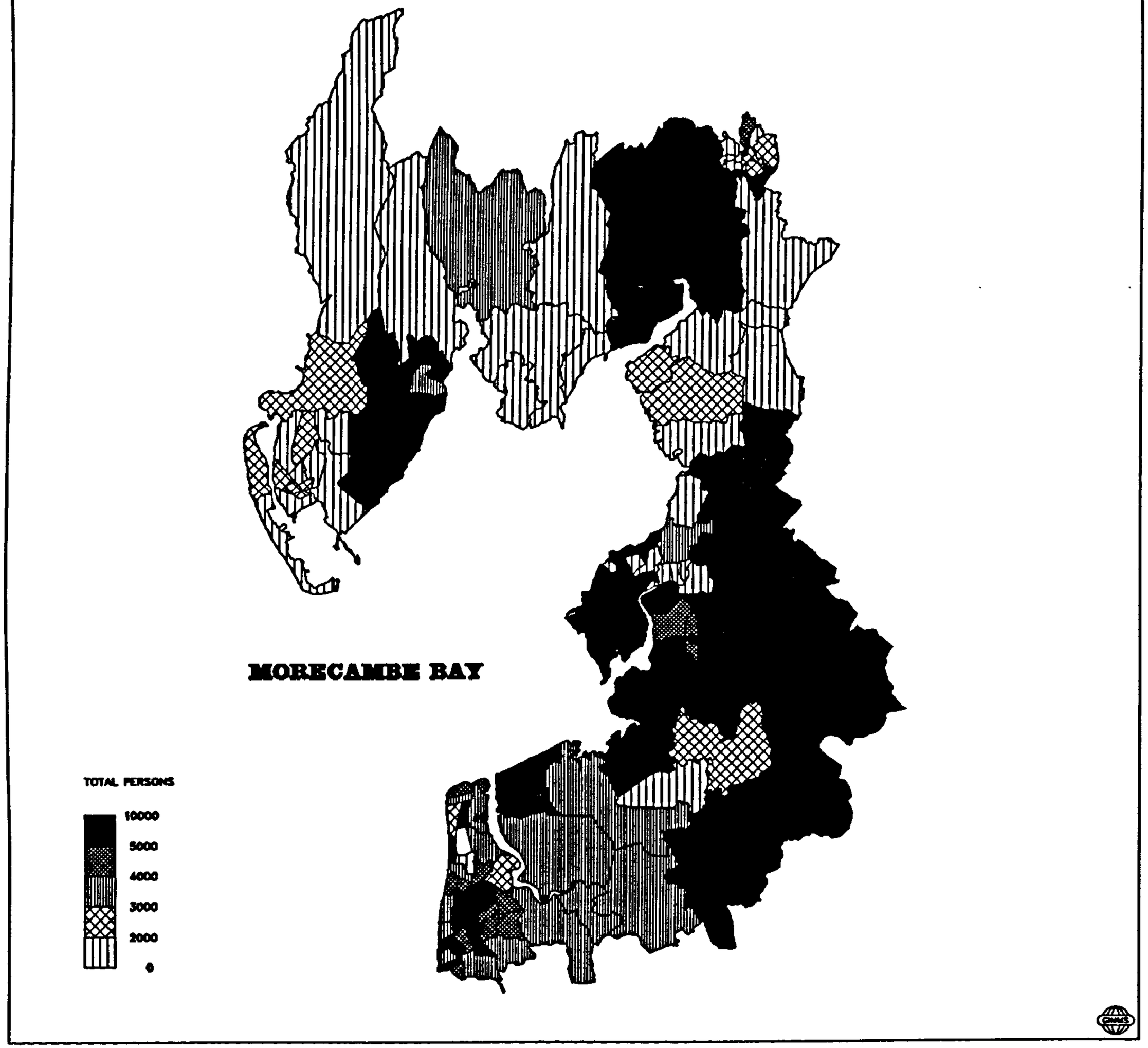


FIGURE 8.5.

Population density ward boundaries of the coastal lowlands around Morecambe Bay.

Unit: persons per square kilometre. Data were collected from the 1981 census.

POPULATION DENSITY

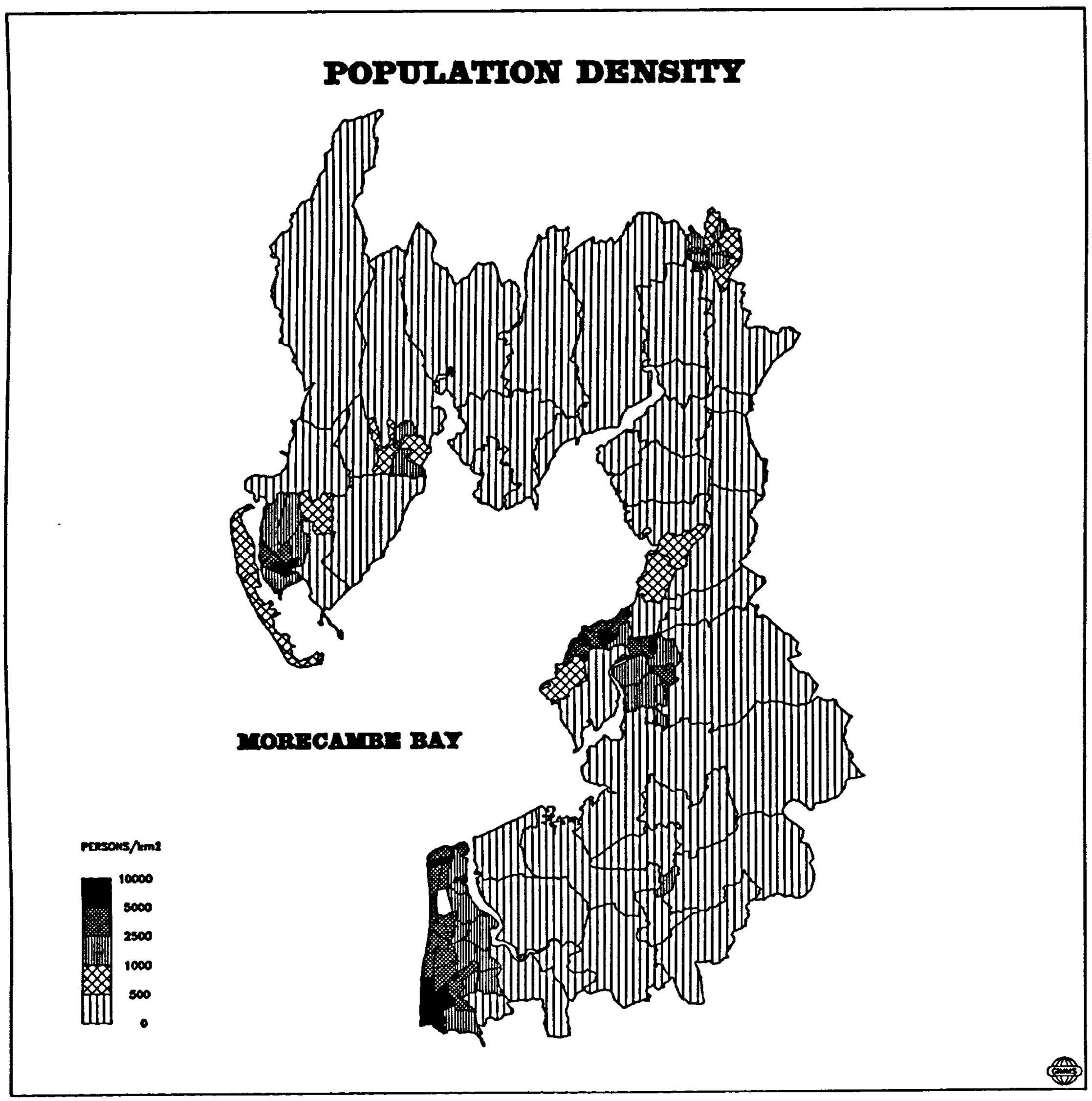


FIGURE 8.6.

Farm houses located on the coastal lowlands below the +10 metre contour around Morecambe Bay.

(from the 1:25,000 O.S. maps)

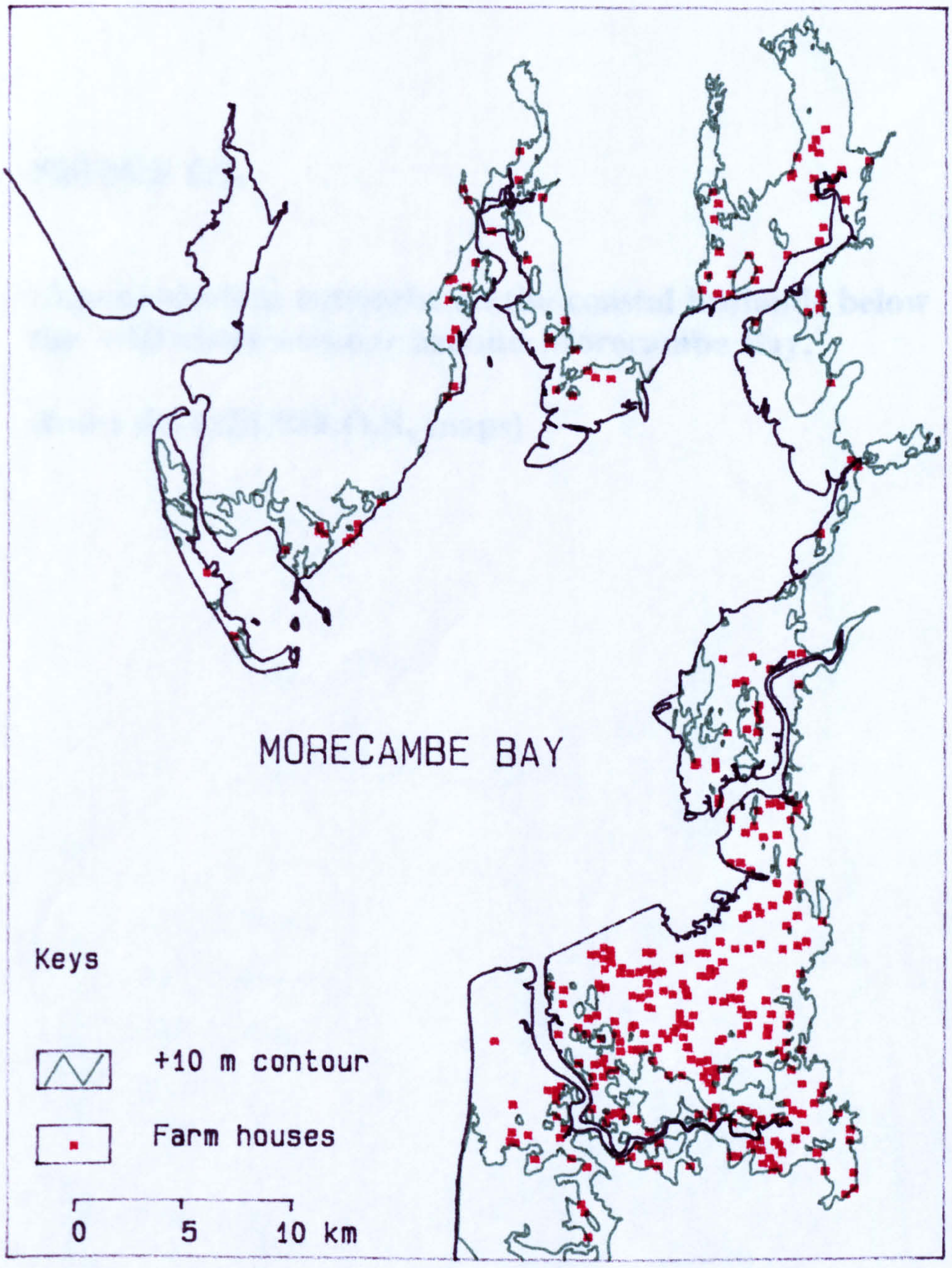


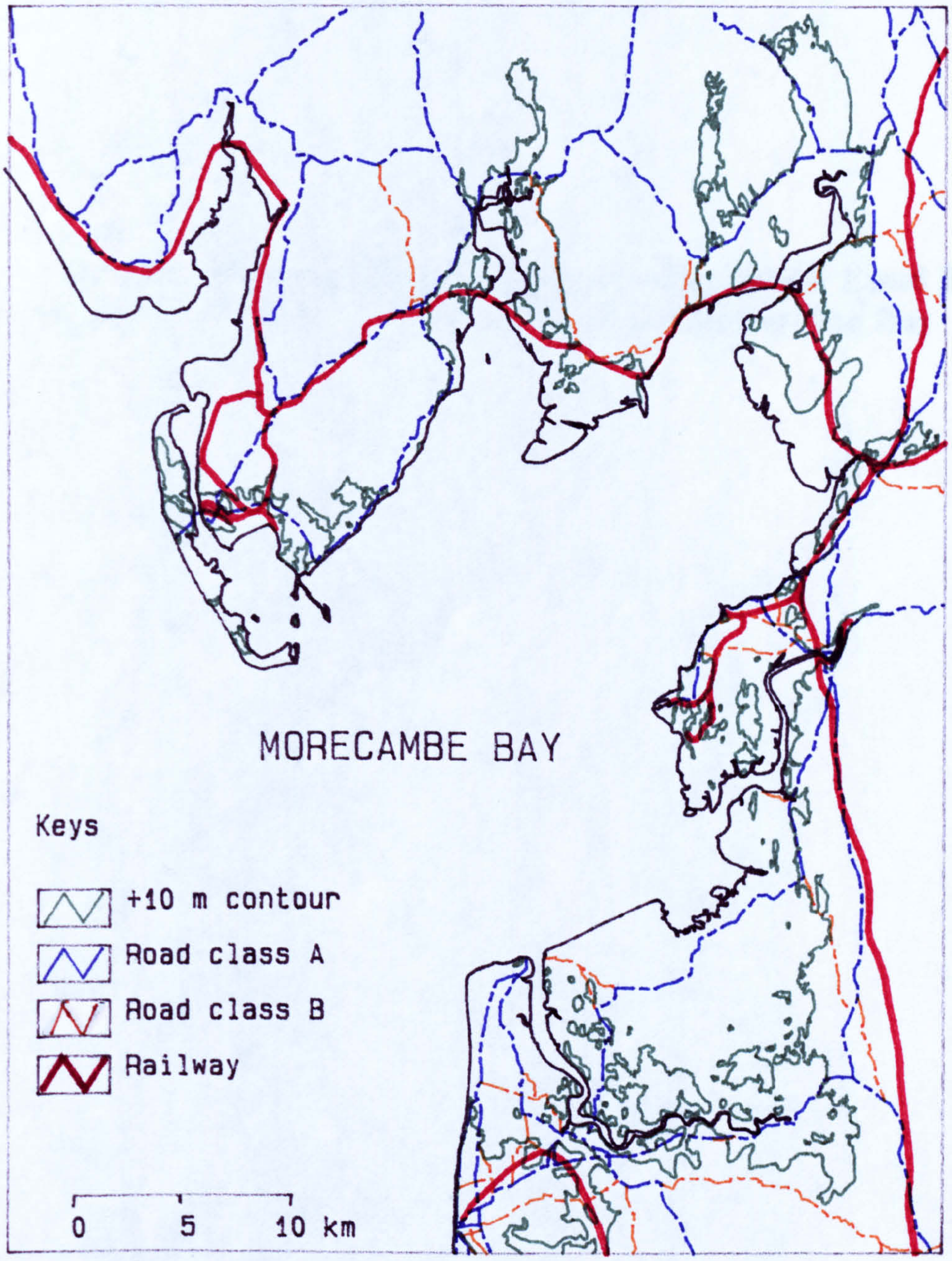
Fig. 8 [illegible]

Farm houses below 10 m O.D.

FIGURE 8.7.

Communication networks on the coastal lowlands below the +10 metre contour around Morecambe Bay.

(from the 1:25,000 O.S. maps)



Communication network on the coastal lowland with a 10 m contour line

FIGURE 8.8.

Predicted high water levels of sea-level scenarios 1 and 2 and the current level of sea defence in Morecambe Bay.

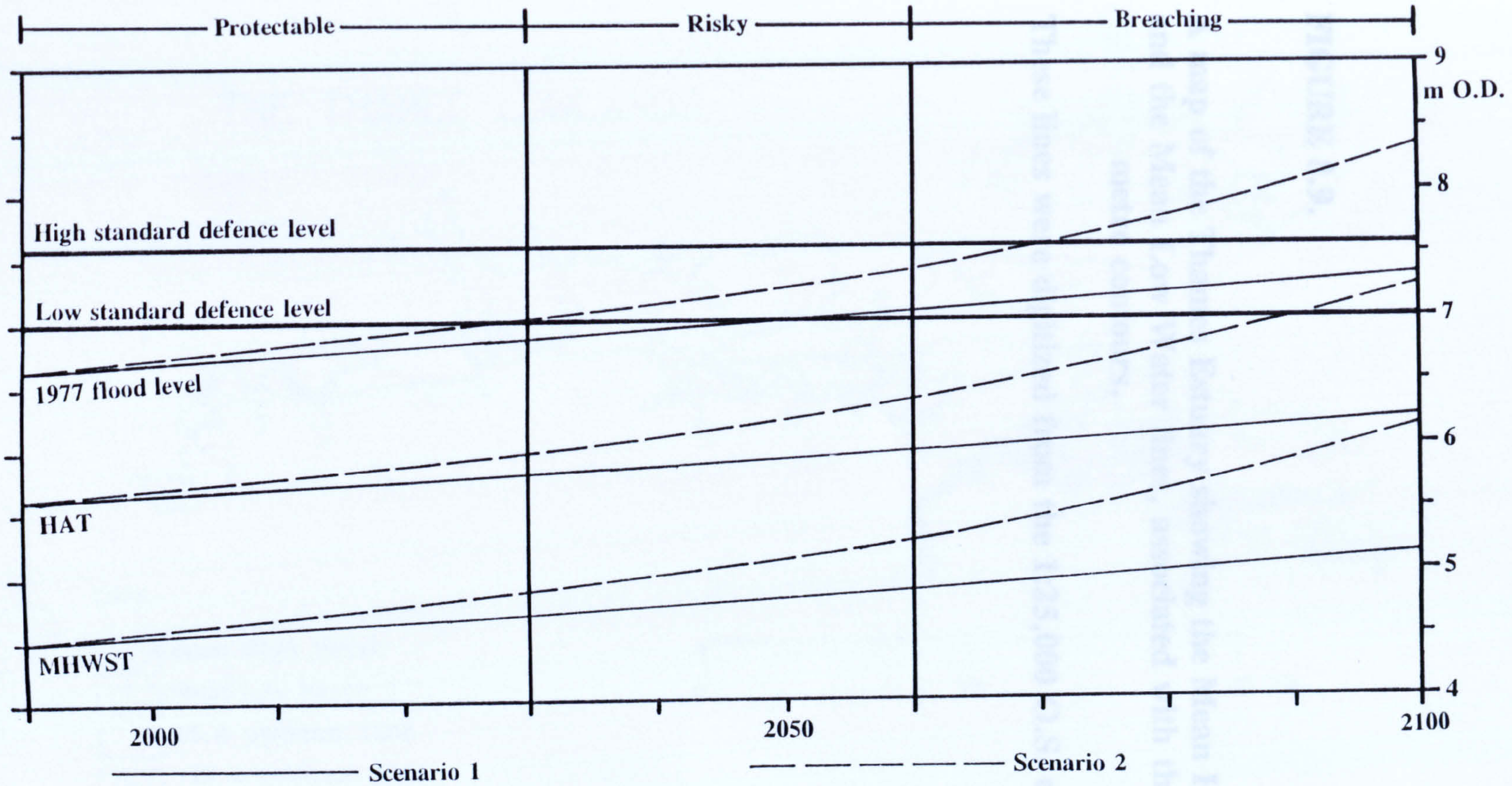
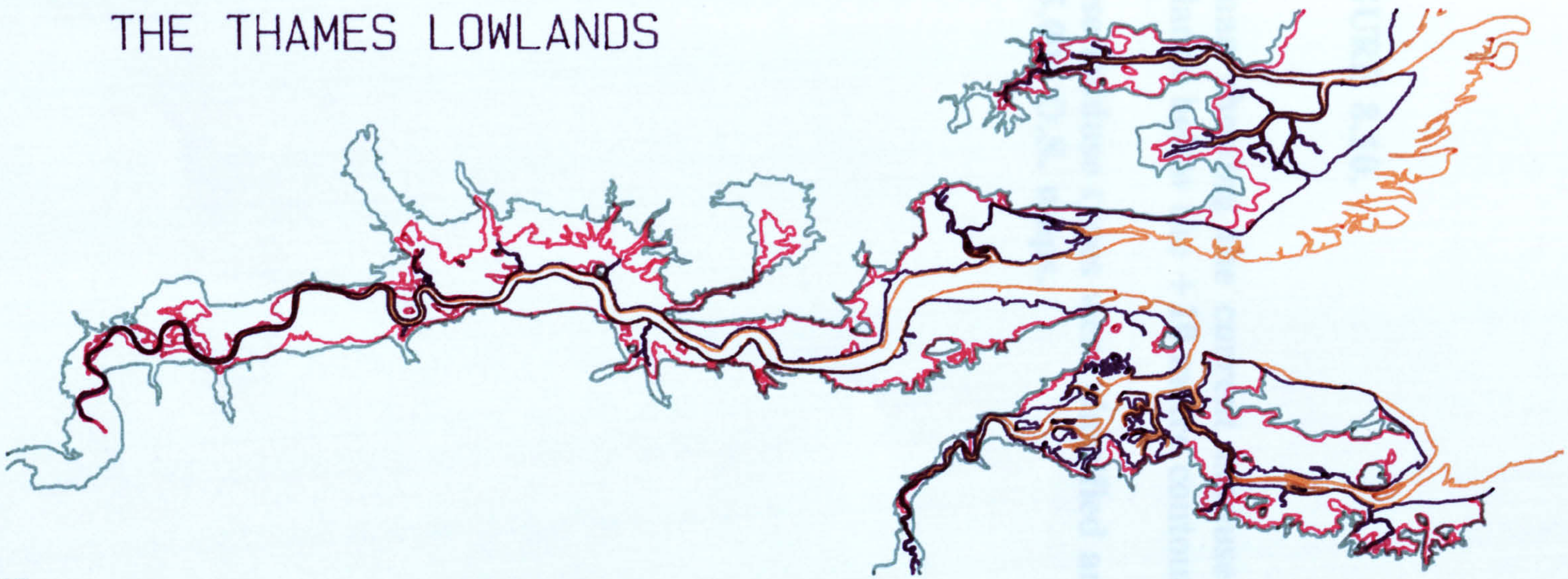

Protectable
Risky
Breaching
9
m O.D.
8
7
6
5
4
High standard defence level
Low standard defence level
1977 flood level
HAT
MHWST
2000
2050
2100
Scenario 1
Scenario 2

FIGURE 8.9.

A map of the Thames Estuary showing the Mean High Water and the Mean Low Water lines, associated with the +5, +10 metre contours.

These lines were digitized from the 1:25,000 O.S. maps.

THE THAMES LOWLANDS



Keys

Mean High Water

Mean Low Water

+5 m contour line

+10 m contour line

0 20 40 km

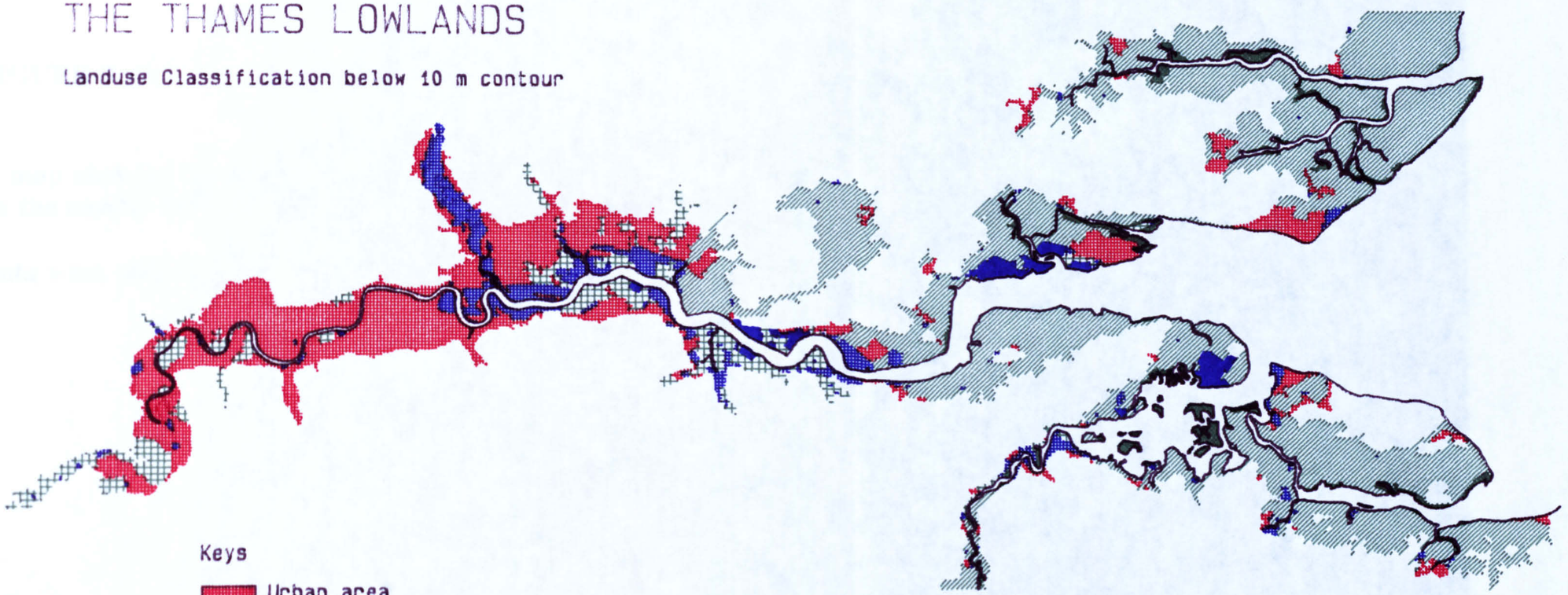
FIGURE 8.10.

A map showing the current landuse patterns on the coastal lowlands below the +10 metre contour in the Thames Estuary.

