



# Shoreline Management Plan

**Babtie Group**  
**ABP Research & Consultancy Ltd**

Final Report



**Babtie Group**  
technical and management consultants



East Lothian Council

# **Shoreline Management Plan Final Report**

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# **East Lothian Council Shoreline Management Plan**

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## **Executive Summary**

This report is the major output from the East Lothian Shoreline Management Plan (SMP) Project.

The principal aim of the SMP is to provide a strategic framework for coastal defence in East Lothian and the main reasons for developing the Plan are:

- to help conserve the coastline and contribute towards the future development of a coastal management strategy;
- co-ordinate and facilitate coastal defence action in East Lothian;
- improve understanding of coastal processes operating within the sediment cell;
- identify the need for site specific research and investigations;
- facilitate consultation between those bodies with an interest in the coastline;
- identify important activities and uses associated with the coast and its environs;
- highlight opportunities for maintaining and enhancing the natural environment of the coast and
- to consider the importance of alternative means of dealing with coastal erosion.

This project involved the collation, interpretation and presentation of a diverse body of data describing the East Lothian shoreline. Based on these data the coastline has been split into management units and appropriate management options have been identified and assessed for each unit.

Chapters 1 and 2 layout the legislative and administrative framework for Shoreline Management. Chapter 3 presents a summary of the various public consultations that were undertaken; Chapter 4 provides an overview of the coastal processes operating along the East Lothian Coast; Chapter 5 reviews coastal defences identified along the East Lothian coast; Chapters 6 and 7 discuss available information about land use, the built and natural environments; Chapter 8 lays out the basis of the economic assessments carried out and Chapter 9 discusses the Management Units in detail, presents the options and highlights the preferred option in each case.

An overall summary of the preferred options for all management units is given in Chapter 10 along with recommendations for ongoing monitoring and maintenance. This SMP provides a framework for ongoing management of the East Lothian coastline and further reviews and surveys will be required to maintain and enhance the benefits of the SMP approach.

### **Other Outputs**

Much of the information presented here has been collated in a Geographical Information System (GIS). This GIS has been passed to East Lothian Council for ongoing use. An Executive Summary Document has also been produced. This document summarises the Management Units, the issues and the preferred management option identified for each unit.

### **Further Information**

Any requests for further information regarding this Shoreline Management Plan should be directed to East Lothian Council, Department Education and Community Services.

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### **1 Introduction**

Babtie Group has been commissioned by East Lothian Council to develop a Shoreline Management Plan (SMP) for the coastline of East Lothian, defined as:

“A document which sets out a strategy for coast defence for a specified length of coast, taking account of natural processes and human and other environmental influences and needs”

(East Lothian Council, Brief for Consultant, 2000)

Babtie Group has combined with the specialist sub-consultants of ABP Research & Consultancy Ltd and Scottish Participatory Initiatives (SPI) to produce the East Lothian Shoreline Management Plan. ABP Research & Consultancy Ltd provide the review of coastal morphology, coastal processes, coastal change and impacts on habitats (ABP 2001), while SPI completed the public consultation exercise (SPI 2001a). A large amount of the text in Chapter 4 and 7 was produced by ABP Research & Consultancy Ltd. The results of the SPI consultation exercises are reproduced in a separate report (SPI 2001a), although the findings have been disseminated herein.

The SMP has been developed following the relevant MAFF/DEFRA guidance (1995, 1998 and 2001) and has identified the preferred option for coastal defence for a specific stretch of coastline. Sustainable options for managing coastal erosion are proposed, which take into account the inter-relationships with existing defences, development, the natural and cultural environment and processes within the cell or sub-cell and which avoid, as far as is practicable, tying future generations into inflexible and expensive options for coastal defence.

The principal aim of the SMP is to provide a strategic framework for coastal defence in East Lothian and the main reasons for developing the Plan are to:

- help conserve the coastline and contribute towards the future development of a coastal management strategy;
- co-ordinate and facilitate coastal defence action in East Lothian;
- improve understanding of coastal processes operating within the sediment cell;
- identify the need for site specific research and investigations;
- facilitate consultation between those bodies with an interest in the coastline;
- identify important activities and uses associated with the coast and its environs;
- highlight opportunities for maintaining and enhancing the natural environment of the coast and
- to consider the importance of alternative means of dealing with coastal erosion.

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### **1.1 The East Lothian Shoreline**

The East Lothian coastline extends for approximately 69km from Musselburgh in the west to just north of Cockburnspath in the east (Figure 1.1). The coastal boundaries are given below:

| <b>Town</b>   | <b>Location</b> | <b>Item</b>    | <b>OS Grid Reference</b> |
|---------------|-----------------|----------------|--------------------------|
| Musselburgh   | Eastfield       | Burnstane Burn | NT 327 732               |
| Cockburnspath | Dunglass        | Dunglass Burn  | NT 772 726               |

Although the towns of Musselburgh, Prestonpans, Cockenzie & Port Seton, North Berwick and Dunbar are located along the coast, it is more typically characterised by natural features such as raised beaches, dune systems and rock outcrops. Much of the East Lothian coast is designated as a SSSI for biological and geological interests and has recently been designated as a Ramsar site and a Special Protection Area (SPA) under the EC Birds Directive (79/409/EEC). Due to the recent SPA/Ramsar designation, over 62km of the coastline is now protected by Natural Heritage Designation, bringing with it additional responsibilities and levels of protection.

The East Lothian coast also includes the Torness nuclear power station (situated ca. 8km to the east of Dunbar), which will require specific management options. The East Lothian coast is considered to be nationally important in terms of recreation and is a significant tourism asset, with more than 2.5 million visits annually. There are nine designated bathing waters in the area, at Seton Sands, Gullane, Yellowcraig, North Berwick Bay, North Berwick Milsey Bay, Belhaven Bay, Dunbar East, White Sands and Throrntonloch.

The Council owns and manages about 75% of its coastline and has significant experience of coastal conservation and protection, including management of seawalls and dynamic sand dune systems.

### **1.2 The SMP Process**

There are a number of stages in the process of producing an SMP. These are designed to ensure that the Plan fulfils its role as an agreed strategy for shoreline management. The first stage is to collect and collate all relevant data that exists with regard to the shoreline, encompassing engineering, scientific, environmental and planning aspects. As part of this stage, all relevant groups and organisations with an interest in the coastline were identified and contacted in order that their views, ideas and requirements may be taken into account.

In the second stage, the SMP itself will be formulated and this involves additional research to obtain existing data, and additional consultations to discuss and, eventually, approve a draft SMP document.

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#### 1.2.1 Key Issues

In preparing the plan, four key issues have been addressed as follows:

- (i) Coastal Processes, including consideration of the historical evolution of the coastline, collection of relevant coastal information for waves, tides and sediment transport, prediction of future evolution of the coastline and an assessment of local geology/geomorphology, effects of sea level change and potential changes in storm characteristics.
- (ii) Coastal Defences, the current defences along the coast, their effectiveness, current condition and life expectancy will be evaluated.
- (iii) Land Use and the Human and Built Environment, including planning policy guidance for the coastal zone, users of the coastline and conflicts arising from such uses.
- (iv) Natural Environment, including designated areas of importance under National and EC legislation and identification of the impacts of coastal defences upon habitats and species.

Once all essential data was collated, the coastline was divided into 'Management Units', which are defined according to geomorphology, land use and natural environment. The options for each management unit was then considered, taking account all of the potential implications and consequences for the management unit. The identified options were then assessed against the management objectives set out in Section 1.3, below.

#### 1.2.2 Generic Management Options

The strategic coastal defence options considered for each Management Unit included the following, based on the guidance given by DEFRA 2001:

- **Hold the existing defence line** by maintaining or changing the standard/type of protection;
- **Advance the existing defence line** by constructing new defences seaward of the original defences;
- **Retreat the existing defence line** by identifying a new line of defence and, where appropriate, constructing new defences landward of the original defences;
- **Limited intervention** by working with natural processes to reduce risks while allowing natural coastal change. This may range from measures which attempt to slow down rather than stop coastal erosion and cliff recession, to measures that address public safety (e.g. promoting the build-up of a beach in front of an unprotected cliff, dune management, visitor management)
- **No active intervention**, where there is no investment in coastal defence assets or operations (i.e. no shoreline management activity)

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Where appropriate site-specific options have also been considered.

Chapter 9 details, for each management unit:

- the preferred coastal defence option and
- the reasoning behind the choice of option.

### **1.3** Management Objectives for Shoreline Management Plan

Management Objectives for the Plan form the basis for the appraisal and development of strategic coastal defence options, which take into account all coastal interests and should interfere as little as possible with the natural coastal processes in the area (MAFF 1998).

MAFF (1998) guidance suggests the following general SMP objectives should be followed for all Plans:

- To set out an integrated approach to coastal defence issues, which will allow for more informed decision making in the future;
- To set out a methodology for informing the statutory planning process and related coastal zone planning;
- To agree, as far as possible, future policies for coastal defences that do not adversely interfere with the behaviour of natural processes within the Plan area or across Plan boundaries;
- To determine sustainable policies for shoreline management for each cell and sub-cell based on a thorough evaluation of the processes and interactions affecting the shoreline in accordance with MAFF policies for Flood and Coastal Defence;
- To take account of compatibility with national and local biodiversity targets by conserving and, where possible, enhancing nature conservation interests and, in particular, to safeguard the integrity of sites of regional, national and international importance (including the historic environment and the landscape);
- To recommend indicative standards and forms of sustainable coastal defence for existing and/or new works that are environmentally acceptable – including the maintenance and management of man-made and natural coastal defences;
- To set out a system for the co-ordinated monitoring of coastal processes and regular shoreline surveys throughout the cell and sub-cell to improve knowledge and understanding of the coastal environment, including identifying gaps in knowledge and proposing further research;
- To develop an improved public awareness of the overall behaviour of the coast and the influences they and others have on it.

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The above objectives of the Shoreline Management Plan have been applied, as far as is practicable, to the East Lothian Shoreline. The MAFF guidance and policies for Flood and Coastal Defence were developed for the English coastline, however they are broadly applicable to the Scottish coast. The degree to which these objectives complement and/or conflict with the legislative, policy and planning context of East Lothian is discussed in Chapter 2, where the SMP is set within its local context.

MAFF (1998) also note that the objectives of an SMP must take account of MAFF's overall policy for flood and coastal defence where the highest priority is aimed at reducing the risks to people and the developed and natural environment from flood and erosion. In addition, long-term objectives for the Plan area should include long-term strategic requirements:

- To analyse monitoring data over a sufficient time period in order to determine trends in coastal processes and re-examine the sustainability of short-term objectives set for management units;
- To utilise the data collected from any recommended further studies to support the work of the ongoing review process.

East Lothian Council should follow these strategic objectives in the long-term to remain committed to sustainable and integrated coastal management.

Objectives specific to management units will consider any specific usage or interest in the particular length of shoreline and any possible or actual conflicts between interested parties in that area (MAFF 1998). General management objectives for the East Lothian SMP related to specific topics are set out in Table 1.1. Management Unit are defined in Chapter 9, where strategic coastal defence options are considered for each Unit in turn.

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**Table 1.1: Management Objectives related to specific topics**

| Topic                          | Objective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Natural Coastal Processes      | <ul style="list-style-type: none"> <li>To maintain the operation of natural coastal processes.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Archaeology and Built Heritage | <ul style="list-style-type: none"> <li>To conserve the archaeology and built heritage resource.</li> <li>To conserve the archaeology of the sea bead and to maintain the diversity of wreck sites for future generations.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                             |
| Land use and Planning          | <ul style="list-style-type: none"> <li>To provide defence from flooding and erosion, taking into account the planning framework.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Fisheries                      | <ul style="list-style-type: none"> <li>To minimise and mitigate any adverse impacts that coastal defence may have on the long-term viability of the local fishing industry.</li> <li>To ensure that coastal defence structures and future works continue to provide adequate access for fishing activities.</li> </ul>                                                                                                                                                                                                                                                                                           |
| Recreation and Tourism         | <ul style="list-style-type: none"> <li>To retain and enhance areas of established recreational amenity.</li> <li>To develop recreation and tourism that are allied to the protection of the coastline.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                |
| Nature Conservation            | <ul style="list-style-type: none"> <li>To conserve or enhance natural coastal habitats, landforms and geological exposures and safeguard these from potentially damaging operations.</li> <li>Where a Management Unit contains a SPA, or priority habitat, a favourable conservation status should be maintained.</li> <li>To conserve and enhance wild species and wildlife habitats</li> <li>To recognise the international, national and local conservation importance of sites.</li> <li>To take account of, and co-ordinate with, local conservation management plans and SSSI management plans.</li> </ul> |
| Landscape                      | <ul style="list-style-type: none"> <li>To maintain and enhance the existing landscape character of the area.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Water Quality                  | <ul style="list-style-type: none"> <li>To ensure that coastal defence works do not affect the water quality of coastal waters in accordance with the EC Bathing Waters Directive</li> <li>To ensure that coastal defence works do not adversely affect the dispersion of effluent from waste management operations</li> </ul>                                                                                                                                                                                                                                                                                    |
| Industry                       | <ul style="list-style-type: none"> <li>To provide sustainable protection from flooding and erosion for industry situated on or within the coastal margin</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Harbours                       | <ul style="list-style-type: none"> <li>To ensure that coastal defence policy does not adversely affect navigable access to harbour facilities</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



## **2**            Setting The SMP In Context

To help guide the SMP it is important to understand any legal requirements that might relate to the coast in terms of designated areas and the protection afforded to it. Whilst it will be important to understand the local context any requirements (current and emerging) at national, European and international levels need to be made explicit. The context is also important in terms of understanding interactions with the development planning process and the legal requirements relating to development at the coast. The SMP cannot be developed in isolation since it will need to respond to multiple (and potentially conflicting) strategies and objectives. Understanding the most significant guiding objectives, and, in turn, setting the objectives for the SMP will be important from the outset.

All planning, management and legal policies and issues that affect the coastal environment have to be considered such that the SMP can provide sustainable coastal defence management avoiding potential conflicts with other initiatives. Accordingly, this chapter will review existing constraints and opportunities placed by planning policies, management plans, legislation and specific interests within the study area.

It is important to identify existing and emerging development policies and to assess the implications of these policies with respect to SMP objectives for coastal defence, so that any proposals are in accord with the policy framework contained within the structure and local plans. To achieve this it is necessary to:

Describe the existing legislative, planning and policy framework within the SMP study area; Describe any local planning applications which may have an influence on the development of the SMP; and Assess the implications of current planning policy on the objectives of the SMP.

## **2.1 Existing Policy Framework Within The SMP Study Area**

### **2.1.1 The Planning and Legislative Framework**

Scottish planning and development legislation comprises a diverse range of statutes, many of which have implications for coastal activities and development. Several excellent reviews of the planning and legislative framework relating to coastal planning and management in Scotland have been carried out (e.g. Cleator & Irvine 1995; Hansom et al 2000; Norman 2001 and SNH 1996a) to which reference should be made for further information. The most relevant statutes are discussed below.

#### **Town and Country Planning Legislation, including environmental assessment**

The Town & Country Planning Act (Scotland) 1997 is the major piece of planning legislation in Scotland. It establishes the methods and authorities of the planning mechanism in Scotland and sets out the framework for the preparation of structure and local plans. The Act also covers the mechanisms for development control and the planning application process. The legislation states that the First Minister for Scotland has an overseeing control of the planning procedure and has responsibility for co-ordinating planning on a national basis. The First Minister requires to be informed of certain types of development and, if required, they can be called in for a public enquiry. In addition, the First Minister has extensive powers under the Act to make subordinate legislation in the form of Circulars, National Planning Guidelines and Planning Advice Notes.

The Environmental Assessment (Scotland) Regulations 1988 /1994 set out the requirements where the planning process may require the preparation of an Environmental Assessment (EA). An EA is required for any proposed works or development, which they consider may have significant environmental impacts on a "sensitive location" such as a Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) or Special Area of Conservation (SAC). Implementation of the EC Habitats and Birds Directive places a requirement that an 'appropriate assessment' should be undertaken covering the implications of a development on the conservation interests for which the site has been designated, if it is concluded that the development is likely to have a significant effect. This may have implications for any proposed coastal protection works at or close to a proposed or existing SPA / SAC sites.

Scottish Planning Legislation has powers down to the mean low water mark of spring tides (MLWS). This means that any coast protection development, which is wholly above MLWS, may be covered in its entirety by the planning control legislation, including the requirement for an EA, where appropriate (SNH, 1996a). However, if a coast protection scheme extends below MLWS, this portion lies outwith the control or influence of the planners, although such schemes are covered under the Coast Protection Act 1949 and the Food and Environmental Protection Act 1985 (see below).

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### **Civic Government (Scotland) Act, 1982**

The Civic Government Act covers many aspects of the legal system in Scotland. Of particular relevance to the SMP are the powers it confers to the local authorities with respect to the seashore and adjacent waters. The Act empowers the local authorities to make bylaws in order to:

- Prevent nuisance or danger the seashore
- Preserve or improve the amenity of the seashore
- Conserve the natural beauty of the seashore by regulating trade or business, regulating the use of vehicles and regulating the exercise of sporting and recreational activities

The Act also empowers local authorities to execute works for preserving improvements or restoring the amenity of the shoreline.

### **Food and Environmental Protection Act, 1985**

The Food and Environmental Protection Act 1985 (FEPA) replaced the Dumping at Sea Act 1974, and concerns the control and licensing of the deposit of substances or articles within UK waters. The Act requires that a license be obtained from Scottish Ministers in order to deposit any articles or substances in the sea or under the seabed.

This is important from a coastal planning perspective as the 1985 Act defines the “sea” as the area submerged at mean high water springs (MHWS), and also includes the tidal arms of rivers, creeks and estuaries. This has implications such that any proposed coastal development works that fall partly or wholly below MHWS require a license from the Scottish Executive, SNH 1996a. Thus, it follows that all planning applications, which include the depositing of substances between the high and low water marks, should be subject to a licence as well as planning permission, (Norman 2001).

### **Flood Prevention (Scotland) Act, 1961**

The Flood Prevention Act (as amended) permits the unitary authorities to carry out schemes, agreed with the Scottish Executive, to prevent the flooding of non-agricultural land, even if this requires physical works outside their area. All flood prevention works carried out by or on behalf of, an authority must be part of an approved scheme, except for maintenance or management operations.

### **Coast Protection Act 1949**

The 1949 Coast Protection Act empowers coast protection authorities (generally local authorities) to carry out coastal protection works to protect land in their area. Such authorities promote their own schemes and regulate those of others. Under the Act, a landowner wishing to carry out works must obtain the agreement of the coast protection authority. If the authority themselves wish to carry out the works they must obtain the agreement of the Scottish Executive.

The Act specifies that consent of Scottish Ministers is required for the construction, alteration or improvement of any works lying on, under or over any part of the seashore lying below MHWS; the deposit of any material or object below the level of MHWS or the removal of any object or materials below the level of MLWS (Norman 2001). No lower limit is specified in the Act.

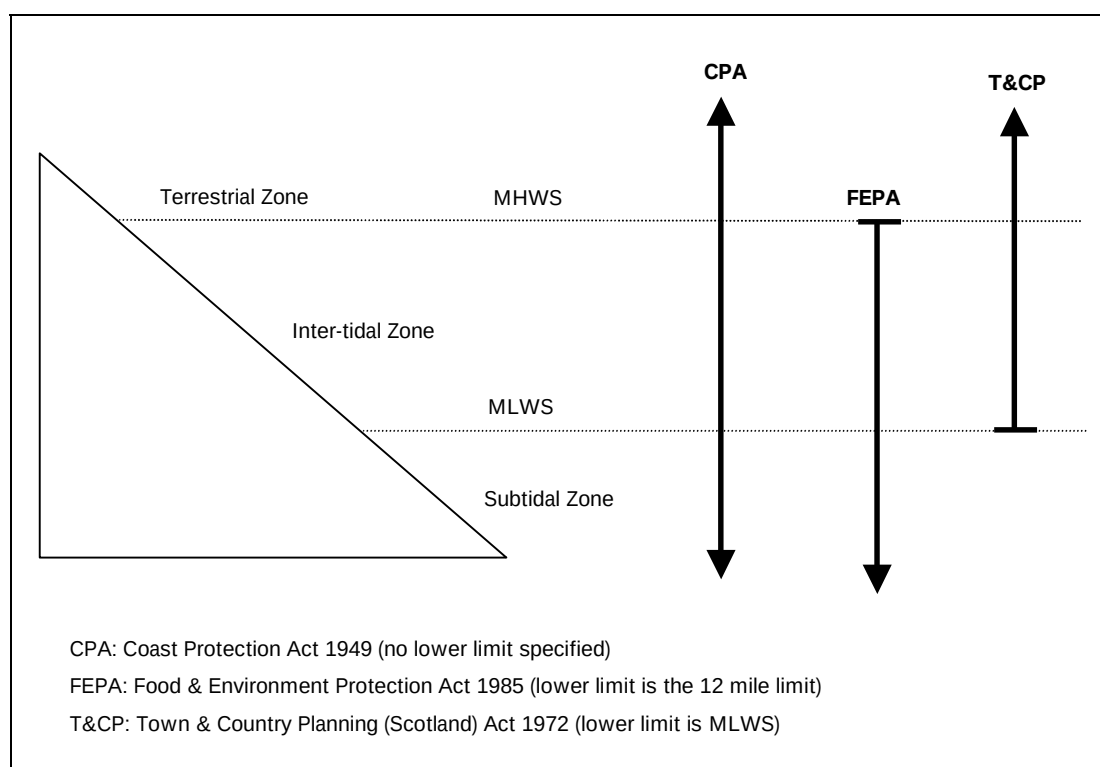
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There is thus overlap in the Scottish legislation relating to the control of coast protection works. For example, any proposed development between MHWS and MLWS, will require a licence under the Food and Environmental Protection Act, consent under the Coast Protection Act and planning consent under the Town & Country Planning Act. If the proposed works are likely to have significant impacts on a designated site, an EA or an Appropriate Assessment may also be required to satisfy the EA Regulations and Habitats Directive described above. An excellent summary of the requirements for consents and consultations for coast protection works is contained in the SNH publication *A Guide to Managing Coastal Erosion in Beach/Dune Systems* (2000) (Table 3.1).

