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CHESIL SEA DEFENCE SCHEME:

ASSESSMENT OF ENVIRONMENTAL IMPLICATIONS

Report to the Wessex Water Authority

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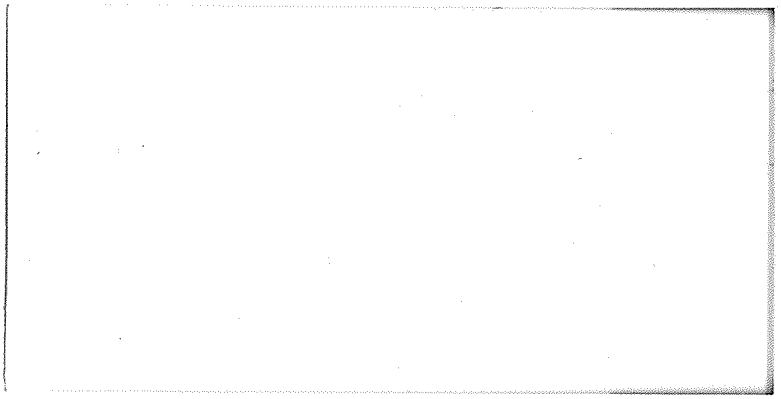

CHESIL SEA DEFENCE SCHEME:

ASSESSMENT OF ENVIRONMENTAL IMPLICATIONS

Report to the Wessex Water Authority

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Institute of Oceanographic Sciences
Crossway
Taunton
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SUMMARY

This Report gives an outline of the nature of the scientific interest of Chesil Beach and of its national and international importance in that context.

While the Sea Defence proposals by C H Dobbie and Partners are unlikely to affect the biology and bedrock geology they are, inevitably, going to have implications on the geomorphological and sedimentological value of the beach over the area where the beach is highest and access at its easiest.

The principal geomorphological and sedimentological importance of Chesil Beach stems from:

a) the scale and uniqueness of the formation

b) the longshore size-grading of beach material, together with the geological composition of that material

c) the accuracy and long-period documentation relating to the site.

It is considered that there are unlikely to be any substantial environmental objections to the modification of the existing sea wall; the improved drainage, whether through culverts or the enlargement of the recently-constructed interceptor ditch; nor to the raising of the Weymouth-Portland road (A 354). However, beach nourishment, whether on the seaward or landward slope of the crest line, and the extensive use of gabions or mattresses is likely to attract adverse reaction both scientifically and aesthetically. Particular care would have to be taken in respect of the source and nature of rock fill used in gabions and in preventing such fill from being dispersed over the wider beach area.

The scientific importance would be best secured by the minimum alterations to the beach commensurate with adequate security from flooding at Chiswell and reliability of access to and from the Isle of Portland. Unnecessary disturbance should be avoided.

1 INTRODUCTION

This Report has been written at the request of the Wessex Water Authority. After outlining the scientific importance of Chesil Beach it then examines the probable environmental impact of the various sea defence scheme options outlined in the recent report by C H Dobbie and Partners (1980). In the present context the term 'environment' is restricted to the natural environment and the impact is measured against the educational and research potential of Chesil Beach rather than its amenity value eg in terms of tourists. Most other implications of the proposed schemes are considered in economic terms in the cost benefit analyses by E C Penning-Rowsell and D J Parker (1980) and will not be considered further here.

2 ENVIRONMENTAL IMPORTANCE OF CHESIL BEACH

2.1 Nature of scientific interest

2.1.1 Biological: In the Nature Conservation Review (1977) Chesil Beach together with the adjacent Fleet tidal lagoon (for place names see Fig 1), was afforded Grade 1 status. This assessment was based on the historical, ornithological and entomological characteristics of the area. (The published description is given here as Appendix 1). Approximately one-sixth of the British breeding population of Little Terns are found in the area while it is the only known British locality of the wingless cricket, Mogoplistes squamiger.