These landuse types were classified and digitized from the 1:25,000 O.S. maps.

THE THAMES LOWLANDS

Landuse Classification below 10 m contour



Keys

- Urban area
- Manufacturies
- Power stations and oil refineries
- Parks and play grounds
- Agricultural lands
- Saltmarshes

0 20 40 km

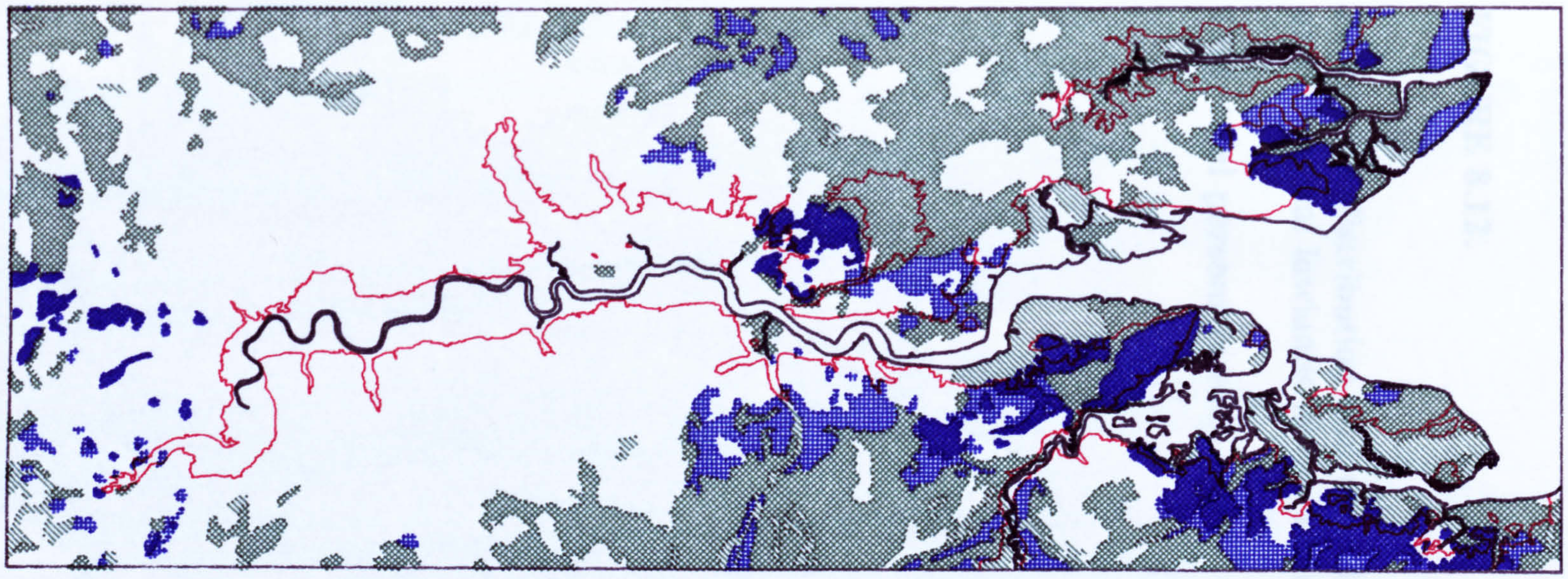
Data source: 1:25,000 Ordnance Survey maps published in 1977-1987

FIGURE 8.11.

A map showing the classification of agricultural land on the coastal lowlands in the Thames Estuary.

Data were collected from MAFF.

THE THAMES LOWLANDS



Keys

Grade 1
Grade 2
Grade 3
Grade 4
Grade 5
+10 m contour

0 20 40 km

data source: 1:250,000 Series Agricultural Land Classification, MAFF, 1977

A map showing the Agricultural Land Classification

FIGURE 8.12.

Population distribution and ward boundaries on the coastal lowlands in the Thames Estuary.

Unit: total persons in each ward

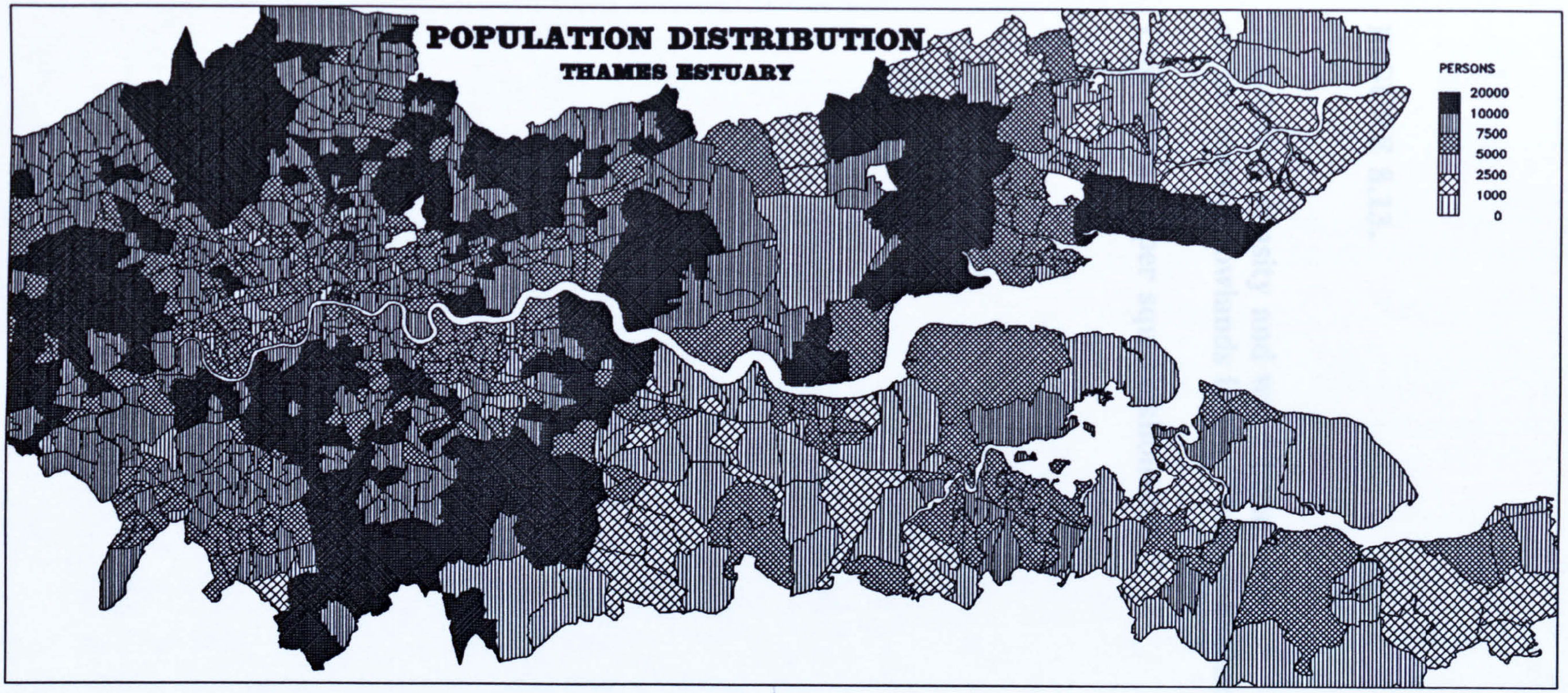

POPULATION DISTRIBUTION
THAMES ESTUARY
PERSONS
20000
10000
7500
5000
2500
1000
0

FIGURE 8.13.

Population density and ward boundaries on the coastal lowlands in the Thames Estuary.

Unit: persons per square kilometre



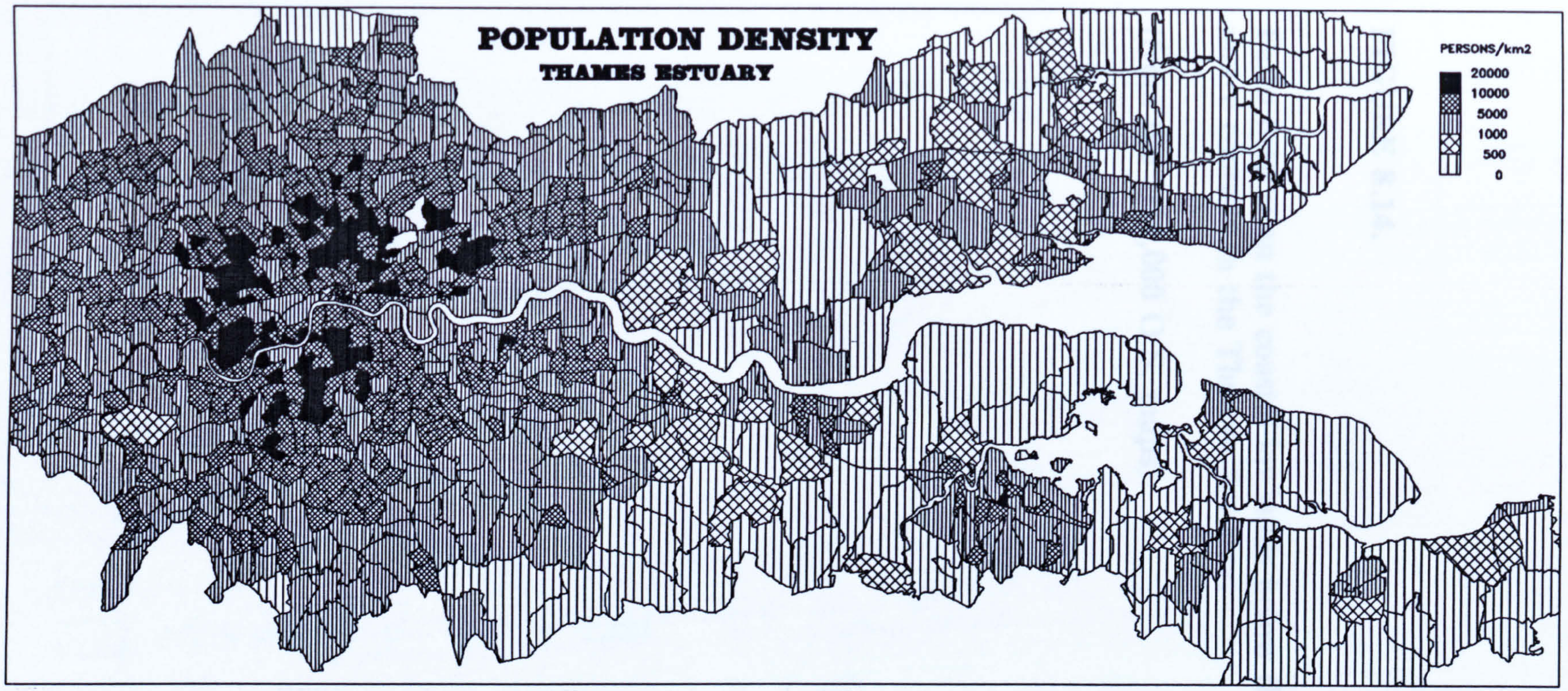
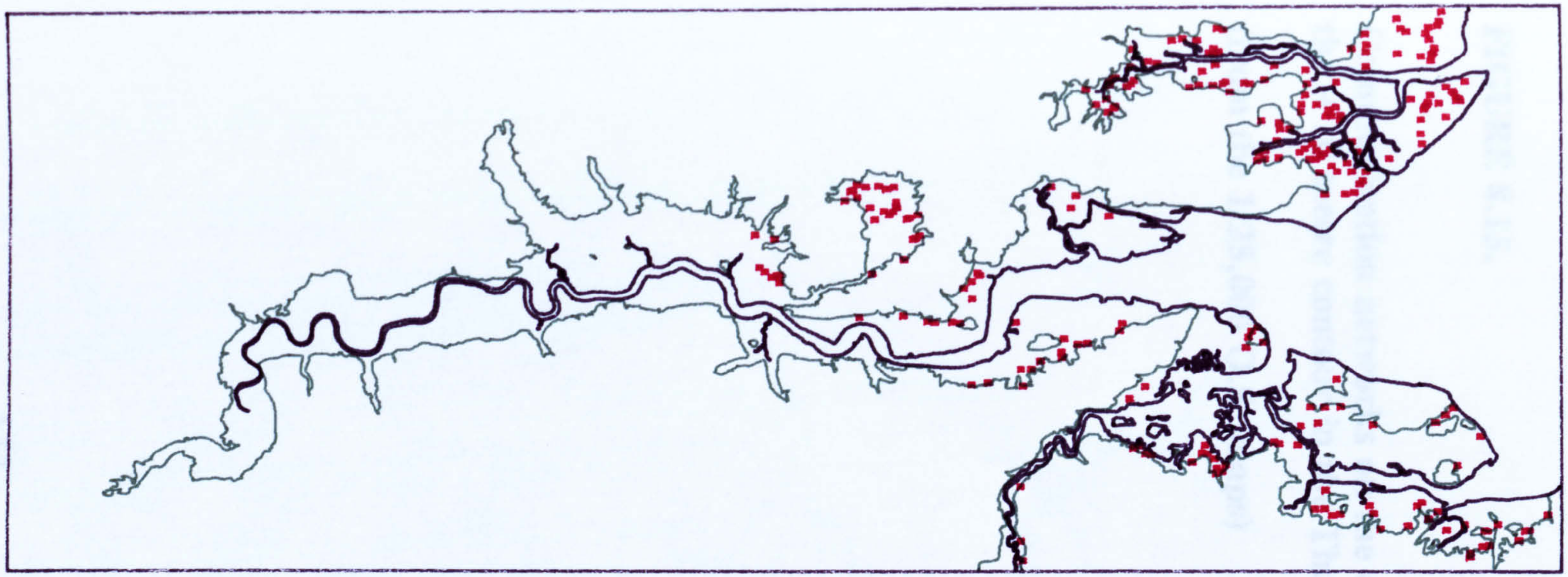

POPULATION DENSITY
THAMES ESTUARY
PERSONS/km2
20000
10000
5000
1000
500
0

FIGURE 8.14.

Farm houses on the coastal lowlands below the +10 metre contour in the Thames Estuary.

(from the 1:25,000 O.S. maps)

THE THAMES LOWLANDS



Keys

+10 m contour

Farm houses

0 20 40 km

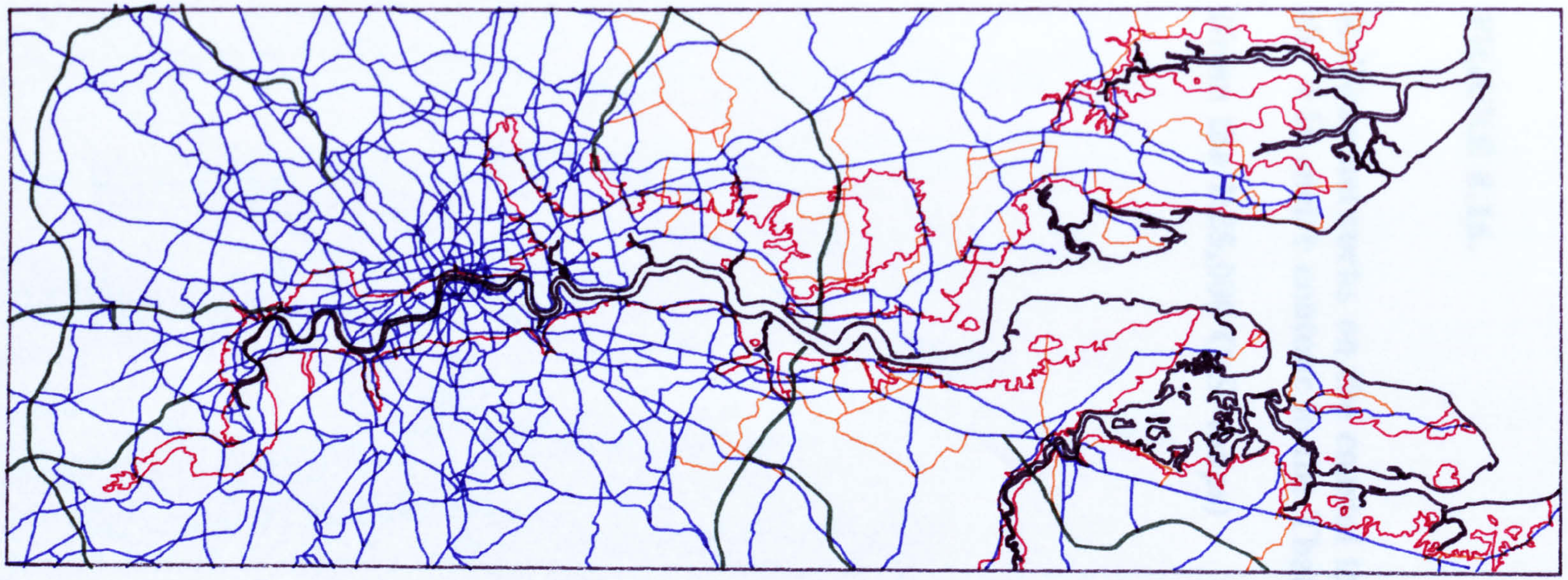
A map showing the farm houses below 10 m contour

FIGURE 8.15.

Communication networks on the coastal lowlands below the +10 metre contour in the Thames Estuary.

(from the 1:25,000 O.S. maps)

THE THAMES LOWLANDS



Keys

Roads (class A)

Roads (class B)

Motor ways

+10 m contour

0 20 40 km

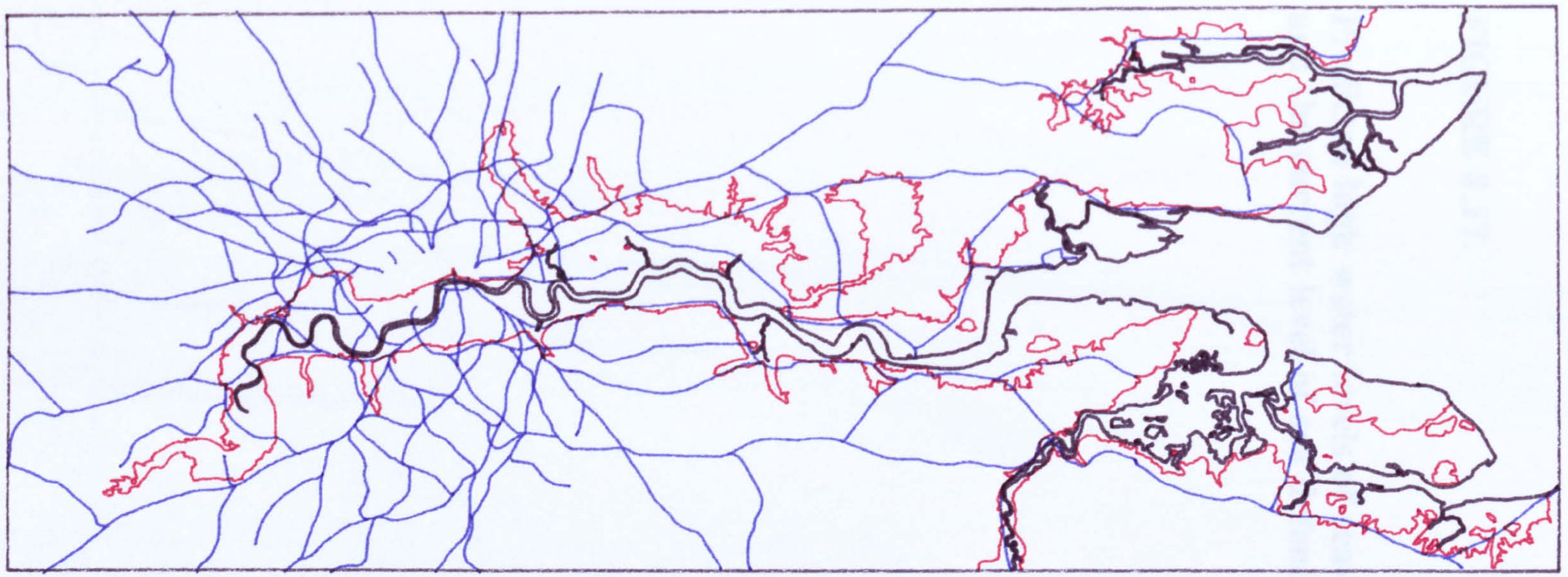
A map showing the communication networks along the Thames with Motorways, Road (class A) and Road (class B, outside London only)

FIGURE 8.16.

Railway networks on the coastal lowlands below the +10 metre contour in the Thames Estuary.

(from the 1:25,000 O.S. maps)

THE THAMES LOWLANDS



Keys

Railways

+10 m contour

0 20 40 km

A map of the railway network along the Thames with 10 m contour showing the sections of railway network at risk from sea flooding

FIGURE 8.17.

Predicted high water levels of sea-level scenarios 1 and 2 and the current level of sea defence in the Thames Estuary.

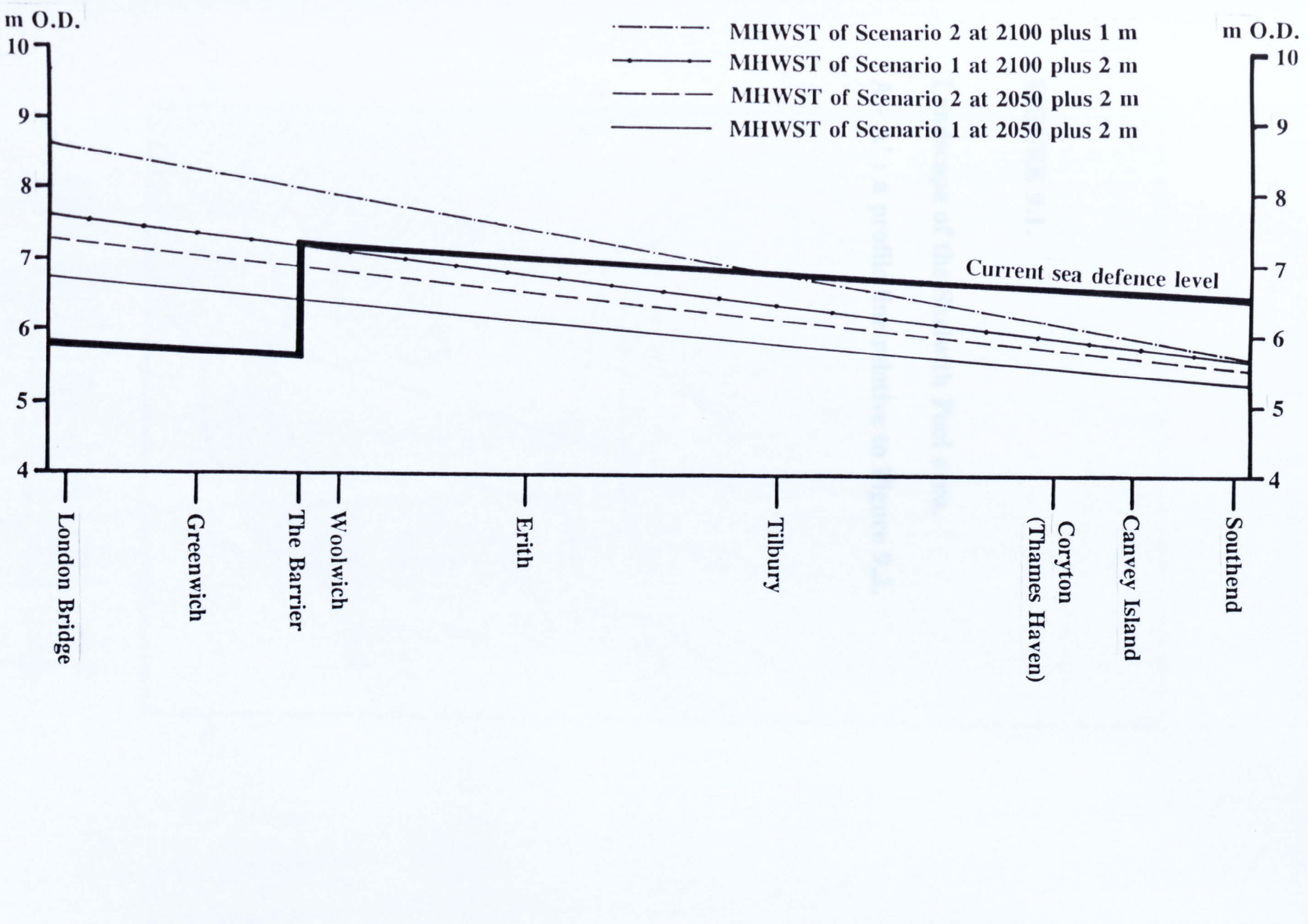

m O.D.
10
9
8
7
6
5
4
MHWST of Scenario 2 at 2100 plus 1 m
MHWST of Scenario 1 at 2100 plus 2 m
MHWST of Scenario 2 at 2050 plus 2 m
MHWST of Scenario 1 at 2050 plus 2 m
Current sea defence level
m O.D.
10
9
8
7
6
5
4
Southend
Canvey Island
Coryton
(Thames Haven)
Tilbury
Erith
Woolwich
The Barrier
Greenwich
London Bridge

FIGURE 9.1.

Landscape of the Skelwith Pool area.

A - A' : a profile line relative to Figure 9.2.