The Ministry of Defence (MoD), Ports Authorities and road and rail authorities all have permissive powers to promote their own coastal protection schemes, although they must seek the views (but do not need consent) of the relevant coast protection authority. For example, the 1984 Roads (Scotland) Act permits the protection of roads from natural hazards. If necessary, the coast protection authority can register any objection to such a scheme with the Scottish Executive. In Scotland, the defence of agricultural land against both flooding and coastal erosion is always the landowner's responsibility (Hansom et al 2000).

**Figure 2.1 Overlapping areas of responsibility for principal legislation controlling development of Coast Protection Works (source SNH 1996a)**



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Other relevant legislation relating to shoreline management in Scotland include The Environment Act 1995; The Agriculture Act 1986; The Biodiversity Convention and Agenda 21; EC Bathing Water Directive; Crown Estates Act 1961. For further information on these and other legislation, refer to Cleator and Irvine (1995).

It is now accepted that the Crown is the full owner of the seabed and foreshore, save where this has been alienated by Crown Grant (Scottish Law Commission 2001). The Crown can grant a real right in the seabed or foreshore to a third party (for example, granting a license to extract minerals or the lease of part of the seabed for fish-farming). The Scottish Law Commission (2001) report contains a discussion of the law of the foreshore and seabed in Scotland, the nature of the Crown's interest and the extent and protection of the public rights exercisable on the foreshore. Scottish Coastal Forum has prepared an overview document on the legislation relating to the granting of foreshore and seabed development consents (Scottish Coastal Forum 2001). The report can be accessed at [www.scotland.gov.uk/environment/coastal\\_forum](http://www.scotland.gov.uk/environment/coastal_forum) under Reports & Papers and provides a useful summary of the legislation relevant to harbour construction and coast protection and flood defence works, amongst others.

#### **2.1.2 National Planning Guidance**

The National Planning Policy Guidelines (NPPGs) detail government guidelines on the implementation of national planning policies at the regional level and is used to direct the development of regional structure plans. The Scottish Office has produced several Circulars, National Planning Guidelines and Planning Advice Notes of relevance to coastal management. The key planning guidance relevant to coastal planning and management is NPPG 13 Coastal Planning.

NPPG 13 was published in August 1997, following recommendations set out in the discussion paper Scotland's Coasts (Scottish Office 1996) that the existing coastal planning guidelines (1974 and 1981) be updated. Reasons for updating the coastal planning guidelines include:

- The introduction of new nature conservation legislation and designations (e.g. the EC Habitats and Birds Directive)
- Recognition that, even in parts of developed lengths of coastline, some important nature conservation interests require to be taken into account when considering new development proposals
- Concerns about sections of the coastline which are under regular or periodic threat from erosion or flooding
- Specific concerns about the erosion of cultural heritage resources
- Greater public awareness and involvement in environmental issues

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NPPG 13 sets out seven basic principles on which coastal planning should be based in order to achieve sustainable development and maintain and enhance its biodiversity:

- Development not specifically requiring a coastal location should not normally be allowed on the coast;
- Development requiring a coastal location should normally be located on a developed coast;
- Coastal development should use available brownfield and reusable land;
- Conservation and, where appropriate, enhancement of the natural and cultural heritage, should be promoted and opportunities for its enjoyment should be identified;
- Understanding of natural processes is a key input into planning policies and decisions;
- Where potential damage to the environment is both uncertain and significant, a precautionary approach is required and;
- The criteria required by the various bodies responsible for environmental protection should be met.

NPPG 13 distinguishes between the developed, undeveloped and isolated coast and sets out the general development control principles for each category (paragraphs 17 - 24). The guidance indicates that development should not normally be permitted within the undeveloped coast unless its social and economic benefits outweigh the potential detrimental impacts on the coastal environment and where there are no feasible alternative sites within existing settlements or on other developed land. NPPG 13 identifies the isolated coast as areas where special characteristics are to be safeguarded and suggests a presumption against development should apply.

Structure plans developed by the local authorities should distinguish between the developed, undeveloped and isolated coast (NPPG 13, paragraph 53). The document also recommends that areas, which are at risk from erosion or inundation be identified in local and structure plans, together with policies to be applied to new development in such areas. There is a presumption against development in areas at high risk from erosion, particularly where these might require expensive engineering works to sustain (paragraph 31).

There is little direct reference to SMPs *per se* in NPPG 13 apart from recommending their preparation in areas where coastal erosion is identified as a problem (paragraph 57). However, paragraph 27 of NPPG 13 stresses that for the majority of the coast, especially where there is little or no development, natural processes of coastal erosion should be allowed to continue. Where human assets are at risk, coastal defence decisions should be based upon a thorough understanding of their likely impact on the environment and natural sediment pathways (paragraph 28).

A Planning Advice Note (PAN 53 Classifying the coast for development purposes) was published by the Scottish Office to set out the practical framework by which planning authorities can classify the coast into one of the three categories advocated by NPPG 13 (developed, undeveloped and isolated). However, it is stressed throughout PAN 53 that the classification of a section of coast as developed does not automatically bring with it a presumption in favour of development.

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Other NPPGs that are relevant to the development of the SMP and should be taken into account during the development of strategic policy options are:

NPPG 1 The Planning System  
NPPG 4 Land for Mineral Working  
NPPG 5 Archaeology and Planning  
NPPG 7 Planning & Flooding  
NPPG 11 Sport, Physical Recreation & Open Space  
NPPG 14 Natural Heritage  
NPPG 15 Rural Development  
NPPG 18 Planning & Historic Environment

Other Planning Advice Notes (PAN) which need to be taken into account in the development of the SMP are:

PAN 42 Archaeology  
PAN 49 Local Planning  
PAN 50 Controlling the Environmental Effects of Surface Mineral Workings  
PAN 51 Planning and Environmental Protection  
PAN 60 Planning for Natural Heritage

### **2.1.3 Non-statutory Initiatives and Plans**

As a guide for effective management of the coast, the Scottish coast has been divided into units or “coastal cells”, based on beach sediment movement (H R Wallingford 1997). A coastal cell is defined as a length of coastline which is relatively self-contained as far as the movement of sand or shingle along the beach or nearshore is concerned and where interruptions to such movement should not have a significant effect on adjacent sediment cells (H R Wallingford 1997). The purpose of identifying these cells was to allow future management of the coastline to be conducted according to natural processes rather than administrative boundaries. Ideally, the SMP area should be defined by these boundaries such that management of coastal processes can take place in a holistic manner for the entire cell. The concept of sediment cells and sub-cells with respect to the East Lothian shoreline is discussed further in Chapter 4.

The East Lothian coast forms part of the southern shoreline of Cell 1, which extends from St Abb's Head in the south to Fife Ness in the north (HR Wallingford 1997). Coastal management plans and strategies that have been developed for this, or adjacent, coastal cells will have to be taken into account during development of the East Lothian SMP. These include:

- St Abbs Head to the River Tyne SMP
- Shoreline Management Plan of Fife.
- The Forth integrated Management Strategy

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The St Abbs Head to River Tyne SMP lies to the south of the coast under consideration, and thus will potentially have an impact on the East Lothian coastline, although HR Wallingford (1997) define St Abb's Head as a drift divide (and thus cell boundary). The SMP of Fife extends along the northern shore of the Forth estuary and Firth of Forth and management strategies developed for the Fife shoreline will potentially have impacts on the East Lothian coast. Any strategic coastal defence options developed for East Lothian must be compatible with the preferred options identified for adjacent management units, as well as the ongoing processes within the sediment cell.

The Forth Integrated Management Strategy, published by the Forth Estuary Forum in 1999, is a non-statutory document setting out a strategy for effective and integrated management of the Forth (defined from the tidal limit at Stirling to Fife Ness in the north and Dunbar in the south). The strategy and action plan contains several themes, several of which are particularly relevant to the development of the SMP

**Table 2.1 The Forth Integrated Management Strategy: Themes and objectives relevant to development of the SMP**

| Theme | Name                                                              | Objective                                                                                                                                                                                                                                                                                                                              |
|-------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Management of Coastal Processes                                   | To allow the natural coastal processes of sediment erosion, transport and deposition to function unimpeded by human intervention and, where this is not viable, to ensure that proposals for new developments or activities in the Forth are made in the light of a full understanding of their potential effects upon these processes |
| 4     | Access to and enjoyment of the Forth                              | Partners are encouraged to promote appropriate and sustainable public access to the Forth, publicising suitable facilities and locations for tourist and recreational use through high quality information and interpretative material                                                                                                 |
| 5     | Improvement of environmental quality                              | To maintain and enhance the Forth's environmental quality both at the coastline and in the water                                                                                                                                                                                                                                       |
| 6     | Conservation of the Forth's cultural heritage and landscape value | To ensure that the unique and varied cultural heritage resource of the Forth, both on land and underwater, is identified, fully appreciated, sustained and where possible enhanced                                                                                                                                                     |
| 7     | Maintenance of biodiversity                                       | To protect and enhance the habitats and species of the Forth                                                                                                                                                                                                                                                                           |
| 8     | Strategic planning                                                | To ensure that planning policies concerning the Forth are up-to-date, informed and holistic                                                                                                                                                                                                                                            |

One of the key actions of Theme 1 of the Integrated Management Strategy is to “prepare a Forth-wide Shoreline Management Plan, for the coastline not yet covered, which incorporates statutory guidance and covers coastal defence, land-use planning and development” (Forth Estuary Forum 1999). The completion of the East Lothian Shoreline Management Plan goes some way towards achieving this.



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Key issues relating to coastal defence in the Forth Estuary are outlined in the coastal defence topic paper report (Forth Estuary Forum 1998) and recommendations are set out. One of the key recommendations is that a Shoreline Management Plan (SMP) be prepared for the Forth shoreline. Successful implementation of a SMP depends fundamentally upon the co-ordination of those responsible for the funding and construction of coastal defences in the Plan area. In the Forth, these are the local authorities, Forth Ports PLC, the MoD, Railtrack and various private landowners and it is recommended that a Coastal Defence Liaison Group (CDLG) be established to enable implementation of a Forth-wide SMP (Forth Estuary Forum 1998). Other recommendations relate to the siting of new development at the coast (following NPPG 13); the need for cognisance of natural processes when planning coastal development; special considerations for development affecting designated sites; and further research and monitoring. It is recommended that a map and inventory of coastal defences in the Firth of Forth be carried out (recommendation 9.1); this SMP goes some way to achieve this.

#### **2.1.4 East Lothian Development Plans and Other Initiatives**

A key part of the context setting exercise is to ensure that the essential linkages between the Council's five main departments are fully understood and how they will relate to the formulation and implementation of the SMP.

#### **East Lothian Structure Plan**

The relevant Structure Plan, which covers East Lothian, is the Lothian Structure Plan 1994. This Plan was jointly produced and published by East Lothian Council, The City of Edinburgh Council, Midlothian Council and West Lothian Council. Preparation of the structure plan preceded the publication of NPPG 13, and thus does not follow the recommendations and criteria set out for coastal planning. The key features of relevance to the development of the SMP of the Lothian Structure Plan 1994 are summarised in Table 2.2.

The revised Edinburgh and the Lothians Structure Plan (2001) is at the consultation stage and has not been finalised. Once the plan is agreed, it will be published for public consultation. The current timetable is that a consultative draft plan will be approved by the end of the November and published in December 2001. The consultation period will last until the end of February and when Scottish Ministers approve the plan, it will repeal and replace the Lothian Structure Plan 1994. The revised structure plan was formulated taking into account the Government's nation planning policy and best practise guidance and sets out the long-term strategy for the development to 2015. The recommendations of NPPG 13 have been followed and the Structure Plan sets out broad areas of the coast to be defined as developed, undeveloped and isolated (paragraph 7.7).

The overarching aim of the Structure Plan is "to provide for the development needs of Edinburgh and the Lothians in accordance with the principle of sustainable development whilst maintaining and enhancing the environmental heritage that underpins the area's quality of life" (paragraph 2.6).

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**Table 2.2 Relevant Policies and Proposals within the East Lothian Structure Plan 1994**

| Relevant Policy/Proposal                                                          | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Policy ENV 5<br>Environment – Conservation & Improvement                          | Local Plans shall contain policies to maintain and enhance the character of conservation areas and to protect all listed buildings and their settings                                                                                                                                                                                                                                                                                                                                        |
| Policy ENV 6<br>Environment – Conservation & Improvement                          | There is a presumption against development that will destroy or adversely affect scheduled ancient monuments, sites and areas of significant archaeological or historic interest and their setting.                                                                                                                                                                                                                                                                                          |
| Policy ENV 12<br>Environment – Green Belt Extensions & Environmental Improvements | There is a presumption against development or changes of use in the green belt unless necessary for the purposes of agriculture, horticulture, forestry, and countryside recreation or other uses appropriate to the rural character of the area.                                                                                                                                                                                                                                            |
| Policy ENV 21<br>Environment – Landscape                                          | Local plans shall: <ul style="list-style-type: none"> <li>• Safeguard areas of great landscape value;</li> <li>• Identify &amp; protect historic gardens &amp; designed landscapes of particular value;</li> <li>• Contain policies for their conservation &amp; enhancement of other valuable landscapes;</li> <li>• Encourage the preparation of integrated management plans where appropriate; and</li> <li>• Define any policy areas for specific rural developments.</li> </ul>         |
| Policy ENV 24<br>Environment – Nature Conservation                                | Development will only be permitted within designated or proposed sites (i.e. SPAs, SACs, RAMSAR) whereupon: <ul style="list-style-type: none"> <li>• An appropriate assessment indicates no significant adverse effect;</li> <li>• There are no alternative solutions; and</li> <li>• Overriding public interest allow it to happen</li> </ul> The above criteria broadly apply for NNRs, SSSIs, and Regional/Local Nature Conservation areas, with the exception of appropriate assessment. |
| Recommendation ENV 26<br>Environment – Nature Conservation                        | Local plans review resources of importance to nature conservation, identify priorities for enhancement, and promote action to create new habitat in both urban and rural areas.                                                                                                                                                                                                                                                                                                              |
| Policy ENV 27<br>Environment – Coastal and Estuarial Waters                       | There is a presumption against land reclamation from the sea that could adversely affect the ecology or the amenity of the coastal or estuarial shoreline.                                                                                                                                                                                                                                                                                                                                   |
| Policy ENV 28<br>Environment – Coastal and Estuarial Waters                       | Where appropriate, local plans shall: <ul style="list-style-type: none"> <li>• Protect coastal landscapes &amp; wildlife habitats;</li> <li>• Promote environmental improvements &amp; recreational opportunities consistent with the character of the coast;</li> <li>• Promote the preparation of coastal management plans;</li> <li>• Contain appropriate conservation &amp; recreation policies for the conservation coastline.</li> </ul>                                               |
| Recommendation ENV 29<br>Environment – Coastal and Estuarial Waters               | It is recommended that the Government designate the Firth of Forth as an EC Special Protection Area as a coastal habitat important for the conservation of wild birds (note: this has since been designated)                                                                                                                                                                                                                                                                                 |

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| Relevant Policy/Proposal                                                      | Comment                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Policy H 7<br>Housing – Strategic Locations for major new housing development | Land shall be allocated in local plans for the approximate numbers of private owner-occupied sector dwellings in the locations shown below: <ul style="list-style-type: none"><li>• Mussleburgh/Wallyford (600);</li><li>• Prestonpans/Cockenzie/Port Seton (800);</li><li>• North Berwick (200);</li><li>• Dunbar (700).</li></ul> |

The Structure Plan aims to encourage a more sustainable pattern of development by:

- Focussing investment on the regeneration of disadvantaged areas;
- Making the best use of scarce resources such as land, buildings and infrastructure;
- Requiring the redevelopment of brownfield land in preference to greenfield land;
- Ensuring that new development is located so as to reduce the need to travel and to facilitate access by foot, cycle and public transport;
- Protecting and enhancing the built and natural environment.

The policies of key relevance to the SMP are set out in Chapter 7 (Environment) of the Structure Plan and summarised in Table 2.3. Implementation of the policies of the Structure Plan is the responsibility of the Councils, through local plans and development control decisions. East of Scotland Water, the Scottish Executive, Scottish Enterprise and the private sector also play a role in bringing forward the development opportunities highlighted in the Plan.

### East Lothian Local Plan

The 7 Local Plans that cover East Lothian are in the process of being replaced by a single Plan, The East Lothian Local Plan 1998: Finalised Draft (with approved modifications, Oct 2001)

The Local Plan has been minded to adopt in 2001, subject to legal challenge.

The 1998 Local Plan addresses planning matters relevant to the SMP, including the countryside and coast (chapter 3), tourism (chapter 8), education & community services (chapter 10) and utilities & infrastructure (chapter 11). Understanding the policies and proposals of this Plan in relation to the SMP will be vitally important since they cover issues relating to:

- Nature conservation areas (SSSIs, SPAs, Listed Wildlife Sites);
- Areas of Great Landscape Value, including coastal areas;
- Countryside Access;
- Importance of tourism (attractive coastline important);
- Torness Consultation Zone (consultation is generally confined to proposals affecting local population increase and industrial development, however it would be appropriate to consider any implications resulting from SMP recommendations).

The approved modifications (2001) to the Local Plan state that any requirement resulting from NPPG 13 will be incorporated by appropriate review and alterations.

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**Table 2.3 Relevant Policies and Proposals in the Edinburgh and Lothians Structure Plan Draft (2001)**

| Relevant Policy/Proposal                            | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ENV1 Safeguarding the natural and built environment | <p>Development affecting international and national natural heritage designations and the historic environment will be assessed under the terms of the national planning policy:</p> <ul style="list-style-type: none"> <li>• Development which would have an adverse effect on SACs, SPAs and RAMSAR sites will only be permitted where it can be demonstrated there is no alternative solution and there are imperative reasons of overriding interest. An appropriate assessment will also be required.</li> <li>• Development affecting nationally important designated sites (SSSIs) will only be permitted if the overall integrity of the site is not compromised or the adverse effects are outweighed by social or economic benefits of national importance. An appropriate environmental or biodiversity assessment is required. Where development is permitted, mitigation measures must be included to reduce adverse impacts and provide sustainable habitat replacement.</li> <li>• Special attention must be taken to preserve or enhance the character or appearance of a designated built or cultural heritage site.</li> </ul> |
| ENV3 Development in the Countryside                 | <p>Development in the countryside will only be allowed where it has an operational requirement for such a location or is compatible with the rural character of the area (which includes agricultural, horticultural, forestry and countryside recreation uses). Exceptions include tourism or recreation uses, reuse of redundant rural buildings, development that promotes diversification of the rural economy.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| ENV4 Landscape                                      | <p>The range of landscape designations will be reviewed to meet a consistent framework. Policies to protect the designated landscapes will be included in local plans and landscape designations will be added to ENV1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| ENV5 The Coast                                      | <p>Broad areas of developed and undeveloped coast have been defined in the Key Diagram contained within the Structure Plan. Local plans should define detailed boundaries and apply national planning policy.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| ENV12 Flooding                                      | <p>The risk of flooding should be reviewed. Development that may lead to a significant increase in the risk of flooding, or that may be at risk to flooding, should not be permitted.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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**Table 2.4 East Lothian Local Plan 1998: Finalised Draft (& Approved Modifications, Oct 2000)**

| Relevant Policy/Proposal                                                                                    | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chapter 3 - The Countryside &amp; Coast</b><br><br>POLICY DC1<br>Development in the Countryside & Coast. | <p>Development should not normally be permitted within the undeveloped coast except in very specific circumstances, which depends on the purpose and requirement of the development being appropriate to the character of the area. In those permitted circumstances, development must be well integrated into the landscape by virtue of its design and siting.</p> <p>The local plans refers to the following supplementary documentation for natural heritage resource interests:<br/>           ASH Consulting Group (1998) The Lothians landscape character assessment<br/> <u>Scottish Natural Heritage Review No 91</u><br/>           Phase 1 Wildlife Habitat Survey for East Lothian (funded by SNH &amp; ELC);<br/>           Local Biodiversity Action Plans;<br/>           Local Agenda 21 (ELC), which sets out the framework for Sustainable Development</p> |
| POLICY DC2<br>Development in The Edinburgh Green Belt                                                       | <p>As per the Structure Plan (Policy ENV12), there is a presumption against development/changes in the Edinburgh Green Belt, unless the development is rurally appropriate (e.g. agriculture, horticulture, forestry, countryside recreation).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| POLICY DC3<br>Wildlife & Geological Areas                                                                   | <p>Development will only be permitted within SPA/SSSIs if there is no significant adverse effect on the subjects being safeguarded; or there are no alternative solutions; and there is overriding public interest to allow it to happen.</p> <p>There are over 20 SSSIs (listed in Appendix 3 of the Local Plan) within East Lothian covering areas of biological/geological importance, however the coastal SSSIs have recently been merged to form the Firth of Forth SSSI. There are 2 SPAs, the Forth Islands SPA (comprising the islands of Fidra, Lamb, Craigleith and the Bass Rock) and the recently designated Firth of Forth SPA/Ramsar site.</p>                                                                                                                                                                                                                 |
| POLICY DC4<br>Areas of Great Landscape Value (AGLVs)                                                        | <p>Development that harms the landscape character and visual amenity of Areas of Great Landscape Value (AGLV) will not be permitted. AGLVs are designated by the local authority and thus are of local importance. They are shown on the Proposals Map and include parts of the coast comprising beaches, bents, dunes, cliffs and rocky foreshore.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| POLICY DC5<br>Historic Gardens and Designed Landscapes                                                      | <p>In accordance with Policy DC1, and 1994 Structure Plan (Policy ENV21), development that would harm the conservation objectives of areas within the Inventory of Gardens &amp; Designed Landscapes will not be permitted. There are currently 19 Inventory sites within East Lothian (Appendix 4 of the Local Plan).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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**Table 2.5 East Lothian Local Plan 1998: Finalised Draft (& Approved Modifications, Oct 2000) Continued**