2.1.2 Geological: Partly due to the structure of the Weymouth Anticline, the coastline provides excellent exposures of Jurassic rocks including the Fullers Earth, Forest Marble, Cornbrash and Oxford Clay and includes important fossil beds, notably of the oyster Liostrea hebridica var elongata near Langton Herring; the Boueti Bed near Herbury Point; and the highly fossiliferous section at Tidmoor Point. Other important geological sites and exposures occur on the Isle of Portland and are scheduled in the Portland Coast Site of Special Scientific Interest (SSSI).

2.1.3 Geomorphological and sedimentological: It is to be noted that while both the biological and geological value of Chesil Beach and the Fleet are extremely important they are at their minimum in the stretch of the beach extending from Chiswell to approximately Small Mouth ie over much of the length of the beach which is the subject of the present coast protection and flood relief schemes. This fortunate relationship does not, however, extend to the geomorphological and sedimentological interest. Such interest and educational value is centred mainly on three aspects. These are the magnitude and uniqueness of the feature; the size-grading of the pebbles and cobbles alongshore, together with the geological composition of that material; and the existence of long-term records of natural changes, for example in position and height of the crest of the beach. These will be examined briefly, in turn.

2.1.3.1 Magnitude and uniqueness - Chesil Beach is one of the three major shingle coastal features in Great Britain and the only one which is essentially a simple storm beach. Its maximum height is approximately 14 m above mean sea level and Chiswell to the W end of the Fleet is a distance of some 17 km. One of the best viewpoints is from the Portland Memorial where the stretch extending NW from Chiswell is obviously most prominent.

2.1.3.2 Beach material - the systematic longshore variation in the size of pebbles and cobbles has attracted attention since at least the mid-eighteenth century and the cause of this sorting has been discussed extensively in the literature. The rate of change of particle size is at its greatest in the Chiswell to Portland Harbour car park stretch of the beach. Additionally, access is particularly easy in the causeway area and the maximum educational usage occurs there. While over 98 per cent of the pebbles and cobbles of which Chesil Beach is composed are of flint and chert the remainder are of diverse geological composition and by their identification it has been possible to shed light as to the initial provenance of the feature.

2.1.3.3 Long-term records - apart from the numerous research papers written about Chesil Beach there are a number of sources of original data. Particularly valuable in this respect are the fair copies of Sir John Coode's topographic surveys dating from between 1846 and 1853. It is possible therefore to examine the natural changes between the mid-nineteenth century and the present time. Some implications of these data are discussed in Section 5.3.

A more extensive outline of the scientific interest of the beach can be found in the Minutes of Evidence given before the Public Inquiry held at the (then) Portland Urban District Council offices on 21-22 February 1973.

2.2 Importance of the site

2.2.1 It was on all the scientific grounds, biological, geological, geomorphological and sedimentological, that the (then) Nature Conservancy scheduled the overall area as an SSSI in 1952, only three years after the organisation's creation. (The Description of the SSSI forms Appendix 2 of this report.) Some indication of the importance of the site, both in a United Kingdom context, and, because of a world-wide lack of shingle beaches, in an international context also, is shown by the following quotations:

'probably the most extensive and extraordinary accumulation of shingle in the world' - Lord Avebury in <u>The Scenery of England</u>

'the Chesil is the finest shingle structure in Britain, and possible in the world' - A Goudie, Honorary Secretary, British Geomorphological Research Group (in correspondence).

'Chesil bank is a unique single storm beach. By 'unique' one signifies in this case what the real meaning of the word seeks to convey. There is no other natural coastal feature of this type or magnitude anywhere in the world' - Professor C Kidson (in correspondence).

'probably the best example anywhere of lateral sorting is that found on Chesil Beach, Dorset, England' - Professor P D Komar in a United States textbook. There are references to Chesil on no less than 7 pages out of 411 of this book.

The author of the present report has conducted five international parties over Chesil Beach at one time or another. Two groups consisted of Quarternary geologists and geomorphologists, the remaining three were of engineers.

The value of Chesil Beach as an outdoor, full-scale experimental laboratory for the study of beach processes is very considerable. The data obtained are frequently generalised and used elsewhere, for example in the design of harbour structures at Europort, Netherlands.