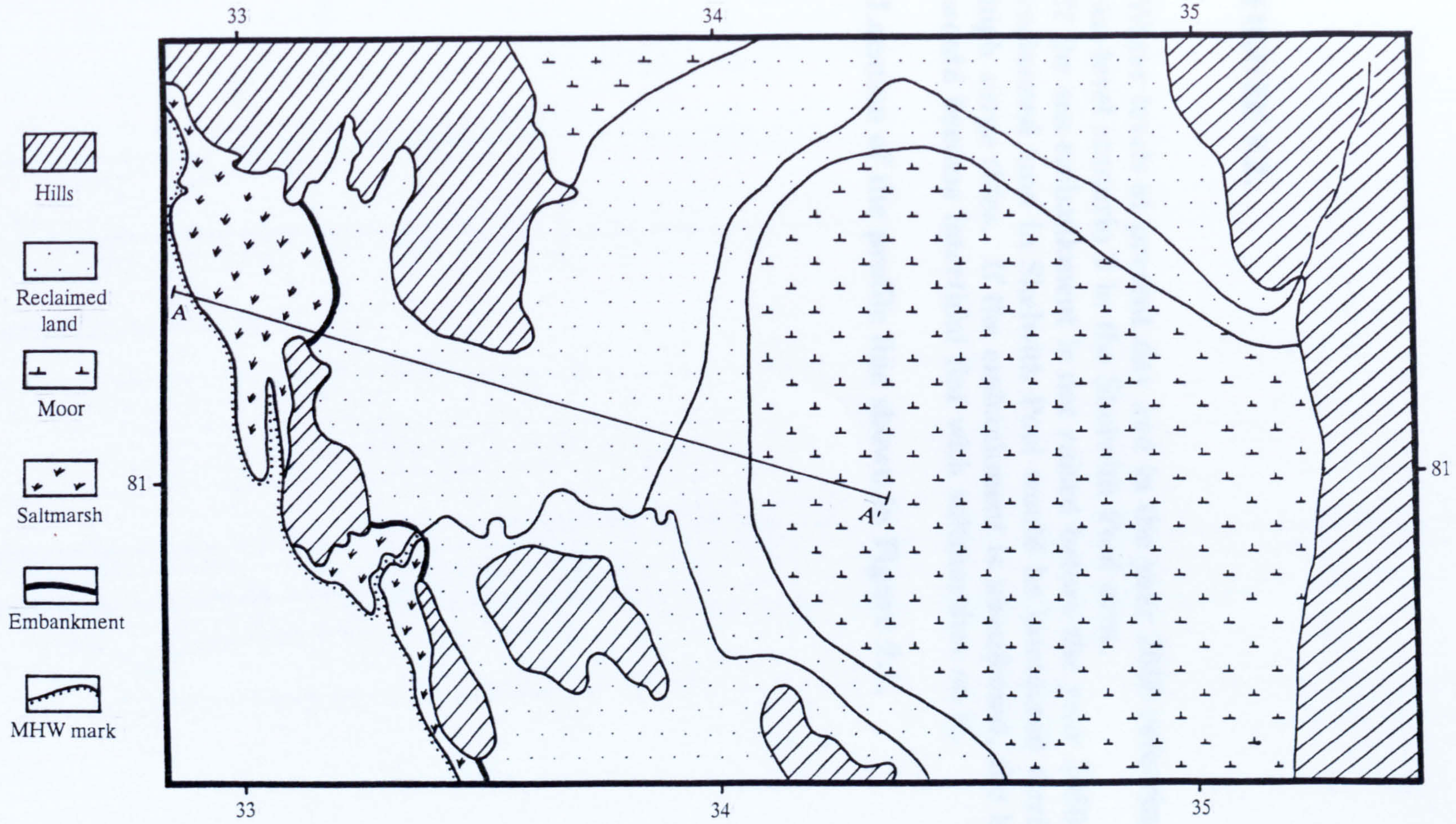
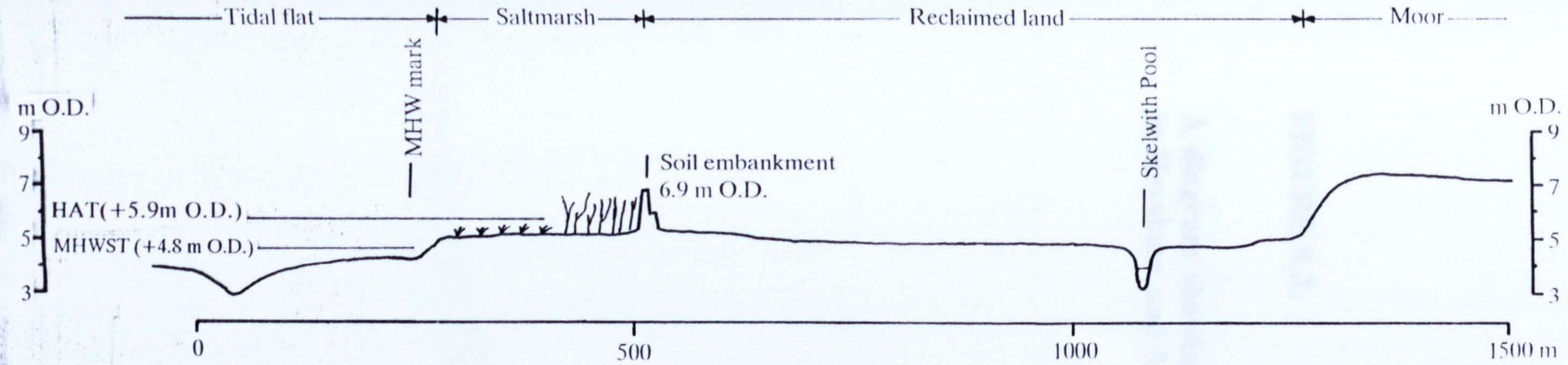

33
34
35
81
81
A
A'
Hills
Reclaimed land
Moor
Saltmarsh
Embankment
MHW mark
33
34
35

FIGURE 9.2.

Water levels at present day and in the year 2050 referring to sea-level scenario 2 in the Skelwith Pool area.
If the sea embankment is not raised before the year 2050, the reclaimed land in Skelwith Pool would be inundated during high surge tides. If the embankment is abandoned, the land would become intertidal flat with saltmarshes on it.

Location of the profile line shown in Figure 9.1.

(A) At present



(B) Scenario 2 at the year 2050

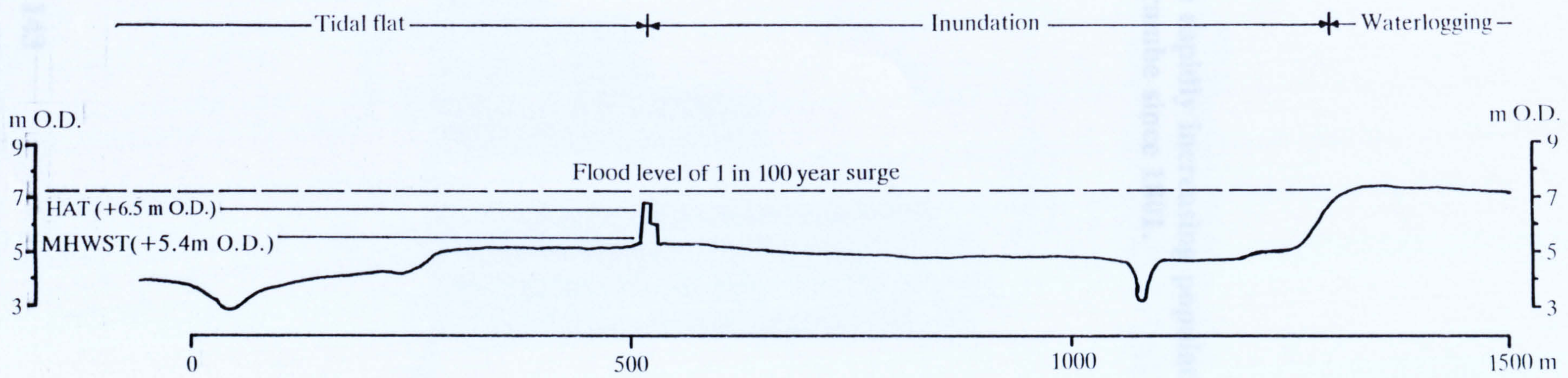


FIGURE 9.3.

A diagram showing the rapidly increasing population in Heysham and Morecambe since 1801.

Population Changes in
Heysham and Morecambe (1801-1981)

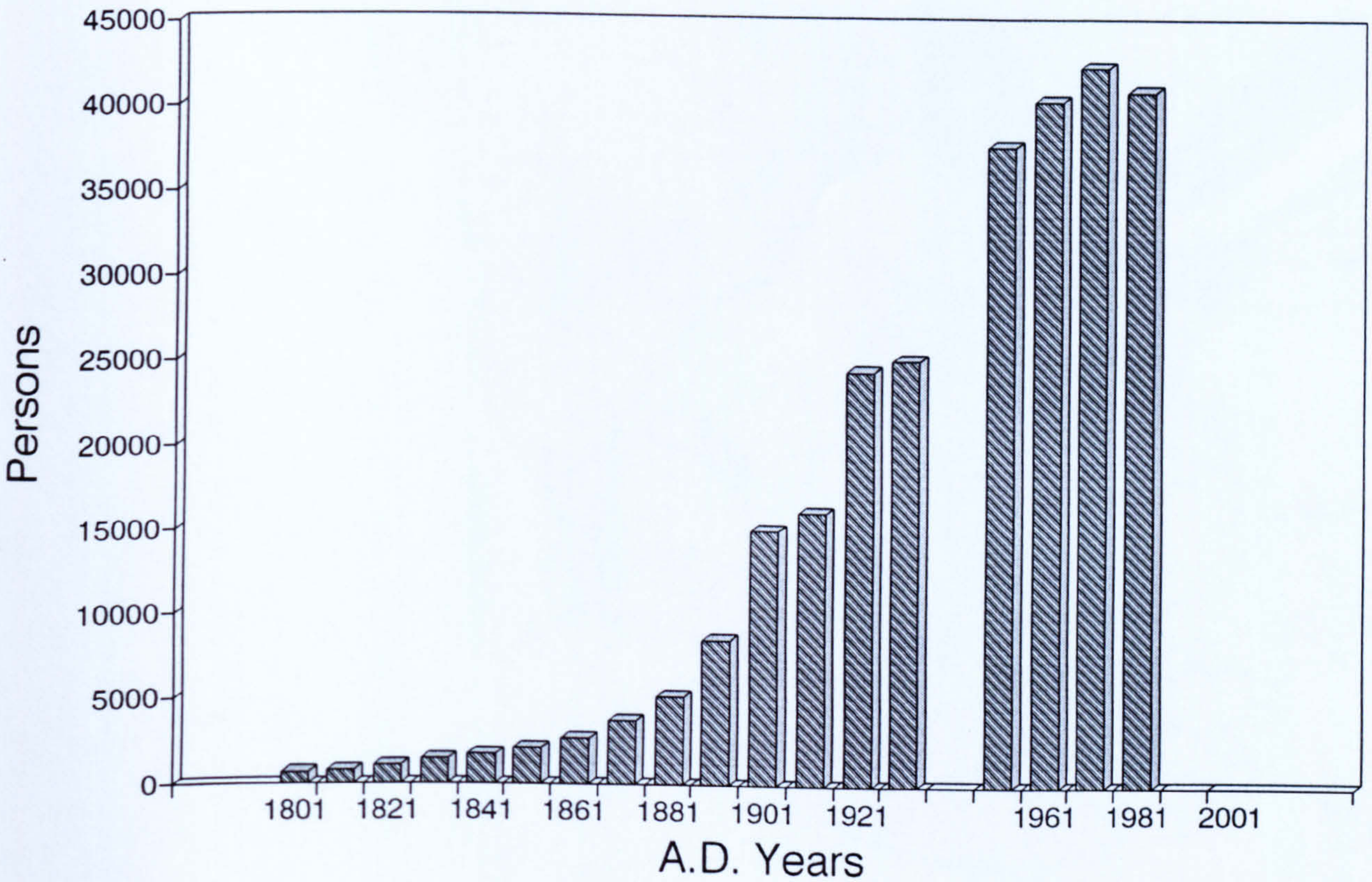
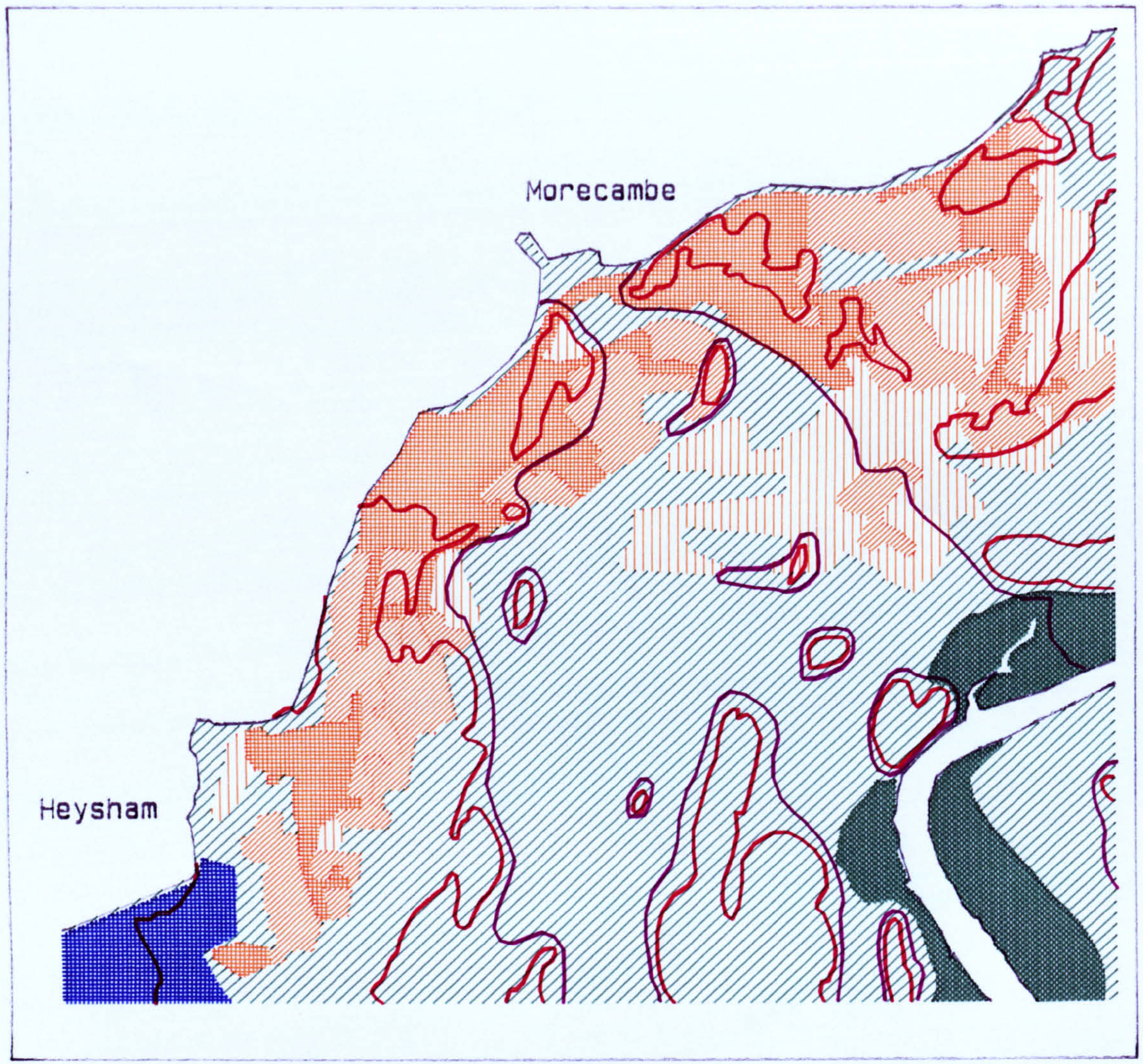


FIGURE 9.4.

A map showing the development of the urban areas and the current landuse types in the Heysham and Morecambe areas since 1931.



A map showing:

the development of the urban areas

and the current landuse types around

Heysham and Morecambe

Keys

- Urban areas before 1931
- Urban areas before 1952
- Urban areas before 1977
- Industrial estates
- Agricultural lands, parks and sport grounds
- Saltmarshes
- +5 m contour
- +8 m contour

0 1 2 km

Data source: 1: 25, 000 Ordnance Survey maps published in 1931, 1951 and 1977

FIGURE 9.5.

A three dimensional plot showing the relief of ground surface in the Heysham and Morecambe areas, generated from spot height data.

FIGURE 9.6.

A plot of contours showing the relief of ground surface in the Heysham and Morecambe areas, generated from spot height data.

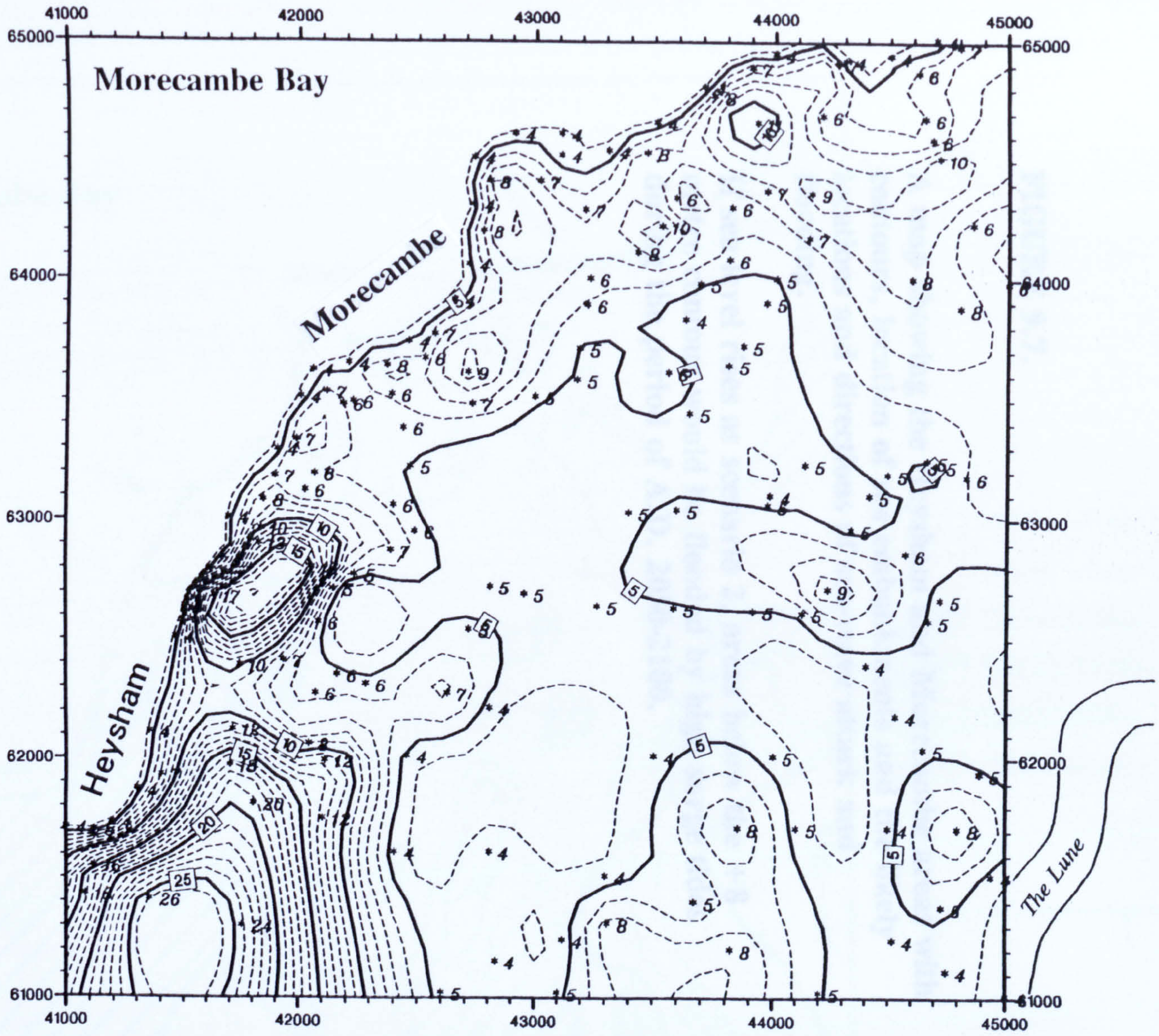

Morecambe Bay
Morecambe
Heysham
The Lune
41000
42000
43000
44000
45000
65000
64000
63000
62000
61000

FIGURE 9.7.

A map showing the Heysham and Morecambe areas with contours, location of sea embankments and the likely locations and directions of sea-wave attack and flooding.

If sea level rises as scenario 2, areas below the +8 metre contour would be flooded by high surge tides during the period of A.D. 2050-2100.

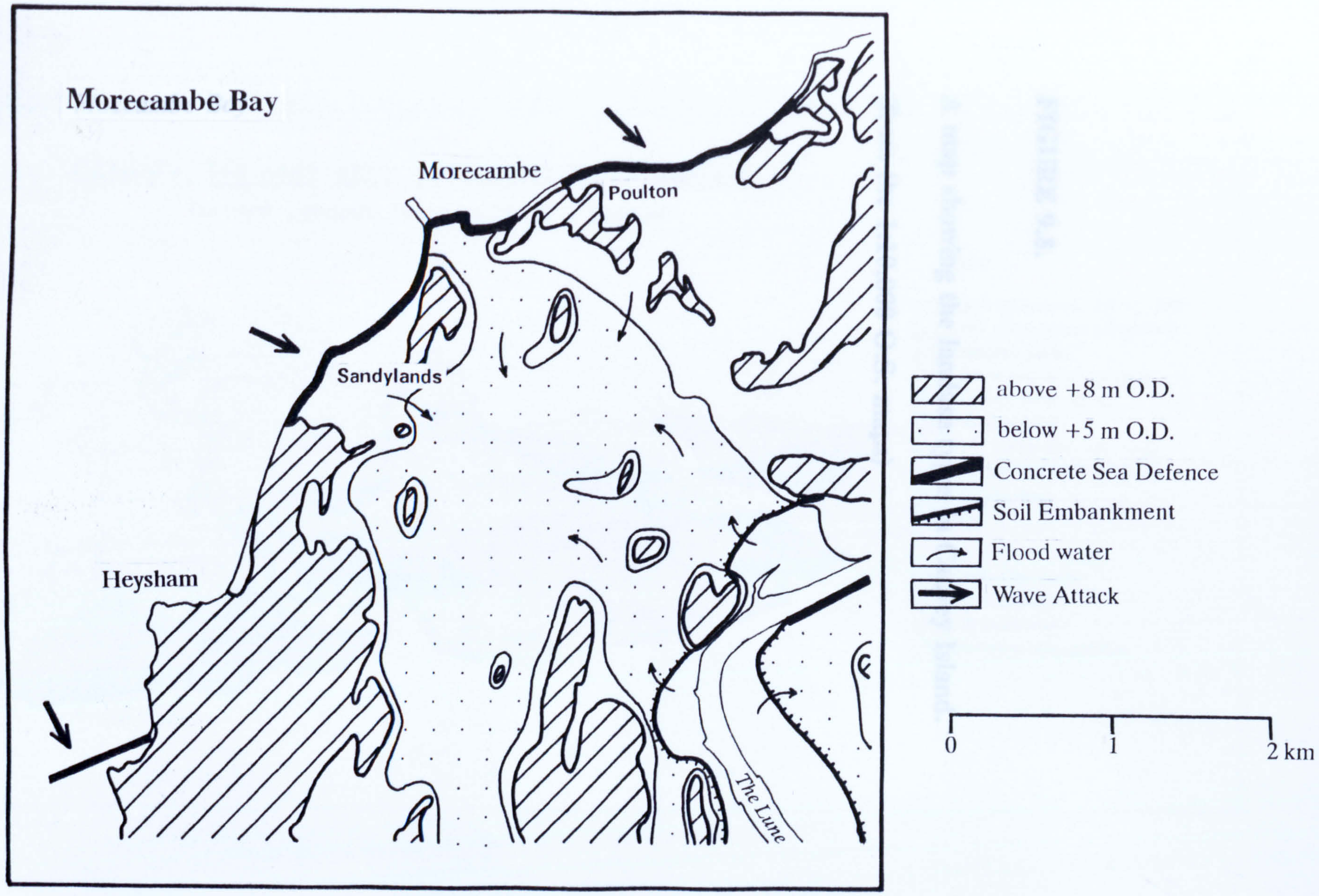

Morecambe Bay
Morecambe
Poulton
Sandylands
Heysham
The Lune
above +8 m O.D.
below +5 m O.D.
Concrete Sea Defence
Soil Embankment
Flood water
Wave Attack
0
1
2 km

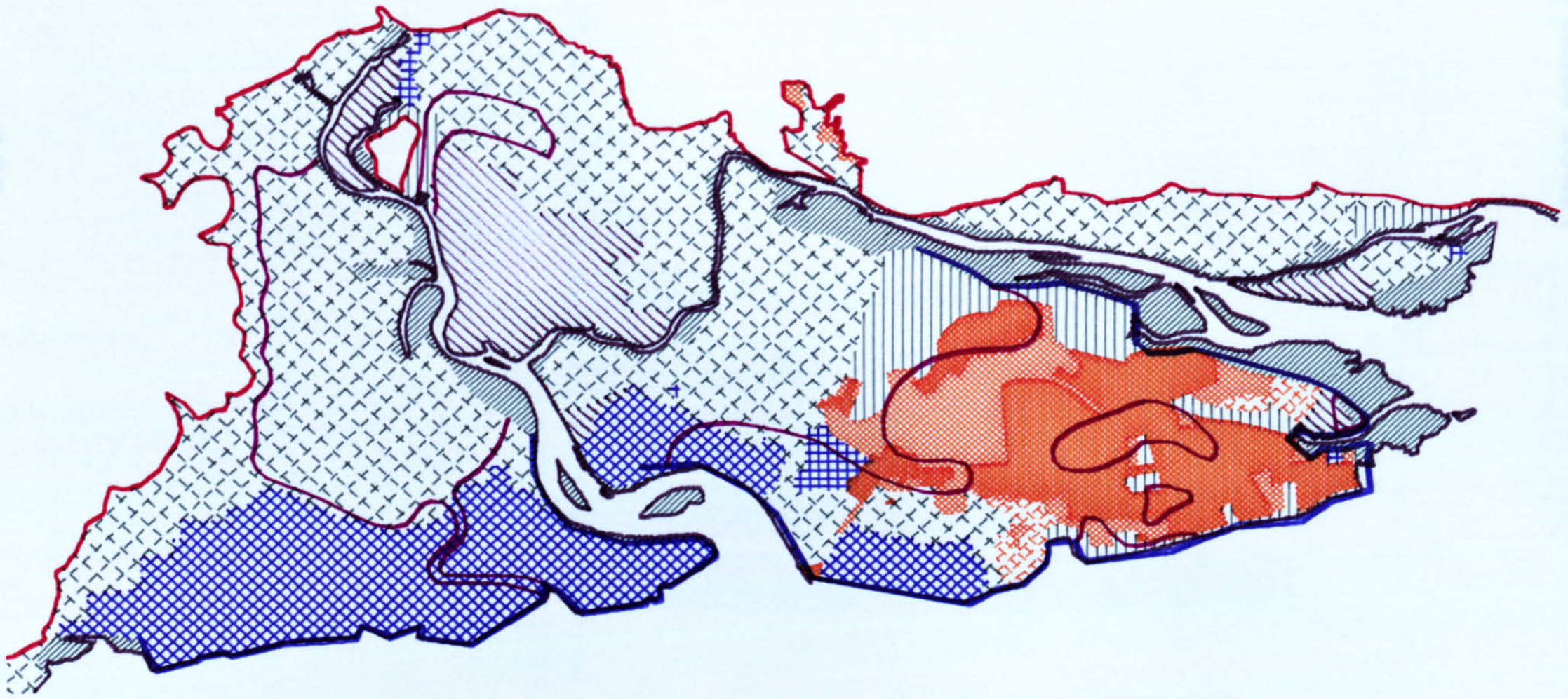
FIGURE 9.8.