| Relevant Policy/Proposal                                                                             | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chapter 8 - Tourism</b><br><br>POLICY TOUR1<br>Enabling Development                               | Where justified as an exception to Policy DC1, tourism related development shall be permitted if: <ul style="list-style-type: none"> <li>It is both essential and necessary to achieve the primary tourism resource; and</li> <li>the economic and other benefits securing that resource justify its inclusion; and</li> <li>it is well integrated into its landscape setting and consistent with other Local Plan policies</li> </ul>                                                                                                                                                                                                                                           |
| <b>Chapter 8 - Tourism</b><br><br>LOCAL PLAN PROPOSALS                                               | Several proposals for tourism development may have implications for the SMP. These are:<br><br>Proposal DN1 Archerfield Estate: The Council supports the principle of a high quality golf-based hotel, leisure and recreation development within Archerfield Estate, in association with the restoration of Archerfield House and its designed landscape.<br><br>Proposal LY1 Gosford Estate: Planning permission has been granted for a high quality golf-based hotel, leisure and hotel development at Gosford Estate and Craighielaw.                                                                                                                                         |
| <b>Chapter 10 – Education and Community Services</b><br><br>Proposal C5 Countryside Access           | The Council managed some 47km of coast and is committed to develop a more comprehensive and integrated access network, taking into account the nature conservation importance and fragility of the coast. Proposal C5 states that the Council will commission a study to develop a strategy for a sustainable path network that will link East Lothian's coast and countryside. This has been completed and the report is:<br><br>Halcrow Fox (1998) A Sustainable Path Network for East Lothian. Final report, Volumes 1 and 2. A report prepared for East Lothian Council, Lothian and Edinburgh Enterprise Ltd, Scottish Natural Heritage and The Paths for all Partnerships. |
| <b>Chapter 11 - Utilities &amp; infrastructure</b><br>POLICY NRG1<br>Electricity Generating Stations | Land identified for use or in association with a power generating station is safeguarded for that purpose. Uses incompatible with such use will not be permitted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| POLICY NRG2<br>Torness Consultation Zone                                                             | All relevant planning applications received within a 4km radius of the Torness Generating Station will be referred to Scottish Nuclear for their Observations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| POLICY NRG7<br>Pipeline Consultation Zone                                                            | Development within 460 metres of the St Fergus to Bishop Auckland gas pipeline will be referred to British Gas & the Health & Safety Executive for their observations before determining the application                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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## **East Lothian Draft Community Plan**

The East Lothian Community Plan was produced by the main public agencies in East Lothian and is the first step to collectively address the major issues that affect East Lothian. It aims to ensure that public sector agencies work together to plan and deliver services to benefit their communities and reflect the views and aspirations of local people through continued public consultation. It is important that the objectives and strategies of the SMP relate to the emerging strategic objectives in terms of environment, economics and social inclusion for East Lothian, as set out in the Community Plan. The Community Plan also covers Local Agenda 21 issues.

The East Lothian Community Plan is based on 3 inter-related themes:

- The Social Theme, which encourages social inclusion, effective consultation and community participation;
- The Economic Theme, which aims to improve the economic and business opportunities in East Lothian. It is recognised that tourism and the outstanding natural environment and heritage are important to the economy of East Lothian. Thus protecting and enhancing the local environment, increasing visitor attractions and expenditure and expanding and improving visitor accommodation are all aims within the economic theme.
- The Environmental Theme, which aims to promote the environment within East Lothian. It aims to improve consultation and community participation, by making use of existing resources such as the East Lothian Environmental Forum. Other aims relevant to the SMP include: reassessing existing cycling and walkways; ensuring regular monitoring and publication of Sea Bathing Water Quality; promoting green tourism; improving community education and awareness of environmental issues.

Following the consultation phase an amended Community Plan that reflects the priorities of the local community will be finalised. An East Lothian Citizens Panel will be established, which will act as a regular sounding board to inform public service delivery. In addition, 3 forums for discussion of social, economic and environmental issues have been established. SMP issues lie mainly within the Environment Forum.

## **East Lothian Draft Environmental Strategy 2000-2005**

The UK Government requires all local authorities to prepare and adopt a Local Agenda 21 Action Strategy. Such a plan should “integrate social, economic and environmental objectives to provide a long term participatory vision, action plan and monitoring programme linking the global problems of climate change, biodiversity loss, unemployment and poverty by attempting to provide solutions at a local level” (Tony Blair, UN General Assembly June 1997). East Lothian Council does not have a Local Agenda 21 Action Plan (J Squires, pers. comm. 2001). However, the draft Environmental Strategy covers issues of sustainability and sets out an Action Plan to improve the Council’s own performance and to integrate the principles of sustainable development into all aspects of the Councils activities (East Lothian Council 2000a).

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The Strategy is closely linked with the Community Planning Strategy outlined above and covers the following 9 environmental themes:

- Energy and Buildings
- Transport
- Economy
- Built Environment
- Natural Environment
- Waste
- Land, Water and Air Quality
- Education and Participation
- Environmental Management

Objectives of key relevance to the development of the SMP are summarised in Table 2.6.

**Table 2.6 East Lothian Draft Environmental Strategy, objectives of relevance to development of the SMP**

| Relevant Objective                                                                                                                           | Key aims                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T2 Encourage walking and cycling                                                                                                             | To improve access for all ages and ability to countryside and coastal sites, by expanding public access to beaches. To complete the path network throughout East Lothian |
| ECON3 Promote sustainable tourism                                                                                                            | To take forward the North Sea Heritage Route, promote and develop the North Sea cycle route, achieve 4 Tidy Britain Seaside Awards.                                      |
| NE3 To undertake and promote sustainable land management                                                                                     | Introduce a Beach Watch Initiative by 2002; implement the Park and Open Space Strategy for East Lothian; develop a SMP by 2002;                                          |
| W4 Reduce levels of inappropriately placed waste                                                                                             | Review litter policies and practises; continue development of the Dog strategy (EP5); monitor levels of fly-tipping                                                      |
| LWA3 Encourage and support ESWA and SEPA in programmes to further improve water quality in East Lothian's rivers, streams and coastal waters | Develop a strategy for evaluating the environmental impact (and promote improvement) of septic tank discharges                                                           |



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## **East Lothian Corporate Plan 2001 to 2004**

Appendix 3 of the Corporate Plan summarises the Council's Manifesto Commitments in Policy relating to Economic Development, Social, Environmental and Local Democratic issues (East Lothian Council 2001b). Policies specifically relevant to the SMP, that have not been discussed elsewhere, are:

- EDP17 Roll-on/roll-off terminal in East Lothian
- EDP22 Promotion of coastal visitor trails
- EDP23 Improve harbour areas at Fisherrow, North Berwick, Dunbar and Cockenzie to attract more visitors
- EP16 Working with other partners to develop a strategy of coastal protection
- EP17 Complete the development of sustainable pathways and cycleways
- EP24 Further expand/develop public access to the coast

## **A Strategy for Parks & Open Spaces in East Lothian**

East Lothian's strategy for parks and open spaces is based on the vision that they "contribute more to the character and quality of life of the area, than merely providing opportunities for recreation" (East Lothian Council 2000b). The strategy aims to ensure that the full potential of parks and open spaces is realised, moving towards a more integrated and inclusive approach to their management. The strategy is translated in 14 objectives (p29-30), several of which may be relevant to the development of the SMP in terms of access and control of litter:

- Objective 6 To maximise access to country and forest parks for urban populations and to maintain them in a manner that maximises their potential for environmental education and informal recreation
- Objective 7 To facilitate public access and enjoyment of designed/golf landscapes through liaison with landowners and appropriate management agreements/mechanisms.
- Objective 14 To introduce, publicise and enforce measures to address dog fouling and potential dog threats in East Lothian's parks and open spaces.

## **Heritage in East Lothian: The Way Ahead 2001 to 2004.**

This document sets out the heritage strategy for East Lothian for the next 4 years (East Lothian Council 2001c). Heritage includes archaeology, archives, building, cultural heritage, family history, historic events and figures, cultural landscapes, industrial archaeology, museums and natural heritage. Much of the East Lothian coast contains outstanding natural heritage and many of the cultural landscapes and archaeological sites of importance lie at, or close to, the coast. Thus, the SMP should be developed with consideration of the heritage strategy. The strategic issues for heritage development in East Lothian are:

- Access
- Conservation
- Partnership
- Management

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The strategy includes the creation of the John Muir Way along the East Lothian coast and the conservation and improved access to some of the sites of archaeological heritage within East Lothian.

### A Sustainable Path Network for East Lothian

This study by Halcrow Fox was commissioned by a partnership comprising East Lothian Council, SNH, LEEL and the Paths for all Partnership to develop a strategy and action plan to create a sustainable path network linking East Lothian's coast and countryside. The strategy aims to widen the range of people who visit and enjoy the coast. The current coastal path covers approximately 45km of the 69km length of East Lothian coastline. A preferred coastal corridor route is recommended in the report, however one of the key constraints includes potential for conflicts with certain land-owning interests along some coastal stretches. The Council own and have established access arrangements on a large proportion of the coast making this path network a real opportunity.

The strategy for a coastal path along the entire East Lothian coast is an initiative stressed in many Council policies and strategies and will be taken into consideration during the development of the SMP.

### The Lothian's Landscape Character Assessment

This study was commissioned by Scottish Natural Heritage and provides a detailed assessment of the landscape character of the Lothians.

**Table 2.7 Guidelines for management of landscape management areas on the East Lothian coast (source: ASH Consulting Group 1998)**

| Character Area                      | Guidelines for management                                                                                                                                                                                                                                                                |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23 Dunbar Plain                     | <ul style="list-style-type: none"><li>• Protect from sand and gravel extraction</li><li>• Take particular account of vulnerability of coastline to further visual intrusion from all types of development</li><li>• Control further unauthorised vehicular access to coastline</li></ul> |
| 24 North Berwick Plain              | <ul style="list-style-type: none"><li>• Promote integrated coastal zone management strategy including visitor management, tourism, recreation and other development</li><li>• Seek to secure long term management of important estate landscape features</li></ul>                       |
| 25 Musselburgh / Prestonpans Fringe | <ul style="list-style-type: none"><li>• Seek to secure long term management of important estate landscape features</li></ul>                                                                                                                                                             |

The study considers the likely pressures and opportunities for change in the landscape, assesses the sensitivity of the landscape to change and includes guidelines indicating how landscape character may be conserved, enhanced or restructured. 26 landscape character areas were identified, 3 of which cover the East Lothian coastline in its entirety (Table 2.7). Guidelines for management for each landscape character area are developed in the report and those relevant to development of the SMP are summarised in Table 2.7. The management guidelines are primarily intended to set the context for SNH staff, however SNH hope that East Lothian Council will use the information during development of local /structure plans and other initiatives (ASH Consulting Group 1998).

## **2.2** Local Planning Issues and Applications

A meeting was organised with Jean Squires of East Lothian Council Planning Department in order to determine the nature of any local planning issues and applications that should be taken into account during the development of the SMP (Table 2.8). A five-year management plan for Archerfield and Yellowcraig has been prepared by East Lothian Council, with assistance from Scottish Natural Heritage, in order to satisfy the concerns of SNH and ELC pertaining to the planning application (East Lothian Council 2000c). The proposed development at Archerfield of golf courses with associated clubhouse, restoration of Archerfield House and construction of 150 houses will create one of the finest golfing destinations in the country (East Lothian Council 2000c). However, due to the sensitive location of the site and the natural heritage and other designations of the site, a management agreement has been drawn up. The SMP will take the management agreement into account when developing the preferred option for coastal defence along this stretch of coast.

Conservation designations (such as SSSIs and SPAs/SACs) confer specific legislative protection and rights, discussed above. There are currently 2 SPAs in East Lothian (the islands of Fidra, Lamb, Craigleith and the Bass Rock, which comprise the Forth Islands SPA) and the newly designated Firth of Forth SPA/Ramsar site, which is broadly based on the existing coastal SSSI network (See Chapter 7).

Much of the coastal area of East Lothian is designated SSSI, the scientific importance of which is discussed in Chapters 7 and 9. Site descriptions and maps are contained within Appendix F. The original SSSI network has recently been modified to form the Firth of Forth Site of Special Scientific Interest. This large site supersedes the individual SSSI network, although management statements have been prepared for the original SSSIs, which contain a description of the site, a review of past management practises, present land use, evaluation of current condition, factors influencing management and objectives for management. Management objectives will be taken into account when developing the preferred option for coastal defence in the SMP.

Detailed management plans have been prepared for Aberlady Bay LNR (East Lothian Council 1977, 1997) and John Muir Country Park (East Lothian Council 2000d). These are taken into account and reviewed in Chapter 9 during the discussion of management units.

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**Table 2.8 Local Planning Issues and Applications on the East Lothian Coast (from meeting with East Lothian Planning Department)**

| Location                                      | Planning Issue/ Concern                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Musselburgh Ash Lagoons                       | Former plan was to develop housing on the site (Dutch village style). However the plan is to leave for wildlife/recreation as the site is designated for birds. Scottish Power has an application to extract pulverised fuel ash (PFA) from lagoon No. 6. The old lagoons are capped and are grass with piles. They are used as wader feeding ground. Scottish Power has a 15 years extraction licence (Scottish Power 1995).                                                                                                                                                                                                                                                                                                                                                  |
| Old harbour at Prestonpans (at Mining museum) | The harbour was filled in approximately 15 years ago. The Council are keen to see the harbour reopened.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Prestonpans / Skateraw                        | East Lothian Council has a long-term commitment to developing a roll-on/ roll-off ferry terminal in East Lothian (EDP17). The Council were considering Prestonpans, but are now considering Skateraw (beside Torness Power Station).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Seton Sands Caravan Park                      | The Caravan Park has poor access to the beach, as the road runs between the park and beach. The Council do not want this situation to be made any worse (i.e. by constructing coastal defences etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Aberlady to Dunbar                            | All of this coastline, with the exception of Gullane, is protected by national and international designations for natural heritage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Archerfield Development                       | There are proposals to develop a golf course complex and luxury houses at Archerfield, along the coastal frontage. The development extends right down to the shore and a management plan for the site has been prepared including a sea-buckthorn barrier along most of frontage. The planning application contains details of archaeology, traffic assessment and environmental assessments.                                                                                                                                                                                                                                                                                                                                                                                  |
| North Berwick Pool site                       | The Council has plans to develop the site of the old swimming pool at North Berwick Harbour. There are no firm plans yet, but there is a long-term commitment to develop the site. Boats are stored there at present.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| North Berwick                                 | There are plans to convert the red sandstone warehouse, close to the pool site, to flats                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Dunbar                                        | The Council is keen on any plans to redevelop/regenerate Dunbar. Specific issues are: <ul style="list-style-type: none"> <li>• There is a plan to upgrade the mock granary beside Dunbar Harbour.</li> <li>• Continued deterioration of Dunbar castle, rocks periodically fall into the harbour entrance. However, the Council plan to do nothing, as repair work at the castle would cost in the order of 1,000,000's.</li> <li>• The old barrage at Broadhaven harbour is approximately 20 years old and is affected by flooding during spring tides. The barrage needs to be rebuilt.</li> <li>• The harbour walls are regularly breached. This is dealt with by the harbour trust.</li> <li>• Ramp access to East Beach causes occasional flooding to property.</li> </ul> |
| Blue Circle Cement Works, Dunbar              | Blue Circle has consent for the extraction of limestone. Creates a local air quality problem.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Torness Power Station                         | Consultation zone for any proposed developments close to Torness. No real issues here.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Dualing of A1, south of Dunbar                | The Council plan to convert the A1 to dual carriageway south of Dunbar. This may affect the coast, however it is likely that the new route will swing inland, away from coast.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**2.3** Implications of the current planning policy and local initiatives on SMP objectives

The management objectives for the Shoreline Management Plan are set out in Section 1.3. The above review of the current legislative, planning and local context of East Lothian shows that the SMP objectives are broadly compatible with the local context. In particular, the development of an SMP for East Lothian specifically targets East Lothian's manifesto commitment to develop a strategy of coastal protection (EP16). Development of an SMP is also compatible with the objectives of the Forth Estuary Forum (Forth Estuary Forum 1999), however, the Forum advocates a cell-wide SMP, which is not practicable given the number of authorities responsible for coastal defence in the Firth of Forth. The East Lothian SMP developed herein should be compatible with the aims and objectives of the Fife SMP (Posford Duvivier 1998).

The Council's commitment to providing a sustainable coastal path will be taken into account when developing the SMP, but does not present any potential conflict. Other local issues such as the development of a roll-on, roll-off ferry terminal and cognisance will be taken of the objectives and initiatives set out in the Strategy for Parks & Open Spaces, Community Planning, the Heritage Strategy, the Environmental Strategy and the Local and Structure Plans.

Management Plans, which have been prepared for specific areas (such as Archerfield, John Muir Country Park and Aberlady Bay) will be taken into account during the appraisal and selection of strategic coastal defence options for those coastal units. In addition, the option appraisal process will utilise the management objectives set out for the SSSI coastline, provided in the management statements produced by SNH.

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### 3 Consultation

Consultation is a key step in the formulation of the Shoreline Management Plan. The importance of consultation cannot be overemphasised, as the co-operation of all interested parties throughout the planning process will allow for smooth adoption of the final Plan. It is essential to involve both statutory organisations and local interest groups in the development of coastal management options. Consultation also facilitates the collection of the wide range of information and data necessary for the study. In order to ensure that as wide an audience as possible could engage in the consultation process, we undertook a comprehensive written consultation stage and held 6 public meetings around the East Lothian coast.

#### 3.1 Written Consultation

Three categories of consultees were involved in the Shoreline Management written consultation process:

- L = Local organisations
- N = National /non-local organisations
- P = Local Public stakeholders

In discussion with East Lothian Council, it was agreed that each category would receive a different letter inviting their comments on the Shoreline Management process and inviting them to the public meeting.

In total 126 consultation letters were sent: 59 to local organisations (L), 57 national/non-local organisations (N) and 10 local public stakeholders (P). Appendix A contains the consultation letters. A summary of the written response to the consultation exercise is given in Table 3.1.

**Table 3.1 : Written Responses to East Lothian SMP Consultation**

| Type Of Consultees               | No of Letters Sent | No of Written Reponses |
|----------------------------------|--------------------|------------------------|
| Steering Group                   | 7                  | 2                      |
| Local Authorities                | 6                  | 2                      |
| Other Regulatory Consultees      | 11                 | 6                      |
| Harbour Authorities & Committees | 10                 | 1                      |
| Community Councils               | 10                 | 1                      |
| Commercial                       | 19                 | 1                      |
| Land-owners                      | 5                  | 0                      |
| Environmental                    | 27                 | 7                      |
| Recreation                       | 24                 | 7                      |
| Estuary/Coastal Organisations    | 3                  | 1                      |
| Other Technical                  | 4                  | 1                      |
| Total                            | 126                | 29                     |
| % Response                       |                    | 23%                    |

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Issues raised during the consultation process were taken on board while developing the management options for management units (Section 9). Other respondents provided data and information relevant to the SMP process.

The written consultation exercise was followed up by phone-calls to the Golf Courses around East Lothian, in order to encourage participation in the consultation exercise. Responses summarised in Table 3.2 indicate the main concerns are coastal erosion and rights of way issues.

**Table 3.2: Response from Golf Courses to SMP Consultation**

| <b>Golf Course</b>        | <b>Written Response</b> | <b>Verbal Response</b> | <b>Attendance at SPI</b> | <b>Concerns</b>                                                                                                                                                                                                                                   |
|---------------------------|-------------------------|------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Longniddry                | No                      | No                     | ?                        | Road between golf course and coast, therefore unlikely to have major concerns                                                                                                                                                                     |
| Kilspindie                | No                      | Yes                    | ?                        | Wemyss and March Estates own and manage the land. Only concern Kilspindie have is rights of way issue.                                                                                                                                            |
| Wemyss and March Estate   | No                      | Yes                    | ?                        | Own all land from Aberlady to Seton Sands.                                                                                                                                                                                                        |
| Luffness                  | Yes                     | n/a                    | ?                        | Priority to avoid any encroachment of the sea onto the golf course.                                                                                                                                                                               |
| Gullane                   | No                      | Yes                    | Yes                      | Do not have any erosion problem. Concern over rights of way (potential implications of the new "Rights to Roam" Legislation)                                                                                                                      |
| Muirfield                 | No                      | Yes                    | ?                        | Happy with SMP process and do not wish to input                                                                                                                                                                                                   |
| North Berwick West Links  | Yes                     | n/a                    | Yes                      | Concerned with coastal erosion                                                                                                                                                                                                                    |
| North Berwick East (Glen) | Yes                     | Yes                    | Yes                      | Concerned about erosion on 13/14th holes. Specific request for professional monitoring                                                                                                                                                            |
| Dunbar Winterfield        | No                      | No                     | ?                        | No response                                                                                                                                                                                                                                       |
| Dunbar East Links         | Yes                     | Yes                    | ?                        | Dunbar Golf course interests are to protect their course - plan to: 1. move large rocks to HWM to protect 14th green 2. erect a manmade barrier around 15th tee and along 15th fairway 3. place boulder and wire cages along edge of 17th fairway |



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#### 3.2 Public Participation

Extensive public consultation exercises were carried out in and around six areas of the East Lothian coast (Musselburgh, Prestonpans, Cockenzie & Port Seton, Longniddry, Gullane, North Berwick). Each area event included:

- running an afternoon meeting for agency staff and/or those people who wouldn't normally be able to attend an evening meeting;
- getting out and about to meet users of the shoreline (for example: fishermen, bird watchers, ramblers, recreational users, youths, shore residents etc.) and
- running an evening open meeting for the public and those who may not be able to attend an afternoon meeting.