3 EFFECTS OF SEA DEFENCE PROPOSALS ON SCIENTIFIC VALUE

3.1 Areal extent of scheme

3.1.1 The Sea Defence Scheme proposals by C H Dobbie and Partners extends for a distance of 1.6 km NW of the northern end of the existing sea well at Chiswell. (See Fig 18 in their Report.) From the standpoint of scientific interest this length can be divided into three parts:

(a) 0-260 m)
(b) 260-1360 m) northwest of the end of the existing sea wall/esplanade
(c) 1360-1600 m)

3.1.2 Area A: This comprises the relatively low beach which is backed by buildings immediately to landward. It has suffered from heavy human pressure and, especially since the construction of the sea wall, from intermittent restoration of the shingle crest at the esplanade/pebble junction. The crest and backslope may be regarded as of relatively low scientific and education value.

3.1.3 Area B: This includes the part of the beach which suffered the greatest drop in crest height during the 1978-79 winter. The most rapid change in pebble size occurs along the beach face here. However there is a broad, relatively flat area between the backslope of the beach crest and the main road which represents the location where shingle was extracted at one time and the

surface is therefore an artifact. It was this factor that precluded outright opposition to the construction of the interceptor ditch when first proposed by WWA.

3.1.5 Area C: Unlike Areas A and B this is more critical in a scientific context. Although a water main was laid on the backslope during the Second World War, slow recession (see Section 5.2) has been sufficient to produce a near natural backslope to the beach at this point, but not elsewhere. Thus it is the only readily accessible portion of Chesil Beach with a moreorless intact profile. It was this consideration that resulted in recent concern over the alignment of the pipes in the Portland–Wyke Regis main drainage scheme.

3.2 Different suggested means of coast protection and sea defence

3.2.1 Sea wall: While any massive sea well extension is likely to cause considerable concern and criticism environmentally, raising of the existing sea wall and a short extension of the order of 200 m as suggested in Option 7 of Dobbie and Partners' Report would be unlikely to provoke major opposition especially since the latter would merely cover an area already considerably disturbed (see Section 3.1.2 above).

It is to be noted, however, that the Hydraulics Research Station (1980) recommends flexible defences, possibly in conjunction with beach nourishment, rather than an extension of the existing sea wall.

3.2.2 Gabions: Beach crest protection using gabions is proposed in Options 2, 3, 5, 6 and 7 of Dobbie and Partners' Report, the extent varying between 500 and 1600 m depending upon the particular option chosen.

Environmental concern would most probably be directed towards the visual impact of wire cage groynes and mattresses and the nature of fill material used (see Section 3.2.3 below). The least favourable circumstance would be if the gabions were constructed and then subsequently damaged resulting in the dispersal of the beach fill. This would cause geological contamination of the natural beach material and substantial disturbance due to repair works.

3.2.3 Beach nourishment (including beach fill): One of the major features of environmental significance of Chesil Beach is the longshore size-grading of material and the geological composition of that material. As noted in section 2.1.3.2 the rate of change is greatest in the proposed area of sea defence. Section 2.1.3.2 also points out that while the vast majority of the pebbles and cobbles comprising Chesil Beach are flints and cherts, the precise original location of which is hard, if not impossible, to determine some 2 per cent are of other geological types. It is from the diverse range of rocks represented in the 2 per cent that some of the initial sources of the beach material have been deduced. Thus concern for beach nourishment falls into two fields: introduction of atypical size grades for the specific section of the beach, and

a distortion of the percentages of the various rock types which can currently be found.

Concern may also be expressed for the addition of different shapes of pebbles and increased angularity which may affect rates of transport.

3.2.3.1 Introduction of atypical size grades. While beach nourishment restricted to the landward slope would initially have no effect on the grading which is best developed on the crest and seaward face it is only a matter of time before unrepresentative sizes of material appeared in the seaward zone. If, however, nourishment was directly placed on the crest or seaward face of the beach the longshore sorting mechanism is such that it is likely that unrepresentative particle sizes would be rapidly transported beyond the area of beach where their protective role was required, eg smaller pebbles not incorporated in the matrix of the beach would be shifted NW towards Abbotsbury. Thus an area of Chesil Beach greater than that directly affected by sea defences would be altered to some degree.