A map showing the landuse types in Canvey Island.

(from the 1:10,000 O.S. maps)

CANVEY ISLAND AND ITS ADJACENT AREAS

Current Landuse Types below 5 m contour



Keys

- Old urban areas before 1950
- New urban areas since 1950
- Caravan parks
- Parks and sport grounds
- Agricultural lands
- Manufactures
- Oil refineries and tanks
- Rubish dumps or bare soil
- Saltmarshes

- Mean High Water
- +5 m contour
- +2 m contour
- Concrete sea defence

0 1 2 km

FIGURE 9.9.

A diagram showing the rapidly increasing population in Canvey Island since 1861.

Increasing Population in Canvey Island

from 1871-1981 Censuses

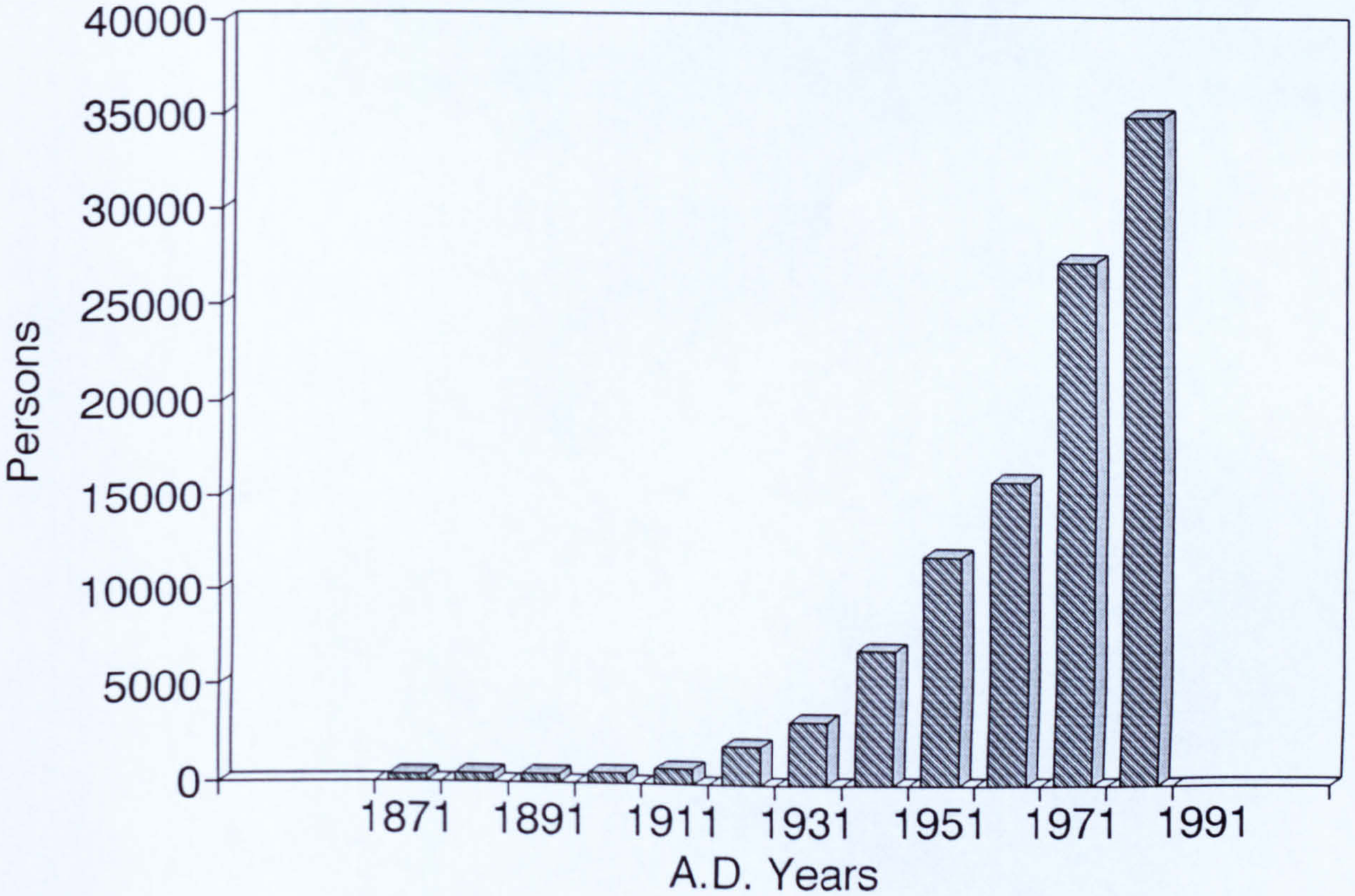
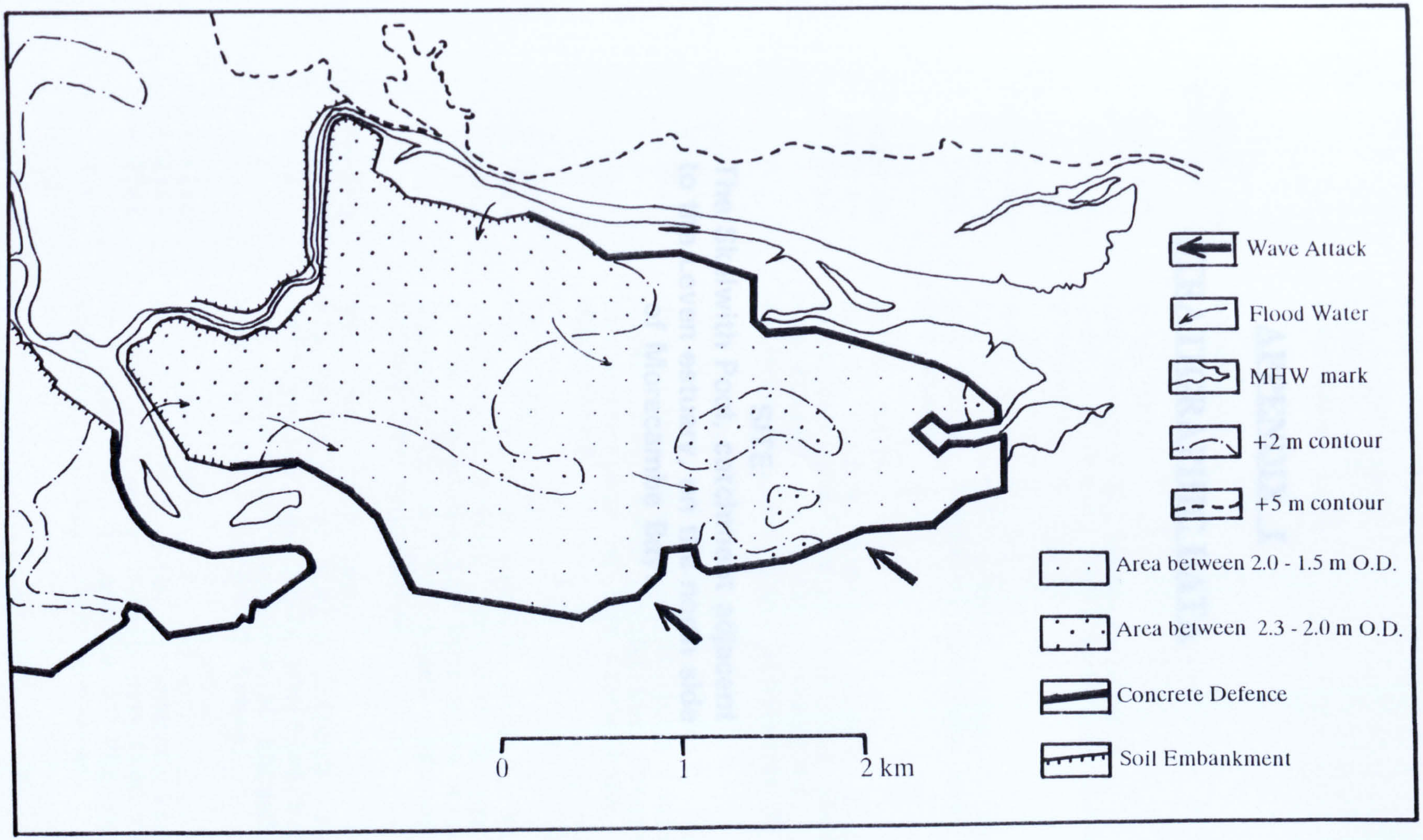


FIGURE 9.10.

A map showing Canvey Island with contours, location of sea embankments and the likely locations and directions of sea-wave attack and flooding.

If sea level rises as scenario 2, during the period of A.D. 2050-2100, sea water could breach the soil embankment along the tidal creek and the entire island would be inundated.


Wave Attack
Flood Water
MHW mark
+2 m contour
+5 m contour
Area between 2.0 - 1.5 m O.D.
Area between 2.3 - 2.0 m O.D.
Concrete Defence
Soil Embankment
0
1
2 km

APPENDIX I

STRATIGRAPHIC DATA

SITE:
The Skelwith Pool, catchment adjacent to the Leven estuary, on the north side of Morecambe Bay.

Borehole No.	**PIT1**
Coordinate	**SD 34155 81040**
Altitude	**7.164 m O.D.**
Date	**8 December 1987**

Layer	Depth (cm) (Altitude m.)	Description
9	000-023 (7.164- 6.934)	$Th^4$4, Sh^3+. nig.4, strf.0, elas.3, sicc.4. dark red brown, well humified herb rootlets.
8	023-043 (6.934- 6.734)	$Th^4$4, Sh^3+. nig.3+, strf.0, elas.3, sicc.3, lim.0. red brown, humified rootlets with seeds and stems.
7	043-119 (6.734- 5.974)	$Th^4$3+, $Sh^3$1-. nig.4, strf.0, elas.3, sicc.3, lim.0. dark red brown, well humified rootlets and stems with a little clastic materials (wind blown sediments ?).
6	119-137 (5.974- 5.794)	$Th^3$3, $Sh^2$1. nig.3+, strf.0, elas.3, sicc.3, lim.0. red brown, humified Sphagnum roots and stems, with some Phragmites fragments; the upper part of the transition considered.
5	137-155 (5.794- 5.614)	$Th^3$2, $Dh^2$2, Sh+. nig.3+, strf.0, elas.3, sicc.3, lim.0. red/yellow brown, humified Phragmites roots and stems and fragments with some Sphagnum roots; the lower part of the transition considered.
4	155-193 (5.614- 5.234)	$Th^2$3, Dl1, Dh^1+, Sh^1+. nig.2+, strf.0, elas.2, sicc.2, lim.0. dark yellow, slightly humified roots and stems and fragments of Phragmites with branches of birch trees.
3	193-236 (5.234- 4.804)	$Th^2$4, Dl+, Tl^3+. nig.2, strf.0, elas.2, sicc.2, lim.0. light yellow, slightly humified roots and stems and fragments of Phragmites with occasional birch branches.

2	236-242 (4.804- 4.744)	$Th^2$2, $Sh^3$1, As1-, Ag+. nig.2+, strf.0, elas.0, sicc.2, lim.0. yellow grey, slightly humified roots and stems and fragments of Phragmites with silty clay. There are more silty clay in the seaward side of the pit.
1	242-250 (4.744- 4.664)	$Th^3$3, $Sh^2$1, Dh+. nig.3+, strf.0, elas.1, sicc.2, lim.0. grey brown, humified roots and stems and fragments of Phragmites with humous substances.

Notes: grey silty clay with occasional fragments of Phragmites is found below the depth of 250 mm by a gouge sampler.

Borehole No. **PIT2**
Coordinate **SD 34120 81030**
Altitude **4.824 m O.D.**
Date **8 December 1987**

Layer	**Depth (cm) (Altitude m.)**	**Description**
9	000-023 (4.824- 4.594)	$Th^3$2+, $Dh^3$2-, Sh+. nig.4-, strf.0, elas.3, sicc.2. dark brown, humified Phragmites roots, stems and leaves with fragments of other plants.
8	023-031 (4.594- 4.514)	$Th^3$2+, $Dh^2$1, As+, Ld+. nig.3, strf.0, elas.1, sicc.2+, lim.0. brown grey, humified Phragmites turfa with clay; a transition layer.
7	031-086 (4.514- 3.964)	As2, Ag1, Ga1, Dh^2+. nig.2, strf.0, elas.0, sicc.2, lim.0. blue grey, silty and sandy clay with occasional Phragmites stems.
6	086-090 (3.964- 3.924)	$Th^2$3, $Dh^2$1-, As+. nig.2+, strf.0, elas.1, sicc.2, lim.3. brown yellow, slightly humified to fresh Phragmites turfa with clay.
5	090-100 (3.924- 3.824)	$Th^3$3, $Dh^2$1, Sh+. nig.4-, strf.0, elas.1, sicc.2, lim.0. brown humified Phragmites turfa.

4	100-104 (3.824- 3.784)	Th^{2}3, Dh^{2}1-, As+. nig.2+, strf.0, elas.1, sicc.2, lim.0. dark grey brown, slightly humified Phragmites with clay of marine origin.
3	104-112 (3.784- 3.704)	Th^{3}3, Dh^{2}1-, Sh+, Ld+. nig.3, strf.0, elas.3, sicc.2, lim.0. dark brown, humified Phragmites turfa.
2	112-120 (3.704- 3.624)	Th^{2}3, Dh^{2}1-, As+. nig.2+, strf.0, elas.1, sicc.2, lim.0. brown, slightly humified Phragmites turfa with clay.
1	120-125 (3.624- 3.574)	As3, Ag1-, Dh^{2}+. nig.2, strf.0, elas.0, sicc.2, lim.2+. blue grey silty clay with Phragmites fragments.

Borehole No. **PIT2C**
Coordinate **SD 34120 81030**
Altitute **3.654 m O.D.**
Date **9 March 1988**

Layer	**Depth (cm) (Altitude m.)**	**Desciption**
10	000-003 (3.654- 3.624)	Th^{2}3, Dh^{2}1-, As+. nig.2+, strf.0, elas.1, sicc.2. brown, slightly humified Phragmites turfa with clay.
9	003-020 (3.624- 3.454)	As3, Ag1-, Dh^{2}+. nig.2, strf.0, elas.0, sicc.2, lim.2+. blue grey silty clay with Phragmites fragments.
8	020-088 (3.454- 2.774)	Ag1, Ga3. nig.2, straf.2, elas.0, sicc.2, lin.0. grey silty sands.
7	088-096 (2.774- 2.694)	Ag2+, Ga1+, Dh^{1}+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey sandy silt with Phragmites fragments.
6	096-149 (2.694- 2.164)	Ag1, Ga3. nig.2, strf.1, elas.0, sicc.2, lim.0. very stiff, grey silty sands.

5	149-192 (2.164- 1.734)	Ag3, Ga1. nig.2, strf.2, elas.0, sicc.2, lim.0. very stiff, blue grey sandy silt.
4	192-202 (1.734- 1.634)	As3, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.2. soft blue grey silty clay.
3	202-205 (1.634- 1.604)	$Dh^4$3, $Sh^4$1. nig.4, strf.0, elas.2, sicc.3, lim.2. very dark brown and well humified <u>Phragmites</u> peat.
2	205-212 (1.604- 1.534)	$Sh^3$2+, $Dh^2$1, As1. nig.3, strf.0, elas.0, sicc.2+, lim.0. dark grey, clayey organic deposits (limus ?).
1	212-242 (1.534- 1.234)	As4. nig.2, strf.0, elas.0, sicc.2, lim.1. light blue and very soft clay.

Borehole No. **PC-1**
Coordinate **SD 33940 81040**
Altitude **4.824 m O.D.**
Date **26 February 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
19	000-011 (4.824- 4.714)	Sc4 many new herb roots.
18	011-024 (4.714- 4.584)	Ag3, As1-, Sh+, Th^1+. nig.2, strf.0, elas.0, sicc.3, lim.0. grey to light brown grey silt with clay and organic substance.
17	024-060 (4.584- 4.224)	$Sh^3$3, $Th^2$1, Tl^3+. nig.3+, strf.0, elas.2, sicc.3, lim.0. deep brown, well humified humous substance, with many herb roots.
16	060-101 (4.224- 3.814)	Ag2+, As2-, Dh^2+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. grey clay and silt with <u>Phragmites</u> fragments and some brown spots.
15	101-107 (3.814-	$Dh^3$3(Phrag.), $Sh^3$1, Th^1+. nig.3, strf.0, elas.2, sicc.2, lim.3.

	3.754)	brown, lightly humified Phragmites fragments and roots.
14	107-118 (3.754- 3.644)	As3-, Ag1+, Dh^{1}+. nig.2, strf.0, elas.0, sicc.2, lim.1. grey silty clay with occasional Phragmites fragments.
13	118-128 (3.644- 3.544)	$Sh^{3}3$, $Dh^{2}1$, Th^{1}+. nig.2+, strf.0, elas.1, sicc.2, lim.2. brown humified organic materials.
12	128-135 (3.544- 3.474)	As2+, $Dh^{1}2$-, Sh+. nig.2, strf.0, elas.0, sicc.2, lim.2. light brown grey clay with many fragments of Phragmites.
11	135-194 (3.474- 2.884)	Ga2, Ag2, Dh+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey sands and silts with occasional fresh Phragmites fragments.
10	194-231 (2.884- 2.514)	Ag3+, Ga1. nig.2, strf.0, elas.0, sicc.2, lim.0. grey sandy slits.
9	231-268 (2.514- 2.144)	Ag3+, As+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clayey silts.
8	268-298 (2.144- 1.844)	As3, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.0. grey silty clay. The layers 8, 9 and 10 demonstrate as a sedimentary coarsening-upwards sequence.
7	298-300 (1.844- 1.824)	As3, Sh1, Dh^{1}+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. light brown grey clay with humous substance and a few Phragmites fragments (transition).
6	300-303 (1.824- 1.794)	$Th^{2}2$(Phrag.), $Dh^{2}2$(Phrag.), Sh+. nig.3, strf.0, elas.2, sicc.2, lim.0. light brown and humified Phragmites peat.
5	303-317 (1.794- 1.654)	As3, $Dh^{1}1$(Phrag.), Sh+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clay and light yellow Phragmites fragments (transition).
4	317-420 (1.654-	As2, Ag2. nig.2, strf.0, elas.0, sicc.2, lim.0.

	0.624)	grey clay and silts coarsening upwards.
3	420-430 (0.624- 0.524)	$Sh^2$2, $Dl^2$1, As1, Ag+. nig.3, strf.0, elas.0, sicc.2, lim.0. dark brown and black, soft humous substance with silty clay and shrub leaves. (limus ?)
2	430-520 (0.524- -0.376)	Ag2, As2, Dh^1+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. grey and blue grey silts and clay with occasional Phragmites fragments.
1	520-539 (-0.376- -0.566)	Ag4. nig.2, strf.0, elas.0, sicc.2, lim.0. grey silts, becoming pinky and hard downwards.

Borehole No. **Bore0**
Coordinate **SD 35020 81000**
Altitude **8.680 m O.D.**
Date **11 May 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
10	000-200 (8.680- 6.680)	$Th^3$2, $Sh^4$1, $Tl^2$1. nig.3+, strf.0, elas.2, sicc.1. red brown, soft and wet, Sphagnum peat with many roots and branches of tree and shrub.
9	200-380 (6.680- 4.880)	$Tl^2$2, $Th^3$1, $Sh^3$1. nig.3, strf.0, elas.2, sicc.2, lim.0. red brown Sphagnum peat with birch roots and branches in the lower part.
8	380-415 (4.880- 4.530)	$Tl^2$2, $Th^3$1, Sh+, Dh^2+(Phrag.). nig.3+, strf.0, elas.2, sicc.2, lim.0. red brown, consolidated Sphagnum peat with birch branches and Phragmites fragments.
7	415-484 (4.530- 3.840)	$Th^2$2, $Dh^2$2(Phrag.), Tl+. nig.3, strf.0, elas.2, sicc.2, lim.0. dark red brown Phragmites peat with some birch branches.
6	484-518 (3.840- 3.500)	Ag3, As1, Dh^2+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. grey clayey silt with occasional

		Phragmites fragments.
5	518-600 (3.500- 2.680)	Ag3, Ga1. nig.2, strf.1, elas.0, sicc.2, lim.0. pink grey sandy silt.
4	600-653 (2.680- 2.150)	Ag3, As1. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clayey silt with black leaves of Phragmites occasionally.
3	653-800 (2.150- 0.680)	Ga3, Ag1. nig.2, strf.2, elas.0, sicc.2, lim.1. pink grey, stratified, stiff, silty sands.
2	800-840 (0.680- 0.280)	Ag2, As1, Ga1. nig.2, strf.0, elas.0, sicc.3, lim.0. grey, dry, stiff sandy silt with clay.
1	840-900 (0.280- -0.320)	Ga3, Ag1. nig.2, strf.3, elas.0, sicc.3, lim.1. pink grey, dry, stratified, stiff, silty sands.

Borehole No. **Bore1**
Coordinate **SD 34830 81000**
Altitude **8.950 m O.D.**
Date **11 May 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
8	000-015 (8.950- 8.800)	no sample.
7	015-450 (8.800- 4.450)	$Th^2$3, $Sh^4$1. nig.3+, strf.0, elas.2, sicc.1. red brown, well humified, very wet and soft, preserved Sphagnum peat, with some birch fragments at bottom.
6	450-467 (4.450- 4.280)	$Th^2$3, $Dh^2$1(Phrag.), Sh^4+. nig.3, strf.0, elas.3, sicc.1+, lim.0. brown, wet, Sphagnum turfa peat with some Phragmites fragments.
5	467-526 (4.280-	$Th^3$4, Sh^4+. nig.3+, strf.0, elas.2, sicc.2, lim.0.

	3.690)	brown Sphagnum turfa peat. No Phragmites !
4	526-580 (3.690- 3.150)	$Th^2$3, $Dh^2$1(Phrag.). nig.3, strf.0, elas.3, sicc.2, lim.0. brown Phragmites roots and fragments.
3	580-736 (3.150- 1.590)	Ag3, As1. nig.2, strf.0, elas.0, sicc.2, lim.2. pinky grey clayey silt with some black leaves.
2	736-950 (1.590- -0.550)	Ag3, As1, Ga+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey to pink grey clayey silt with some sands.
1	950-1020 (-0.550- -1.250)	Ag2, Ga2. nig.2, strf.2, elas.0, sicc.2, lim.0. pink grey, stratified silt and sands.

Borehole No. **Bore2**
Coordinate **SD 34580 81000**
Altitude **9.131 m O.D.**
Date **11 May 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
18	000-025 (9.131- 8.881)	no sample.
17	025-225 (8.881- 6.881)	$Tl^3$2, $Th^3$1, $Sh^4$1. nig.3+, strf.0, elas.1, sicc.2. red brown, well humified, very wet and soft Sphagnum peat.
16	225-410 (6.881- 5.031)	$Tl^3$2, $Th^3$1, $Sh^3$1+. nig.3, strf.0, elas.1, sicc.1, lim.0. red brown, wel humified, very wet and soft Sphagnum peat with some shrub branches.
15	410-583 (5.031- 3.301)	$Th^2$4-, Sh^3+, Dh^2+(Phrag.). nig.3, strf.0, elas.2, sicc.2-, lim.0. red brown, humified and wet, Sphagnum peat with Phragmites fragments and birch branches occasionally.
14	583-597	$Dh^1$3(Phrag.), $Th^1$1, As+.

	(3.301- 3.161)	nig.2+, strf.0, elas.2, sicc.2, lim.2. light brown and grey, fresh Phragmites peat with clay.
13	597-672 (3.161- 2.411)	As4-, Ag+, Dh^1+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.2. light blue/grey silty clay with occasional Phragmites fragments.
12	672-697 (2.411- 2.161)	As2, Ag2. nig.2, strf.0, elas.0, sicc.2, lim.0. grey, stiff silt and clay.
11	697-707 (2.161- 2.061)	As1, Ag2, $Sh^2$1. nig.2+, strf.0, elas.0, sicc.2, lim.2. dark grey clayey silt with organic materials.
10	707-735 (2.061- 1.781)	Ag3, As1. nig.2, strf.0, elas.0, sicc.2, lim.2. grey clayey silt.
9	735-820 (1.781- 0.931)	Ag3, Ga+, As+. nig.2, strf.0, elas.0, sicc.2, lim.0. pink grey, stiff sandy silt, with black Phragmites fragments at 790 mm.
8	820-850 (0.931- 0.631)	Ga2, Ag2. nig.2, strf.2, elas.0, sicc.3, lim.0. pink grey, dry and stratified silt and sands.
7	850-932 (0.631- -0.189)	Ag3, As1-, Dh^1+(Phrag.). nig.2, strf.0, elas.o, sicc.2, lim.0. grey clayey silt with Phragmites fragments.
6	932-1020 (-0.189- -1.069)	Ga2, Ag2. nig.2, strf.2, elas.0, sicc.3, lim.2. pink grey, dry and stratified silt and sands.
5	1020-1090 (-1.069- -1.769)	Ag3, As1. nig.2, strf.0, elas.0, sicc.0, lim.0. grey, soft clayey silt.
4	1090-1110 (-1.769- -1.969)	Ag3, Ga1. nig.2, strf.1, elas.0, sicc.3, lim.0. pink grey, dry and stiff, stratified sandy silt.
3	1110-1160	Ag2, As2.