Scottish Participatory Initiatives (SPI) carried out the public participation exercise and the results and raw data are reported in "SPI (2001) East Lothian Shoreline Consultation".

A total of 382 people expressed their views to the team of SPI facilitators, split approximately evenly between areas (Table 3.3). A diverse range of interests was represented at the SPI meetings (Figure 3.1). Path users represented the largest interest group (156) and shore residents represent the second largest group (90).

**Table 3.3 Number of people who participated in the SPI consultation exercise**

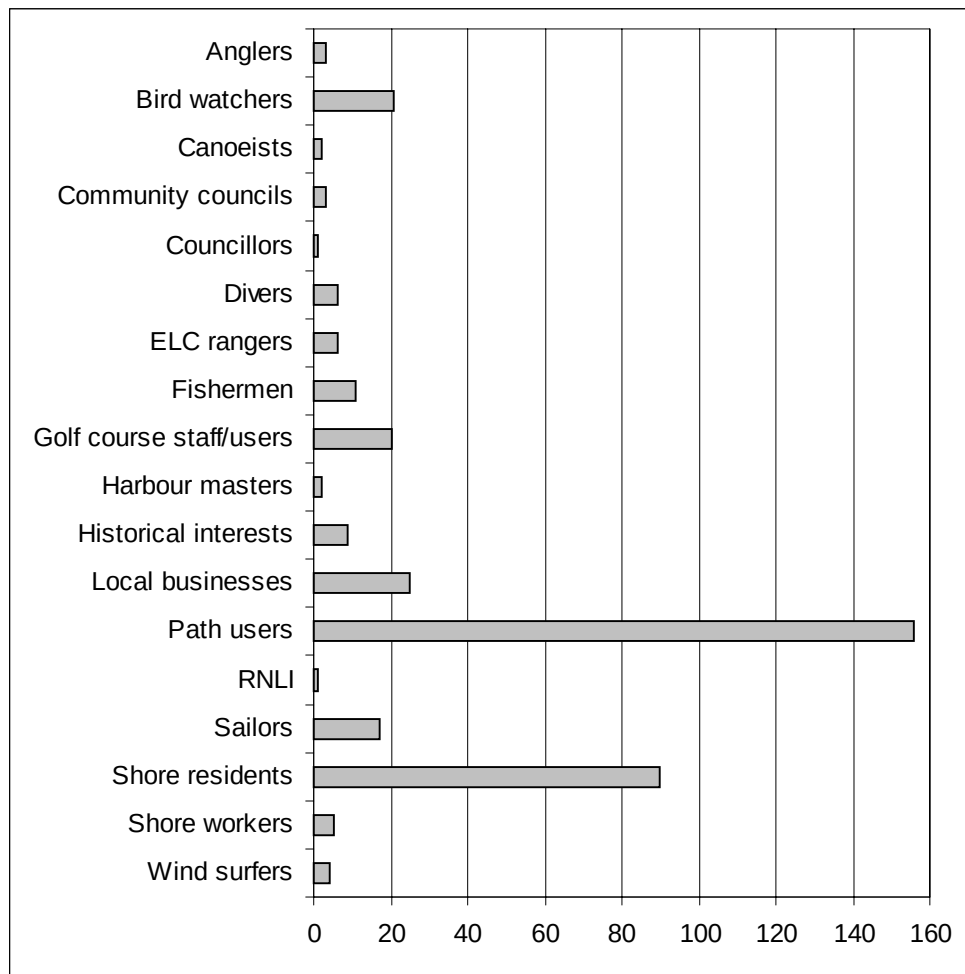
| Area                                  | Attendance |
|---------------------------------------|------------|
| Musselburgh                           | 65         |
| Prestonpans, Cockenzie and Port Seton | 68         |
| Longniddry                            | 58         |
| Gullane                               | 65         |
| North Berwick                         | 63         |
| Dunbar                                | 63         |
| <b>Total</b>                          | <b>382</b> |

The key issues and concerns expressed during the public participation process are discussed below for each area. Public comments were grouped according to location and the key issues expressed in a comment summarised into the relevant category. While it is accepted that this may be a subjective assessment of public opinion, it facilitates a better understanding of the key issues and concerns on the East Lothian coast. All results are given in Appendix B and the key issues discussed below.

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**Figure 3.1 Range of people who participated in the SPI consultation exercise**



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### **3.2.1 Musselburgh**

For the purposes of the public consultation exercise, the Musselburgh coastline extended from Joppa in the west (NT 320 736) to Port Seton in the east (NT 407 760). The 65 participants in the Musselburgh area were asked to give a score for the condition of the coast between 0 (couldn't be worse) and 10 (couldn't be better). The average score for Musselburgh was 6 and the modal score was 8.

#### **Concerns**

The main public concerns were related to Amenity issues (Appendix B). A breakdown of the concerns by location highlighted that Fisherrow was the area where public concern was highest, with 43% of the concerns relating to this area (Appendix B).

Only 15 out of the 89 concerns related to coastal processes, with 7 of these in the Fisherrow area. Other concerns in the Musselburgh area were related to litter, dog mess, safety, users, access and water pollution issues (Appendix B).

#### **Positive Aspects**

Wildlife, nature and views were seen as the most positive aspects of the Musselburgh coastline, with 25 out of the 73 comments relating to these issues (Appendix B). Other important positive aspects about this stretch of coast are related to general amenity value, walkways and improved cleaning of the beaches/walkways. Fisherrow and the Ash Lagoons received the largest number of positive comments from the public, with 25 and 15 of the comments related to each area, respectively (Appendix B).

#### **Suggested Improvements**

The public expressed 103 issues, relating to possible improvements along the Musselburgh coast. The majority of improvements related to improvements in cleaning/ maintenance of the coast and amenity issues (Appendix B). Other suggestions were related to improvements in coastal and flood defence, education and provision of information signs, nature conservation, access and users. Again, the Fisherrow area was the area that the public felt required the most improvement.

#### **Trends and Changes**

Only 10 comments were received related to trends and changes along the Musselburgh stretch of coastline (Appendix B). Of these, 4 were related to an increase in flooding and higher tides.

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### **3.2.2 Prestonpans, Cockenzie and Port Seton**

The Prestonpans, Cockenzie and Port Seton coastline extends from the Ash Lagoons, Musselburgh (NT350 740) in the west to Longniddry in the east (NT 437 767) and hence there is some overlap with the adjacent areas. 68 people participated in the consultation exercise for this stretch of shoreline and were asked to give a score for the condition of the coast between 0 (couldn't be worse) and 10 (couldn't be better). The average score was 5.6 and the modal classes were 5 and 7.

#### **Concerns**

The main concerns of the public of Prestonpans, Cockenzie and Port Seton can be summarised into three categories (Coastal Process, Other Litter and Water Pollution/Sewage) with 73% of the comments falling into one of these three categories (Appendix B). Concerns with coastal processes are mainly in the vicinity of Prestonpans, Cockenzie /Port Seton and Seton Sands (Appendix B). Specific comments and concerns were considered further when developing the management options for each management unit (Section 9) and used to highlight problem areas to target field visits.

#### **Positive Aspects**

Walkways were considered as one of the main positive aspects of this stretch of coast, with 21 of the 57 comments relating to this aspect. General amenity and wildlife, nature and view aspects were also considered as the principal positive aspects of the coast, each with 12 comments.

#### **Suggested Improvements**

The public of the Prestonpans, Cockenzie and Port Seton area suggested that significant improvements in cleaning and maintenance of the shoreline is required, with around 40% of the suggestions relating to these issues (Appendix B). 17% of the comments related to improvements in information signs/education, 13% related to general amenity and 10% related to improvements in coastal and flood defence (Appendix B).

#### **Trends and Changes**

Public comments relating to trends and changes in the Prestonpans, Cockenzie and Port Seton coastline covered a wide variety of issues, including fishing, amenity, changing sedimentation patterns, water quality improvements (Appendix B). However, 28% of the comments raised related to flooding and erosion issues, with erosion problems at Prestonpans, Preston Grange and Seton Sands highlighted (Appendix B).

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#### **3.2.3 Longniddry**

For the public consultation exercise the Longniddry shoreline extends from Seton Sands in the west (NT 415 759) to Aberlady Bay in the east (NT 461 818). 58 people attended the public meeting and when asked to rate the stretch of shoreline from 0 (couldn't be worse) to 10 (couldn't be better) recorded an average score of 6.1 and a modal score of 7.

#### **Concerns**

The principal public concern on the Longniddry shoreline is related to general litter and the provision of bins (Appendix B). Over 30% of the concerns raised related to these issues. Car Parks No 1 and 2 were noted as areas of particular concern (Appendix B). Water pollution and water quality concerns were also an important issue on the Longniddry shoreline, with Seton Sands and Seton Mains identified as areas of particular concern. Only 3% of the issues raised related to coastal processes and erosion (Appendix B) and these were all at Seton Sands.

#### **Positive Aspects**

The principal positive aspects of the Longniddry shoreline are related to the natural beauty of the coastline, the wildlife and the view, with over a quarter of the comments relating to these issues (Appendix B). Other positive aspects were related to the cleanliness of the shoreline (19%), access (15%), walking and other activities (14%) and good management of the shoreline (12%).

#### **Suggested Improvements**

The main category of improvements suggested by the public fell into the category of improving cleaning and maintenance of the shoreline and providing more bins, with 38% of the comments relating to these issues (Appendix B). Other suggestions related to improving the amenities (13%), providing more information signs and public education (14%), and improving access and parking (15%). 3 comments related to coastal and flood defence issues, at Seton Sands and Ferny Ness. Around 6% of the public commented on the fact that the coastline should be left alone, with no further development.

#### **Trends and Changes**

A variety of trends and changes were noted on the Longniddry shoreline (Appendix B). Improvements in cleaning and water quality improvement were the largest category of trends noted by the public (18%). However, a similar number of comments related to an increase in litter and pollution (Appendix B). Only 4 comments related to issues in flooding and erosion and Gosford Bay was highlighted as an area of particular concern.

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#### **3.2.4** Gullane

The Gullane stretch of coastline extends from Aberlady Point (NT 454805) in the west to Longskelly Point (NT523863) in the west. Again the participants of the public consultation were asked to provide a score for the condition of the shoreline. The Gullane shoreline scored relatively highly with an average score of 7.5 and a modal score of 8 (10 is “couldn’t be better”).

#### **Concerns**

The main issue of public concern on the Gullane shoreline was that of general litter and the need for provision of more bins (Appendix B). 28% of the comments raised were related to these issues. Coastal process and access were also important issues on the Gullane coastline, with each issue receiving 11% of comments. The Gullane Bents area was the locality in which there was most public concern (Appendix B). Other public concern related to amenity, dog mess, users, water pollution/sewage, wildlife/ vermin, building development, poor management and sea buckthorn. Potential building development at Archerfield was of concern.

#### **Positive Aspects**

Wildlife, nature and view issues were seen as the most positive aspect of the Gullane stretch of coastline, with 35% of the comments relating to these issues. Walking /outdoor activities, cleanliness and general amenity were also viewed as major positive aspects of the Gullane shoreline.

The public viewed the approach to coastal protection at Gullane Bents as a positive aspect (the comments specifically related to sea buckthorn and marram grass planting).

#### **Suggested Improvements**

The two main categories of improvement along the Gullane shoreline related to improving cleaning, maintenance and bin facilities and providing more information signs and education (Appendix B). Over 50% of the public comments fell into these two categories. Other key issues that were raised included improvement to amenities and access (parking, paths).

Gullane Bents was the main area where the public felt improvement should be focussed, with 55% of the public comment relating to this area (Appendix B).

#### **Trends and Changes**

A large proportion (34%) of the public comments related to flooding and erosion issues (Appendix B). Some of the reasons for the increase in dune erosion on the Gullane shoreline were expressed as:

- Loss of stability of dunes during WW2 practice bombing
- Sand removal by humans (for sandbags)
- Humans / walkers
- Higher tides

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#### **3.2.5 North Berwick**

The 63 participants in the North Berwick public consultation exercise were asked to give a score from 1 to 10 (where 10 is “couldn’t be better”) for the condition of the shoreline, which extends from Fidra in the west (NT 512 870) to Scoughall in the east (NT 615832). The average score was 7 and modal scores were 7 and 8 (SPI 2001a).

#### **Concerns**

Of the 130 issues raised by the public, the main concern on the North Berwick shoreline was that of general litter and the need for bins (Appendix B). However, a significant amount of public concern related coastal process issues (18%). Broadsands and North Berwick East Beach were highlighted as areas with erosion problems (Appendix B). Other concerns in the North Berwick area related to amenity, dog mess, safety, users, access, water pollution /sewage, wildlife /vermin, building development and poor management /maintenance issues (Appendix B).

#### **Positive Aspects**

48% of all public comments on the positive aspects of the North Berwick coastline were related to wildlife, nature and view issues (Appendix B). Cleanliness of the shoreline was also seen as a key positive factor (22%) and the other positive issues raised related to historical interest, general amenity, walking/activity, lack of erosion, access and management issues (Appendix B).

#### **Suggested Improvements**

Issues relating to cleaning, maintenance and provision of bins were the largest category of improvements suggested by the public for the North Berwick coastline (25%, Appendix B). Improvements to coastal and flood defences along this stretch of shoreline were also a high priority for the public, with 20% of the suggestions relating to these issues. Other key issues related to improvements in access, paths and parking.

#### **Trends and Changes**

The trends and changes noted on the North Berwick coastline are varied (Appendix B). The four key trends commented on by the public were flooding / erosion issues (25%); decline of fishing, wildlife and trees (24%); changing sedimentation / wind patterns (16%); and water quality/improvement issues (11%). 10% of the public commented that there has been no noticeable change in the coast (Appendix B).

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#### **3.2.6 Dunbar**

For the purposes of the public consultation exercise the Dunbar coastline extends from Tynemouth in the west (NT 640810) to Barns Ness in the east (NT 723773). The average score for this stretch of coastline was 6.9 and the modal score was 8 (where 10 is “couldn’t be better”)(SPI 2001a).

#### **Concerns**

The majority of public concern fell into one of four categories: coastal process (19%); general litter and need for bins (18%); access (16%); and water pollution/ sewage (19%) (Appendix B). Dunbar East Beach was the locality that caused the most public concern, with 30 out of the 130 comments relating to concerns at that location (Appendix B). Coastal erosion was noted as a concern at several localities around the Dunbar coastline, including Bellhaven Bay, Dunbar Castle, Dunbar Golf Course, Dunbar Harbour, East Barns, East Beach, Tynninghame, White Sands and Winterfield Golf Course (Appendix B).

#### **Positive Aspects**

Over 50% of the positive aspects of the Dunbar shoreline expressed by the public related to issues concerning wildlife, nature and view (Appendix B). The remaining positive aspects related to issues of historical interest, general amenity, walking /activity, cleanliness, lack of erosion, access and management.

#### **Suggested Improvements**

Coastal and Flood Defence improvements made up the largest category of suggestions by the public, with 20% of the comments relating to this topic. Other key areas where improvements were suggested include cleaning, maintenance and provision of bins (18%) and access / parking issues (16%). Improvements in management, environmental monitoring and provision of information signs and education were also suggested as some of the key issues.

#### **Trends and Changes**

Of the 55 trends and changes noted along the Dunbar shoreline, 20 were related to flooding, erosion and coastal protection issues (Appendix B). The locality that received the most concern regarding increases in coastal erosion was the Dunbar clifftop trail area, near Bayswell Hotel. Other key issues raised were an increase in rubbish and pollution, changing sedimentation and wind patterns, and a decline of fishing, wildlife and trees (Appendix B).



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### **3.2.7** East of Dunbar

The east of Dunbar shoreline extends from Barns Ness in the west (NT 723773) to the Fast Castle, which is east of the jurisdiction of East Lothian Council.

Concerns about coastal processes and industries (Blue Circle and Torness) were the only issues raised by the public along this stretch of shoreline (Appendix B). The 3 positive aspects noted by the public were related to the outstanding coastal landscape. Improvements suggested by the public including developing the harbour at Skateraw and improving amenities and nature conservation. All 9 of the comments on trends and changes on the stretch of shoreline related to Thorntonloch and were generally related to the coastal erosion trend in that locality.

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### **4 Coastal Processes and Evolution**

This chapter reviews coastal morphology and processes on the East Lothian Coastline (Musselburgh to Cockburnspath) in terms of:

- Geology
- Holocene changes
- Wind
- Waves
- Tides
- Surges
- Sediment transport.

The various morphological environments (dunes, beaches, cliffs etc) are also briefly described. An analysis of coastal change over the last 90 years has been carried out based upon OS map data. This has allowed the identification of potential areas of erosion and accretion as well as the types of habitats gained or lost. This information, along with an appreciation of coastal processes, has been used to identify a series of coastal process units and assess the likely changes to the coastline in the future. Finally, a brief evaluation of measures to address future habitat loss is given.

#### **4.1 Study Area**

The East Lothian coastline lies on the east coast of Scotland (Figure 1.1), extending 69 km from Musselburgh in the west to Cockburnspath in the east (East Lothian Council 2001a). The western section of the coastline lies within the Firth of Forth embayment, which itself extends inland to the Forth Estuary. Previous workers have considered that together the Forth and the Firth of Forth constitute the largest estuary on the east coast of Scotland (Buck, 1993). Zones of sediment divergence are located to the south of Cockburnspath at St. Abb's Head, and to the north of the Firth of Forth at Fife Ness.

#### **4.2 Geology and Sedimentology**

##### **4.2.1 Onshore**

The solid geology of the East Lothian region was heavily influenced by events which occurred during the Devonian period. At this time, the depression of Scotland's Midland Valley created the relatively low-lying Lothian Plain area to the north of a major fault, the Southern Uplands Fault. This depression facilitated the deposition of Carboniferous sediments, which underwent later stages of folding and are presently exposed between St. Andrews, Fife and Cockburnspath (Barne et al., 1997). The Firth of Forth results from glacial and fluvial processes which have exploited the weaker geological strata.

The solid geology of the area (Figure 4.1) is composed principally of sedimentary and igneous rock types from the Carboniferous age, with some older pre-Carboniferous igneous rocks also present. The overall form of the present day coast is governed by the juxtaposition of the different geological strata, with more resistant igneous rocks occurring as headlands. This is particularly evident along the North Berwick coastline where the igneous rocks form the higher cliffs. The sedimentary rocks are less resistant to erosion and give rise to gently rolling lowlands and bays between headlands (GUARD, 1996).

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Calcareous Sandstone and Carboniferous Limestone Series form the major coastal outcrops between Musselburgh and Dunbar, although Extrusive Olivine-Basalt Lavas of Carboniferous and Old Red Sandstone age outcrop on the coast around North Berwick (Barne et al., 1997; Rose, 1980). The islands in the Firth of Forth, for example Bass Rock, are formed of igneous intrusions of basic and intermediate rock, namely Basalt and Dolerite (Barne et al., 1997; Rose, 1980). There is a significant outcrop of Carboniferous Limestone around Barns Ness and the coal mining areas around Musselburgh are founded on the existence of productive Carboniferous Coal Measures (Rose, 1980).

The solid geology is overlain by more recent deposits of till, fluvio-glacial/alluvial material and blown sand from the Late Pleistocene and Holocene epochs (Rose, 1980) (Figure 4.2). The final glacial stage of the Pleistocene in Britain, the Devensian, lasted from about 70000 to 10 300 years BP. The Late Devensian lasted from 25000 to 10 300 years BP, and included the maximum ice-advance approximately 18-20000 years BP (Whittow, 2000). Most of the superficial deposits were laid down during this period, including the raised beach materials, which occur extensively along the coastal margins of the East Lothian area, e.g. Muirfield, Aberlady Bay, Barns Ness, Peffer Sands and Ravensheugh Sands (Rose, 1980). The blown sand deposits began accumulating during the last 5-6000 years, following the Post Glacial Transgression, as relative sea levels began to fall. These deposits have been subsequently reworked by coastal processes, which have redistributed existing material. Additional material has also been supplied by riverine sources (GUARD, 1996). Further details are located in the Holocene Evolution section.

#### **4.2.2 Offshore**

The Pre-Quaternary solid geology is composed of Carboniferous rocks, which underlie the Firth of Forth and East Lothian region, including an area of Coal Measures across the Firth at Edinburgh. Elsewhere under the Firth of Forth, the pre-Coal Measures, sandstones and mudstones are largely deltaic and fluvial in origin, apart from marine sediments, which include oil-shales and thin limestones (Barne et al., 1997). These older rocks are overlain by glacial sands and inter-bedded muds and silts from the Pleistocene epoch, which are in turn overlain by a thin layer of Holocene interglacial sediments (Barne et al., 1997).