3.2.3.2 Introduction of unrepresentative types of geological material. As noted above the introduction of pebbles and cobbles for beach replenishment, or angular rock or quarry waste for gabion fill, is liable to add new rock types and/or distort the present proportions of geological constituents. Ideally introductions should be of readily recognizable types which are totally absent at present but this is clearly ruled out on economic grounds because of transport costs. Portland limestone might prove acceptable as fill material for gabions since it would become rapidly worn away by abrasion if it reached the active seaward part of the beach. Local sources of chert rock, eg from Portland, would be resistant but sharp and angular. Virtually no Portland limestone pebbles occur W of Wyke Regis.

At the present time a very restricted range of pebble shapes occurs on Chesil Beach and any introduced material is likely to be less well rounded. Appendix 3 outlines problems which arose between 1967 and 1973 consequent upon a planning decision to require replacement of an equal volume of pebbles equivalent to those extracted for industrial purposes. As will be seen not only were there problems scientifically but opposition to the introduction of larger and/or fragmented material on grounds of potential hazard, as well as aesthetic objections. Volumes involved, some 350 tonnes per year, were extremely small in comparison with those likely to be required under the current sea defence proposals.

3.2.4 Drainage culverts and channels. The construction of drains behind the existing sea wall is unexceptionable. Nor is it envisaged that the alignment

of either of the two culverts extending from Victoria Square to Portland Harbour would cause serious concern. The widening and deepening of the WWA interceptor channel from its origin to its termination just N of the tank farm is slightly more contentious since one of its aims is to lower the water table characteristics of the beach. However, the proposals merely suggest enlargement of an existing feature and are likely to only cause minimum visual impact. Care should, however, be taken to avoid unnecessary disturbance and keep the effects as unobtrusive as possible.

3.3 Recommended scheme by C H Dobbie and Partners

Of the various options outlined in Dobbie's Report, beach armouring (Options 1, 2 and 4) is dismissed. So, too, is the adoption of extensions to the existing sea wall (Options 7, 8, 9 and 10) although it is noted that seepage through the beach would be reduced with this form of protection. The benefits of beach widening are regarded as uncertain, whether material is deposited on the seaward or landward face. There would be no reduction in seepage; the possibility of the blocking of the interceptor ditch; and a need for substantial maintenance.

A combination of gabions and beach widening would not reduce seepage and while somewhat speculative is considered probly viable.

The consultants however propose Scheme 5i at a cost, in July 1980, of £4.5m. This option consists of a 1600 m length of gabions along the crest of Chesil Beach from the N limit of the existing sea wall, the crest height of the gabions to be 14.5 m; a new interceptor drain linked to a modification of WWA's existing interceptor channel; modifications of the existing sea wall; and the raising of the Weymouth-Portland (A354) road to + 3 m OD.

C H Dobbie and Partners calculate (Section 8.6.1, page 64 of their Report) the economic life of a sea wall as 40 years but only 15 years for gabion protection and 10 years for beach widening, thus particularly with these methods disturbance of the beach must be expected.

The consultants point out (Section 8.1.1 on page 60) that:

'Our investigations confirm that whilst a scheme for the major flood protection of Chiswell and the securing of access to the mainland under severe short period wave attack is feasible, protection against long period swell attack is not viable due to the very high run-ups anticipated'.

4 ANTICIPATED RESPONSE BY SCIENTIFIC COMMUNITY

4.1 No biological or solid geology interest is considered to be at risk by the sea defence proposals. While individual reactions may vary from indifference to excessive concern over the geomorphological implications of the

defence proposals it is thought that any rational and widespread reaction would be governed by the geographical extent of the works as well as their specific content. Comments hereafter refer only to the potential geomorphological and sedimentological hazards.