	(-1.969-	nig.2, strf.0, elas.0, sicc.2, lim.0.
	-2.469)	blue grey, soft and wet silt and clay.
2	1160-1172	Ag2, Ga2.
	(-2.469-	nig.2, strf.2, elas.0, sicc.2, lim.2.
	-2.589)	pink grey, stratified silt and sands.
1	1172-1220	Ag2, As2.
	(-2.589-	nig.2, strf.0, elas.0, sicc.2, lim.0.
	-3.069)	pink grey silt and clay.

Borehole No. Bore3
Coordinate SD 34340 81040
Altitude 8.681 m O.D.
Date 11 May 1988

Layer	Depth (cm) (Altitude m.)	Description
11	000-010 (8.681- 8.581)	no sample.
10	010-200 (8.581- 6.681)	$Sh^4$2, $Dl^3$1, $Tl^3$1. nig.3+, strf.0, elas.1, sicc.1. red brown, very soft and wet, humified humous substance and stems and roots of shrub plants.
9	200-380 (6.681- 4.881)	$Tl^3$2, $Th^3$1, $Sh^3$1. nig.3+, strf.0, elas.1, sicc.2, lim.0. red brown, soft and humified shrub and herb fragments. A few fragments of birch roots and branches found at a depth of 250-280 mm.
8	380-415 (4.881- 4.531)	$Th^3$3, $Tl^2$1, Dh^2+(Phrag.). nig.3+, strf.0, elas.2, sicc.2, lim.0. red brown, consolidated and light humified Sphagnum turfa and fragments of birch and Phragmites.
7	415-484 (4.531- 3.841)	$Th^2$2(Phrag.), $Dh^2$2(Phrag.), Tl^2+. nig.3, strf.0, elas.2, sicc.2, lim.0. red-dark brown, light humified roots, stems and leaves of Phragmites, with birch woody fragments.

6	484-518 (3.841- 3.501)	Ag3, As1, Dh^2+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. grey clayey silts with occasional Phragmites fragments.
5	518-600m (3.501- 2.681)	Ag3, Ga1. nig.2, strf.1, elas.0, sicc.2, lim.0. pinky grey sandy silts with on organic material.
4	600-653 (2.681- 2.151)	Ag3, As1. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clayey silts with black spots.
3	653-800 (2.151- 0.681)	Ga3, Ag1. nig.2, strf.2, elas.0, sicc.2, lim.1. pinky grey, stratified and stiff silty sands.
2	800-840 (0.681- 0.281)	Ag2, As1, Ga1. nig.2, strf.0, elas.0, sicc.3, lim.0. grey, dry and stiff sandy silts with clay.
1	840-900 (0.281- -0.319)	Ga3, Ag1. nig.2, strf.3, elas.0, sicc.3, lim.1. pinky grey, stratified, dry and stiff silty sands.

Borehole No.	**Bore4**
Coordinate	**SD 34120 81040**
Altitude	**7.014 m O.D.**
Date	**29 October 1987**

Layer	**Depth (cm) (Altitude m.)**	**Description**
19	000-009 (7.014- 6.924)	$Tb^4$3, $Th^3$1. nig.3+, strf.1, elas.3, sicc.2-. dark red brown, well humified humous substance with some herb roots.
18	009-035 (6.924- 6.664)	$Tb^4$2, $Th^3$2, Tl+. nig.4, strf.2, elas.3, sicc.2+, lim.1. darkred brown, very humified humous substance and herb roots and stumps.
17	035-040 (6.664- 6.614)	$Tb^2$3, $Th^2$1. nig.3-, strf.1, elas.1, sicc.2, lim.0. red brown, slightly humified humous substance with Sphagnum and Cladium

		turfa.
16	040-089 (6.614- 6.124)	$Tb^3$2, $Th^3$1, $Sh^3$1. nig.3, strf.0, elas.1, sicc.2, lim.0. dark red brown, humified humous substance and Cladium and Sphagnum turfa.
15	089-113 (6.124- 5.884)	$Sh^3$2, $Tb^3$1, $Th^3$1. nig.3, strf.0, elas.1, sicc.2, lim.0. dark brown, well humified humous substance and Sphagnum and Phragmites roots and stumps.
14	113-128 (5.884- 5.734)	$Th^2$2(Phrag.), $Sl^2$1, Sh1, Dl+. nig.3-, strf.0, elas.1, sicc.2, lim.0. light brown yellow, slightly humified Phragmites turfa and occasional birch branches.
13	128-157 (5.734- 5.444)	$Th^1$4(Phrag.), Tl+. nig.2+, strf.0, elas.1, sicc.2, lim.0. yellow, less humified Phragmites turfa.
12	157-183 (5.444- 5.184)	Dl2, $Th^2$1+(Phrag.), Tl+. nig.3, strf.0, elas.1, sicc.2, lim.1. brown and yellow, birch branches and Phragmites roots and stumps.
11	183-232 (5.184- 4.694)	$Sh^3$3, $Th^2$1-, Th^2+(Phrag.). nig.3-, strf.0, elas.1, sicc.2, lim.0. dark brown and yellow, humified humous substance and some rootlets.
10	232-289 (4.694- 4.124)	Ag3, As1, Th+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.3. grey clayey silt with occasional black stainings and Phragmites fragments.
9	289-309 (4.124- 3.924)	Sh2-, $Th^3$1+(Phrag.), $Tl^2$1. nig.3, strf.0, elas.1, sicc.2, lim.3. brown and humified humous substance and Phragmites roots and stumps.
8	309-372 (3.924- 3.294)	Ag3-, As1, Dh^2+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.3. grey clay and silt with occasional Phragmites fragments.
7	372-464 (3.294- 2.374)	Ag3, Ga1. nig.2+, strf.0, elas.0, sicc.2, lim.3. dark grey sandy silt.
6	464-487	As3, Ag1, Th^2+(Phrag.).

	(2.374- 2.144)	nig.2, strf.0, elas.0, sicc.2, lim.0. blue grey silty clay.
5	487-515 (2.144- 1.864)	$Sh^3$2, $Th^2$1(Phrag.), Ag1. nig.3, strf.0, elas.1, sicc.2, lim.2. dark brown humous substance and Phragmites roots and fragments, with some silt.
4	515-610 (1.864- 0.914)	As3, Ag1, Sh+. nig.2, strf.1, elas.0, sicc.2, lim.1. grey silty clay.
3	610-620 (0.914- 0.814)	$Th^1$3(Phrag.), Sh+, As+. nig.2, strf.0, elas.1, sicc.0, lim.2. yellow grey, fresh Phragmites roots and fragments with a little clay.
2	620-630 (0.814- 0.714)	As2, Ag2. nig.2, strf.3-, elas.0, sicc.2, lim.1. blue grey, stratified silt and clay.
1	630-870 (0.714- -1.686)	Ag2+, Ga2-, Sh+. nig.2, strf.0, elas.0, sicc.2, lim.1. colour changed upwards from pinky grey to blue grey, sandy silt coursening downwards with black staining spots in the upper part.

Borehole No.	**Bore5**
Coordinate	**SD 33940 81040**
Altitude	**4.824 m O.D.**
Date	**26 February 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
19	000-010 (4.824- 4.724)	Sc4 many new herb roots.
18	010-022 (4.724- 4.604)	Ag3, As1-, Sh+, Th^1+. nig.2, strf.0, elas.0, sicc.3, lim.0. grey to light brown grey silt with clay and organic substance.
17	028-069 (4.604- 4.134)	$Sh^3$3, $Th^2$1, Tl^3+. nig.3+, strf.0, elas.2, sicc.3, lim.0. deep brown, well humified humous substance, with mary herb roots. Very clayey in 50-59 cm.

16	069-101 (4.134- 3.814)	Ag2+, As2-, Dh^{2}+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. grey clay and silt with Phragmites fragments and some brown spots.
15	101-107 (3.814- 3.754)	Dh^{3}3(Phrag.), Sh^{3}1, Th^{1}+. nig.3, strf.0, elas.2, sicc.2, lim.3. brown, lightly humified Phragmites fragments and roots.
14	107-118 (3.754- 3.644)	As3-, Ag1+, Dh^{1}+. nig.2, strf.0, elas.0, sicc.2, lim.1. grey silty clay with occasional Phragmites fragments.
13	118-128 (3.644- 3.544)	Sh^{3}3, Dh^{2}1, Th^{1}+. nig.2+, strf.0, elas.1, sicc.2, lim.2. brown humified organic materials.
12	128-135 (3.544- 3.474)	As2+, Dh^{1}2-, Sh+. nig.2, strf.0, elas.0, sicc.2, lim.2. light brown grey clay with many fragments of Phragmites.
11	135-194 (3.474- 2.884)	Ga2, Ag2, Dh+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey sands and silts with occasional fresh Phragmites fragments.
10	194-231 (2.884- 2.514)	Ag3+, Ga1. nig.2, strf.0, elas.0, sicc.2, lim.0. grey sandy slits.
9	231-268 (2.514- 2.144)	Ag3+, As+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clayey silts.
8	268-298 (2.144- 1.844)	As3, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.0. grey silty clay. The layers 8, 9 and 10 demonstrate as a sedimentary coarsening-upwards sequence.
7	298-300 (1.844- 1.824)	As3, Sh1, Dh^{1}+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. light brown grey clay with humous substance and a few Phragmites fragments (transition).
6	300-303 (1.824- 1.794)	Th^{2}2(Phrag.), Dh^{2}2(Phrag.), Sh+. nig.3, strf.0, elas.2, sicc.2, lim.0. light brown and humified Phragmites peat.

5	303-317 (1.794- 1.654)	As3, $Dh^{1}1$(Phrag.), Sh+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clay and light yellow Phragmites fragments (transition).
4	317-420 (1.654- 0.624)	As2, Ag2. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clay and silts coarsening upwards.
3	420-430 (0.624- 0.524)	$Sh^{2}2$, $Dl^{2}1$, As1, Ag+. nig.3, strf.0, elas.0, sicc.2, lim.0. dark brown and black, soft humous substance with silty clay and shrub leaves. (limus ?)
2	430-520 (0.524- -0.376)	Ag2, As2, Dh^{1}+(Phrag.). nig.2, strf.0, elas.0, sicc.2, lim.0. grey and blue grey silts and clay with occasional Phragmites fragments.
1	520-539 (-0.376- -0.566)	Ag4. nig.2, strf.0, elas.0, sicc.2, lim.0. grey silts, becoming pinky and hard downwards.

Borehole No.	**Bore6**
Coordinate	**SD 33740 81040**
Altitude	**5.004 m O.D.**
Date	**2 February 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
11	000-027 (5.004- 4.734)	$Sh^{4}3$, $Th^{0}1$. nig.4, strf.0, elas.1, sicc.3+, lim.0. black, dry and humified humous substance with many roots of new plants.
10	027-042 (4.734- 4.584)	$Sh^{4}4$, Th^{3}+. nig.4, strf.0, elas.0, sicc.3, lim.0. black and humified humous substance with rootlets.
9	042-050 (4.584- 4.504)	Ag2, $Dh^{2}2$, Sh^{3}+. nig.3-, strf.0, elas.0, sicc.2, lim.0. mottled grey silts, and brown and lightly humified Phragmites fragments. The level of 42 cm in depth is probably a contact of regressive overlap.

8	050-107 (4.504- 3.934)	Ag3, Dh[1]1, Th[1]+. nig.2+, strf.0, elas.0, sicc.2, lim.0. mottled and dark grey silts with many Phragmites fragments.
7	107-130 (3.934- 3.704)	Ag2+, As2. nig.2, strf.0, elas.0, sicc.2, lim.0. blue grey silts and clay. A sequence of fining upwards in particle size with layers 6 and 5.
6	130-221 (3.704- 2.794)	Ag3, Ga+, As+. nig.2, strf.1, elas.0, sicc.2, lim.0. grey sandy silts with clay.
5	221-275 (2.794- 2.254)	Ga2+, Ag2. nig.2, strf.2, elas.0, sicc.2, lim.0. pinky grey and stratified silty sands.
4	275-304 (2.254- 1.964)	Ag3, As+, Dh[1]+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clayey silts with some Phragmites fragments. A sequence of fining upwards in particle size with Layers 3 and 2. The level of 275 mm in depth is probably a transitional contact of regressive and transgressive overlaps.
3	304-382 (1.964- 1.184)	Ag3, Ga1. nig.2, strf.2, elas.0, sicc.2, lim.0. grey and stratified sandy silts.
2	382-664 (1.184- -1.636)	Ag2, Ga2. nig.2, strf.3, elas.0, sicc.2, lim.0. pinky grey and well stratified silty sands. (tidal channel deposits?)
1	664-782 (-1.636- -2.816)	Ag3, Ga1. nig.2, strf.2, elas.0, sicc.2, lim.0. grey and stratified sandy silts.

Borehole No.	**Bore7**
Coordinate	**SD 33540 81070**
Altitude	**5.013 m O.D.**
Date	**2 February 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**

11	000-021 (5.013- 4.803)	$Sh^4$3, $Th^1$1. nig.4, strf.0, elas.0, sicc.3+. black, very humified humous substance with many new roots.
10	021-039 (4.803- 4.623)	$Sh^4$3, $Th^3$1, Ag+. nig.4, strf.0, elas.0, sicc.3+, lim.0. black to dark brown and very humified humous substance with some herb roots.
9	039-063 (4.623- 4.383)	As2, Ag1, $Dh^2$1. nig.3-, strf.0, elas.0, sicc.3, lim.0. mottled dark grey silty clay with many herb fragments.
8	063-108 (4.383- 3.933)	Ag2, As1+, Dh^1+. nig.2+, strf.0, elas.0, sicc.2, lim.0. mottled grey clayey silts with some Phragmites fragments.
7	108-308 (3.933- 1.933)	As2+, Ag2-. nig.2, strf.0, elas.0, sicc.2, lim.0. grey silts and clay. A sequence of fining upwards in particle size with layers 6, 5 and 4.
6	308-443 (1.933- 0.583)	Ag3, As1. nig.2, strf.0, elas.0, sicc.2, lim.0. grey and stiff clayey silts.
5	443-508 (0.583- -0.067)	Ag3, Ga1. nig.2, strf.1, elas.0, sicc.2, lim.0. pinky grey, stiff and stratified sandy silts.
4	508-578 (-0.067- -0.767)	Ga2, Ag2. nig.2, strf.2, elas.0, sicc.2, lim.0. pinky grey, stiff and stratified silts and sands. (tidal channel deposits?)
3	578-583 (-0.767- -0.817)	Ag3, As1, Dh^1+. nig.2, strf.0, elas.0, sicc.2, lim.0. blue grey and soft clayey silts with Phragmites fragments.
2	583-694 (-0.817- -0.827)	Ga2, Ag2. nig.2, strf.2, elas.0, sicc.2, lim.0. grey, stiff and stratified silts and sands.
1	694-709 (-0.827- -2.077)	Ag3, Ga1-, As+. nig.2, strf.1, elas.0, sicc.2, lim.0. blue grey, soft and stratified sandy

silts with clay.

Borehole No.	**Bore8**
Coordinate	**SD 33330 81120**
Altitude	**5.423 m O.D.**
Date	**2 March 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
11	000-026 (5.423-5.163)	Sc4. nig.4, strf.0, elas.0, sicc.3. organic soil with new roots of grasses.
10	026-037 (5.163-5.053)	Ag2, Ga1, As1. nig.3, strf.0, elas.0, sicc.3, lim.0. browning grey mottled silts with sands and clay.
9	037-063 (5.053-4.793)	As4, Ag+. nig.4, strf.0, elas.0, sicc.3, lim.0. very dark grey clay with silts and some brown mottlings.
8	063-080 (4.793-4.623)	As3, Ag1, Ga+. nig.3, strf.1, elas.0, sicc.3, lim.0. grey silty clay with coarser bands of silty sands and some brown mottlings.
7	080-113 (4.623-4.293)	Ag2, As2, Ga+. nig.2, strf.0, elas.0, sicc.3, lim.0. light browning-grey clay and silts, with sands and browning mottlings, becomes more clay on places with fragments of poorly humified Phragmites and black mottlings.
6	113-141 (4.293-4.013)	As4, Ag+, Ga+. nig.3, strf.0, elas.0, sicc.3, lim.0. browning grey clay with silts and sands.
5	141-161 (4.013-3.813)	Ag3, As1, Ga+, Dh^{1}+. nig.2+, strf.0, elas.0, sicc.2, lim.0. browning grey clayey silts with a few fragments of Phragmites.
4	161-233 (3.813-3.093)	Ag2, As2, Ga+. nig.3, strf.1, elas.0, sicc.2, lim.0. grey silts and clay with coarser layers; some black streaking coarser

		layers are generally mottled.
3	233-309 (3.093- 2.333)	Ga2, Ag2, As+. nig.3, strf.1, elas.0, sicc.2, lim.0. brown to grey-brown sands and silts with coarser and finer layers.
2	309-496 (2.333- 0.463)	Ga3, Ag1, As+, Dh^3+. nig.3, strf.2, elas.0, sicc.2, lim.0. brown to grey-brown silty sands with <u>Phragmites</u> fragments, black streaking and lamination.
1	496-596 (0.463- -0.537)	Ag2, As2, Ga+. nig.3, strf.1, elas.0, sicc.3, lim.0. grey to grey-brown clay and silts with black streaking and lamination.

Borehole No. Bore9
Coordinate SD 33370 80920
Altitude 5.150 m O.D.
Date 2 March 1988

Layer	Depth (cm) (Altitude m.)	Description
9	000-032 (5.150- 4.830)	Ag3+, $Tl^2$1-, Sh^2+. nig.2+, strf.0, elas.0, sicc.3, lim.0. dark grey silts with organic substance, and some new roots upwards.
8	032-035 (4.830- 4.800)	$Sh^4$3, Ag1-, Dh^3+. nig.4, strf.0, elas.0, sicc.3+, lim.0. black to dark grey organic substance with silts.
7	035-049 (4.800- 4.660)	Ag2, As1-, $Sh^3$1+. nig.3, strf.2, elas.0, sicc.3, lim.0. mottled dark grey clayey silts with more organic materials and lamination.
6	049-064 (4.660- 4.510)	Ag3+, Th^2+, Sh^3+. nig.3, strf.0, elas.0, sicc.3+, lim.0. mottled brown-grey silts with <u>Phragmites</u> fragments and yellow-black marks.
5	064-088 (4.510-	Ag3, $Th^2$1, Dh^1+. nig.3, strf.0, elas.0, sicc.3, lim.0.

	4.270)	brown-grey silts with fragments and roots of Phragmites.
4	088-150 (4.270- 3.650)	Ag3, Dh^{1}1, As+. nig.2, strf.0, elas.0, sicc.2, lim.0. light grey silts and Phragmites fragments.
3	150-292 (3.650- 2.230)	Ag3, As1. nig.2, strf.0, elas.0, sicc.2, lim.0. light grey clay and silts with some black organic streakings.
2	292-297 (2.230- 2.180)	Dh^{2}1+, Sh^{3}1, Th^{1}+, Ag1+, As+. nig.2, strf.0, elas.0, sicc.2, lim.0. dark grey organic silts.
1	297-327 (2.180- 1.880)	Ga2, Gg1, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.0. light brown-grey silty sands and shingles.

Borehole No. **Bore10**
Coordinate **SD 33230 81190**
Altitude **5.333 m O.D.**
Date **2 February 1988**

Layer	**Depth (cm) (Altitude m.)**	**Description**
9	000-022 (5.333- 5.113)	Sc4 nig.4, strf.0, elas.0, sicc.3.
8	022-045 (5.113- 4.883)	As4, Ag+. nig.4-, strf.0, elas.0, sicc.3, lim.0. black to very dark grey clay with silts and streakings and some brown mottlings.
7	045-064 (4.883- 4.693)	As4, Ag+. nig.3, strf.0, elas.0, sicc.3, lim.0. grey clay with silts and brown mottlings.
6	064-070 (4.693- 4.633)	Dh^{3}2, Th^{2}1, As1, Ag+. nig.3, strf.1, elas.0, sicc.3-, lim.0. poorly humified herbs fragments and

		rootlets and clay.
5	070-150 (4.633- 3.833)	As4, Ag+, Dh^2+, Dl^2+, Tl^2+. nig.2, strf.0, elas.0, sicc.2+, lim.0. grey silty clay with herbs and woody fragments and rootlets, quite well humified.
4	150-222 (3.833- 3.113)	As3, Ag1, Dh+, Dl+. nig.3, strf.0, elas.0, sicc.2, lim.0. browning grey silty clay with herbs, woody fragments, and black streakings.
3	222-391 (3.113- 1.423)	Ag2, Ga1, As1, Dh+. nig.3, strf.1, elas.0, sicc.2, lim.1. browning grey silts with sandy and clayey zones, and some Phragmites fragments.
2	391-393 (1.423- 1.403)	$Dh^3$4(Phrag.). nig.4, strf.0, elas.2, sicc.2, lim.1. well humified, dark brown Phragmites peat.
1	393-574 (1.403- -0.407)	Ag2, Ga1, As1, Dh+(Phrag.). nig.3, strf.1, elas.0, sicc.2, lim.0. browning grey silt with clayey and sandy zones and some Phragmites fragments.

Borehole No. Bore11
Coordinate SD 33980 80970
Altitute 4.607 m O.D.
Date 29 October 1987

Layer	Depth (cm) (Altitude m.)	Description
13	000-010	Sc4.
12	010-022 (4.507- 4.387)	$Sh^3$2, $Th^2$1, Ag1. nig.3, strf.0, elas.1, sicc.3, lim.3. dark brown, well humified humous substance with some herbaceous roots and silt.
11	022-045 (4.387- 4.157)	Ag3, Ga1. nig.2, strf.2, elas.0, sicc.3, lim.3. light grey and stratified sandy silt.

10	045-056 (4.157- 4.047)	$Sh^3$3, $Tl^2$1. nig.3, strf.0, elas.1, sicc.3, lim.2. brown and humified humous substance and some herbaceous and woody fragments.
9	056-089 (4.047- 3.717)	Ag3, Ga1. nig.2, strf.1, elas.0, sicc.2+, lim.3. grey sandy silt.
8	089-106 (3.717- 3.547)	$Sh^3$4, Th^2+. nig.2, strf.0, elas.1, sicc.2, lim.2. brown and humified humous substance with a little herbaceous roots.
7	106-140 (3.547- 3.207)	Ag3, As1. nig.2, strf.0, elas.0, sicc.2, lim.2. grey clayey silt.
6	140-150 (3.207- 3.107)	$Sh^3$4, Th^2+. nig.2+, strf.0, elas.1, sicc.2+, lim.3. brown and humified humous substance with some rootlets.
5	150-256 (3.107- 2.047)	Ag4. nig.2, strf.0, elas.0, sicc.2, lim.2. grey silt.
4	256-264 (2.047- 1.967)	$Sh^2$2, $Th^2$2, Dh^2+. nig.3, strf.0, elas.2, sicc.2, lim.4. yellow and slightly humified <u>Phagmites</u> turfa and humous substance.
3	264-273 (1.967- 1.877)	$Sh^3$4, Th^2+. nig.3, strf.0, elas.1, sicc.2, lim.1. dark brown and humified humous substance.
2	273-298 (1.877- 1.627)	Ag3, As1. nig.2, strf.1, elas.0, sicc.2, lim.3. grey clayey silt.
1	298-350 (1.627- 1.107)	As3, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.1. grey and soft silty clay.

Borehole No.	**Bore12**
Coordinate	**SD 34390 81040**
Altitute	**7.001 m O.D.**
Date	**29 October 1987**

Layer	Depth (cm) (Altitude m.)	Description
9	000-016 (7.001- 6.841)	$Sh^4$2, $Tl^4$1, $Dl^3$1, TH+. nig.4, strf.0, elas.3, sicc.3. dark red-brown, soft and wet, humified humous substance and shrub and herbaceous fragments with new rootlets.
8	016-100 (6.841- 6.001)	$Ld^3$2, $Tl^3$1, $Sh^3$1. nig.3+, strf.0, elas.3, sicc.2, lim.1. dark red-brown, humified shrub and herbaceous fragments, with humous substance.
7	100-187 (6.001- 5.131)	$Tl^3$3, $Sh^3$1, Ld+. nig.3+, strf.0, elas.2, sicc.2, lim.1. red-brown, soft and humified shrub branches and herbaceous fragments, with humous substance.
6	187-328 (5.131- 3.721)	$Th^3$3, $Tl^2$1, Dh^2+(Phrag.). nig.3, strf.0, elas.3, sicc.2, lim.1. brown, hard and humified Sphagnum turfa with leaves and rootlets of Phragmites at the bottom.
5	328-363 (3.721- 3.371)	$Th^2$2(Phrag.), $Dh^2$2(Phrag.). nig.2+, strf.0, elas.3, sicc.2, lim.1. dark yellow, slightly humified Phragmites peat.
4	363-400 (3.371- 3.001)	Ag4, As+, Dh^2+(Phrag.). nig.2, strf.1, elas.0, sicc.2, lim.1. grey clayey silt with occasional Phragmites fragments.
3	400-410 (3.001- 2.901)	$Dh^2$4(Phrag.), Th+. nig.2, strf.0, elas.2, sicc.2, lim.1. yellow, slightly humified Phragmites leaves.
2	410-518 (2.901- 1.821)	Ag4, As+. nig.2, strf.1, elas.0, sicc.2, lim.1. grey clayey silt with black spots.
1	518-650 (1.821- 0.501)	Ag3, Ga1. nig.2, strf.3, elas.0, sicc.2, lim.0. pinky grey, stratified and stiff silt and sands.