There are three main elements to the Holocene seabed sedimentology (Figure 4.3) in this region:

- The outer estuary floor has fine sediments derived from rivers. Offshore of the Firth of Forth a patch of muddy sand is elongated in the direction of the tidal flow, due to transport out of the estuary.
- Large areas of exposed bedrock occur off the coast from Eyebroughy to Cockburnspath where tidal currents scour the sea floor (Barne et al., 1997).
- Further seawards sand dominates, with extensive areas of gravelly and clean sands, with low mud and high shell contents. Further offshore, the mobile material is sand, with localised areas of gravelly sand and sandy gravel. In this area, mega ripples and sinuous sandbanks are present, sculpted by strong tidal currents flowing parallel to coastline (Barne et al., 1997).

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### **4.3 Holocene Coastal Evolution**

The coastline of East Lothian is characterised by the juxtaposition of contemporary features with those resulting from earlier periods of different sea level. Holocene sea level changes in the region are complicated by the interaction of glacio-isostatic changes in land level and eustatic changes in sea level. Generally, during this period the crust has been rising as a response to the removal of the Late Devensian Scottish ice sheet (glacio-isostatic change). At the same time, global sea levels have risen dramatically, in response to the decay of the North American and Scandinavian ice sheets (eustatic change).

In the early Holocene (10000 - 8500 years BP), glacioisostatic uplift exceeded eustatic rise in sea level, and the region experienced a fall in relative sea level. This is indicated by the estuarine flat deposits covered in terrestrial peats which are now buried beneath later marine sediments.

By 8000 years BP, relative sea level was rising due to delivery of meltwater from the decay of the American and Scandinavian ice sheets. This time was known as the Main Postglacial Transgression (Sissons et al., 1966 cited in Firth et al., 1995 p.80). At this time, sea level rise outstripped glacioisostatic rebound in Scotland, and extensive deposits of estuarine clays (carse) were laid down (Dawson et al., 1988; 1989; and 1990 in Firth et al., 1995 p.80).

The rise in relative sea level culminated in the formation of the most distinctive raised marine features in the region, namely the Postglacial Shoreline (Sissons et al., 1966 cited in Firth et al., 1995 p.82). This shoreline is associated with the raised sandflats in the Aberlady and Tyne valleys, and raised sand and shingle pocket beaches along the North Berwick coastline. The altitude of these raised beach features decreases away from the centre of uplift, from 14.8 m at the head of the Forth Valley to 6.3m OD at Dunbar (Cullingford et al., 1991 cited in Firth et al., 1995 p.82). The modern day beaches between Aberlady and North Berwick, lie seawards of a fossil cliff line and are often backed or underlain by unconsolidated marine sand and gravel raised beach deposits (Rose, 1980). On the east coast of the region, a similar relationship exists southeastwards from Tantallon Castle in the bays of Ravensheugh, Barns Ness and Thorntonloch (Rose, 1980). Many of the raised beach deposits bear sedimentological evidence of a tsunami event 7000 years BP, which was triggered by a submarine slide located on the continental slope off the coast of Western Norway (Best, 2001). This event coincided with the peak of the Holocene transgression (Carter and Woodroffe, 1994).

During the later Holocene (6000 years BP - present), relative sea level is believed to have fallen generally (Robinson, 1993 cited in Firth et al., 1995 p.82). For example, in Aberlady Bay radiocarbon dating of brackish water peat (approximately 2500 years BP) suggests relative sea level must have dropped slightly after the Main Postglacial Transgression. A sea level fall from 5500 BP is also suggested by the fact that the contemporary coastline in Tynninghame Bay is cut in Holocene sediments that appear to be related to the Main Postglacial Transgression approximately 5500 years BP. The sand dunes in the East Lothian region began accumulating during this period, as the large tracts of glacio-fluvial sediments deposited on the continental shelf were reworked by coastal processes as relative sea levels fell.

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Since approximately 2500 BP relative sea level has been comparatively stable, allowing the transport of offshore sediments towards the shoreline, and contributing to the development of a wide sandy bay at Aberlady Bay (Firth et al., 1995). The similarity of earlier raised beach features and contemporary deposits between Eyebroughy and Peffer Sands as well as in Tynninghame Bay, suggest that coastal processes have not changed significantly during the last 6000 years. The current position of the Peffer Burn in Aberlady Bay appears to be a consequence of southerly spit or sand bar development across the mouth of the bay commencing 2500 years BP. This was accompanied by the southward expansion of Gullane Sands which is continuing today (Firth et al., 1995).

An abridged geological time-scale chart is given in Figure 4.4 to illustrate significant events for the East Lothian region. It shows the geological formation, sea level fluctuations and the formation of dunes and raised beaches. Present day rates of sea level rise and future predictions are described in Section 4.10, Future Coastal Evolution.

#### **4.4 Hydrodynamic Regime**

The hydrodynamic regime is considered in terms of the bathymetry and the forcing agents of winds; waves; tides and storm surges. The relative importance of these forcing agents varies both spatially and temporally:

1. From west to east - there is a change in environment from estuarine (Firth of Forth) to open coast (Cockburnspath);
2. From shallower (typically < 10 m ) to deeper waters - waves become less important whilst tidal forces become more important (Stive et al., 1990); and
3. In a temporal sense - extreme storms are of more importance over the short-term (< 1 year) than the long-term (> 10 years), when the cumulative effects of the more regular storms become important.

##### **4.4.1 Bathymetry**

The nearshore zone decreases in width from the mouth of the Firth of Forth to the more open North Sea coast (Figure 4.5). This results in a steeper offshore gradient on the open coast compared to the Firth of Forth. The mouth of the Firth of Forth is 40-50 m deep, with a number of narrow enclosed channels between 30-60 m depth parallel to the main axis (Barne et al., 1997). These channels have evolved along the axis of the tidal currents moving in and out of the Firth of Forth.

Examining the bathymetry (Figure 4.5), it is observed that along the North Berwick coast, the depth contours are parallel to the coast and close together. Moving west from near Fidra, where coastal orientation changes, the contours spread out evenly towards the south, with the 30 metre contour continuing roughly along an east-west axis (IOE, 1995). Rose (1980) also highlights the marked difference in offshore gradient between the Firth and open coast beaches.

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### **4.4.2 Wind**

In this region, the predominant wind direction is from the west and is influenced by the topography (Figure 4.6a and 4.6b) (Barne et al., 1997). Winds are severely affected by the high ground of the Southern Uplands and the funnel effect of the Forth-Clyde valley, which means winds tend to follow a northeasterly/southwesterly axis (Barne et al., 1997). In terms of windspeed, the mean hourly windspeed exceeded 75% of time is 3-3.5 m/s, which is typical for the east coast of Scotland (Barne et al., 1997). About 50% of all winds exceed 5 m/s, which is sufficient to move dry sand across beach and dune surfaces (GUARD, 1996). In addition, wind speeds of 120 km/h are not uncommon during severe westerlies in the autumn and early winter (East Lothian District Council, 1976).

The changing alignment and exposure of the East Lothian coastline means that different stretches of the coast are exposed to winds from different directions (Rose, 1980). This variation in coastal alignment also means that typical airstreams have different effects along different sections of the shoreline (Firth et al., 1995). For example, along the exposed coast, winds predominantly blow offshore, whereas inside the Firth of Forth onshore winds predominate. Measurements obtained at Turnhouse, west of Edinburgh, indicate (Figure 4.6a) the dominance of westerly and southwesterly winds (over 50%), coupled with the high incidence of northeasterly and easterly winds (over 35 %). Rose (1980) analysed wind measurements from the Fidra Lighthouse and these show prevailing southwesterly surface winds associated with the advance of depressions and cyclonic weather systems from the North Atlantic. The northeasterly winds, occurring mainly in spring and early summer, are associated with high pressure systems formed over the northern North Sea and Scandinavia (GUARD, 1996). These northeasterly and easterly flows can also be partly attributed to the development of sea breezes from the North Sea (Barne et al., 1997).

The coast from North Berwick to Cockburnspath is exposed to easterly storms as well as being open to winds from the north. However, the northerly winds are not very frequent, since they require a rather unusual pressure distribution with low pressure over the North Sea or even over the Baltic Sea. Previous work (East Lothian District Council, 1976) has considered that the strong to gale force winds from the north are responsible for the blown sand deposits on the exposed northern section of the East Lothian coast from North Berwick to Scoughall Rocks. From Dunbar to Cockburnspath the Lammermuir Hills provide a degree of shelter from westerly and southwesterly winds. As a result, at Barns Ness for example, southeasterly winds are nearly twice as frequent as southerly winds (Rose, 1980).

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## 4.4.3 Waves

The predominant waves for most of the exposed East Lothian coast are from the north and east (Barne et al., 1997). This stretch of coast has significant wave heights of >1.5 m for 10% of the time (Table 4.1, Figure 4.8). In the context of the east coast of the UK, wave energy is relatively high and arises due to the deeper water inshore allowing greater exposure to the dominant waves from the north-northeast and northeast. Offshore wave measurements indicate that significant wave heights exceeding 4 m for 10 % of the year are most common from a north to east-southeast direction (Department of Energy, 1991), which is shown in Figure 4.7 (Ramsay and Brampton, 2000). Approximately 60% of swell conditions originate from the north-northeast to east-northeast, according to figures generated by the UK Meteorological Office European Wave Forecasting Model (HR Wallingford, 1996). Extreme sea and swell conditions for the area are shown in Table 4.2.

**Table 4.1 Significant wave heights (H<sub>s</sub>) for different annual percentage exceedances within the study area. a) minimum H<sub>s</sub>; b) maximum H<sub>s</sub> (Source : Department of Energy, 1991)**

a)

| Annual % Exceedance | H <sub>s</sub> (M) | Location                     |
|---------------------|--------------------|------------------------------|
| 10                  | 1.0 - 1.5          | Musselburgh to North Berwick |
| 25                  | 0.5 - 1.0          | Musselburgh to Cockburnspath |
| 50                  | 0 - 0.5            | Musselburgh to Gullane Point |
| 75                  | 0 - 0.5            | Musselburgh to Dirleton      |

b)

| Annual % Exceedance | H <sub>s</sub> (M) | Location                       |
|---------------------|--------------------|--------------------------------|
| 10                  | 1.5 - 2.0          | North Berwick to Cockburnspath |
| 25                  | as a)              | as a)                          |
| 50                  | 0.5 - 1.0          | Gullane Point to Cockburnspath |
| 75                  | 0.5 - 1.0          | Dirleton to Cockburnspath      |

**Table 4.2 Offshore Extreme Total Sea and Swell Conditions (Source: Posford Duvivier, 1998. Data from The Meteorological Office European Wave Forecasting Model)**

| Return period (years ) | Total sea significant wave height (m) | Swell sea significant wave height (m) |
|------------------------|---------------------------------------|---------------------------------------|
| 1                      | 6.2                                   | 3.6                                   |
| 10                     | 7.6                                   | 4.5                                   |
| 100                    | 9.0                                   | 5.4                                   |

The varying orientation of the East Lothian coast means that different parts of the coastline are exposed to waves of varying heights from different directions (Table 4.1 and Figure 4.8):



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- along the Dunbar coast waves approach from the North Sea having a maximum fetch length of approximately 500 km;
- along the North Berwick coast waves approach from the North Sea and the Firth of Forth, with fetch lengths of approximately 500 km and 30 km, respectively; and
- inside the Firth of Forth waves originate from the Firth only and are fetch limited, with maximum fetch lengths of 30 km (IOE, 1995).

This means that the Firth of Forth, from Musselburgh to Eyebroughy, represents a relatively sheltered environment, whilst the open coast between Eyebroughy and Cockburnspath is substantially more exposed.

#### 4.4.4 Tides

The East Lothian coastline is subjected to an Atlantic tidal wave which propagates southwards down the east coast of the UK. In the context of the UK, the maximum bottom stress due to tidal components is weak ( $2.5 \text{ dynes cm}^{-2}$ ) according to Pingree and Griffiths (1979) (Figure 4.9). The tide is semi-diurnal with a mean spring tidal range of over 4 m. Tidal range increases up the Firth of Forth reaching 5 m at Rosyth (Lee and Ramster, 1981 cited in Barne et al., 1997). Further details of tidal range are displayed in Table 4.3.

**Table 4.3 Tidal Range for selected locations in the East Lothian region referred to Ordnance Datum (OD)**

| Location  | Neap Tidal Range (m) | Spring Tidal Range (m) |
|-----------|----------------------|------------------------|
| Dunbar    | 2.2                  | 4.5                    |
| Fidra     | 2.2                  | 4.6                    |
| Cockenzie | 2.2-2.4              | 4.6-4.8                |

Generally, flood currents enter the Firth of Forth along the northern shore and ebb currents leave along the southern shore (GUARD, 1996) (Figure 4.10a). Thus, ebb tidal currents dominate along the shore of the East Lothian coastline, with the ebb being shorter in duration than the flood, and velocities being higher (Barne et al., 1997). Surface water tends to ebb earlier than bottom water and bottom water flows in on flood tides earlier than surface water (Barne et al., 1997). There is a long period of slack water, up to 3 hours in duration occurring around low water, particularly in the lower reaches of the Forth estuary.

Tidal current information has been obtained from Proudman Oceanographic Laboratory (2001) and the results are displayed in Figure 4.10b. Currents are relatively weak (maximum 0.40 metres/sec) and decrease on entering the Firth of Forth. Tidal ellipses for the region indicate that currents become more rectilinear inside the Firth of Forth being orientated parallel to the axis of the estuary.

#### 4.4.5 Storm Surges

The study area is exposed to surges although in the context of the east coast of the UK, these are relatively small. However, small surges occur more frequently, with surges of approximately 0.2 m occurring approximately 200 times per year. Storm surges combined with strong winds and storm waves may have significant implications for coastal erosion and the stability of beaches and dunes (IOE, 1995).

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#### 4.5 Morphology

##### 4.5.1 Overview

The present day morphology of the coastline contains many features from former coastlines formed during periods of different sea level associated with a number of periods of glaciation. Previous coastal features include raised beaches, old cliff lines and wave-cut rock platforms. Many rock platforms pre-date the last glaciation, as indicated by the fact that they themselves bear evidence of glaciation (Barne et al., 1997; Rose, 1980). Much of the debris of successive glaciations has been deposited on low-lying land and areas of the continental shelf now submerged by postglacial rises in sea level. Generally, the sea and wind have combined to rework these deposits into the present day coastal landforms of East Lothian (Scottish Natural Heritage, 2001), which include (Figure 4.11):

- beaches;
- cliffs;
- sand dunes;
- shingle structures;
- tombolos;
- estuaries, and;
- inter-tidal mudflats and saltmarsh.

Around the East Lothian coast the cliffs of igneous and sedimentary Carboniferous rocks have undergone differential erosion to produce headlands and bays. The formerly glaciated hinterland is low relief in comparison to the north and west of Scotland. The Firth of Forth has an area of 85 km<sup>2</sup> and represents a major indentation to the coastline. The estuary at Tynninghame Bay is smaller, situated between two rocky headlands and is bar built. This estuary has been predominantly infilled with mud and sand flats behind the sandy spits at the mouth, and has experienced substantial reclamation in the past (Barne et al., 1997).

The coast becomes more exposed moving in an eastwards direction and is reflected in a greater predominance of rock between North Berwick and Cockburnspath (Barne et al., 1997). Moving in an eastward direction, the coastline at Musselburgh, Prestonpans and Cockenzie has sea walls with a rocky or sandy foreshore. From here to North Berwick the coast consists of wide exposed bays with significant inter-tidal sands such as Gosford Sands, Aberlady Bay and Gullane Bay (GUARD, 1996). The inter-tidal flats are predominantly sandy whilst the shoreline is more variable, with rocky outcrops and sand-and-shingle beaches. Aberlady Bay has an extensive complex of mudflat, saltmarsh and sand dunes. The largest and most complex dune system in the Lothians lies in Gullane Bay (Barne et al., 1997). The rocky promontories of Ferny Ness, Craigiellaw, Gullane Point and Eyebroughy at the eastern edge of Gullane Bay separate the bays.

The coast from North Berwick to Cockburnspath is backed by raised beaches, with rock platforms or small areas of dunes on the seaward side (Barne et al., 1997). Between Eyebroughy and St. Baldred's Boat, the coast comprises rocky shores and sandy beaches. There are four islands close to the shore (>2.5 km); Fidra, Lamb, Craigleath and Bass Rock, which are composed of hard igneous intrusive rock. At Tantallon Castle, near Auldham, cliffs climb to over 20 m high with a rocky foreshore. As the coastline turns southeastwards

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to face the North Sea, there are cliffs at Seacliff, a broad sandy bay at Ravensheugh, which reaches the rock promontory of St. Baldred's Cradle; one of a number of low rock headlands between the larger northeasterly facing bays (Rose, 1980). From Belhaven to Dunbar, the coast is rocky, with sandstone cliffs over 10 m high. Dunbar has a rocky foreshore and sandy beach. To Cockburnspath there are rocky shores and a few small sandy bays at White Sands and Thorntonloch (GUARD, 1996). There has been substantial reclamation and coastal defence construction at Torness Point power station. The main geomorphological elements of the East Lothian coast are now discussed.

#### **4.5.2 Beaches**

The beaches of East Lothian are principally formed of sand and represent both contemporary and relict features. The Firth of Forth beaches of Fisherrow Sands and Seton Sands have developed recently behind a wide inter-tidal foreshore, backed by human development. According to Rose (1980) coastal processes in these areas are being affected by anthropogenic actions. In contrast, the northerly and northwesterly facing Firth beaches between Aberlady and North Berwick are largely unaffected by sea walls or groyne systems and are characterised by the largest areas of both active and fossil blown sand features in southeast Scotland (Rose, 1980).

The region has no extensive shingle structures, fundamentally because underlying rocks do not provide shingle-sized fragments. However, shingle forms part of the beach sediments at Musselburgh, Aberlady Bay, Barns Ness and Thorntonloch. Additionally, at Musselburgh, river-borne pebbles and small boulders are found at the mouth of the River Esk, whilst at Barns Ness the shingle with a sandy matrix is derived from a local limestone outcrop (Barne et al., 1997). In Aberlady Bay, mudflats give way to sand and sandy shingle containing high levels (over 10 %) of shelly material; most of the shingle originating from volcanic basalt and dolerite from off-lying rocks and skerries (Dargie, 1994 cited in Barne et al., 1997).

#### **4.5.3 Cliffs**

Hard rock cliffs dominate the region with few examples of soft cliff types except where soft glacial tills overlie cliffed bedrock. Cliffed headlands also provide the necessary bay conditions for the accumulation of the many sand dune systems found in this region. Most of the cliffs are relatively low (less than 5 m elevation), usually having a wave-cut platform at the base, and one or more raised beaches. The absence of sea defences means that some erosion of cliff bases occurs (Barne et al., 1997).

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#### 4.5.4 Sand Dunes

The origin of the East Lothian sand dunes is discussed Section 4.3. The present day form is a result of the sediments being reworked by coastal erosion processes, with additional sediments sourced from the deposition of river-borne material (GUARD, 1996).

Contemporary dune formation in the East Lothian region is limited by the lack of wide flat foreshores to act as sources and provide space for dune accumulation. The only true dune systems are found at Aberlady, Gullane and Tynemouth (Anon., 1970 cited Coulson, 1995).

Barne et al. (1997) identified four main dune types in the region based upon geomorphological form and sand supply (Table 4.4). Some sites possess more than one dune type, e.g. Aberlady Bay, yet it is important to note that the region lacks one major dune type, the dune hindshore system, which requires strong onshore winds and a good sand supply on an open coast (Barne et al., 1997).

One of the largest accumulations of dunes occurs at Gullane Bay and this has been the focus of several studies. The dunes accumulated in the last 5 - 6000 years following the Postglacial Transgression as relative sea levels fell again. Since sea levels stabilised 2500 years ago the previous systems have undergone reworking (Cawkwell, 1997). More recently changes in the dunes have been connected with both anthropogenic effects, such as the planting of sea buckthorn and trampling by visitors, as well as changes in the hydrodynamic regime and alongshore sediment supply (Coulson, 1995) (Table 4.5). The work of Coulson (1995) suggested that significant dune erosion occurred at the same time as large surge events recorded on the tidal gauge at Leith.