4.1.1. Proposals unlikely to cause concern: These consist of the modifications to the existing sea wall and, possibly, any extension as far N as the N edge of the Masonic Hall, Chiswell; the construction of drainage culverts at Chiswell and the widening and deepening of the interceptor channel from Chiswell to the N end of the tank farm; the raising of the Weymouth-Portland road (A354).

4.1.2. Opposition can be expected to suggestions of beach nourishment and the use of gabions or mattresses along the beach crest. The degree of concern is likely to be influenced by the extent of the sea defence works and the relative proportions of each type; the source and kind of material used as beach and gabion fill; and the overall degree of disturbance of the area, especially towards the proposed NW limits of the sea defence scheme where a largely natural profile has been regained over the last 40 years or so.

5 DISCUSSION AND CONCLUSIONS

5.1 Introduction

Section 2.1 of this Report indicated the nature of the scientific interest of Chesil Beach while Section 2.2 gave some intimation of its geomorphological importance in both national and international terms. Section 3 has considered the specific implications of the main components of C H Dobbie and Partners' Sea Defence Scheme, while Section 4 envisaged the likely nature of legitimate scientific concern over the proposals. Two other aspects need to be considered: the stability of the beach and possible alternatives and options to the proposed scheme.

5.2 Stability of Chesil Beach

Carr and Gleason (1972) showed that between 1852/3 and 1968/9 most of Chesil Beach remained spatially stable but recession of the crest line was measurable along the Beach near the present northern limit of the tank farm reaching a maximum of 17 m over the period. Occasional over-topping and breaching are thought to have occurred over at least the past four centuries. Chesil, in common with many other coastal features, has reached a stage of late maturity in its evolution where its existence is becoming precarious because there is no substantial source of new material and volume is being lost eg through attrition. Fig 2 shows that SE of Coode's Section 7, there has been a fall in height of up to 3.5 m since 1852. However, apart from the area adjacent to the existing sea wall nearly all of this occurred in the exceptional conditions of the 1978-79 winter. Various surveys carried out between October 1955 and September 1978 -

a 23-year period - show identical beach crest profiles along all but the most southerly 300 m of the proposed Sea Defence Scheme. Because of Chesil Beach's indirect economic significance some modification by man may therefore be inevitable over this latter stretch. But, whether substantial sea defence works should be undertaken over the remaining 1500 m bearing in mind the 23-year period of stability cited above and the design life of 10 to 15 years quoted by C H Dobbie and Partners for beach nourishment and gabion construction, respectively, is open to doubt. This is especially true because C H Dobbie's Report states (Section 8.1.1, page 60) that it is not viable to provide protection against main swell wave events, and it was one of these which caused the bulk of the crest lowering, which took place on 13 February 1979. From opposite Small Mouth to as far W as Abbotsbury an actual increase in beach height has been observed between 1852 and 1968/79, although the width of the beach has been somewhat reduced, and the question of sea defence is not at present relevant.

5.3 Possible alternatives and variations on the proposed scheme

In a scientific and educational context the problems of sea flooding and coast defence at Chiswell and along the Weymouth-Portland road would be best met by:

(i) a sea defence scheme that was restricted to the Chiswell area in conjunction with a bank or wall from Chesil Beach running NE of Victoria Square, rather than a more extensive scheme along the beach or the evacuation of the remaining people in the low-lying parts of Chiswell;

(ii) restoration of the original beach crest profile with the indigenous material alone;

(iii) some form of armouring on the Chesil Beach side of the raised Weymouth-Portland road (A354);

(vi) an enlargement of the existing interceptor channel.

Although in most respects the scientific interest of the site would be best maintained with the least man-made intervention, it may be argued with some justification that an element of sea defence work is necessary to enable the very existence of Chesil Beach itself as both protective bastion and scientific entity.