Borehole No.		**Bore13**
Coordinate		**SD 33840 81040**
Altitude		**4.901 m O.D.**
Date		**2 March 1988**

Layer	Depth (cm) (Altitude m.)	Description
13	000-019 (4.901-4.711)	$Sh^4$3, $Th^3$1, Ag+. nig.4, strf.0, elas.0, sicc.3+. black, humified peat with some new roots at the top.
12	019-026 (4.711-4.641)	$Sh^3$2+, $Th^2$1+, $Dh^2$1-. nig.4-, strf.0, elas.1, sicc.3, lim.2. brown soft peat with occurrence of Phragmites fragments.
11	026-038 (4.641-4.521)	$Sh^2$2+, $Th^2$1+, $Dh^2$1-, As+. nig.3, strf.0, elas.2, sicc.2+, lim.0. brown and soft, Phragmites peat with a little clay.
10	038-058 (4.521-4.321)	As2, Ag1+, $Dh^2$1-, Th^2+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey silty clay with leaves and stems of Phragmites.
9	058-067 (4.321-4.231)	As3, $Dh^2$1-, Ag+. nig.2, strf.0, elas.0, sicc.2, lim.0. light grey clay with leaves and stems of Phragmites.
8	067-073 (4.231-4.171)	As2, $Dh^2$2-, Th^1+. nig.2+, strf.0, elas.0, sicc.2, lim.0. dark grey clay and fragments of Phragmites (transitional layer).
7	073-078 (4.171-4.121)	$Dh^2$2+, $Sh^2$1-, Ag1-, Th^1+. nig.2+, strf.0, elas.1, sicc.2, lim.0. greyey brown silty Phragmites peat.
6	078-081 (4.121-4.091)	As2, $Dh^2$2-, Th^1+. nig.2+, strf.0, elas.0, sicc.2, lim.0. dark grey clay with a lot of Phragmites fragments (transitional layer).
5	081-252 (4.091-2.831)	Ag2+, As2-, Dh^2+. nig.2, strf.0, elas.0, sicc.2, lim.0. light grey clay and silt with occasional Phragmites fragments and

		black marks.
4	252-257 (2.831- 2.781)	$Dh^3$3, $Th^2$1. nig.3, strf.1+, elas.2, sicc.3, lim.1. brown Phragmites peat.
3	257-267 (2.781- 2.681)	As2+, $Dh^2$1, Sh+, Ag+. nig.2+, strf.0, elas.0, sicc.2, lim.1. dark grey clay with a lot Phragmites (trasitional layer).
2	267-303 (2.681- 1.871)	As3, Ag1, Dh^2+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey clay with occasional Phragmites.
1	303-404 (1.871- 0.861)	Ag3+, As+ Ga+. nig.2+, strf.0, elas.0, sicc.2, lim.0. pinky grey silt with clay and sands.

Borehole No. Bore14
Coordinate SD 34060 81040
Altitude 5.174 m O.D.
Date 9 March 1988

Layer	**Depth (cm) (Altitude m.)**	**Description**
19	000-015 (5.174- 5.024)	Sc4. nig.4, strf.0, elas.0, sicc.3. top soil.
18	015-035 (5.024- 4.824	Ag3+, Ga+, Th^2+. nig.3, strf.0, elas.0, sicc.3, lim.4. brown-grey sandy silts with roots.
17	035-079 (4.824- 4.384)	As2+, Ga1-, $Th^2$1-. nig.2, strf.2+, elas.0, sicc.3, lim.2. grey sandy silts with Phragmites turfa and fine sand lenses.
16	079-116 (4.384- 4.014)	Ag3, Ga+, As+, Th^2+. nig.2, strf.0, elas.0, sicc.2+, lim.0. grey silt with Phragmites turfa and clay and sands.
15	116-136 (4.014- 3.814)	Ag3-, Ga1+, Dh^1+. nig.2, strf.2+, elas.0, sicc.2, lim.0. grey and liminated, sandy silts with fresh Phragmites fragments.

14	136-170 (3.814- 3.474)	Ag2, As2, Dh^{1}+. nig.2, strf.0, elas.0, sicc.2, lim.0. blue-grey silt and clay with occasional Phragmites fragments.
13	170-175 (3.474- 3.424)	Dh^{3}2, Th^{2}1, Sh^{2}1. nig.3, strf.0, elas.2, sicc.2, lim.2. dark brown, humified, Phragmites peat.
12	175-181 (3.424- 3.364)	Ag3-, Dh^{2}1, Th^{1}+. nig.2+, strf.0, elas.0, sicc.2, lim.1. dark grey silt with roots and stems of Phragmites.
11	181-184 (3.364- 3.334)	Sh^{3}2, Dh^{3}2, Th^{2}+. nig.3+, strf.0, elas.2, sicc.2, lim.2. dark brown and humified, detrital fen peat.
10	184-191 (3.334- 3.264)	Dh^{4}3+,. Th^{3}1-, Sh+. nig.3, strf.0, elas.3, sicc.2, lim.1. dark brown and very humified, detrital Phragmites.
9	191-197 (3.264- 3.204)	Ag3-, Dh^{2}1, Sh^{2}+. nig.2+, strf.0, elas.0, sicc.2, lim.1. dark grey silt with many Phragmites fragments.
8	197-243 (3.204- 2.744)	As4, Dh^{2}+. nig.2, strf.0, elas.0, sicc.2, lim.2. light blue-grey clay with occasional Phragmites fragments.
7	243-330 (2.744- 1.874)	As4, Dh^{3}+. nig.2, strf.0, elas.0, sicc.2, lim.0. pinky grey clay with humified fragments of Phragmites.
6	330-342 (1.874- 1.754)	Sh^{3}3-, Dh^{2}1+, Th^{2}+. nig.3+, strf.0, elas.1, sicc.0, lim.3. dark brown and well humified, organic materials with detrital Phragmites.
5	342-347 (1.754- 1.704)	As2, Sh^{2}2-, Dh^{2}+. nig.3, strf.0, elas.0, sicc.2, lim.1. dark grey clay and organic material (transitional layer).
4	347-363 (1.704- 1.544)	Ga2, Ag2, Dh^{1}+. nig.2, strf.3, elas.0, sicc.2, lim.2. grey and laminated sands and silt with slightly humified and occasional Phragmites.

3	363-452 (1.544- 0.654)	Ga2, Ag2. nig.2, strf.3, elas.0, sicc.2, lim.1. pinky grey and laminated sands and silt.
2	452-461 (0.654- 0.564)	As2, $Dh^2$1+, Sh^3+. nig.3, strf.0, elas.0, sicc.2, lim.2. dark grey organic clay with Phragmites fragments.
1	461-504 (0.564- 0.134)	Ga3, Ag1. nig.2, strf.3, elas.0, sicc.2, lim.2. pinky grey and laminated silty sands.

Borehole No. Bore15
Coordinate SD 34010 81040
Altitude 5.054 m O.D.
Date 9 March 1988

Layer	**Depth (cm) (Altitude m.)**	**Description**
14	000-021 (5.054- 4.844)	Sc4 nig.4, strf.0, elas.0, sicc.3. with many new roots.
13	021-059 (4.844- 4.464)	Ag3+, As1-, Tl^1. nig.2+, strf.0, elas.0, sicc.3, lim.3. dark grey and very stiff clayey silt with some roots of trees and grasses.
12	059-100 (4.464- 4.054)	Ag3+, As1-. nig.2, strf.0, elas.0, sicc.2, lim.0. light grey clayey silt.
11	100-175 (4.054- 3.304)	As4-, Ag+. nig.2, strf.0, elas.0, sicc.2, lim.0. light grey clay.
10	175-213 (3.304- 2.924)	Ga3, Ag1. nig.2, strf.3, elas.0, sicc.2, lim.2. pinky grey and laminated silty sands.
9	213-218 (2.924- 2.874)	As3, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.2. blue-grey silty clay.
8	218-238 (2.874-	Ga2, Ag2. nig.2, strf.3, elas.0, sicc.2, lim.2.

	2.674)	pinky grey and laminated silt and sands.
7	238-338 (2.674- 1.674)	As2+, Ag2-, Dh^{1}+. nig.2, strf.0, elas.0, sicc.2, lim.3. pinky grey to blue grey silt and clay with less humified Phragmites fragments.
6	338-347 (1.674- 1.584)	Dh^{3}3, Sh^{4}1, Th^{2}+. nig.3, strf.0, elas.1, sicc.2, lim.2. dark brown and well humified Phragmites peat.
5	347-361 (1.584- 1.444)	As3, Ag1, Dh^{1}+. nig.2, strf.0, elas.0, sicc.2, lim.1. light grey silty clay with fragments of Phragmites and black spots.
4	361-447 (1.444- 0.584)	Ga2, Ag2. nig.2+, strf.3, elas.0, sicc.2, lim.3. pinky grey and laminated silty sands.
3	447-460 (0.584- 0.454)	As3, Ag1, Dh^{1}+, Sh+. nig.2, strf.0, elas.0, sicc.2, lim.1. grey silty clay with organic materials and Phragmites fragments.
2	460-483 (0.454- 0.224)	As3+, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.1. grey silty clay.
1	483-510 (0.224- -0.046)	Ga2, Ag2. nig.2, strf.3, elas.0, sicc.2, lim.2. pinky gray and laminated silty sands.

Borehole No. Bore16
Coordinate SD 34230 81040
Altitude 7.104 m O.D.
Date 9 March 1988

Layer	**Depth (cm) (Altitude m.)**	**Description**
17	000-020 (7.104- 6.904)	Dh^{4}3, Th^{3}1. nig.4, strf.0, elas.2, sicc.3. dark brown, well humified herbaceous turfa.

16	020-059 (6.904- 6.514)	$Dh^{2}2$, $Th^{1}2$. nig.3+, strf.0, elas.3, sicc.2, lim.2. brown, humified herbaceous (Sphagnum) rootlets and fragments.
15	059-100 (6.514- 6.104)	$Th^{1}3$, $Sh^{2}1$. nig.3, strf.0, elas.3, sicc.2, lim.2. brown, less humified Sphagnum turfa.
14	100-215 (6.104- 4.954)	$Th^{2}3+$, $Dh^{3}+$, $Tl^{1}+$. nig.3, strf.0, elas.3, sicc.2, lim.0. red-brown, humified Sphagnum turfa with alder roots in 130-135 cm.
13	215-272 (4.954- 4.384)	$Th^{3}3$, $Dh^{2}1$. nig.3+, strf.0, elas.3, sicc.2, lim.0, brown and well humified Sphagnum turfa, with less humified Phragmites fragments occasionally.
12	272-310 (4.384- 4.004)	$Dh^{1}3+$, $Th^{2}1$. nig.2+, strf.0, elas.3, sicc.2, lim.2. yellow-brown and less humified Phragmites peat.
11	310-329 (4.004- 3.814)	As3, $Dh^{1}1$. nig.2, strf.0, elas.0, sicc.2, lim.2. grey clay with Phragmites fragments.
10	329-363 (3.814- 3.474)	$Dh^{1}2$, $Th^{1}1$, $Sh^{2}1$, Tl+. nig.3+, strf.0, elas.2, sicc.2, lim.2. dark brown and very humified Phragmites peat with some birch roots occasionally.
9	363-395 (3.474- 3.154)	$Dh^{1}3$, $Th^{1}1$, Sh+, As+. nig.2+, strf.0, elas.1, sicc.2, lim.2. grey-brown and less humified Phragmites peat with a little clay.
8	395-515 (3.154- 1.954)	As4-, Ag+. nig.2, strf.0, elas.0, sicc.2, lim.2. blue-grey silty clay.
7	515-539 (1.954- 1.714)	$Dh^{2}3$, $Sh^{2}1$, $Th^{1}+$. nig.3, strf.0, elas.2, sicc.2, lim.2. dark to light brown and humified peat of Phragmites.
6	539-575 (1.714- 1.354)	As4-, Ag+. nig.2, strf.0, elas.0, sicc.2, lim.2. blue grey silty clay.
5	575-587	$Dh^{2}3$, $Sh^{2}1$, As+.

	(1.354- 1.234)	nig.3, strf.0, elas.2, sicc.2, lim.3. dark to light brown and less humified <u>Phragmites</u> peat with a little clay in the lower part.
4	587-720 (1.234- -0.096)	As4. nig.2, strf.0, elas.0, sicc.2, lim.0. blue-grey clay.
3	720-725 (-0.096- -0.146)	As3, $Sh^2$1, Dh^2+. nig.3, strf.0, elas.0, sicc.2, lim.1. dark grey organic clay with fragments of <u>Phragmites</u>.
2	725-750 (-0.146- -0.396)	As4. nig.2, strf.0, elas.0, sicc.2, lim.1. light grey clay.
1	750-815 (-0.396- -1.046)	As2, Ag2. nig.2, strf.0, elas.0, sicc.2, lim.0. pinky grey silt and clay.

Borehole No. Bore17
Coordinate SD 34180 81040
Altitude 7.094 m O.D.
Date 2 March 1988

Layer	Depth (cm) (Altitude m.)	Description
11	000-034 (7.094- 6.754)	Sc4 nig.4, strf.0, elas.2, sicc.3. dark brown herbaceous turfa.
10	034-180 (6.754- 5.294)	$Th^3$3, $Sh^3$1, Tl^1+. nig.3, strf.0, elas.2, sicc.2, lim.2. red brown and well humified <u>Sphagnum</u> turfa with roots and branches of alder occasionally.
9	180-282 (5.294- 4.274)	$Th^2$3, $Dh^2$1, Sh+, Tl+. nig.3, strf.0, elas.3, sicc.2, lim.1. dark yellow-brown and humified <u>Sphagnum</u> turfa, with alder and birch roots in the upper part, <u>Phragmites</u> fragments in the lower part, and two black organic layers of 5 cm in thickness each in 205-210 and 265-270 cm.
8	282-287	As3, $Sh^2$1, Dh^1+.

	(4.274- 4.224)	nig.2+, strf.0, elas.0, sicc.2, lim.0. dark grey organic clay with Phragmites fragments (transitional layer).
7	287-316 (4.224- 3.934)	As4, Ag+. nig.2, strf.0, elas.0, sicc.2, lim.0. light grey silty clay.
6	316-382 (3.934- 3.274)	$Dh^{1}3$, $Th^{1}1$, Sh+. nig.3, strf.0, elas.3, sicc.2, lim.3. yellow-brown, fresh Phragmites peat.
5	382-388 (3.274- 3.214)	As2, $Dh^{1}1$, $Th^{1}1$, Sh+. nig.2+, strf.0, elas.0, sicc.2, lim.0. dark grey clay with Phragmites roots and fragments (transitional layer).
4	388-532 (3.214- 1.774)	As3, Ag1. nig.2, strf.0, elas.0, sicc.2, lim.0. blue-grey silty clay.
3	532-539 (1.774- 1.704)	$Dh^{3}2$, $Th^{2}1$, $Sh^{3}1$. nig.3+, strf.0, elas.2, sicc.2, lim.3. dark brown and well humified Phragmites peat.
2	539-665 (1.704- 0.444)	As3, Ag1, Dh^{1}+. nig.2, strf.0, elas.0, sicc.2, lim.0. grey silty clay with fresh Phragmites fragments occasionally.
1	665-715 (0.444- -0.056)	Ag3, Ga1. nig.2, strf.3, elas.0, sicc.2, lim.2. pinky grey and stratified sandy silt.

Borehole No. Bore18
Coordinate SD 34290 81040
Altitude 7.056 m O.D.
Date 2 March 1988

Layer	**Depth (cm) (Altitude m.)**	**Description**
9	000-280 (7.056- 4.256)	$Th^{3}3$, $Tl^{1}1$, Sh^{3}+, Dh+. nig.3+, strf.0, elas.2, sicc.2. red-brown and well humified Sphagnum turfa with roots and branches of alder occasionally.

8	280-319 (4.256- 3.866)	$Dh^2$3, $Th^2$1. nig.2+, strf.0, elas.3, sicc.2, lim.2. yellow-brown and less humified Phragmites peat.
7	319-327 (3.866- 3.786)	As4, Ag+. nig.2, strf.0, elas.0, sicc.2, lim.2. grey silty clay.
6	327-341 (3.786- 3.646)	$Dh^1$4-, Th^1+. nig.2+, strf.0, elas.3, sicc.2, lim.3. dark yellow, fresh Phragmites peat.
5	341-365 (3.646- 3.406)	$Th^2$3, $Dh^2$1, Sh+. nig.3, strf.0, elas.2, sicc.2, lim.2. brown and less humified Sphagnum turfa with occasional Phragmites fragments.
4	365-408 (3.406- 2.976)	$Dh^1$3, $Th^1$1. nig.2+, strf.0, elas.3, sicc.2, lim.2. dark yellow fresh Phragmites peat.
3	408-505 (2.976- 2.006)	As4, Ag+. nig.2, strf.0, elas.0, sicc.2, lim.2. grey silty clay.
2	505-515 (2.006- 1.906)	$Sh^2$2+, $Th^1$1, $Dh^1$1. nig.3, strf.0, elas.2, sicc.2, lim.2. light brown, humified humous substance and Phragmites.
1	515-715 (1.906- -0.094)	As2, Ag2. nig.2, strf.0, elas.0, sicc.2, lim.2. grey silt and clay, becoming pinky grey downwards.

APPENDIX II

POLLEN COUNTS FROM SKELWITH POOL

From boreholes PC-1 and PIT2C, pits PIT1 and PIT2.

Borehole No.	PIT 1							
Depth (cm)	025	035	045	055	065	075	085	095
Betula	2	5	4	5	11	6	10	11
Pinus	0	1	1	0	0	0	0	1
Populus	1	0	0	0	2	1	3	2
Ulmus	1	0	0	2	0	0	4	5
Quercus	20	22	18	19	27	25	30	20
Tilia	0	0	0	0	0	0	0	0
Alnus	48	38	35	34	37	28	25	21
Corylus	42	32	43	48	59	63	76	65
Salix	0	1	0	3	2	0	1	2
Ericaceae	19	14	23	34	35	46	29	47
Gramineae	24	31	27	25	11	9	4	6
Cyperaceae	29	28	41	25	12	16	8	12
Ranunculaceae	7	2	0	2	0	3	5	0
Caryophyllaceae	1	4	0	0	2	0	0	7
Chenopodiaceae	0	0	0	0	0	0	0	0
Rosaceae	0	1	3	1	0	0	3	0
Umbelliferae	0	0	0	0	0	0	0	0
Polygonaceae	0	0	0	1	0	0	0	1
Urticaceae	0	6	1	1	0	0	0	1
Rubiaceae	0	0	0	0	0	0	0	0
Plantaginaceae	7	18	6	0	7	5	7	5
P. maritima	0	0	0	0	0	0	0	0
Nymphaea	0	0	0	0	0	0	0	0
Alisma	0	0	0	0	0	0	0	0
Myriophyllum	0	0	0	0	3	0	0	0
Typha angustifolia	0	8	0	0	0	0	0	0
Lycopodium	13	10	2	2	2	2	7	1
Pteridium	0	4	1	2	0	0	2	0
Polypodium	0	4	2	1	3	7	4	3
Sphagnum	25	27	19	32	18	11	17	3
Filicales	3	6	2	5	3	7	2	1
Total tree pollen	72	66	58	60	77	60	72	60
Total land pollen	201	203	202	200	205	202	205	206
Total pollen	242	254	228	242	234	229	237	214

Borehole No.	PIT1 (continued)							
Depth cm	105	115	125	135	145	155	165	175
Betula	5	4	6	10	20	32	28	31
Pinus	1	0	5	4	2	1	1	0
Populus	0	0	0	1	0	1	0	2
Ulmus	4	4	0	0	0	0	2	3
Quercus	19	26	23	18	21	26	22	20
Tilia	0	1	2	0	0	0	0	0
Alnus	18	20	13	14	24	39	28	43
Corylus	60	53	49	42	45	69	90	62
Salix	0	3	1	4	2	3	0	0
Ericaceae	48	77	69	55	49	8	2	2
Gramineae	10	6	13	27	25	12	15	25
Cyperaceae	9	11	10	20	8	7	10	11
Ranunculaceae	0	1	0	0	0	0	0	0
Caryophyllaceae	6	4	0	4	0	0	0	0
Chenopodiaceae	0	0	0	0	2	0	1	1
Rosaceae	0	0	3	0	1	1	1	0
Umbelliferae	1	0	0	0	0	0	0	0
Polygonaceae	5	0	3	0	0	2	4	0
Urticaceae	0	7	0	0	0	0	0	0
Rubiaceae	0	0	0	0	0	0	0	0
Plantaginaceae	15	8	5	1	1	0	2	0
P. maritima	0	0	0	0	0	0	3	0
Nymphaea	0	0	0	0	0	0	2	0
Alisma	0	0	1	0	0	0	0	0
Myriophyllum	0	0	0	0	0	0	0	0
Typha angustifolia	0	0	0	0	0	0	0	0
Lycopodium	2	2	1	0	4	2	21	5
Pteridium	2	1	0	1	3	5	6	4
Polypodium	3	5	2	0	5	6	15	4
Sphagnum	0	4	1	4	10	4	20	9
Filicales	1	1	1	1	4	10	47	21
Total tree pollen	47	55	49	47	67	99	81	99
Total land pollen	201	225	202	200	200	201	209	200
Total pollen	209	238	207	206	226	228	232	243

Borehole No.	PIT1 (continued)						
Depth cm	185	195	205	215	225	235	245
Betula	23	29	21	27	21	22	20
Pinus	2	1	3	4	3	8	8
Populus	1	0	0	1	0	0	0
Ulmus	2	0	2	3	1	3	4
Quercus	15	12	19	20	22	31	28
Tilia	0	0	0	1	1	0	0
Alnus	47	39	33	39	24	28	22
Corylus	68	50	36	37	28	32	28
Salix	2	2	4	2	1	0	0
Ericaceae	1	2	8	4	9	3	3
Gramineae	21	33	39	31	46	40	22
Cyperaceae	14	18	20	21	28	25	29
Ranunculaceae	0	0	0	0	0	0	0
Caryophyllaceae	0	2	4	0	0	0	0
Chenopodiaceae	4	2	0	1	6	2	4
Rosaceae	2	2	6	2	1	0	1
Umbelliferae	0	0	0	0	0	0	0
Polygonaceae	0	0	0	1	0	2	5
Urticaceae	0	0	0	0	0	0	0
Rubiaceae	0	0	3	2	0	0	0
Plantaginaceae	1	2	2	0	0	0	0
P. maritima	0	0	6	4	9	7	15
Nymphaea	0	0	2	0	4	1	0
Alisma	0	0	0	0	0	0	0
Myriophyllum	0	0	0	0	0	0	0
Typha angustifolia	0	8	5	8	21	12	8
Lycopodium	3	9	12	5	1	0	1
Pteridium	1	3	8	2	4	3	2
Polypodium	11	4	7	14	29	22	4
Sphagnum	7	19	17	11	6	4	7
Filicales	72	98	91	62	51	42	63
Total tree pollen	90	81	78	95	72	92	82
Total land pollen	203	200	200	200	200	203	201
Total pollen	297	341	342	302	316	287	286

Borehole No.	PIT 2						
Depth (cm)	120	115	110	102	095	088	085
Betula	18	26	25	26	30	26	20
Pinus	46	26	22	23	14	14	34
Ulmus	5	4	6	6	2	4	2
Quercus	45	46	49	48	45	56	46
Alnus	8	12	10	14	19	13	9
Corylus	41	48	42	43	40	31	25
Salix	4	1	0	0	2	2	1
Ericaceae	0	0	0	0	0	0	5
Gramineae	6	24	35	28	32	29	18
Cyperaceae	8	9	10	10	8	20	29
Chenopodiaceae	12	4	3	2	6	10	8
Rosaceae	1	0	0	0	0	0	1
Umbelliferae	2	0	0	0	1	0	0
Plantago maritima	6	0	0	0	1	6	2
Typha angustifolia	6	6	10	6	4	3	7
Lycopodium	1	0	0	1	0	2	2
Pteridium	1	0	0	0	0	3	1
Polypodium	2	0	0	0	2	9	5
Sphagnum	2	2	1	0	0	1	0
Filicales	2	1	6	0	1	12	7
Total tree pollen	122	114	112	117	110	113	111
Total land pollen	202	200	200	200	200	211	200
Total pollen	216	209	207	207	207	241	222

Borehole No.	PIT 2 (continued)				
Depth (cm)	035	025	020	015	005
Betula	12	15	15	20	19
Pinus	34	6	3	1	0
Ulmus	1	4	4	1	1
Quercus	32	45	27	26	29
Alnus	14	31	67	52	41
Corylus	33	43	39	38	45
Salix	2	0	1	0	2
Ericaceae	2	0	0	1	0
Gramineae	10	25	27	36	32
Cyperaceae	41	20	12	21	28
Chenopodiaceae	11	9	5	1	0
Rosaceae	0	1	0	1	1
Umbelliferae	2	0	0	0	0
Plantago maritima	6	1	0	2	2
Typha angustifolia	14	2	0	0	0
Lycopodium	3	1	0	2	6
Pteridium	6	1	0	0	0
Polypodium	6	10	8	8	2
Sphagnum	1	2	4	4	8
Filicales	12	35	61	32	16
Total tree pollen	93	101	116	100	90
Total land pollen	200	200	200	200	200
Total pollen	242	251	273	242	232

Borehole No.	PIT 2C							
Depth (cm)	201	202	203	204	205	206	207	208
Betula	18	10	16	18	22	25	29	35
Pinus	42	35	23	18	12	12	19	11
Ulmus	10	4	5	4	8	10	11	6
Quercus	15	20	17	19	20	35	35	37
Tilia	0	0	2	0	1	0	0	0
Alnus	12	6	7	9	8	8	6	11
Corylus	32	35	39	38	32	50	50	52
Salix	1	0	1	0	1	0	1	3
Ericaceae	2	3	1	1	0	0	0	0
Gramineae	32	59	67	70	65	42	21	25
Cyperaceae	36	25	20	23	21	18	24	14
Ranunculaceae	0	0	1	0	1	0	0	0
Chenopodiaceae	0	4	6	5	2	1	0	3
Rosaceae	0	0	0	0	1	1	2	2
Urticaceae	0	0	0	0	1	0	1	0
Plantago maritima	0	2	1	2	5	1	2	1
Typha angustifolia	2	5	8	8	4	9	8	12
Lycopodium	1	2	2	1	2	1	2	0
Pteridium	0	3	1	2	4	2	2	1
Polypodium	1	2	2	2	1	2	1	4
Filicales	0	0	1	1	1	0	1	1
Total tree pollen	97	75	70	68	71	90	100	100
Total land pollen	200	205	206	207	200	203	201	200
Total pollen	204	217	220	221	212	217	215	218