**Table 4.4 Description and locations of East Lothian sand dunes**

| <b>Dune Type</b>      | <b>Main Characteristics</b>                                                                                                                                                 | <b>Locations</b>           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Cuspate foreland/ness | Largest dunes, formed from sediments delivered from two different directions from offshore, aided by a predominant onshore wind.                                            | Aberlady Bay, Belhaven Bay |
| Spit                  | Develop at mouths of estuaries from sediments transported downstream from rivers meeting coastal currents carrying further sediment loading.                                | Aberlady Bay, Belhaven Bay |
| Bay                   | Beach and dune systems developed on sand trapped within the shelter of rocky headlands,                                                                                     | Gullane, Muirfield         |
| Climbing              | Sand blown up onto inland terrain on the edge of main dune system, forming a variable, often thin, sand layer over the bedrock. Require predominantly strong onshore winds. | Aberlady Bay, Muirfield    |

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**Table 4.5 Chronology of events in recent times that have influenced the status of the Gullane dunes**

| Time period                                   | Significant events                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Approx. 1992                                  | Foredune reprofiling, with marram grass re-planted on the foredune and gaps filled in with sea-lyme grass. Wooden fence constructed along the foredune to encourage stabilisation.                                                                                                                                    |
| 1980's                                        | Notable erosion during storms and high tides. The foredune had a steep eroded seaward edge.                                                                                                                                                                                                                           |
| Until 1977                                    | Small scale sand and shingle extraction for the shingle industry                                                                                                                                                                                                                                                      |
| 1960's and 1970's                             | Major dune stabilisation and visitor management programme, comprising dune fencing, re-building and re-profiling the foredune, stabilisation with vegetation planting. During this period, the greatest rates of accretion took place which continued at the western end until 1990 (3.9 m per year) (Cawkwell, 1997) |
| 1906 - 1954                                   | Greatest rates of erosion (5 m per year)                                                                                                                                                                                                                                                                              |
| Post war until 1960s                          | Subsequent coastal erosion and blowout development after military manoeuvres                                                                                                                                                                                                                                          |
| 1940                                          | Utilisation of area for practising World War II Normandy landings                                                                                                                                                                                                                                                     |
| 20 <sup>th</sup> century                      | Development of recreation                                                                                                                                                                                                                                                                                             |
| 19 <sup>th</sup> century                      | Muirfield golf course opening, completion of branch railway                                                                                                                                                                                                                                                           |
| 17 <sup>th</sup> - 18 <sup>th</sup> centuries | Destruction of vegetation by rabbits, pulling for thatch, village inundation by blown sand                                                                                                                                                                                                                            |

The chronology of events at Gullane indicates that the erosion has exceeded accretion for at least the last 100 years. Overall from 1892 - 1990, there has been a narrowing of the inter-tidal, although there have been periods of accretion which have led to the progradation of the high water line. Without the partially successful dune rehabilitation and visitor management programme that occurred in the 1960's and 1970's, the recent pattern would be overwhelmingly of erosion. Several workers have considered the dune system at Gullane to be so heavily stabilised by man that it now represents a 'fossil' system (Hughes, 1994; Lauder, 1982). Man has certainly had an extensive effect in dune stabilisation; paling fences having assisted the construction of the foredune and the artificially planted vegetation (predominantly the non-native Sea Buckthorn) has stabilised the backdunes and fixed the landward side of the foredunes. Today the height of the coastal dune is tending to increase whilst the dune slack area becomes lower. Additionally, the secondary dune ridge to the landward side is prograding and aggrading (ASH, 1993 cited in Hughes, 1994).

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#### **4.6 Sediment Transport**

This section considers the nearshore (<10 m depth) and the offshore (> 10 m) zones to distinguish the main forcing processes responsible for sediment transport; waves being dominant in the nearshore and tides dominating the offshore. However these zones should not be regarded as independent of each other, since cross-zone interactions will occur.

##### **4.6.1 Offshore**

The transport regime in the offshore zone is predominantly tidal, with northerly transport being evident inshore in the vicinity of the East Lothian region, as shown in Figures 4.12a and 4.12b. A bed load divergence zone is located at Snook Point, southeast of Berwick-upon-Tweed (Stride, 1973).

IOE (1995) considered that the sand reaching the East Lothian coast originates from the east coast of Scotland, and the sand in the Firth of Forth principally originates from the offshore zone of the East Lothian coast between Cockburnspath and St. Baldred's Boat.

##### **4.6.2 Nearshore**

In the nearshore zone, the predominant wave directions from the northeast and east result in an overall westerly movement of material on the East Lothian coastline (Barne et al, 1997). In their work on the coastal cells of England, Motyka and Brampton (1993) identify the St. Abb's Head headland, southeast of Dunbar, as a point of sediment divergence. Sediment is transported in a northwesterly direction from St. Abb's Head towards the Firth of Forth (Figure 4.13a). On the northern coast of the Firth, sediment transport is also in a westerly direction (Barne et al., 1997), implying that the Firth of Forth is a sediment sink.

In terms of onshore-offshore transport of sediment, it is likely that some movement occurs due to storm-fair weather cycles. Additionally, Barne et al. (1997) believed that the only contemporary sand supply to the beaches and dune systems was likely to be the immediate sublittoral zone. The largest episodes of offshore transport occur at the time of storm surges (IOE, 1995). Although ebb currents swing south-eastwards at Bass Rock, and are significantly stronger than the flood, little evidence exists in the form of beaches to suggest any large south-eastwards movement of sediments in the nearshore zone (Rose, 1980).

Nearshore sediment transport is now considered for two areas:

- i. Inside the Forth Estuary from Musselburgh to North Berwick;
- ii. The open coast from North Berwick to Cockburnspath.

#### ***Musselburgh to North Berwick***

Between Musselburgh and North Berwick, there is a general low to moderate westerly transport into the Firth of Forth dominated by wave action from the North Sea (Ramsay and Brampton, 2000; Barne et al., 1997).

However, inside the Firth of Forth a reversal occurs, which gives rise to easterly transport (Barne et al., 1997) (Figure 4.13b). The extent of this easterly transport is uncertain due to the small volume of net sand transport and variable influence of southwesterly waves from the Firth of Forth and northeasterly waves from the North Sea (IOE, 1995). Easterly transport inside the Firth (IOE, 1995) is encouraged by the predominance of westerly and

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southwesterly winds, however the magnitude of this transport is limited by the fact that the waves are fetch limited. The greater potential for sediment movement under waves from the northeast is indicated by the importance of these waves in the erosion at Gullane (Ramsay and Brampton, 2000). For this reason, IOE (1995) predicted a potential easterly transport volume of  $<5000 \text{ m}^3/\text{yr}$  occurring from Aberlady Bay to as far east as Eyebroughy. Barne et al. (1997) however, believed this easterly transport to be limited to two zones in the form of weak anti-clockwise gyres, between Musselburgh and Prestonpans and in the bay between Port Seton and Gosford.

Westerly transport into the Firth of Forth is also indicated by the apparent supply at Gullane. Here, it has been suggested, that sand can only be supplied from offshore and by south westerly transport alongshore into the Firth of Forth. IOE (1995) deduced this on the basis that sediment will only move south at Craigielaw Point and is unlikely to move north at Gullane Point.

As well as material moving alongshore, it is likely that some of the sand that is transported into the Firth of Forth is distributed across the offshore zone between Aberlady Bay and Eyebroughy (IOE, 1995). Previous workers have also suggested that westerly sediment transport bypassing Aberlady Bay and Gosford Bay settles at the shoreline further to the west, e.g. Fisherrow Sands (Ramsay and Brampton, 2000).

#### ***North Berwick to Cockburnspath***

Outside the Firth of Forth on the open coast, any transport that does occur between North Berwick and Cockburnspath is generally believed to be low rate, wave-induced westerly drift (Barne et al., 1997). However, the embayed nature of the shoreline, along with a lack of beach material in a number of areas, suggests limited alongshore movement (Ramsay and Brampton, 2000) (Figure 4.13c). Rose (1980) commented that the orientation of spits and bays demonstrated a response to local closed cell current systems, rather than dominant regional sediment movement. Beach sediments were derived formerly from the erosion of sandstone cliffs, e.g. Dunbar, or glacially derived sands and gravels, e.g. Belhaven Bay, Barns Ness and Thorntonloch. There is little fresh input of beach material into the beaches today, other than reworking of hinterland glacial deposits (Ramsay and Brampton, 2000).

Estimates (IOE, 1995) for the Dunbar (Gin Head to Whitberry Point) and North Berwick (Eyebroughy to Gin Head) coasts, suggest that the potential exists for the westerly transport of up to approximately  $300000 \text{ m}^3/\text{year}$  of material into the Firth of Forth. This is large in comparison with other areas of the UK, e.g.  $260000 \text{ m}^3/\text{year}$  for the East Anglian coast and reflects the high wave energy. However as noted above, the actual transport is likely to be substantially less than this.

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Despite the general consensus for overall westerly transport, some workers have suggested southeasterly transport over part of the region. Firth et al., (1995) believed that St. Baldred's Boat to the east of North Berwick was a littoral divide (Figure 4.13d), with material moving both to the west and south east. The southeasterly transport was believed to result in accumulation of Peffer Sands, with material passing further eastwards around St. Baldred's Cradle and into Tynninghame Bay. Although the southeasterly transport into Tynninghame Bay contradicts Barne et al., (1997), the northwest-southeast orientation of the coast in this area would allow south easterly transport under the influence of north-northeasterly waves (see Section 4.9).

On the northeasterly facing beaches of North Berwick coast, the predominant northeasterly waves are less important than waves from the east-northeast and east in producing sediment transport into the Firth of Forth (IOE, 1995). Similarly on the northeasterly facing Dunbar coast from Cockburnspath to Gin Head, waves from the east and southeast are the most important directions for westerly longshore sediment transport.



## **4.7** Historical Coastal Change

### **4.7.1** Methods and Errors

An assessment of coastal change for the East Lothian coastline is possible based on the combination of digitised OS data and observations from the literature. The historical coastal change has been calculated using high and low water information for 1907 and 1999, which has been incorporated into a GIS. The 1907 MHWS (Mean High Water Springs) and MLWS (Mean Low Water Springs) lines have been digitised at a scale of 1:2000 on screen, using historical OS raster maps at a scale of 1:2500. The 1999 MHWS and MLWS lines are OS LANDLINE data at a scale of mostly 1:2500, although some tiles are at a scale of 1:1250. All these lines have been represented on a background raster image of the East Lothian coastline, which is at a scale of 1:10000, to give information on location. The historical change GIS outputs for the East Lothian region are presented in Appendix C.

A number of errors and limitations exist in the data, some of which are quantifiable and some of which are more difficult to establish. The 1999 MHWS LANDLINE data, at a scale of 1:2500 has an error of  $\pm 2.4$  m, with a confidence level of 99% uncertainty (Ordnance Survey, 2001). The 1907 MHWS and MLWS lines each have a mapping error of  $\pm 6$  m, based on the accuracy of OS pre-1946 County Series mapping. When comparing 1907 and 1999 high water data, taking both errors into account, the overall error in the measurement is  $\pm 6.5$  m. The errors that have not been quantified are the errors of scanning historical maps, along with the error in digitising shoreline features, i.e. MHWS and MLWS.

The errors described in the mapping preclude the identification of areas with less than 6.5 m of change in the position of high water for the period 1907-1999. Therefore, in the assessment of coastal change, only areas showing  $\pm 10$  m of change have been identified for the high water line. For the high water line, the magnitude of change is the maximum observed for the location in any one place and is not necessarily the change for an entire area or stretch of coastline. For the MLWS data set for 1907, large gaps in the data set limit further interpretation. Only areas where there is a change of greater than 100 m have been used for the purposes of calculating changes in coastal habitats.

### **4.7.2** Areas of Erosion and Accretion

According to the OS information for the MHWS position, the largest areas of change correspond to areas of reclaimed land located at Musselburgh (an equivalent average of 8.2 m/yr), Prestonpans (2.4 m/yr), Cockenzie (3.2 m/yr) and Torness Point (3.4 m/yr). There has been significant accretion in Belhaven Bay, principally in the growth of the two spits at the mouth of the bay (approximately 2-4 m/yr). Additionally, a number of other areas of accretion have been identified where accretion is generally in the order of 0.2-0.6 m/yr (e.g. Fisherrow Sands). According to the OS data there are few areas where there has been significant erosion ( $>10$  m) over the period 1907-1999. The highest rates of erosion are associated with river mouths, for example, Peffer Sands and Belhaven, along with West Links Golf Course (0.7-1.0 m/yr). Elsewhere, erosion is much lower with typical rates being 0.2-0.4 m/yr, e.g. Gullane Bents dunes. These areas, together with locations of erosion and accretion identified from other sources are compiled in Table 4.6 and Table 4.7.

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**Table 4.6 Accretion areas and magnitude of change for the East Lothian coastline**

| Location                                                       | Dates     | Maximum Change (m) | Equivalent average yearly change (m/yr) | Source      |
|----------------------------------------------------------------|-----------|--------------------|-----------------------------------------|-------------|
| Eastfield                                                      | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| Fisherrow Sands                                                | 1907-1999 | 30                 | 0.3                                     | OS maps     |
| Musselburgh - reclaimed land ash lagoons                       | 1907-1999 | 750                | 8.2                                     | OS maps     |
| Prestonpans - reclaimed land of disused workings               | 1907-1999 | 220                | 2.4                                     | OS maps     |
| Cockenzie - reclaimed land for power station                   | 1907-1999 | 290                | 3.2                                     | OS maps     |
| Bell's Rock to Port Seton Harbour                              | 1907-1999 | 30                 | 0.3                                     | OS maps     |
| Port Seton - reclaimed land                                    | 1907-1999 | 30                 | 0.3                                     | OS maps     |
| Seton Sands to Longniddry                                      | 1907-1999 | 80                 | 0.9                                     | OS maps     |
| Green Craig                                                    | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| Aberlady Bay - at Kilspindie and southern shore of Peffer Burn | 1907-1999 | 50                 | 0.5                                     | OS maps     |
| Aberlady Bay - at Yellow Mires                                 | 1907-1999 | 100                | 1.1                                     | OS maps     |
| Opposite Eyebroughy                                            | 1907-1999 | 40                 | 0.4                                     | OS maps     |
| Longskelly Rocks                                               | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| Broad Sands                                                    | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| Opposite Black Murphies                                        | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| North Berwick Bay                                              | Unknown   | Unknown            | -                                       | GUARD, 1996 |
| Canty Bay                                                      | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| Scoughall Rocks                                                | 1907-1999 | 30                 | 0.3                                     | OS maps     |
| Bathan's Strand (Ravensheugh Sands)                            | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| Belhaven Bay - Sandy Hirst spit and northern shore             | 1907-1999 | 230                | 2.5                                     | OS maps     |
| Belhaven Bay - Spike Island spit and southern shore            | 1907-1999 | 400                | 4.3                                     | OS maps     |
| Belhaven Bay - south of inner River Tyne                       | 1907-1999 | 210                | 2.3                                     | OS maps     |
| Southern Belhaven Bay (eastern end of Spike Island spit)       | 1907-1999 | 200                | 2.2                                     | OS maps     |
| East Dunbar (western end of East Esplanade)                    | 1907-1999 | 10                 | 0.1                                     | OS maps     |
| East of Dunbar at eastern end of golf course (Fluke Dub)       | 1907-1999 | 60                 | 0.7                                     | OS maps     |
| Lawrie's Den to White Sands                                    | 1907-1999 | 20                 | 0.2                                     | OS maps     |
| Barns Ness to Chapel Point                                     | 1907-1999 | 30                 | 0.3                                     | OS maps     |
| Skateraw harbour                                               | 1907-1999 | 40                 | 0.4                                     | OS maps     |
| Torness Point - reclaimed land for power station               | 1907-1999 | 310                | 3.4                                     | OS maps     |
| Dunglass to Reed Point                                         | 1907-1999 | 50                 | 0.5                                     | OS maps     |

Note: shaded cells indicate that the shoreline advance is due to land claim

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**Table 4.7 Erosion areas and magnitude of change for the East Lothian coastline**

| Location                                          | Dates          | Maximum Change (m)   | Equivalent average yearly change (m/yr) | Source                       |
|---------------------------------------------------|----------------|----------------------|-----------------------------------------|------------------------------|
| Gosford Bay                                       | Last 100 years | 5                    | 0.05                                    | GUARD, 1996                  |
| Gullane Bay - Gullane Bents dunes                 | 1907-1999      | 40                   | 0.4                                     | OS maps                      |
| West Links Golf Course                            | 1907-1999      | 60                   | 0.7                                     | OS maps                      |
| North Berwick (Milsey Bay)                        | 1907-1999      | 30                   | 0.3                                     | OS maps                      |
| Seacliff Bay                                      | Unknown        | Unknown              | -                                       | GUARD, 1996                  |
| Peffer Sands                                      | 1907-1999      | 90 (highly variable) | 1.0                                     | OS maps                      |
| Peffer Sands and Ravensheugh Sands                | Unknown        | Unknown              | -                                       | GUARD, 1996                  |
| St. Baldred's Cradle                              | Unknown        | Unknown              | -                                       | GUARD, 1996                  |
| Hedderwick Sands - southern shore of Belhaven Bay | 1907-1999      | 60                   | 0.7                                     | OS maps                      |
| Southern Belhaven Bay - Biel Water                | Unknown        | Unknown              | -                                       | GUARD, 1996                  |
| Winterfield Golf Course                           | Unknown        | Unknown              | -                                       | East Lothian Council, 1993   |
| Dunbar, including East Dunbar beach               | Unknown        | Unknown              | -                                       | GUARD, 1996                  |
| East sides of bays south of Dunbar                | Unknown        | Unknown              | -                                       | Barne <i>et al.</i> , 1997   |
| Mill Stone Neuk                                   | 1907-1999      | 20                   | 0.2                                     | OS maps                      |
| Catcraig                                          | 1907-1999      | 30                   | 0.3                                     | OS maps                      |
| Torness to Cockburnspath                          | Unknown        | Unknown              | -                                       | Brazier <i>et al.</i> , 1998 |

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#### **4.8 Coastal Process Units**

According to current DEFRA guidance on SMPs (DEFRA, 2001), a coastal process unit is:

‘A length of shoreline (it may include an estuary) in which the physical processes are relatively independent from the processes operating in adjacent coastal process units.’

The coastline of East Lothian has been split into different sections representing headland-bay-headland units (Figure 4.14). Specifically, the boundaries used to identify these coastal process units have been chosen on the basis of:

- prominent headlands or promontories which are likely to impede sediment transport between adjacent units;
- changes in coastal orientation; and
- changes in coastal morphology.

Although the headland-bay-headland units have coherent characteristics and to an extent behave independently from each other, the functioning of coastal processes in the whole region means that some interactions are likely to occur between units, especially over longer temporal scales.

The following process units have been identified:

1. Edinburgh to Musselburgh
2. Musselburgh to Cockenzie
3. Cockenzie to Craigielaw Point
4. Craigielaw Point to Gullane Point
5. Gullane Point to Eyebroughy
6. Eyebroughy to Longskelly Point
7. Longskelly Point to North Berwick (Rugged Knowes)
8. North Berwick to St. Baldred's Boat
9. St. Baldred's Boat to St. Baldred's Cradle
10. St. Baldred's Cradle to Dunbar Harbour
11. Dunbar Harbour to Mill Stone Neuk
12. Mill Stone Neuk to Torness Point
13. Torness Point to Cockburnspath

The process units are used as the basis to split the East Lothian coastline into management units to develop the strategic coastal defence option for a particular stretch of coast. The geomorphological form, littoral character, erosional/accretional character, anthropogenic impacts and coastal processes of each process and management unit are discussed in Chapter 9.

## **4.9** Conceptual Model for the East Lothian Coastline

### **4.9.1** Introduction

The overall form of the East Lothian coast is dominated by underlying geology which determines the coastal orientation and location of headlands. The coastal orientation and location of headlands controls the exposure to wave energy. Outside the Firth of Forth, the open coast is more exposed to wave action and is characterised by rock cut platforms and limited sediment volumes in the littoral zone. However in the more sheltered areas within the Firth of Forth and within embayments between rocky headlands on the open coast, sandy beaches, marshes and dunes have accumulated.

In general terms the Firth of Forth represents a sediment sink, receiving material from the open coasts to both the north and south (Figure 4.15). On a more local scale significant sediment sinks occur at Gosford Bay, Aberlady Bay and Belhaven Bay. Aberlady Bay represents the largest sink on the coast. With the exception of the Forth Estuary itself, there are relatively few river inputs. There are a few small burns at Aberlady Bay, Eastfield, Musselburgh, and Thorntonloch. In terms of the East Lothian coast, the River Tyne forms a fairly extensive estuary at Belhaven Bay and has trapped a significant amount of sand and mud. The reclamation which has occurred in this area is likely to have had some impact on coastal processes at the mouth of the estuary, although without further study the extent of the impacts is not clear.

### **4.9.2** Discussion

Previous workers (GUARD, 1996; Barne et al., 1997) have stated that the erosion occurring along parts of the coast supplies sediment to downdrift accreting areas, thus creating an alternating pattern of erosion and accretion along the west to east transport pathway:

- erosion along the east sides of some of the bays south of Dunbar supplying sand to the accreting sand bars to NW of Dunbar;
- erosion at Gullane Bay supplying sediment to Aberlady Bay and Gosford Bay.

Whilst there may be some longshore transport of material from eroding areas to accreting areas, this model is rather over simplistic for the East Lothian Coast since the embayed nature of the coastline and relatively low volumes of beach sediments mean that, although wave energy is high, the actual longshore transport of material is relatively low. Hence many of the bays represent relatively closed littoral systems (Figure 4.15). Although previous workers have considered sediment transport to be generally from east to west throughout the region, the variable wave direction can result in reversals and littoral divergences, especially at headlands. On the open coast, one such reversal is believed to occur at St Baldred's Cradle (Figure 4.15).

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Additionally, a recent study at Dunbar demonstrated the potential for west to east transport within a bay, under increasing wave energy from northerly sectors (ABP Research, 2001). It is therefore likely that under northerly wave conditions west to east transport can occur in a number of the bays on the open coast. Within the Firth of Forth, whilst previous workers have suggested an overall east to west transport of material, reversals occur between Musselburgh and Eyebroughy due to:

- Existence of gyres between Port Seton and Gosford, Musselburgh to Prestonpans;
- Variation in wave direction.

The hydrodynamic regime is dominated by waves from the northern and eastern sectors, and has a significant swell component. The seasonal variation in wave climate, notably the severity of winter storms, drives seasonal changes in beach levels with the small scale onshore-offshore movement of beach material in response to storm-fair weather cycles. Although onshore transport of sediment to littoral systems may have occurred in the past (see below) it appears to be limited under contemporary conditions, despite significant deposits of sand offshore.