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APPENDIX 1

Biological description of Chesil Beach and the Fleet as given in Nature Conservancy Council's A Nature Conservation Review (1977)

pp 13-14: C.25. CHESIL BEACH/THE FLEET, DORSET

SY 487890-683733. 800 ha Grade I*

Coastal lagoon (480 ha)

This is the largest regularly tidal lagoon in Britain with claybottom deposits and has unusual transitional habitats with shingle. There is also the most extensive mixed population of all three Zostera spp. and Ruppia maritima in Britain, and these carry an invertebrate fauna extinct in many parts of Europe since the Zostera decline of the 1930s. For these features alone it is of international interest. It is notable for the diversity of waders and wildfowl in winter (wigeon - 4500; mallard, teal, pintail, pochard, tufted duck and goldeneye) and has the largest resident mute swan population in Britain (650 birds) supported by the Zostera food resources.

Shingle (320 ha)

Chesil Beach is one of the five largest shingle beaches in Britain and is of international interest both as a rare habitat in Europe as a whole and for its particularly unusual linear form, with small pebbled shingle in the west which is well vegetated in parts. It is notable for very large populations of local species such as Crambe maritima, Glaucium flavum, Lathyrus japonicus, Suaeda fruticosa and Trifolium scabrum, all characteristic plants of shingle. It is also the only British locality for the wingless cricket Mogoplistes squamiger and supports about 15% of the British breeding population of little terns (200 pairs).

APPENDIX 2

Description of Chesil Beach and the Fleet as given in the SSSI schedule.

Chesil Beach is of international interest for its rare physiographic form and as an unusual plant and animal habitat: it supports about one fifth of the British breeding population of Little Terns and a number of localised species including a rare insect for which it is the only known British locality. This coastline provides easily accessible exposures of Jurassic rocks, including important fossil beds.

The Fleet is the largest regularly tidal lagoon in Great Britain and is of international interest for its clay bottom deposits and its unusual plant and animal transitional habitats. The intertidal area around Smallmouth acts as a reservoir for invertebrate marine organisms moving into and out of the Fleet. It is notable for the diversity of waders and wildfowl in winter and the largest Mute Swan population is found at Abbotsbury.

APPENDIX 3

Implications of the 1967 planning decision to require pebble replenishment on Chesil Beach.

1. Extraction of approximately 355 tonnes of pebbles for commercial purposes had been carried out under planning permission from Dorset County Council since 1959. An extension of that permission, sought by the extractors in 1967, was linked by DCC to replacement by a similar volume of pebbles on coast protection grounds.

2. On 6 December 1967 DCC held a meeting with the (then) Nature Conservancy to try and reach agreement over a source of replacement material which might be scientifically acceptable.