Borehole No.	PIT 2C (continued)					
Depth (cm)	209	210	211	212	213	214
Betula	27	22	19	15	18	22
Pinus	24	32	34	41	75	72
Ulmus	6	11	12	14	10	11
Quercus	32	30	38	32	22	23
Tilia	0	0	0	0	0	0
Alnus	11	7	4	3	2	2
Corylus	49	56	51	47	31	29
Salix	0	0	0	1	0	1
Ericaceae	0	0	0	0	0	0
Gramineae	31	24	22	16	8	6
Cyperaceae	18	18	20	29	31	32
Ranunculaceae	0	0	0	1	0	0
Chenopodiaceae	0	0	1	1	0	2
Rosaceae	0	0	1	0	2	0
Urticaceae	0	1	0	0	1	0
Plantago maritima	3	0	0	2	0	1
Typha angustifolia	11	4	5	1	0	0
Lycopodium	1	1	0	2	1	1
Pteridium	1	0	2	1	0	2
Polypodium	2	0	2	1	0	0
Filicales	0	0	0	0	0	0
Total tree pollen	100	102	107	105	127	130
Total land pollen	201	201	202	202	200	201
Total pollen	216	207	210	208	201	204

Borehole No. **PC-1**

Depth (cm)	421	422	423	424	425	426	427	428	429
Betula	9	13	11	10	6	12	10	17	14
Pinus	57	56	62	60	74	61	48	51	55
Ulmus	6	4	12	7	10	4	2	4	2
Quercus	26	21	16	15	5	18	14	20	18
Corylus	3	25	15	21	10	20	23	25	16
Salix	10	0	2	0	2	0	1	0	5
Gramineae	6	11	8	14	10	15	13	5	6
Cyperaceae	21	11	14	14	10	18	21	15	10
Chenopodiaceae	3	4	2	6	7	2	8	7	10
Malva	0	1	4	0	0	0	0	1	0
Rosaceae	3	1	0	1	4	0	2	1	4
Umbelliferae	0	2	0	1	8	0	5	2	7
Polygonaceae	0	0	0	0	2	0	0	0	0
Urticaceae	6	2	4	2	1	0	0	1	1
Plantago maritima	0	1	0	0	0	0	3	1	2
Nymphaea	0	0	0	0	2	0	0	1	0
Typha angustifolia	12	10	16	10	18	25	39	31	34
Lycopodium	3	0	0	0	2	0	5	0	0
Selaginella	0	0	0	0	5	0	4	0	0
Pteridium	0	2	0	0	10	4	15	1	2
Polypodium	3	2	4	1	0	1	5	2	4
Filicales	0	1	6	0	0	1	3	2	4
Total tree pollen	98	94	101	92	95	95	74	92	89
Total land pollen	150	152	150	150	151	150	150	150	150
Total pollen	168	167	176	161	188	181	221	187	194

Borehole No.	PC-1						
Depth (cm)	300	301	302	303	305	307	309
Betula	21	22	26	30	35	31	23
Pinus	24	18	12	19	32	40	45
Ulmus	5	8	7	9	10	16	11
Quercus	36	51	48	48	39	25	31
Alnus	2	5	12	8	4	8	9
Corylus	60	53	67	60	72	71	76
Salix	4	0	2	0	0	0	0
Gramineae	24	25	32	8	3	2	1
Cyperaceae	12	5	5	10	4	1	1
Chenopodiaceae	9	10	3	2	0	2	0
Rosaceae	2	0	0	1	0	0	1
Umbelliferae	0	0	0	1	0	2	0
Polygonaceae	1	0	0	0	0	1	0
Urticaceae	0	1	0	1	0	1	2
Plantago maritima	4	2	1	5	2	0	0
Nymphaea	1	0	0	1	2	1	0
Typha angustifolia	12	1	1	3	8	10	2
Lycopodium	0	1	1	0	0	1	1
Pteridium	1	2	2	1	0	0	1
Polypodium	1	2	1	1	1	1	2
Filicales	0	1	0	0	0	0	0
Total tree pollen	88	104	105	114	120	120	119
Total land pollen	204	200	215	202	201	200	200
Total pollen	219	206	220	208	212	213	206

Borehole No.	PC-1 (continued)									
Depth (cm)	103	104	105	106	117	119	121	123	125	127
Betula	23	22	15	12	26	31	24	22	25	20
Pinus	1	6	2	5	10	22	12	20	18	15
Ulmus	8	7	7	3	7	11	9	9	7	12
Quercus	29	47	46	44	32	30	28	36	34	38
Alnus	88	22	20	12	8	9	15	10	11	10
Corylus	21	30	35	34	42	37	52	36	41	46
Salix	6	1	1	2	3	1	1	0	2	0
Ericaceae	0	0	0	1	0	0	0	0	0	0
Gramineae	7	27	36	32	18	20	26	10	6	8
Cyperaceae	2	18	32	56	32	26	21	31	20	29
Caryophyllaceae	0	0	0	0	0	0	0	0	1	0
Chenopodiaceae	8	10	6	6	10	7	9	19	25	18
Malva	0	1	0	2	3	2	0	1	4	2
Rosaceae	1	0	0	0	2	1	2	0	1	0
Umbelliferae	0	0	0	0	1	0	0	1	0	0
Polygonaceae	0	0	0	0	0	0	0	1	0	0
Urticaceae	0	0	0	0	1	1	0	1	0	0
Plantaginaceae	0	2	0	0	2	0	0	0	0	0
P. maritima	6	8	1	3	3	2	4	3	6	2
Nymphaea	0	0	0	0	2	8	10	6	6	2
Myriophyllum	0	0	0	0	0	0	1	2	2	0
Potamogeton	0	0	0	0	1	0	6	3	2	2
Typha angustifolia	0	0	0	0	4	2	6	11	10	4
Lycopodium	2	0	1	0	5	1	2	0	1	0
Pteridium	5	1	0	4	3	1	3	1	0	0
Polypodium	0	0	1	2	3	2	4	1	2	1
Sphagnum	2	1	1	0	1	0	0	0	0	0
Filicales	10	8	2	2	3	2	2	1	2	4
Total tree pollen	149	104	90	76	83	103	88	97	95	95
Total land pollen	200	200	201	211	200	200	203	200	200	200
Total pollen	219	210	206	219	222	216	237	225	225	213

Borehole No.	PC-1 (continued)							
Depth (cm)	34	36	38	40	42	44	46	48
Betula	9	22	12	16	24	22	26	22
Pinus	0	0	1	0	1	3	2	1
Populus	0	0	0	0	2	2	0	0
Ulmus	0	0	4	1	3	2	2	0
Quercus	19	29	19	28	20	35	48	46
Tilia	0	3	0	0	6	2	1	2
Alnus	69	68	64	70	58	50	54	72
Fraxinus	0	0	0	0	0	0	0	0
Corylus	34	28	39	33	34	33	24	21
Juniperus	0	0	0	0	0	2	1	3
Salix	2	2	1	1	8	6	4	4
Ericaceae	0	0	0	1	0	0	0	0
Gramineae	25	32	46	32	22	25	12	5
Cyperaceae	8	6	6	10	7	8	15	14
Ranunculaceae	0	0	0	0	0	0	0	0
Chenopodiaceae	7	3	6	6	1	0	0	0
Malva	1	0	0	0	0	0	0	0
Rosaceae	2	1	0	1	6	5	5	3
Saxifragaceae	0	0	0	0	0	0	0	0
Umbelliferae	0	0	0	0	3	0	0	2
Polygonaceae	0	1	0	0	1	0	0	3
Urticaceae	0	0	0	0	1	1	3	0
Plantaginaceae	0	0	0	0	1	1	1	0
P. maritima	24	6	3	1	0	0	0	0
Rubiaceae	0	0	0	0	2	3	2	1
Nymphaea	1	0	1	0	2	2	0	1
Myriophyllum	0	0	0	0	1	2	0	0
Potamogeton	0	0	0	0	2	4	1	2
Typha angustifolia	9	11	5	6	6	8	3	2
Lycopodium	0	0	0	0	2	3	1	0
Selaginella	0	0	0	0	0	0	0	0
Pteridium	14	5	0	0	7	3	3	1
Polypodium	4	1	4	5	10	7	16	6
Sphagnum	0	0	0	0	8	6	6	5
Filicales	10	12	20	13	25	28	22	25
Total tree pollen	97	122	100	115	114	116	133	143
Total land pollen	200	201	201	200	200	200	200	200
Total pollen	238	225	231	224	263	263	252	242

Borehole No.	PC-1 (continued)					
Depth (cm)	50	52	54	56	58	60
Betula	13	28	24	19	18	20
Pinus	1	2	3	9	11	15
Populus	0	0	0	0	0	0
Ulmus	1	1	5	2	3	6
Quercus	36	42	32	36	35	25
Tilia	0	2	3	1	0	0
Alnus	89	75	65	44	32	35
Fraxinus	0	2	2	0	0	0
Corylus	18	14	28	22	28	31
Juniperus	2	1	1	0	0	0
Salix	6	3	2	0	0	0
Ericaceae	0	0	0	0	0	0
Gramineae	6	6	10	22	39	32
Cyperaceae	8	2	12	36	25	20
Ranunculaceae	0	0	2	0	0	0
Chenopodiaceae	0	0	0	3	3	6
Malva	0	0	0	1	0	0
Rosaceae	5	0	2	0	2	1
Saxifragaceae	5	2	4	0	0	0
Umbelliferae	2	6	2	0	0	0
Polygonaceae	3	6	2	0	1	0
Urticaceae	0	3	1	0	0	0
Plantaginaceae	5	0	0	0	0	0
P. maritima	0	0	1	5	3	9
Rubiaceae	0	5	1	0	0	0
Nymphaea	0	0	0	0	0	0
Myriophyllum	0	0	0	0	0	0
Potamogeton	0	0	0	0	0	0
Typha angustifolia	0	0	0	0	0	3
Lycopodium	3	0	2	0	0	1
Selaginella	0	0	2	0	0	0
Pteridium	0	1	4	1	1	2
Polypodium	8	1	6	3	1	2
Sphagnum	1	4	2	0	0	0
Filicales	26	31	69	52	48	67
Total tree pollen	140	152	134	111	99	101
Total land pollen	200	200	202	200	200	200
Total pollen	238	237	287	256	250	275

APPENDIX III

DIATOM COUNTS FROM SKELWITH POOL

From boreholes PC-1 and PIT2C
and pits PIT1 and PIT2

Diatoms from PIT2

Depth (cm) Species		Author	Ecol.*	Liv.@	124	117	108	101	095	088	085
Caloneis	bacillaris	(Greg.) Cleve	FB	b	0	0	0	0	12	2	0
Caloneis	brevis	(Greg.) Cleve	M	?	4	2	0	0	0	3	0
Caloneis	westii	(W.Smith) Hendey	B	?	0	0	85	35	91	95	42
Coscinodiscus	stellaris	Roper	M	b	2	0	0	0	0	0	4
Coscinodiscus	excentricus	Ehrenberg	MB	p	1	0	0	0	0	0	0
Coscinodiscus	wittianus	Pantocsek	M	p	0	0	0	1	0	0	3
Cyclotella	striata	(Kutz.) Grunow	B	p	0	0	1	5	2	0	8
Cymbella	aspera	(Ehr.) Cleve	FB	p	0	2	13	2	3	3	0
Cymbella	affinis	Kutzing	FB	p	0	4	34	6	33	8	0
Cymbella	sp.	Agardh	FB	?	0	2	15	0	3	0	0
Diploneis	chersonensis	(Grun.) Cleve	M	p	12	22	0	4	0	0	10
Diploneis	crabro	Ehrenberg	MB	p	193	167	36	50	6	37	80
Diploneis	incurvata	(Greg.) Cleve	M	p	2	0	0	0	0	0	0
Diploneis	smithii	(Breb.) Cleve	MB	b	1	1	0	0	0	0	1
Fragilaria	constuens	Ehrenberg	FB	p	0	0	4	1	0	3	0
Gomphonema	dichotomum	Kutzing	FB	?	0	0	0	6	4	0	3
Gomphonema	angustatum	(Kutz.) Rabenhorst	FB	?	0	0	0	12	1	0	0
Navicula	cincta	(Ehr.) van Heurck	FB	?	0	0	0	3	7	2	4
Navicula	clementis	Grunow	B	p	14	18	7	5	0	0	3
Navicula	crucicula	(W.Smith) Donkin	B	p	0	0	26	75	45	13	3
Navicula	palpebralis	W. Smith	M	p	0	12	0	8	0	26	21
Navivula	ramosissima	(Ag.) Cleve	BM	b	0	0	4	10	14	23	14
Nitzschia	marina	Grunow	M	p	2	1	0	0	0	0	2
Pinnularia	brevicostata	Cleve	FB	?	0	0	0	0	10	0	0
Pinnularia	gentilis	(Donk.) Cleve	F	?	0	0	4	6	24	33	21
Triceratium	favus	Ehrenberg	M	p	0	0	0	0	0	0	0
Total	26 species				231	231	227	249	255	248	220

* Ecology of the diatoms: **M** marine, **MB** marine-brackish,
BM brackish-marine, **B** brackish, **BF** brackish-fresh,
FB fresh-brackish, and **F** fresh water species.

@ Living of the diatoms: **b** banthonic and **p** planthonic species.

A summary of diatom counts from PIT-2

(in species)

Depth cm	M p	M b	MB p	MB b	BM p	BM b	B p	B b	FB	F
085	3	1	2	1	0	1	4	0	2	1
088	2	0	1	0	0	1	2	0	5	1
095	0	0	1	0	0	1	3	0	8	1
101	3	0	1	0	0	1	4	0	6	1
108	0	0	1	0	0	1	4	0	4	1
117	4	0	1	1	0	0	1	0	3	0
124	5	1	1	1	0	0	1	0	0	0

(in individual)

Depth cm	M p	M b	MB p	MB b	BM p	BM b	B p	B b	FB	F
085	33	4	83	1	0	14	56	0	7	21
088	29	0	37	0	0	23	108	0	18	33
095	0	0	6	0	0	14	138	0	73	24
101	13	0	50	0	0	10	120	0	30	6
108	0	0	36	0	0	4	119	0	66	4
117	37	0	167	1	0	0	18	0	8	0
124	23	2	191	1	0	0	14	0	0	0

Diatoms from PC-1

Depth (cm)					510 129	459 110	432 069	418 062	405 060	330 034	269 032	200 029
Species		Author	Ecol.	Liv.								
Actinoptychus	senarius	(Ehr.) Ehrenberg	M	p	3 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Actinoptychus	undulatus	(Bail.) Ralfs	M	p	0 0	0 0	0 0	1 0	0 0	0 0	1 0	0 0
Amphora	costata	W. Smith	MB	p	1 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Amphora	exigua	Gregory	BM	p	0 0	0 8	1 0	3 0	0 0	0 0	0 0	0 0
Amphora	hyalina	Kutzing	B	p	0 0	0 3	1 0	1 0	0 1	0 1	0 1	0 0
Amphora	terroris	Ehrenberg	MB	p	0 0	0 3	0 0	0 0	0 0	0 0	0 0	0 0
Auliscus	sculptus	(W.Smith) Ralfs	M	p	0 0	0 0	0 1	0 2	0 2	0 0	0 4	0 0
Biddulphia	Biddulphiana	(W.Smith) Boyer	M	p	0 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Campylodiscus	ralfsii	W. Smith	M	p	0 2	0 0	0 0	0 0	7 0	2 0	3 0	1 0
Campylodiscus	decorus	Brebisson	M	?	2 0	0 0	0 0	0 0	2 0	3 0	0 0	0 0
Caloneis	bacillaris	(Greg.) Cleve	FB	b	0 0	0 0	3 0	0 0	0 4	0 9	0 6	0 6
Caloneis	brevis	(Greg.) Cleve	M	p	0 0	0 1	0 0	6 0	0 10	0 0	0 2	0 1
Caloneis	linearis	(Grun.) Boyer	M	p	0 0	0 0	0 0	0 0	0 0	0 2	0 2	0 1
Caloneis	permagna	(Bail.) Cleve	BF	?	0 0	0 8	6 0	16 2	0 4	0 0	0 4	0 0
Caloneis	robusta	(Grun.) Cleve	M	b	0 0	0 2	0 0	0 0	0 0	0 0	0 0	0 0
Caloneis	westii	(W.Smith) Hendey	B	?	2 0	0 0	0 0	1 1	0 0	1 1	0 4	0 3
Cocconeis	scutellum	Ehrenberg	MB	p	0 2	0 75	0 0	0 0	6 0	0 0	0 0	0 0
Coscinodiscus	africanus	Janisch	M	b	0 0	0 1	0 0	0 0	0 0	0 0	0 0	2 0
Coscinodiscus	bipartitus	Rattary	BM	b	0 0	0 0	0 1	1 1	0 0	0 0	0 0	0 0
Coscinodiscus	denarius	A. Schmidt	M	b	0 0	0 0	0 0	0 0	0 0	0 0	7 4	8 4
Coscinodiscus	excentricus	Ehrenberg	MB	p	31 0	11 2	0 0	0 0	0 0	0 0	0 0	0 0
Coscinodiscus	hexagonus	Chin	M	P	2 1	6 0	0 6	2 0	4 0	0 0	11 0	2 0

Diatoms from PC-1 (continued)

Coscinodiscus	kutzingii	A. Schmidt	M	b	0	0	0	0	0	0	3	0
					0	0	0	0	0	0	0	0
Coscinodiscus	paradoxus	Chin	B	b	0	0	0	4	23	4	7	7
					0	0	0	0	0	0	0	0
Coscinodiscus	nodulifer	A. Schmidt	M	p	0	0	0	0	0	0	5	0
					0	0	0	0	0	0	0	0
Coscinodiscus	rothii	(Ehr.) Grunow	BM	p	0	0	0	1	0	0	0	0
					0	0	0	1	0	0	0	0
Coscinodiscus	stellaris	Roper	M	b	7	0	0	0	0	0	2	28
					2	8	8	0	0	2	3	3
Coscinodiscus	wittianus	Pantocsek	M	p	0	0	0	0	1	0	0	0
					0	0	0	0	0	0	1	2
Cyclotella	striata	(Kutz.) Grunow	B	p	9	0	0	1	4	3	9	8
					4	1	2	1	2	0	0	0
Cyclotella	stylorum	Brightwell	BM	?	0	0	0	1	5	0	0	0
					0	0	0	0	0	0	0	0
Cymatopleura	soleu	(Breb.) W. Smith	FB	p	0	0	0	0	0	0	0	0
					0	0	0	0	0	3	7	7
Cymatopleura	lorenziana	Grunow	M	p	0	0	1	1	0	0	0	0
					0	0	0	0	0	0	0	0
Cymbella	lunata	W. Smith	F	?	1	0	1	2	0	0	0	0
					0	2	0	1	2	6	6	4
Diploneis	borealis	(Grun.) Cleve	MB	p	0	0	0	0	0	0	2	1
					2	0	0	0	0	0	4	2
Diploneis	chersonensis	(Grun.) Cleve	M	p	15	14	0	0	10	11	7	2
					6	1	11	0	0	0	0	5
Diploneis	crabro	Ehrenberg	MB	p	0	12	6	10	0	0	0	0
					0	0	63	1	18	1	12	1
Diploneis	finnica	(Ehr.) Cleve	M	b	0	0	0	0	0	0	0	0
					0	1	0	0	0	0	0	0
Diploneis	fusca	(Greg.) Cleve	M	p	0	0	2	0	0	0	0	0
					0	0	0	6	2	0	0	0
Diploneis	incurvata	(Greg.) Cleve	M	p	9	5	0	0	4	6	6	0
					0	0	0	2	4	0	4	2
Diploneis	littoralis	(Donk.) Cleve	M	?	0	0	4	2	0	0	0	0
					0	0	0	0	0	0	0	7
Diploneis	schmidtii	Cleve	M	b	0	0	0	0	0	0	0	0
					0	4	0	0	0	0	0	0
Diploneis	smithii	(Breb.) Cleve	MB	b	0	0	0	3	0	0	0	0
					0	0	13	0	2	0	0	0
Diploneis	Splendida	(Greg.) Cleve	M	p	0	0	0	13	0	0	0	0
					0	0	0	26	0	0	0	0
Eunotia	arcus	Ehrenberg	F	?	0	0	0	0	0	2	0	0
					0	0	0	1	2	5	2	0
Eunotia	lunaris	(Ehr.) Grunow	F	?	0	0	0	2	0	0	0	0
					0	0	0	0	3	6	7	0
Fragilaria	capucina	Desmazieres	F	p	0	0	1	0	0	0	1	1
					0	0	0	0	3	5	4	0
Fragilaria	constuens	(Ehr.) Grunow	FB	p	6	0	1	0	0	0	0	0
					0	0	0	0	1	3	3	0

Diatoms from PC-1 (continued)

Fragilaria	pinnata	Ehrenberg	FB	p	0	0	0	0	0	0	1	0
					2	0	0	0	0	0	0	0
Glyphodesmis	distans	(Greg.) Grunow	M	p	0	0	0	0	0	0	1	2
					3	35	0	0	0	0	0	0
Grammatophora	oceanica	(Ehr.) Grunow	MB	p	4	2	0	0	0	0	8	11
					12	2	5	0	2	0	0	1
Gyrosigma	balticum	(Ehr.) Cleve	B	?	0	0	2	1	0	0	2	0
					0	1	0	0	0	0	2	0
Gyrosigma	strigilis	(W.Smith) Hendey	MB	p	0	0	0	0	4	0	0	0
					0	1	0	0	0	0	0	0
Hantzschia	amphioxys	(Ehr.) Grunow	FB	?	0	0	0	1	0	0	0	0
					0	0	0	0	4	10	7	9
Hantzschia	marina	(Donk.) Grunow	MB	?	0	2	1	1	0	0	0	7
					0	0	1	0	0	0	0	9
Melosira	sulcata	(Ehr.) Kutzing	MB	p	0	3	9	17	0	0	20	23
					20	8	6	0	1	1	0	2
Navicula	arenaria	Donkin	MB	?	0	0	0	0	0	0	7	0
					0	4	0	0	0	0	0	0
Navicula	cancellata	Donkin	M	p	0	0	0	0	5	3	6	0
					2	0	10	0	0	0	0	3
Navicula	cincta	(Ehr.) van Heurck	FB	?	0	0	0	0	0	0	0	0
					2	0	0	0	1	2	1	0
Navicula	clementis	Grunow	B	p	0	0	0	1	0	0	0	0
					0	15	0	0	0	0	0	0
Navicula	crucicula	(W.Smith) Donkin	B	p	0	0	2	55	0	0	3	4
					0	0	0	0	5	2	11	10
Navicula	distans	(W.Smith) Ralfs	M	p	0	0	2	11	5	14	10	5
					4	23	6	0	8	0	0	5
Navicula	elegans	W. Smith	B	?	0	0	0	2	0	0	0	0
					0	0	0	1	3	1	6	4
Navicula	forcipata	Greville	MB	?	10	0	0	2	14	0	0	0
					0	0	0	0	0	0	0	0
Navicula	granulata	Bailey	MB	p	0	0	0	4	0	12	14	12
					6	7	0	2	0	0	0	4
Navicula	longa	(Greg.) Ralfs	MB	p	0	0	0	0	0	0	0	9
					0	0	0	0	0	0	0	0
Navicula	maculosa	(Bail.) Edwards	BM	p	0	0	0	1	0	0	0	0
					0	2	0	0	0	0	2	0
Navicula	marina	Ralfs	MB	?	0	0	0	0	0	0	0	2
					4	0	0	0	0	0	0	0
Navicula	mollis	(W.Smith) Cleve	M	?	0	0	0	0	0	0	3	2
					2	3	0	0	0	0	1	0
Navicula	palpebralis	W. Smith	M	?	0	6	0	0	2	0	5	0
					0	0	10	0	0	0	0	2
Navicula	pinna	Chin	B	p	0	4	0	0	0	0	0	0
					0	0	0	0	0	0	2	0
Navicula	praetexta	Ehrenberg	M	?	5	5	0	0	9	0	0	0
					0	0	0	0	0	0	0	0
Navicula	ramosissima	(Ag.) Cleve	BM	b	0	0	2	0	0	0	0	0
					0	0	0	0	0	0	2	2

Diatoms fom PC-1 (continued)

Navicula	rhynchocephala	Kutzing	FB	?	0	0	0	0	0	0	0	0
					0	1	0	0	0	0	4	0
Navicula	spectabilis	Gregory	M	p	0	0	0	1	0	0	1	0
					0	0	0	0	0	0	0	0
Nitzschia	acuminata	(W.Smith) Grunow	MB	?	4	0	0	0	0	0	8	0
					0	0	0	0	0	0	0	0
Nitzschia	cocconeiformis	Grunow	M	b	0	0	0	0	4	0	0	0
					0	0	0	0	0	0	0	0
Nitzschia	frustulum	(Kutz.) Grunow	BF	b	0	0	0	0	0	0	0	0
					0	11	0	0	10	4	14	12
Nitzschia	granulata	Grunow	BM	b	28	2	29	14	9	110	8	23
					70	2	18	36	50	4	10	1
Nitzschia	lanceolata	W. Smith	B	?	0	0	0	1	0	0	0	0
					0	3	0	0	0	0	0	0
Nitzschia	lorenziana	Grunow	B	b	0	0	0	1	0	0	0	0
					0	0	0	0	0	0	1	4
Nitzschia	marginulata	Grunow	M	b	0	0	0	0	0	0	0	0
					0	3	0	0	0	0	0	0
Nitzschia	navicularis	(Breb.) Grunow	B	b	39	8	26	27	32	37	30	92
					22	13	13	22	68	10	16	17
Nitzschia	paleacea	Grunow	FB	?	0	0	0	0	0	0	0	0
					0	0	0	0	1	10	9	11
Nitzschia	petitiana	Grunow	FB	?	0	0	0	0	0	0	0	0
					0	0	0	0	2	2	5	10
Nitzschia	plana	W. Smith	B	?	0	0	0	0	0	0	0	0
					0	4	0	0	0	0	0	0
Nitzschia	punctata	(W.Smith) Grunow	BM	b	0	0	0	3	0	0	0	0
					0	0	19	24	34	0	10	0
Nitzschia	scalaris	W. Smith	BF	?	0	0	0	0	0	0	0	0
					0	0	0	0	2	0	5	1
Nitzschia	sigmoidea	(Nitz.) W. Smith	FB	b	0	0	2	1	0	0	0	0
					0	2	0	0	0	1	0	0
Opephora	schwartzii	(Grun.) Petit	BM	?	0	0	1	1	3	0	0	2
					0	20	0	0	0	0	6	11
Pinnularia	cruciformis	(Donk.) Cleve	M	?	0	0	0	0	0	0	0	0
					0	1	0	0	0	0	0	8
Pinnularia	gentilis	(Donk.) Cleve	F	?	0	0	0	0	0	0	0	0
					0	0	0	0	12	0	0	0
Pinnularia	major	(Kutz.) Cleve	FB	?	4	0	7	13	2	1	5	2
					0	0	1	2	14	13	8	0
Pinnularia	rectangulata	(Greg.) Rabenhorst	M	?	0	0	0	0	0	0	0	0
					0	0	0	0	0	0	0	15
Pinnularia	stauoptera	(Rab.) Cleve	F	?	0	0	0	0	0	0	0	0
					0	0	0	0	4	1	0	0
Plagiogramma	pulchellum	Greville	M	p	0	0	0	0	0	0	1	0
					0	1	0	0	0	0	0	0
Plagiogramma	staurophorum	(Greg.) Heiberg	M	p	1	0	1	1	0	0	0	0
					0	0	0	0	0	0	0	0
Pleurosigma	angulatum	(Quek.) W. Smith	BM	b	0	0	0	1	8	0	0	0
					0	0	0	0	0	0	0	0