The morphological features of the present day coastline are strongly influenced by features formed early in the Holocene under different sea levels. The Holocene history of the East Lothian area shows a number of rises and falls in sea level relative to the coastline:

- 10000 - 8500 years BP sea level fall;
- 8000 - 6000 years BP sea level rise;
- 6000 - 2500 years BP sea level fall;
- 2500 - present relatively stable sea level.

These changes in relative sea level are important because, coupled with the large volumes of sediment in the coastal zone after the end of the last ice age, they allowed accretion of a number of beach and dune systems. However differences in sea levels and sediment supply under contemporary conditions can potentially lead to instability and erosion of these coastal features. This is similar to the conclusion reached by IOE (1995) who stated that the erosion problems seen along the East Lothian coastline were due to changes in onshore-offshore transport and/or gradients in longshore sand transport.

The extensive aeolian dunes throughout the region are examples of features formed under conditions different to those of the present. The dunes began accumulating in the last 5 – 6000 years, following the Postglacial Transgression when sediment supplies were abundant and as relative sea levels fell again. They formed in areas of strong onshore winds where there were suitable backshore conditions to accommodate them inside the Firth of Forth (e.g. Aberlady Bay, Gullane Bay). In places, where the underlying geology provided a sloping platform, the dunes migrated inland, forming climbing dune systems which are now vegetated and used predominantly as golf courses.

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It is worth noting that the East Lothian coastline lacks the hindshore type dune system, which requires strong onshore winds and supply to form (Barne et al., 1997). This implies that even in the past, when there were higher sea levels and increased sediment available for dune construction, the dune forming potential was still not as high as elsewhere in the world. The fall in relative sea level which occurred in the initial part of the Holocene from 10000 to 8500 BP and latterly between 6000-2500 BP is likely to have assisted the progradation of many beach systems such as those in Aberlady, Gullane and Tynemouth Bays. It is possible that the stabilisation in sea levels from 2500 years BP onwards led to a reduction in the rates of coastal progradation.

The impact of the Little Ice Age on dune action in East Lothian is not well understood. This period, which lasted from 650/550 to 100 BP, was marked by colder and windier climatic conditions and was associated with a fall in sea level. Elsewhere in Northern Europe these conditions gave rise to increased coastal dune activity and it seems likely that this was also the case in East Lothian.

Today many of the East Lothian dune systems are essentially relict having formed under earlier conditions. At Gullane contemporary dune accretion is limited by the small alongshore transport and the lack of strong onshore winds (IOE, 1995). The Gullane dunes have undergone a net erosion over the last 100 years, although this has been interspersed with periods of accretion. However, much of this accretion can be attributed to the use of paling fences and planting of Sea Buckthorn, without which erosion would have been more dominant.

#### **4.9.3 Summary**

Over the last 100 years some of the largest changes in coastal morphology have been brought about by the action of man. Large-scale reclamations for power stations or industry have advanced the MHWS seawards by several hundred metres in a number of places e.g. Cockenzie, Prestonpans, Torness Point. Where the MHWS is unconsolidated, such as at Cockenzie, erosion has taken place in recent years. This has presumably been due to the increased wave energy associated with moving the MHWS further seawards.

Over the last 100 years, the analysis of historical map information illustrates that for the majority of the East Lothian coast accretion has been more common than erosion at MHWS. The low or negligible rates of coastal erosion over large lengths of the East Lothian coastline are attributable to the presence of rocky cliffs. The largest areas of coastal change have been associated with estuary or river mouths where spits have accumulated. These features have produced accretion rates of 2-4 m/yr at areas such as Belhaven Bay, and erosion rates of 0.7-1.0 m/yr at Peffer Sands, Belhaven Bay and Broad Sands. Elsewhere on the coast rates of change have been much lower, with accretion rates of 0.2-0.6 m/yr and erosion rates of 0.2-0.4 m/yr.

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#### **4.10** Future Coastal Evolution

##### **4.10.1** Introduction

The coast is subject to changes which span enormous temporal and spatial scales. These changes, particularly those at large scales, are dependent upon a large number of variables (e.g. hydrodynamic, sedimentological, morphological elements) which can combine in an almost infinite number of ways. Furthermore changes at one location can be influenced by changes at a number of other locations. These complications have led some workers to the conclusion that quantitative predictions of large scale coastal behaviour (10's km, 10's-100's of years) is impossible (e.g. Terwindt & Battjes, 1990; Halcrow, 2001). However, in line with the thinking developed in the EA and DEFRA funded Futurecoast project for England and Wales (Halcrow, 2001), it is possible to make some estimations of coastal evolutionary trends.

##### **4.10.2** Approach

The prediction of future coastal evolutionary trends in the Futurecoast project relies on dividing the coast up into segments of different scales. The basic unit of this division is the geomorphic unit (e.g. cliffs, saltmarshes), which combine to form shoreline behavioural units (e.g. embayments, estuaries), groups of which form coastal behavioural systems (e.g. groups of embayments along a stretch of coast).

The prediction of future evolutionary tendency needs to start by considering large stretches of the coast, i.e. shoreline behavioural systems. The prediction of future evolutionary tendency for shoreline behavioural units, in terms of coastal alignment, is based on a consideration of the past evolution, controls and linkages, behaviours/sensitivities and behavioural constraints. Influencing factors include:

- Changes in geological control;
- Hydrodynamic forcing;
- Sediment transport;
- Sediment budget;
- Human intervention.

The future tendency of the geomorphic units relies upon a consideration of:

- Formation and evolution of processes
- Typical behaviour
- Links with other geomorphological elements
- Sensitivity
- Pressures imposed by shoreline behavioural unit tendencies.

The most common pressure applied to geomorphic units, resulting from changes at a shoreline behavioural unit level, is that of foreshore sediment balance which influences backshore responses such as cliff or dune erosion. The predicted evolutionary tendencies for a coast also need to be viewed in the context of historical changes for the area being considered.



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#### **4.10.3** The East Lothian Coast

The shoreline behavioural units on the East Lothian Coast include:

- Headlands and embayments;
- Estuaries.

These shoreline behavioural units are composed of the following key geomorphic units:

- Saltmarshes;
- Sand dunes;
- Sandy beaches;
- Spits;
- Rocky cliffs and platforms.

The major influencing factors on future coastal tendency are changes in the rate of sea level rise and storminess. These would be expected to result in changes in erosion, sediment supply, sediment transport and accretion. In general terms, the amount of shoreline change, at both behavioural unit and geomorphic unit level, is dependent on the degree of change in the driving forces, such as sea level rise and storminess, as well as the ability of the system to respond (for example by landward migration).

##### **4.10.3.1** Sea Level and Storminess

Over the last 100 years global sea level has risen by between 0.3 and 3 mm/yr, with most estimates being in the range of 1-2 mm/yr (Gornitz, 1995 in Hill et al., 1998). The rate of global mean sea level rise is expected to increase to 6 mm/yr by 2050 (Hadley Centre scenario for IPCC in Hill et al., 1998).

The rate of relative sea level rise in Scotland is governed by a combination of rise in mean global sea level and isostatic uplift following the last ice age (See Section 4.3). It is unclear as to the precise sea level trends for the East Lothian coast over the last 100 years. However, it is clear that over the Holocene, the rate of eustatic SLR has increased, whilst the rates of uplift have decreased. From 6000 years BP to present, sea level rise has been approximately 2.2 mm/yr, whilst the average uplift for Scotland has been 1.9 mm/yr. Firth et al., (1995) report that some areas, notably the Inverness Firth, Beaulieu Firth, Orkney and Shetland, have experienced higher rates of isostatic uplift and have therefore seen a continuous fall in sea level. In the East Lothian area, the late Holocene may have been characterised by falling sea level coupled with minor transgressive events or stillstands (Hill et al., 1998).

In East Scotland the rate of sea level rise for 2050 is estimated as being 1.3-11.5 mm/yr (Hulme and Jenkins, 1998). With such a great range it is difficult to predict either a fall in sea level or a rise (Firth et al., 1995). However, allowing for isostatic readjustment of the crust (Shennan, 1989), and taking four UKCIP (UK Climate Impacts Programme) climate change scenarios (Hulme and Jenkins, 1998), it has been estimated that by 2050, the rate of sea level rise on the East Lothian coast will be 5-6 mm/yr (Hill et al., 1998 p33). Over the next 100 years, other estimates for the East Lothian region consider a rate of sea level rise of 3.2-5.8 mm/yr (Firth et al., 1995). Previous work suggests that this may be comparable with rates experienced during the rise during the Main Postglacial Transgression on the east coast of Scotland (4 mm/yr) (Firth et al., 1995).

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Future climatic change may also lead to an increase in the frequency and magnitude of storms which influence wave action at the coast. However there is some uncertainty regarding the temporal change in the wind-wave climate around the UK. For example, Carter and Draper (1988) showed that there was an increase in significant wave height in the North Atlantic between 1962 and 1984. However, more recent research by WASA (1998) shows that although there was an increase in wave height and storminess from 1962, the recorded values of the last two decades are similar to those from the beginning of the century.

The analysis of wind records off the East Lothian Coast (ABP Research, 2001) suggest that wind speeds and directions have changed over the last 40 years. Overall there was an increase in the mean wind speed by 40% from 1957 to 1996, primarily due to winds from the southeast and southwest sectors. Furthermore, over the last 10 years (1987-1996) there has been an increase in the frequency of the mean Beaufort class north-northwest to northeast, coupled with a decrease in the frequency of winds from the northeast to east-southeast. These changes may have led to similar changes in wave height and direction.

Future predictions for storminess on the East Lothian coastline are uncertain with different models producing different results (Hulme and Jenkins, 1998). However, Hill et al., (1998) make predictions for future changes in wind speed by 2100, suggesting autumn values will almost double compared to present levels, whilst winter values will drop. This suggests that the coastline of East Lothian may be subjected to increased storm action in the future.

#### **4.10.3.2 Coastal Change**

Predictions of how the East Lothian coastline will evolve in the future are made difficult by:

- the uncertainty surrounding future predictions in the rate of relative sea level rise and degree of storminess;
- an incomplete understanding of sediment transport and supply (Firth et al., 1995).

In this section, future coastal evolutionary tendencies have been developed by assuming that the rate of sea level rise will increase, and that this may be associated with an increase in storminess (Hulme and Jenkins, 1998). The direction of sediment transport and supply of material to various environments is fundamental in determining their likely evolutionary responses. High rates of supply can allow progradation even under rising sea levels, whilst low supply rates mean that erosion is more prevalent. The issue of sediment supply is poorly understood and is discussed further below.

Previous workers (Firth et al., 1995) have suggested that at a large scale, the impact of rising sea levels would be lower in magnitude in the Forth Estuary than on the more open coastline, presumably due to the greater exposure on the open coast. At a large scale, i.e. shoreline behavioural unit, the future coastal evolution of the East Lothian coast is governed by the response of headland/embayments and estuary systems.

The headlands are not likely to change greatly due to the solid geology forming them. The response of the embayments between the headlands is strongly governed by the wave direction which will control the equilibrium planshape form of the bay (Silvester, 1989).

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Changes in the direction of winds and therefore waves, may result in erosion and accretion within bays as the planshape form adjusts. The degree to which the planshape will change is governed by the composition of the shoreline in terms of geomorphic units and anthropogenic structures. For example, undefended sandy coasts will be more responsive than rocky or artificially defended coasts. Ultimately, if sea level rise is great enough, inundation up to the base of cliffs will result in the loss of beaches and the inundation of other low lying areas.

The response of estuaries to rising sea level is believed to be a landward and upward translation of the whole estuary form, known as 'estuary rollover' (Allen, 1990). This is accomplished by erosion of the inter-tidal in the outer estuary and deposition in the inner parts of the estuary. The degree to which this translation of form occurs is governed by the geomorphic units present. The most change is likely to occur where the coast is composed of unconsolidated sediments.

These large scale responses of the coast to changes in sea level and storminess will contribute to future coastal evolution of the geomorphic elements composing the East Lothian Coast. It should be noted that many responses of geomorphic units are dependent upon sediment supply. The sediment transport linkages that exist between the various parts of the East Lothian coastal system are not fully understood (e.g. sediment supply), and this therefore limits the ability to predict future coastal tendencies (cf. Firth et al., 1995). However, under contemporary conditions it appears that many parts of the East Lothian coastal system are relatively independent, being enclosed within embayments, which potentially limits the potential for future increases in sediment supply.

The generic response of each of these geomorphic units is now discussed. Refer to Table 4.6 and Table 4.7 for rates of accretion and erosion for specified areas and habitats.

### ***Saltmarshes***

Over the last 90 years marshes have tended to show accretion at the MHWS. The mean historical rate of change in saltmarshes (m/yr for the period 1907-99) is +1.2 m/yr. This is based on measurements at:

- Aberlady Bay - at Kilspindie and southern shore of Peffer Burn (+0.5)
- Belhaven Bay - south of River Tyne (+2.3);
- Southern Belhaven Bay (eastern end of Spike Island spit) (+2.2) (dunes also present);
- East of Dunbar at eastern end of golf course (Fluke's Dub) (+0.7) (dunes also present);
- Barns Ness to Chapel Point (+0.3) (dunes also present).

(Note: the changes in the saltmarsh associated with the two spits of Belhaven Bay has been excluded since it is difficult to interpret the complex changes which have occurred in the MHWS indicated on the OS map.)

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Under rising sea levels the response of the saltmarshes and mudflats will be largely dependent on the rate of sediment supply. Under high rates of sediment supply, marshes and mudflats are able to accrete vertically and migrate landwards, thereby keeping pace with sea level rise. However, in practise the presence of hard structures (e.g. roads, embankments) constrain this natural landward migration, a phenomena known as “coastal squeeze” resulting in a narrowing of the marsh and erosion of the outer edge. If rates of sediment supply are low, erosion of the marsh will occur. Under low sediment supply conditions marshes may be replaced by mudflats and mudflats may decrease in width and ultimately become subtidal areas.

On the East Lothian coastline, the fact that many saltmarshes probably formed under stable/falling sea levels suggests that, under conditions of higher SLR and storminess, the future tendency is likely to be for erosion. This agrees with the assessment of (Firth et al., 1995) who considered that, unless sediment supply is high, saltmarshes in the Firth of Forth and Belhaven Bay are likely to become inundated and replaced by wider mudflats. Additionally on the East Lothian coast, marsh behaviour is also dependent on the behaviour of other geomorphic units such as dunes (see below).

### ***Dunes and beaches***

Sandy beaches and dunes form a continuum of habitats around the high water mark and dunes are virtually always fronted by sandy beaches. Thus on the East Lothian coast changes in the MHWS are often due to changes in both dune and beach areas.

Over the last 90 years most dune/sandy beach systems have shown accretion at the MHWS. The mean historical rate of change in the MHWS (m/yr for the period 1907-99) is +0.2 m/yr. This is based on measurements at:

- |                                                   |                                        |
|---------------------------------------------------|----------------------------------------|
| 1 Seton Sands to Longniddry (+0.9);               | 12 Lawrie's Den to White Sands (+0.2); |
|                                                   | Barns Ness to Chapel Point (+0.3)      |
| 2 Aberlady Bay - at Yellow Mires (+1.1);          | 13 (saltmarsh also present);           |
| 3 Opposite Eyebroughy (+0.4);                     | 14 Skateraw Harbour (+0.4);            |
| 4 Longskelly Rocks (+0.2);                        | 15 Dunglass to Reed Point (+0.5);      |
| 5 Broad Sands (+0.2);                             | 16 Gosford Bay (-0.05);                |
| 6 Opposite Black Murphies (+0.2);                 | 17 Gullane Bay (-0.4);                 |
| 7 Seacliff (+0.2);                                | 18 Broad Sands golf course (-0.7);     |
| 8 Scoughall Rocks (+0.3);                         | 19 Peffer Sands (-1.0);                |
| 9 Bathan's Strand (Ravensheugh Sands) (+0.2);     | 20 Hedderwick Sands (-0.7);            |
| Southern Belhaven Bay (eastern end of Spike       |                                        |
| 10 Island spit) (+2.2) (saltmarsh also present);  | 21 Mill Stone Neuk (-0.2);             |
| East of Dunbar at eastern end of golf course      |                                        |
| 11 (Fluke's Dub) (+0.7) (saltmarsh also present); | 22 Catcraig (-0.3).                    |

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(Note: the changes in the dunes associated with the two spits of Belhaven Bay have been excluded since it is difficult to interpret the complex changes which have occurred in the MHWS indicated on the OS map.)

Under rising sea levels and increased levels of storminess, with no additional supply of material, dune systems would be expected to undergo erosion at their seaward faces and migrate landward if wind and backshore conditions allow. However, if sediment supply is high and results in beach accretion, then this may allow dune progradation. It is therefore apparent that future dune behaviour is heavily dependent on the rates of sediment supply, which is poorly understood at present and difficult to predict for the future. Additionally some dunes, such as those at Belhaven Bay are dependent on spit dynamics (See below).

On the East Lothian coast, given the fact that many dune systems apparently formed under conditions of sea level fall, it seems likely that the general trend under rising sea level will be for erosion. This agrees with the work of (Firth et al., 1995) who believed that the dunes of the North Berwick coastline are likely to experience increased erosion as a result of sea level rise and an increase in storm incidence and magnitude. They also stated that the dune field may move further onshore, or blowouts and wash-overs may cause a breakthrough in the barrier. It should be noted that the potential for onshore dune movement is dependent on topography and management actions. Additionally, future increases in storminess are likely to increase the seasonality of dune responses with greater erosion in stormy periods followed by a degree of recovery in intervening periods.

#### ***Sand beaches/flats***

Over the last 90 years, whilst most beaches/dunes have shown accretion at the MHWS, beaches/sandflats have shown erosion at MLWS. This implies a steepening of inter-tidal profiles for beaches/sandflats. The mean historical rate of change in MLWS for beaches and sandflats (m/yr for the period 1907-99) is -0.9 m/yr. This is based on measurements at:

- Mid Gosford Bay to south end of Aberlady Bay (+2.0);
- Seton Sands (-1.0);
- Gosford Bay (-1.0);
- North Aberlady Bay (-1.0);
- South Gullane Bay (-3.0);
- North Gullane Bay (-1.0);
- Broad Sands (-1.0);
- North Berwick (Milsey Bay) sandy areas (-1.0).

In the long term, under conditions of rising sea level, sand beaches will adjust in profile form by migrating upwards and landwards to maintain the same relative position within the tidal frame. In the short term, the response of sand beaches to storms is for the profile form to flatten, with material being moved offshore.

On the East Lothian coast future increased rates of SLR and storminess would be expected to result in increased rates of beach erosion. However, this is dependent on sediment supply from both alongshore and across shore, both of which are poorly understood. Across shore sediment supply is partly controlled by the degree of erosion of MHWS, which is

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dependent on the nature of the backshore, e.g. cliffs, dunes, raised beaches, sea walls etc. Under conditions of increasing sea level rise and storminess, the long-term trend for inter-tidal steepening would be expected to continue. Additionally, increases in storminess are likely to increase the seasonality of beach responses with greater variations in beach levels occurring.

Previous workers have suggested a number of scenarios for the sandy beach systems along the East Lothian coast (Firth et al., 1995).

- Wide sandflats, such as Aberlady Bay will probably experience increased erosion along the shoreline (Firth et al., 1995), although this may be tempered by the fact that the warmer temperatures and increased winds may encourage dune development.
- Narrow beach and sandflats, such as those which occur along the Dunbar coast, are likely to undergo net erosion as the coast moves towards its former Main Postglacial limit, although this in itself would provide a sediment supply which would limit the initial rate of shoreline retreat (Firth et al., 1995).

### ***Spits***

Historically the greatest changes in coastal position due to natural change have occurred due to the development of spits (see Section 4.7). Although erosion and accretion have both occurred, the dominant trend over the last 90 years has been for accretion at the MHWS. The mean historical rate of change in spits (m/yr for the period 1907-99) is +3.4 m/yr. This is based on measurements at the following places:

- Belhaven Bay - Sandy Hirst Spit and northern shore (+2.5);
- Belhaven Bay - Spike Island Spit and southern shore (+4.3).

Future changes in sea level and storminess are likely to lead to the renewed development of spits. This development may involve either onshore movement or alongshore extension (Firth et al., 1995). Whether these changes result in an overall loss or gain of spits will be dependent on the level of sediment supply.

### ***Rocky shores***

The Outer Firth coast (North Berwick to Cockburnspath) is dominated by rocky features such as cliffs and rock platforms. Over the last 90 years the analysis of historical map information shows that the position of the MHWS for these areas has remained predominantly unchanged. Future increases in the rate of SLR and storminess would not be expected to substantially impact cliffs and rock platforms. However, a reduction in inter-tidal width under SLR could lead to the potential loss of sand beaches from in front of cliffs.

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### ***Reclaimed areas***

The Inner Firth (Musselburgh to Gullane Bay) has large areas of reclamation which have moved the MHWS further seawards than would naturally be the case. The mean historical rate of change at the MHWS for reclaimed areas (for the period 1907-99) is +3.5 m/yr. This includes measurements at:

- Musselburgh - reclaimed ash lagoons (+8.2);
- Prestonpans - reclaimed land of disused workings (+2.4);
- Cockenzie - reclaimed land for power station (+3.2);
- Port Seton - reclaimed land (+0.3);
- Torness Point - reclaimed land for power station (+3.4).

Some of these areas have shown erosion over the last decade and these areas would be expected to continue to erode in the future under rising sea levels and increasing storminess. Furthermore, it is likely that some of the large reclamations may continue to influence coastal processes and downdrift areas in the future.