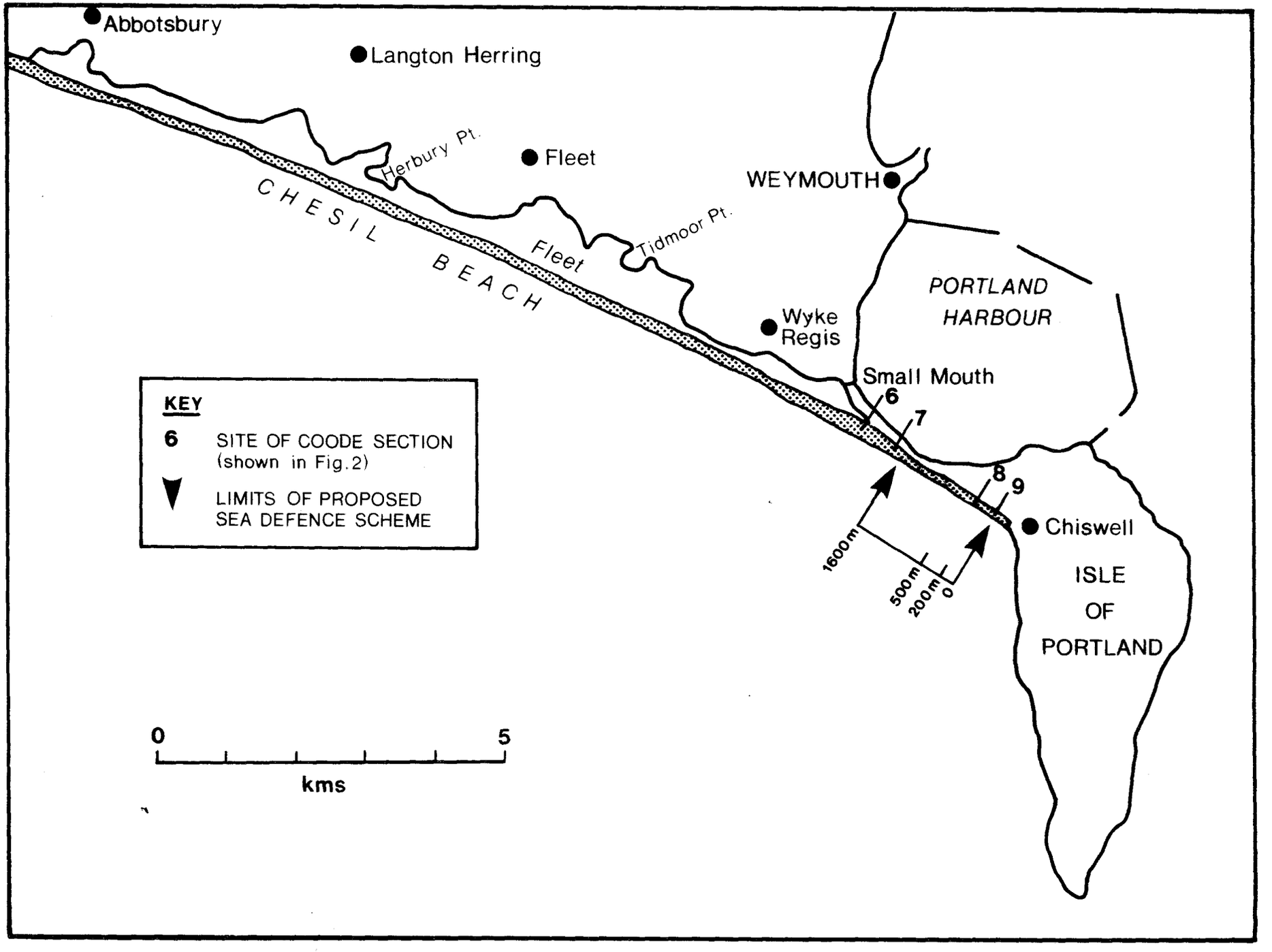
3. Althought the extractors advocated the introduction of gravel dredged from the sea floor this was ruled out as a possibility by N C because available material was too fine to remain on the appropriate stretch of beach and because the geological composition could not be reliably determined.

4. After examination of various land sources N C proposed, with reluctance, the use of 'rejects' from a gravel pit (Elliotts Pits) at Moreton, near Wool. These pebbles were rounded and reasonably similar in size to the beach material which had been extracted. Furthermore, by examination of the very restricted range of geological types present in the quarry, a fairly reliable indication of the types actually used for replenishment could be obtained.

5. The planning permission became due for renewal in December 1970. At the time the contractor expressed the view that the replacement material was unsatisfactory and fragmented and 'unsuitable for a public beach'.

6. The Area Planning Sub-Committee discussed the merits of replacement of beach material versus the 'detrimental affect on the beach by the introduction of alien material' at their meeting of 17 October 1972.

7. Planning refusal for further extraction resulted in a Public Inquiry in February 1973. This upheld the decision with the result that questions related to further replenishment no longer arose.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Fleet
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CHESIL BEACH
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Tidmoor Pt.
PORTLAND HARBOUR
Wyke Regis
Small Mouth
6
7
8
9
Chiswell
ISLE OF PORTLAND
1600m
500m
200m
0
KEY
6 SITE OF COODE SECTION (shown in Fig.2)
LIMITS OF PROPOSED SEA DEFENCE SCHEME
0
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Fig.1