Diatoms from PC-1 (continued)

Pleurosigma	intermedium	W. Smith	BM	b	0	0	0	0	0	0	0	0
					0	1	0	0	0	0	0	0
Pleurosigma	speciosum	W. Smith	M	b	3	0	0	0	0	0	2	5
					0	3	0	0	0	0	0	0
Rhaphoneis	amphiceros	(Ehr.) Ehrenberg	MB	?	5	8	34	20	19	4	31	22
					6	14	3	2	8	0	0	4
Rhaphoneis	surirella	(Ehr.) Grunow	MB	?	7	16	4	4	14	5	6	5
					16	2	1	0	4	0	0	2
Stauroneis	amphioxys	Gregory	BF	?	26	19	6	0	31	5	15	10
					2	6	5	1	3	2	6	4
Surirella	capronii	Brebisson	FB	?	0	0	0	1	0	0	0	0
					0	0	0	0	4	6	0	2
Surirella	fastuosa	Ehrenberg	M	b	0	0	0	0	0	0	0	1
					6	0	0	0	0	0	0	0
Surirella	linearis	W. Smith	FB	?	0	0	0	1	0	0	0	0
					0	0	0	0	11	10	11	8
Surirella	striatula	Turpin	B	p	0	0	2	0	0	0	0	0
					0	1	0	0	0	0	0	0
Synedra	crystallina	(Ag.) Kutzing	MB	?	0	0	0	0	0	0	0	0
					0	7	0	0	0	0	0	0
Synedra	formora	Hantzsch	M	b	1	0	0	0	3	0	0	3
					0	5	5	0	0	0	0	9
Synedra	gallionii	(Bory.) Ehrenberg	MB	?	0	0	0	0	0	0	0	0
					0	4	2	0	0	0	0	0
Tabellaria	fenestrata	(Lyn.) Kutzing	FB	p	0	0	4	2	0	0	1	0
					0	1	0	0	5	4	0	0
Triceratium	favus	Ehrenberg	M	p	0	0	0	0	0	0	3	1
					2	0	0	0	0	0	0	3
Triceratium	perpendiculare	Chin	M	p	2	2	0	0	0	1	0	1
					0	0	0	0	0	0	0	4
Trachyneis	aspera	Ehrenberg	B	?	0	0	0	4	0	0	0	0
					0	16	0	0	0	0	0	0
Total: 113 species					226	125	162	261	230	225	257	294
					201	344	210	133	319	130	222	224

A summary of diatom counts from PC-1

(total species)

Depth cm	M p	M b	MB p	MB b	BM p	BM b	B p	B b	BF	FB	F	Total
029	11	5	8	0	0	3	3	2	2	7	1	42
032	6	2	2	0	2	3	6	2	5	10	4	42
034	1	1	2	0	0	1	4	1	2	13	5	30
060	5	0	5	1	0	2	5	1	4	10	6	39
062	4	0	2	0	1	3	3	1	2	1	2	19
069	6	2	7	1	0	3	1	1	1	1	0	23
110	7	8	12	0	3	2	7	1	3	3	0	46
139	9	2	8	0	0	1	1	1	1	2	0	25
200	8	6	9	0	1	1	2	2	1	1	1	32
299	14	4	8	0	0	1	3	2	2	3	1	38
320	7	0	3	0	0	1	2	2	1	1	1	18
405	10	2	5	0	2	2	1	2	1	1	0	26
418	9	0	6	1	5	3	9	3	1	5	2	44
432	5	0	5	0	2	2	4	1	2	5	7	38
459	6	0	7	0	0	1	1	1	1	0	0	17
510	7	3	7	0	0	1	2	1	1	2	1	25

(total valves)

Depth cm	M p	M b	MB p	MB b	BM p	BM b	B p	B b	BF	FB	F	Total
029	58	16	25	0	11	3	17	21	16	53	4	224
032	16	7	14	0	8	22	26	18	30	62	19	222
034	2	2	2	0	0	4	5	10	6	75	24	130
060	26	0	33	2	0	84	14	68	19	47	26	319
062	36	0	3	0	1	61	3	22	3	2	2	133
069	44	13	81	13	0	38	2	13	5	1	0	210
110	65	27	122	0	31	4	28	29	25	4	2	344
139	23	8	68	0	0	70	4	22	2	4	0	201
200	16	47	90	0	2	23	12	89	10	2	1	294
299	63	14	88	0	0	8	14	37	17	7	1	257
320	49	0	21	0	0	110	4	41	6	1	2	225
405	49	7	57	0	8	17	4	55	31	2	0	230
418	36	0	58	3	7	19	67	32	16	19	4	261
432	10	0	54	0	2	32	7	26	12	17	2	162
459	38	0	54	0	0	2	4	8	19	0	0	125
510	38	11	62	0	0	28	11	39	26	10	1	226

ADDITION

I. Diatoms from silty clay in borehole M1 (-14.17 m O.D., above the transgressive contact), Heysham Head.

Species		Author	Ecol.	Liv.	Num.
Achnanthes	delicatulu	(Kutz.) Grunow	B	p	9
Amphora	costata	W. Smith	MB	p	5
Caloneis	linearis	(Grun.) Boyer	M	p	15
Cocconeis	scutellum	Ehrenberg	MB	?	7
Cocconeis	distans	Gregory	M	?	5
Coscinodiscus	excentricus	Ehrenberg	MB	p	2
Coscinodiscus	paradoxus	Chin	B	b	3
Coscinodiscus	stellaris	Roper	M	b	5
Cyclotella	striata	(Kutz.) Grunow	B	p	12
Diploneis	crabro	Ehrenberg	MB	p	7
Diploneis	smithii	(Breb.) Cleve	MB	b	28
Melosira	sulcata	(Ehr.) Grunow	MB	p	20
Navicula	scintillans	A. Schmidt	M	?	3
Nitzschia	frustrulum	(Kutz.) Grunow	BF	b	3
Nitzschia	lanceolata	W. Smith	B	?	21
Nitzschia	lorenziana	Grunow	B	b	4
Nitzschia	punctata	(W.Smith) Grunow	BM	b	7
Nitzschia	sigmoidea	(Nitz.) W. Smith	FB	b	9
Rhaphoneis	amphiceros	(Ehr.) Ehrenberg	MB	?	79
Rhaphoneis	surirella	(Ehr.) Grunow	MB	?	9
Surirella	elegans	Grunow	BF	?	2
Triceratium	favus	Ehrenberg	M	p	5

Total Species: 22 Total diatoms: 260

II. Diatoms from silty clay in borehole M1 (-15.60 m O.D., immediately above the transgressive contact), Heysham Head.

Species		Author	Ecol.	Liv.
Achnanthes	delicatula	(Kutz.) Grunow	BM	p
Amphora	costata	W. Smith	MB	p
Amphora	ostrearia	Kutzing	BM	?
Campylodiscus	ralfsii	W. Smith	M	p
Cocconeis	placentula	Ehrenberg	BF	b
Cocconeis	distans	Gregory	M	?
Coscinodiscus	wittianus	Pantocsek	M	p
Cyclotella	striata	(Kutz.) Grunow	B	p
Cyclotella	stylirum	Brightwell	BM	?
Diploneis	Chersonensis	(Grun.) Cleve	M	p
Diploneis	crabro	Ehrenberg	MB	p
Diploneis	didyma	(Ehr.) Cleve	BM	?
Diploneis	smithii	(Breb.) Cleve	MB	b
Grammatophora	marina	(Lyn.) Kutzing	MB	p
Melosira	sulcata	(Ehr.) Kutzing	MB	p
Navicula	palpebralis	W. Smith	M	?
Navicula	scintillans	A. Schmidt	M	?
Nitzschia	frustrulum	(Kutz.) Grunow	BF	b
Nitzschia	puntata	(W.Smith) Grunow	BM	b
Nitzschia	sigmoidea	(Nitz.) W. Smith	FB	b
Opephora	schwartzii	(Grun.) Petit	BM	?
Pinnularia	rectangulata	(Greg.) Rabenhorst	M	?
Synedra	elegans	Grunow	BF	?
Triceratium	favus	Ehrenberg	M	p

Total: 24 species

III. Diatoms from the peat in borehole C8 (-16.0+/-0.4 m O.D.), western Morecambe Bay.

Species		Author	Ecol.	Liv.	Num.
Amphora	coffeaeformis	(Ag.) Kutzing	BM	p	3
Amphora	exigua	W. Smith	BM	p	12
Caloneis	permagna	(Bail.) Cleve	BF	?	4
Cocconeis	scutellum	Ehrenberg	MB	p	2
Coscinodiscus	excentricus	Ehrenberg	MB	p	4
Cymatopleura	saleu	(Breb.) W. Smith	FB	p	6
Cymbella	cuspidata	Kutzing	F	?	2
Cymbella	laevis	Naegell	F	?	4
Cymbella	lunata	W. Smith	F	?	14
Cymbella	perpusilla	Cleve	F	?	11
Cymbella	pusilla	Grunow	B	?	18
Diatoma	hyemale	(Lyn.) Heiberg	F	?	15
Diatoma	vulgare	Bory	F	?	6
Diploneis	borealis	(Grun.) Cleve	MB	p	6
Diploneis	crabro	Ehrenberg	MB	p	4
Epithemia	argus	Kutzing	F	?	34
Epithemia	sorex	Kutzing	FB	?	15
Epithemia	turgida	(Ehr.) Kutzing	BF	?	9
Epithemia	adnata	(Kutz.) Rabenhorst	F	?	8
Eunotia	arcus	Ehrenberg	F	?	2
Eunotia	sudetica	(Mull.) Hustedt	F	?	9
Fragilaria	capucina	Desmazieres	FB	?	2
Fragilaria	constuens	(Ehr.) Grunow	FB	?	6
Gomphonema	acuminatum	Ehrenberg	F	?	8
Gomphonema	angustatum	(Kutz.) Rabenhorst	F	?	7
Gomphonema	gracile	Ehrenberg	F	?	45
Hantzschia	amphioxys	(Ehr.) Grunow	FB	?	21
Hantzschia	elongaia	(Hant.) Grunow	F	?	4
Navicula	cincta	(Ehr.) van Heurck	FB	?	6
Navicula	clementis	Grunow	B	p	2
Navicula	crucicula	(W.Smith) Donkin	B	p	6
Navicula	elegans	W. Smith	B	?	3
Navicula	granulata	Bailey	MB	p	15
Navicula	pinna	Chin	B	P	3
Nitzschia	frustulum	(Kutz.) Grunow	BF	B	9
Nitzschia	linearis	W. Smith	F	?	10
Nitzschia	lorenziana	Grunow	B	b	3
Nitzschia	paleacea	Grunow	FB	?	15
Nitzschia	petitiana	Grunow	FB	?	14
Pinnularia	gracillima	Grunow	F	?	16
Pinnularia	major	(Kutz.) Cleve	FB	?	2
Rhaphoneis	amphiceros	(Ehr.) Ehrenberg	MB	?	9
Surirella	capronii	Brebinsson	FB	?	5
Synedra	acus	Kutzing	F	?	8
Synedra	amphicephala	Kutzing	F	?	21
Tabellaria	fenestrata	(Lyn.) Kutzing	FB	p	5

Total: 46 species Toatal diatoms: 433

IV. Diatoms from the peat in borehole A5 (-16.7+/-0.3 m O.D.), western Morecambe Bay.

Species		Author	Ecol.	Liv.
Amphora	exigua	W. Smith	BM	p
Calineis	permagna	(Bail.) Cleve	BF	?
Caloneis	westii	W. Smith	B	?
Cymatopleura	saleu	(Breb.) W. Smith	FB	p
Cymbella	luntata	W. Smith	F	?
Cymbella	perpusilla	Grunow	F	?
Cymbella	pusilla	Grunow	B	?
Diatoma	hyemale	(Lyn.) Heiberg	F	?
Diploneis	crabro	Ehrenberg	MB	p
Epithemia	argus	Kutzing	F	?
Epithemia	turgida	(Ehr.) Kutzing	BF	?
Fragilaria	constuens	(Ehr.) Grunow	FB	?
Gomphonema	acuminatum	Ehrenberg	F	?
Gomphonema	gracile	Ehrenberg	F	?
Hantzschia	amphioxys	(Ehr.) Grunow	FB	?
Hanthschia	elongaia	(Hant.) Grunow	F	?
Opephora	schwartzii	(Grun.) Petit	BM	?
Navicula	apiculata	Brebinsson	B	p
Navicula	elegans	W. Smith	B	?
Navicula	granulata	Bailey	MB	p
Nitzschia	paleacea	Grunow	FB	?
Nitzschia	sigmodea	(Nitz.) W. Smith	FB	?
Rhaphoneis	amphiceros	(Ehr.) Ehrenberg	MB	?
Synedra	amphicephala	Kutzing	F	?

Total: 24 species

V. Diatoms from the peat in borehole C7 (-16.01+/-0.42 m O.D.), western Morecambe Bay.

Species		Author	Ecol.	Liv.
Achnanthes	delicatula	(Kutz.) Grunow	BM	p
Caloneis	bacillaris	(Greg.) Cleve	FB	b
Caloneis	permagna	(Bail.) Cleve	BF	?
Ceratoneis	arcus	Kutzing	F	p
Cymbella	aspera	(Ehr.) Cleve	FB	p
Cymbella	cuspidata	Kutzing	F	?
Cymbella	luntata	W. Smith	F	?
Cymbella	parva	(W.Smith) Cleve	BF	p
Diatoma	hyemale	(Lyn.) Heuberg	F	?
Epithemia	adnata	(Kutz.) Rabenhorst	F	?
Epithemia	hyndmanii	W. Smith	F	?
Epithemia	sorex	Kutzing	FB	?
Epithemia	turgida	(Ehr.) Kutzing	BF	?
Eunotia	lunaris	(Ehr.) Grunow	F	?
Eunotia	pectinalis	(Kutz.) Rabenhorst	FB	?
Fragilaria	brevistriata	Grunow	F	p
Fragilaria	capucina	Desmarzieres	FB	p
Fragilaria	construens	Ehrenberg	FB	p
Fragilaria	virescens	Ralfs	F	p
Gomphonema	gracile	Ehrenberg	F	?
Gomphonema	dichotomum	Kutzing	F	?
Gyrosigma	acuminatum	(Kutz.) Rabenhorst	F	?
Navicula	cancellata	Donkin	M	p
Navicula	capitata	Ehrenberg	F	?
Navicula	cincta	(Ehr.) van Heurck	FB	?
Navicula	elegans	W. Smith	B	?
Nitzschia	paleacea	Grunow	FB	?
Nitzschia	punctata	(W.Smith) Grunow	BM	b
Nitzschia	sigmodea	(Nitz.) W. Smith	FB	b
Opephora	schwartzii	(Grun.) Petit	BM	?
Pinnularia	ambigua	Cleve	B	?
Pinnularia	brevicostata	Cleve	FB	?
Pinnularia	subcapitata	Gregory	F	?
Synedra	acus	Kutzing	F	?
Synedra	fasciculata	(Ag.) Kutzing	F	?
Synedra	ulna	(Nitz.) Ehrenberg	F	?

Total: 36 species

VI. Diatoms from the peat in borehole C6 (-16.34+/-0.61 m O.D.), eastern Morecambe Bay.

Species		Author	Ecol.	Liv.
Achnanthes	longipes	Agardh	MB	p
Campylodiscus	ralfsii	W. Smith	M	p
Cocconeis	sancti-paulii	Heiden	MB	?
Diploneis	crabro	Ehrenberg	MB	p
Eunotia	arcus	Ehrenberg	F	?
Eunotia	lunaris	(Ehr.) Grunow	F	?
Grammatophora	marina	(Lyn.) Kutzing	MB	p
Navicula	pennata	Schmidt	M	b
Pinnularia	cruciformis	(Donk.) Cleve	M	?
Synedra	formosa	Hantzsch	M	b
Triceratium	favus	Ehrenberg	M	p

Total: 11 species

VII. Samples with sparse and no diatom found.

Borehole M1, the peat (-15.90 m O.D.) ------ no diatom
the peat (-16.32 m O.D.) ------ no diatom

Borehole M2, the peat (-16.03 m O.D.) ------ no diatom

Borehole M3, above the transgressive contact:

silty clay (-11.28 m O.D.) ------	Campylodiscus ralfsii W. Smith	(M p)
	Diploneis chersonensis (Grun.) Cleve	(M p)
	Melosira sulcata (Ehr.) Kutzing	(MB p)
	Nitzschia granulata Grunow	(BM b)
	Rhaphoneis amphiceros (Ehr.) Ehrenberg	(MB ?)

below the basal peat:
silty clay (-20.36 m O.D.) ------ no diatom
silty clay (-20.96 m O.D.) ------ no diatom
silty clay (-21.26 m O.D.) ------ no diatom

Borehole M5, above the transgressive contact:

silty clay (-8.99 m O.D.) ------	Diploneis chersonensis (Grun.) Cleve	(M p)
	Nitzschia granulata Grunow	(BM b)
	Nitzschia navicularis (Breb.) Grunow	(B b)
	Trachyneis aspera Ehrenberg	(B ?)

Borehole B1, the peat (-11.24 m O.D.) ------ no diatom

PIT 1 (240 cm in depth) ----------	Triceratium favus Ehrenberg	(M p)
(226 cm) ----------	no diatom	
(176 cm) ----------	no diatom	
(146 cm) ----------	no diatom	
(126 cm) ----------	no diatom	
PIT 2 (65 cm in depth) ----------	Diploneis crabro Ehrenberg	(MB p)
	Diploneis smithii (Breb.) Cleve	(MB b)
	Nitzschia marina Grunow	(M p)
(50 cm) ----------	no diatom	
(35 cm) ----------	Diploneis crabro Ehrenberg	(MB p)
	Navicula palpebralis W. Smith	(M p)
	Nitzschia marina Grunow	(M p)
	Triceratium favus Ehrenberg	(M p)
(25 cm) ----------	no diatom	

VIII. A list of synonyms cross-checked from Hartley (1986)

Names commonly used:	Names properly used (Hartley, 1986):
Coscinodiscus excentricus Ehernberg ----------	Thalassiosira eccentrica (Ehr.) Cleve
Eunotia lunaris (Ehr.) Grunow ----------	Eunotia curvata (Kutz.) Lagerst
Melosira sulcata (Ehr.) Kutzing ----------	Paralia sulcata (Ehr.) Cleve
Navicula cancellata Donkin ----------	N. retusa var. cancellata (Donk.) R. Ross
Navicula cincta (Ehr.) Ralfs ----------	N. cari var. cincta (Ehr.) Lange-Bertalot
Navicula mollis (W. Smith) Cleve ----------	N. ramosissima var. torquata (Harv.) R. Ross
Nitzschia lorenziana Grunow ----------	N. incurva var. lorenziana (Grun.) R. Ross
Pleurosigma intermedium W. Smith ----------	P. nubecula var. intermedium (W.Smith) Cleve
Rhaphoneis surirella (Ehr.) Grunow ----------	Delphineis surirela (Ehr.) Andrews

APPENDIX IV

PHOTOGRAPHS

APPENDIX IV

PHOTOGRAPHS



PHOTO 1. Looking south from Jenny Brown's Point (SD346473), NE of Morecambe Bay. This photo shows the upper part of intertidal zone with high saltings and cliff of mature saltmarshes.



PHOTO 2. Silverdale Marsh (SD345475), east shore of Morecambe Bay. The edge of the marsh is collapsing due to erosion from sea water.



PHOTO 3. Pilling marsh (SD342449), south of Morecambe Bay, showing saltings and mature saltmarshes in front of the sea embankment. The front edge of the saltmarshes is being eroded and is collapsing.



PHOTO 4. Pilling marsh, looking to the Bay. Erosion is also happening along tidal creeks.



PHOTO 5. Saltmarshes near Crook Cottage (SD343454) at the mouth of River Lune, southeast of Morecambe Bay.



PHOTO 6. The narrowbelt of saltmarshes and saltings along the concrete sea wall at Knott End-on-Sea (SD335448), east to the mouth of River Wyre.



PHOTO 7. Saltmarshes at Roudsea Wood (SD332481), north of Morecambe Bay.

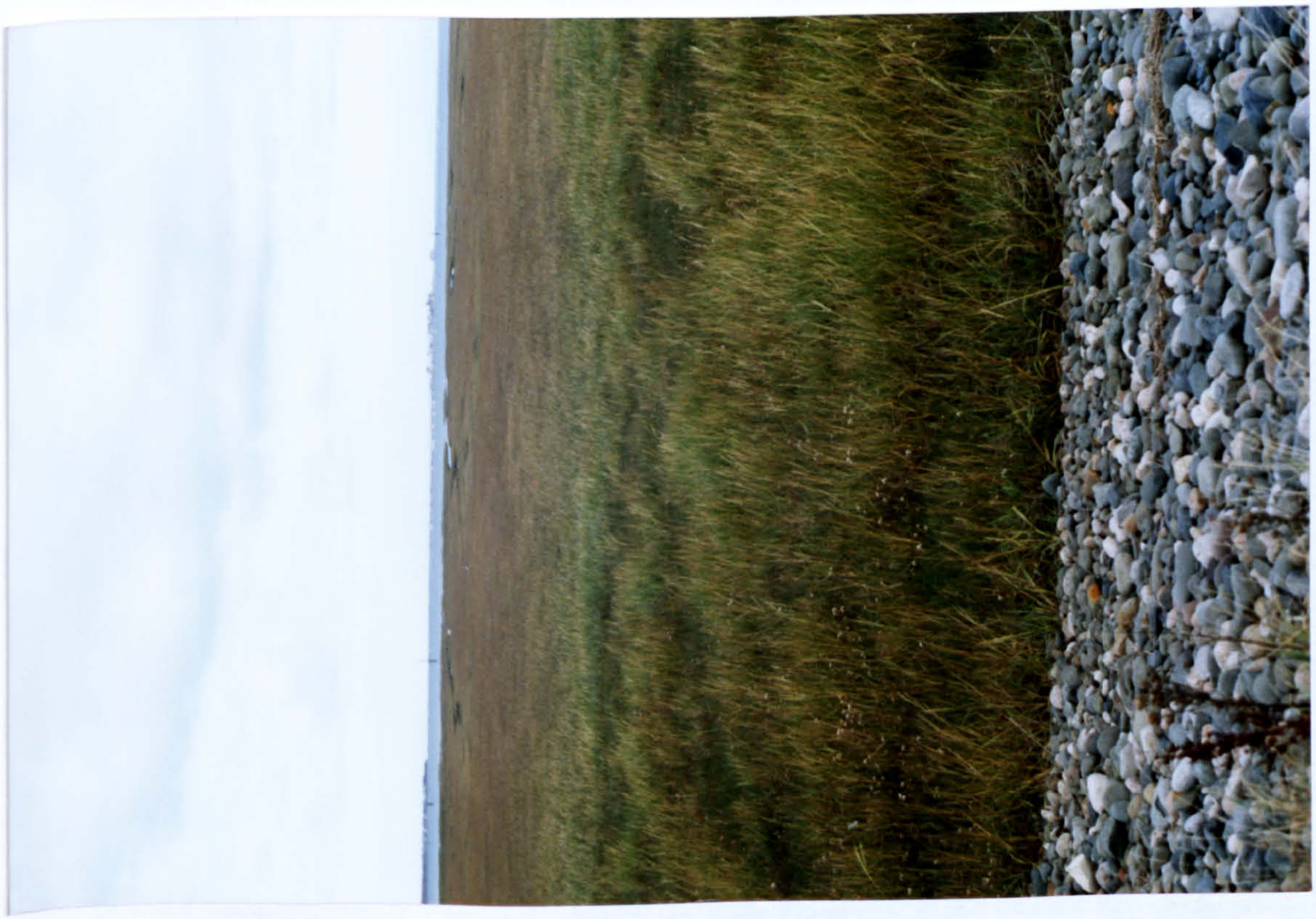


PHOTO 8. Tummer Hill Marsh (SD318467), south to Vickerstown, Walney Island, west of Morecambe Bay.



PHOTO 9. Heysham Nuclear Power Station at Heysham Head, Morecambe Bay.



PHOTO 10. The remaining framents of saltmarshes at the east head of Canvey Island.



PHOTO 11. Oil refinery at Coryton, west to Canvey Island, on the lower Thames Estuary.



PHOTO 12. Soil embankment along the tidal creek behind Canvey Island.



PHOTO 13. Concrete sea defence along the south coast of Canvey Island. The top of the wave reflection wall is at 6.91 m O.D. The ground level of the car park is at 2.00 m O.D., i.e. 0.8 m lower than the MHWST level outside of the sea defence.



PHOTO 14. Oil refinery and canavan park protected by sea defence at south coast of Canvey Island.



PHOTO 15. Concrete sea wall along the southeast coast of Canvey Island.



PHOTO 16. Houses behind the sea wall (Photo 15). The ground level around the houses is at about 1.6 m O.D. according to a spot height nearby (from 1:10,000 O.S. map).



PHOTO 17. Oil refinery behind the sea wall in south coast of Canvey Island. The ground level varies from 0.9 to 1.2 m O.D. according to spot height data from the 1:10,000 O.S. maps.



PHOTO 18. New houses built in the 1980s at the east end of Canvey Island.

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