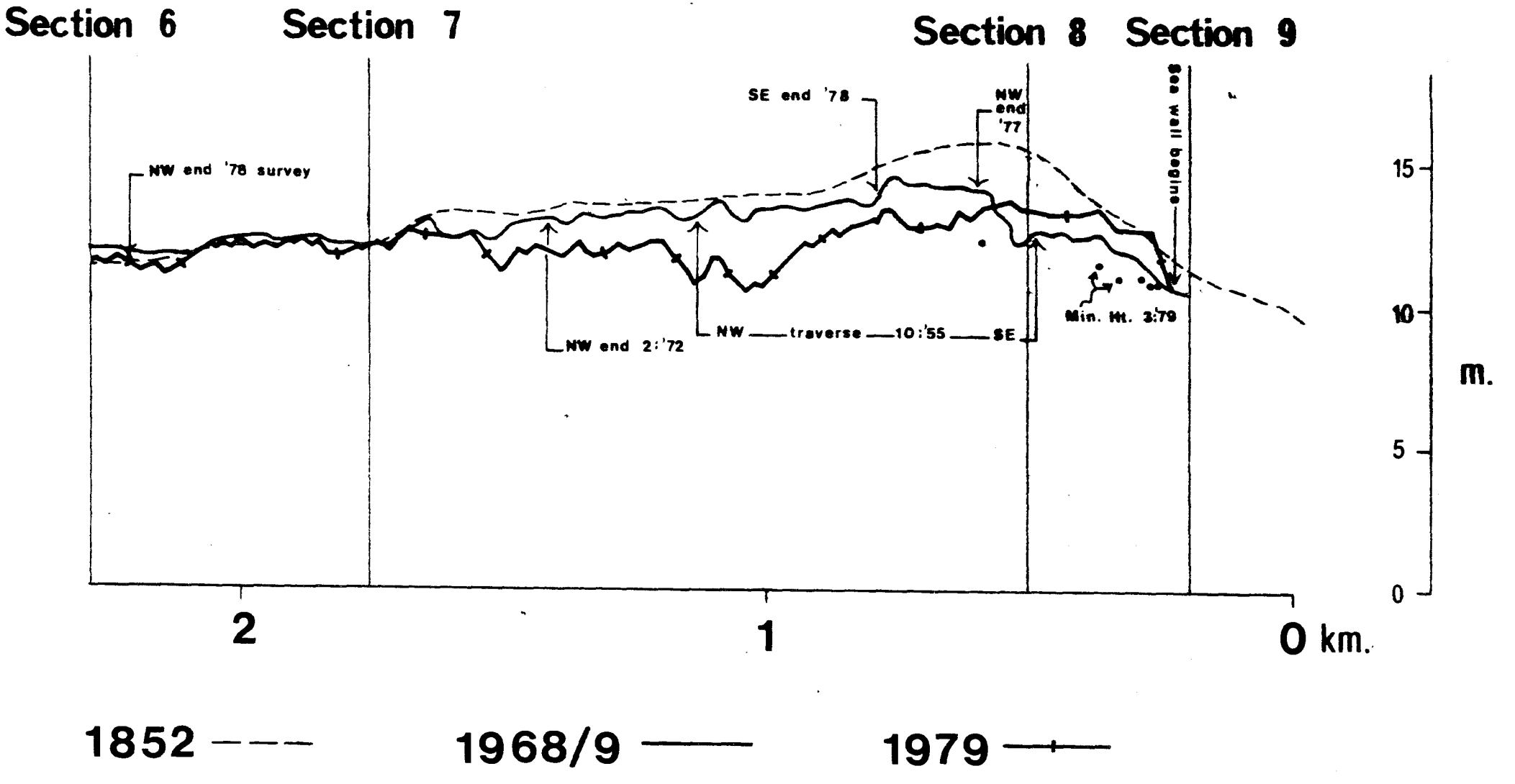
Section 6
Section 7
Section 8
Section 9
NW end '78 survey
SE end '78
NW end '77
sea wall begins
NW end 2:'72
NW
traverse
10:'55
SE
Min. Ht. 3:79
15
10
5
0
m.
2
1
0 km.
1852
1968/9
1979

Fig. 2