## **4.11 Summary**

### **4.11.1 Hydrodynamics**

The hydrodynamic regime has a significant swell component and outside the Firth of Forth is dominated by waves from the northern and eastern sectors. Inside the Firth of Forth waves from westerly sectors are important. The significant wave height exceeded for 10% of the time is 1.5-2.0 m on the open coast and 1.0-1.5 m in the Firth of Forth. The mean spring tidal range for the region exceeds 4 m and increases into the Forth Estuary. The 1 in 50 year storm surge height is 1.5 m and smaller surges of around 0.2 m occur several hundred times a year.

### **4.11.2 Sediment Transport**

The embayed nature of the coastline and relatively low volumes of beach sediments mean that, although wave energy is high, the actual longshore transport of material is relatively low. Hence many of the bays represent relatively closed littoral systems. Although previous workers have considered sediment transport to be generally from east to west, the variable wave direction can result in reversals and littoral divergences, especially at headlands. It is likely that under northerly wave conditions west to east transport can occur in a number of the bays on the open coast. Within the Firth of Forth reversals occur between Musselburgh and Eyebroughy due to the existence of gyres between Port Seton and Gosford, Musselburgh to Prestonpans. Additionally, variation in wave direction can be important.

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#### **4.11.3** Morphology

The overall form of the East Lothian coast is dominated by underlying geology which determines the coastal orientation and location of headlands. The geology is predominantly composed of Carboniferous sedimentary rocks and igneous intrusions. There are more recent Quaternary deposits of wind blown sand, till, fluvioglacial and alluvial material.

The coastal orientation and location of headlands controls the exposure to wave energy. Outside the Firth of Forth, the open coast is more exposed to wave action and is characterised by rock cut platforms and limited sediment volumes in the littoral zone. However, in the more sheltered areas within the Firth of Forth and within embayments between rocky headlands on the open coast, sandy beaches, marshes and dunes have accumulated.

Many of the morphological features of the present day coastline represent the reworking of features formed early in the Holocene under different sea levels. In comparison with the rest of the UK, the Scottish coast is unusual in having experienced a relative fall in sea level over much of the Holocene due to isostatic uplift:

- 10000 - 8500 years BP sea level fall
- 8000 - 6000 years BP sea level rise
- 6000 - 2500 years BP sea level fall
- 2500 - present relatively stable sea level

Many of the coastal morphological features of the East Lothian Coast, such as the aeolian dunes, may therefore be considered as being out of equilibrium with current hydrodynamic and sediment dynamic regimes.

#### **4.11.4** Coastal Process Units

The coastline of East Lothian has been split into different sections representing headland-bay-headland units, which have coherent characteristics and to an extent behave independently from each other:

1. Edinburgh to Musselburgh
2. Musselburgh to Cockenzie
3. Cockenzie to Craigielaw Point
4. Craigielaw Point to Gullane Point
5. Gullane Point to Eyebroughy
6. Eyebroughy to Longskelly Point
7. Longskelly Point to North Berwick (Rugged Knowes)
8. North Berwick to St. Baldred's Boat
9. St. Baldred's Boat to St. Baldred's Cradle
10. St. Baldred's Cradle to Dunbar Harbour
11. Dunbar Harbour to Mill Stone Neuk
12. Mill Stone Neuk to Torness Point
13. Torness Point to Cockburnspath



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#### **4.11.5** Historical Evolution

It appears likely that the late Holocene has been characterised by falling sea level, coupled with minor transgressions or stillstands. Over the last 100 years the exact trend in sea level for the East Lothian coast is unclear, although the rate of global sea level rise has been increasing, whilst the rates of isostatic uplift in Scotland have been decreasing.

Over this time period some of the largest changes in coastal morphology have been the large scale reclamations for power stations or industry which have advanced the MHWS seawards by several hundred metres e.g. Cockenzie, Prestonpans, Torness Point.

Large lengths of the East Lothian coastline are characterised by rocky cliffs and these have undergone low or negligible rates of coastal erosion. Elsewhere accretion has been more common than erosion. The largest areas of coastal change have been associated with estuary or river mouths where spits have accumulated. These features have produced accretion rates of 2-4 m/yr at areas such as Belhaven Bay, and erosion rates of 0.7-1.0 m/yr at Peffer Sands, Belhaven Bay and Broad Sands. Elsewhere on the coast rates of change have been much lower, with accretion rates of 0.2-0.6 m/yr and erosion rates of 0.2-0.4 m/yr.

#### **4.11.6** Future Coastal Evolution

Detailed responses of coastal features can only really be evaluated if the factors influencing current development are well understood and, at present, there are relatively few areas in the region for which adequate information is available (Firth et al., 1995). However, examination of literature and studies that have been carried out suggest the following responses for the East Lothian coastline in the future:

- By 2050 Sea level rise is likely to be between 5-6 mm/yr (Hill et al., 1998).
- There is likely to be an increase in storminess in the future, which may influence incident wave heights, directions and frequencies.
- Many coastal responses are dependent on the sediment supply, which is poorly understood at present and difficult to predict in the future.
- There is likely to be a reduction in width of saltmarshes coupled with a replacement by mudflats.
- On North Berwick coast, the dune fields (Gullane Bay to St. Baldred's Cradle) may experience increased erosion from rising sea level and storms, with a possibility of onshore migration or barrier breakthrough. However this is heavily dependent on sediment supply.
- On open coast (St. Baldred's Boat to Cockburnspath), there will be a general tendency for the landward movement of beaches coupled with a reorientation of bays in planshape. Unless supply increases, there is likely to be continued erosion of beaches such as East Dunbar.
- Spit features, such as those of Belhaven Bay, are likely to be more active showing migration onshore or extension alongshore.

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## **5 Coastal Defences**

### **5.1 Introduction**

The surveys of coastal structures reported herein have been undertaken in order to provide information appropriate to the preparation of the Shoreline Management Plan. They should not be construed as detailed structural surveys. The data collected during the visual inspection is of a similar level of detail to that gathered in the MAFF structural survey of the English coastline. Data on each coastal defence is also held in the GIS database, which can be updated by East Lothian Council as required.

### **5.2 Coastal Defence Survey**

An experienced marine engineer and a coastal geomorphologist completed the structural survey over 2 days (29/10/01 and 30/10/01). These visits follow up earlier site visits on 11/07/01, 12/07/01 and 22/08/01, although the earlier visits mainly concentrated on the unprotected coastline. Details of the survey and a summary table showing the attributes of the coastal defences are contained within Appendix D. The defences are described in detail in Section 9, in the discussion of management units.

The visual inspection of identified coast defence 'structures' was carried out in a necessarily short visit. As such, it was not possible to carry out detailed inspections, nor was it possible to observe conditions at different states of tide. Lower reaches of harbour walls for example could therefore not be inspected in most cases, except where tide level and access allowed for this. Topographic survey information could not be included within the resource constraints and timescale available to the visit. Nevertheless, some reference to apparent relative levels is offered as guidance where practicable and appropriate.

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### 5.3 Coastal Defence in East Lothian

Existing coastal defences in East Lothian are mainly located along the shoreline of the built-up areas of Musselburgh, Prestonpans, Cockenzie, North Berwick and Dunbar, although short sections of defence were identified elsewhere along the East Lothian shoreline (Figure 5.1).

**Table 5.1 Summary Table of Coastal Defences in East Lothian**

| Asset Type                                          | Number | Total Length (m) |
|-----------------------------------------------------|--------|------------------|
| Concrete / Masonry Wall                             | 31     | 10,316           |
| Concrete/Rock Revetment and Concrete / Masonry Wall | 1      | 1,493            |
| Gabions                                             | 5      | 1,147            |
| Geotextile                                          | 1      | 115              |
| Groyne                                              | 1      | 49               |
| Harbour                                             | 5      | 1,620            |
| Rock Revetment                                      | 13     | 1,984            |
| Timber Wall                                         | 3      | 433              |
| Total                                               | 60     | 17,157           |

Some form of hard coastal defence protects a total of 17.2km of the shoreline of East Lothian (Table 5.1). Each defence is described in detail in Chapter 9 of the Plan. Concrete / masonry sea-walls were the most common type of coastal defence identified, covering a length of over 10km, while rock revetments extend over approximately 2km of shoreline. However, most of the East Lothian coast is natural, with no hard coastal defences stabilising the shoreline (Figure 5.1). Natural geomorphic features of the shoreline, such as rock outcrops, beaches, saltmarshes and sand dunes form natural coastal defences for the hinterland.

East Lothian Council have prepared a Property Maintenance Survey, which includes a summary of the condition of some of the coastal defences and an estimated maintenance/repair cost. This is included in Appendix E and the findings are discussed further in Chapter 9.

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### 6 Land-use and the Human and Built Environment

Development of the Shoreline Management Plan requires consideration of land-use, the human and the built environment to develop strategic management options. A detailed description of land-use, human and built environment is provided in Chapter 9 for each management unit identified on the East Lothian Shoreline. This chapter provides an overview.

#### 6.1 Land-use

Macaulay Land Use Research Institute (MLURI) mapped the land-use of the whole of Scotland in 1988. The digital land-use data for East Lothian was purchased from MLURI for the purpose of developing the Shoreline Management Plan. Land-use in each management unit is described in detail in Chapter 9 and mapped in Figure 9.3.

Arable land is the main land-use in the 1km hinterland of the East Lothian shoreline, covering 3031ha (44%) (Table 6.1). Factories and the urban area comprise only 22% of the hinterland. The remaining land supports low intensity land-uses, comprising recreational land, grasslands, woodlands, dunes etc.

**Table 6.1 Land-use type within 1km of the East Lothian coast, summarised from MLURI (1988) land-use data**

| Land-use                     | Area (ha) | Percentage |
|------------------------------|-----------|------------|
| Arable                       | 3031.7    | 43.8%      |
| Factories & urban            | 1509.1    | 21.8%      |
| Recreational land            | 626.8     | 9.0%       |
| Improved grassland           | 398.2     | 5.7%       |
| Mixed woodland               | 350.8     | 5.1%       |
| Coniferous plantation        | 309.2     | 4.5%       |
| Smooth grassland             | 271.3     | 3.9%       |
| Duneland                     | 189.4     | 2.7%       |
| Quarries                     | 100.4     | 1.4%       |
| Coarse grassland             | 64.3      | 0.9%       |
| Salt marsh                   | 39.6      | 0.6%       |
| Broadleaved woodland         | 16.4      | 0.2%       |
| Maritime grasslands & heaths | 14        | 0.2%       |
| Water                        | 5.2       | 0.1%       |
| Total                        | 6926.4    | 100%       |

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#### **6.2 Cultural Heritage**

The East Lothian coastline is rich in archaeological and built heritage (GUARD 1996). GUARD (1996) surveyed the south shore of the Firth of Forth from Dunbar to Stirling. The survey included all listed building, designed landscapes, scheduled and unscheduled monuments within 50m of the MHWS. This report and database was drawn heavily upon whilst compiling the SMP.

All listed buildings, scheduled and unscheduled monuments within 1km of MHWS were considered for the SMP. In addition, information on the marine heritage (to the 20m depth contour) was obtained (Table 6.2). Listed Building data was obtained from East Lothian Council. Information on Scheduled Monuments was obtained from the Scheduled Ancient Monument's Database compiled by Historic Scotland. The Royal Commission of Ancient and Historic Monuments Scotland (RCAHMS) provided data on unscheduled monuments (archaeological and architectural) and marine heritage.

There are 38 scheduled ancient monument within 1km of the East Lothian shoreline (Table 6.2) some of which are very close to the shoreline, potentially at risk to erosion/flooding, including:

- Tantallon Castle (NT595850)
- Seacliff Tower (NT613841)
- Dunbar Castle and Fort (NT678793)

919 unscheduled monuments were identified within the SMP area. These include sites of both archaeological and architectural importance. A number of these sites lie close to the shoreline, buried under sand dune deposits or associated with the raised beach deposits, which form much of the coastal hinterland of East Lothian. Several caves or rock-cut shelters were identified, often associated with midden material (GUARD 1996). These include:

- Kilspindie cave, post-medieval
- Archerfield, Iron Age
- Fidra, Medieval
- Yellow Man Cave
- Leckmorran Ness
- St Baldred's Cave, Early Iron Age

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The archaeological record includes several sites where midden material has been exposed in the past, although during the GUARD (1996) survey no exposed or eroding middens were found. The following areas have been recognised as important by GUARD (1996), who suggest periodic monitoring in case further midden becomes exposed beneath slumped raised beach deposits or sand dunes:

- Gullane Links
- Fidra
- North Berwick Glen Golf Course
- Yellow Man Cave
- Tantallon Castle
- The Gegan, Seacliff
- Seacliff

44 shipwrecks lie in the East Lothian inter-tidal area to the 20m depth contour. These are discussed in further detail in Chapter 9.

**Table 6.2: Cultural Heritage within 1km of the East Lothian Shoreline**

| Category                                                    | Number | Source            |
|-------------------------------------------------------------|--------|-------------------|
| Scheduled Ancient Monuments                                 | 38     | Historic Scotland |
| Unscheduled Monuments<br>(archaeological and architectural) | 919    | RCAHMS            |
| Maritime Sites                                              | 44     | RCAHMS            |
| Listed Buildings                                            | 1095   | ELC               |
| TOTAL                                                       | 2096   |                   |

A total of 1095 Listed Buildings lie within the 1km coastal zone of East Lothian. These are concentrated in the built-up areas of Musselburgh, Prestonpans, North Berwick, Belhaven and Dunbar. The majority of Listed building were domestic houses of the 18<sup>th</sup> and 19<sup>th</sup> century. Several churches are Listed, including Prestonpans and North Berwick church. Listed harbours include Fisherrow Harbour, Cockenzie and Port Seton and Dunbar (including the Battery). The rich industrial heritage of East Lothian is preserved at Preston Grange (mining) and several listed maltings and warehouses at Dunbar Harbour. Listed building close to the coast may be affected by the salty environment, they are not generally suffering from coastal erosion as sea-defences generally protect the built-up areas (GUARD 1996).

The reader is referred to GUARD (1996) for further detailed information regarding the archaeological and built heritage of East Lothian.

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### **6.3 Further General Information**

Forth Estuary Forum has produced the following topic papers, which were used as important general source documents for issues relating to land-use, human and built environment, discussed in further detail in Chapter 9:

1. Coastal and Marine Pollution
2. Tourism and Recreation
3. Built and Archaeological Heritage
4. Fisheries
5. Nature Conservation
6. Landscape and Amenity

Barne et al (1997) summarises land-use, human and built environment issues and provides a general overview of the coasts and seas of southeast Scotland.



## **7** Natural Environment

This chapter provides an overview of the natural environment of the East Lothian coastal area. A detailed discussion of the natural environment interests within specific management units is included in Chapter 9. The Natural Heritage Designations on the East Lothian shoreline are summarised here. This chapter also includes analysis of past and future habitat change and makes recommendations for conservation measures and Coastal Habitat Management Plans (ChaMPs).

### **7.1** Natural Heritage Designations

Much of the coast of East Lothian is designated as Site of Special Scientific Interest (SSSI) (Figure 7.1, Table 7.1). Many of individual SSSIs shown in Table 7.1 have recently been extended and amalgamated to form one SSSI (the Firth of Forth SSSI, Appendix F), which includes all SSSIs within the Firth of Forth. However, throughout the text of the SMP the original names of the SSSIs are used for ease of reference. The majority of SSSIs are designated for their outstanding geological, botanical and ornithological interests. Details of the SSSI designations and boundaries are provided in Appendix F.

A large part of the East Lothian Coastline forms part of the Firth of Forth Special Protection Area (SPA) under the EC Birds Directive (79/409/EEC) and Ramsar site under the Ramsar Convention on Wetlands of International Importance (Figure 7.2, Appendix F). The SPA and Ramsar site includes extensive inter-tidal flats containing rich assemblages of invertebrates that provide important feeding and roosting areas for wildfowl and waders. The site is a large coastal area comprising a complex of estuaries, mudflats, rocky shorelines, beaches and saltmarshes, including many fragmentary bits of shoreline considered to act as a single ecological unit. Several large urban areas, including Edinburgh, are adjacent to the site and include areas of heavy industry and well-used maritime shipping lanes. The site provides habitat for large numbers of wintering waders and wildfowl, many in nationally and internationally important numbers, and a number of aesthetic, archaeological, sporting and recreational interests lend added value. The conservation significance of the SPA and Ramsar site are discussed further below. The Forth Islands SPA has been designated for its outstanding ornithological interest (including the islands of Fidra, Lamb, Craigleith and the Bass Rock)

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**Table 7.1 Coastal Sites designated as Sites of Special Scientific Interest (SSSI) in East Lothian**

| Name                       | National Grid Reference      | Size (ha.) | Interest                                         | Comment                                                                                                                                                                  |
|----------------------------|------------------------------|------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aberlady Bay               | NT437795 – NT474834          | 866.2      | Botanical, Ornithological, Geological            | Aberlady Bay SSSI includes Aberlady Bay LNR<br>SPA / Ramsar site<br>Geological Conservation Review (GCR) Site<br>Now part of the Firth of Forth SSSI                     |
| Barns Ness Coast           | NT696781 – NT749757          | 271.3      | Botanical, Geological, Coastland                 | Geological Conservation Review (GCR) Site                                                                                                                                |
| Bass Rock                  | NT602873                     | 7.7        | Ornithological, Geological                       | Geological Conservation Review (GCR) Site<br>Part of Forth Islands SPA                                                                                                   |
| Dunbar Coast               | NT661793 – NT678794          | 81.2       | Geological, Biological                           | Geological Conservation Review (GCR) Site<br>SPA / Ramsar site<br>Now part of the Firth of Forth SSSI                                                                    |
| Forth Islands              | NT513868, NT535866, NT553870 | 22.5       | Ornithological                                   | Comprises the islands of Fidra, Lamb and Craighleith (all part of the Forth Islands SPA).<br>Fidra and Lamb are also RSPB reserves.                                      |
| Gosford Bay – Port Seton   | NT397756 – NT445796          | 306.2      | Ornithological                                   | SPA / Ramsar site<br>Now part of the Firth of Forth SSSI                                                                                                                 |
| Gullane to North Berwick   | NT479840 – NT552855          | 344.4      | Botanical, Ornithological, Geological            | Includes Eyebroughy<br>Geological Conservation Review (GCR) Site<br>SPA / Ramsar site<br>Now part of the Firth of Forth SSSI                                             |
| Musselburgh to Prestonpans | NT327731 – NT372754          | 156.9      | Biological, Geological                           | Part of the site is under the jurisdiction of Edinburgh Council<br>Geological Conservation Review (GCR) Site<br>SPA / Ramsar site<br>Now part of the Firth of Forth SSSI |
| Musselburgh Lagoons        | NT350737- NT360735           | 31.5       | Biological, Geological                           | Newly designated in 2001<br>SPA / Ramsar site<br>Now part of the Firth of Forth SSSI                                                                                     |
| North Berwick Coast        | NT552855- NT622829           | 231.9      | Botanical, Ornithological, Geological, Coastland | Geological Conservation Review (GCR) Site<br>SPA / Ramsar site<br>Now part of the Firth of Forth SSSI                                                                    |
| North Berwick Law          | NT555842                     | 36.6       | Botanical                                        |                                                                                                                                                                          |
| Tynninghame Shore          | NT640800                     | 608.3      | Botanical, Ornithological, Coastland             | Part of the SSSI is the John Muir Country Park<br>SPA / Ramsar site<br>Now part of the Firth of Forth SSSI                                                               |

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Scottish Wildlife Trust (SWT) has provisionally identified 16 Wildlife Sites along the East Lothian coast (Table 7.2). A number of sites are awaiting survey and only two have been designated. However, the locations provide an indication of those sites considered to be of outstanding importance for wildlife.

**Table 7.2 Wildlife Sites within 1km of the East Lothian Coastline (provisional, surveyed and designated) (source: East Lothian Council)**

| Name                          | NG Ref.  | Type        |
|-------------------------------|----------|-------------|
| Biel Water                    | NT657785 | Provisional |
| Dry Burn                      | NT734759 | Provisional |
| Dunglass Burn                 | NT772726 | Provisional |
| Dunglass Gorge                | NT768718 | Provisional |
| Maggie's Waas Wood            | NT478795 | Site        |
| Musselburgh Shore and Lagoons | NT355738 | Surveyed    |
| North Berwick Law Reservoir   | NT552840 | Site        |
| River Esk                     | NT345734 | Provisional |
| River Tyne                    | NT625793 | Provisional |
| Spott Burn                    | NT696782 | Provisional |
| Thornton Burn                 | NT753743 | Provisional |
| Thornton Glen                 | NT735738 | Provisional |
| Archerfield Estate            | NT502847 | Provisional |
| Gosford Estate                | NT455787 | Surveyed    |
| Tynninghame Estate            | NT621800 | Provisional |
| Longniddry Bents              | NT440777 | Provisional |

## 7.2 Analysis of Habitat Change

The following section provides a preliminary analysis of the implications of identified potential future coastal change for protection of conservation values in the area. Since the Firth of Forth, including the East Lothian coast, has been designated as a Special Protection Area under the EC Birds Directive (79/409/EEC), there is an obligation to consider the implications of shoreline management for those features on which the proposal was based. The framework for management of these implications is provided by Coastal Habitat Management Plans (CHaMPS), the purpose of which is to document predicted gains and losses of habitats and to set out measures to address net losses. The present study also comments on implications of predicted changes and consequent habitat-management requirements.

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#### 7.2.1 Methods

1. The broad types of habitats represented by the areas of erosion and accretion identified in Section 4.7 (and see Appendix C) were determined from Ordnance Survey maps (1:25000), aerial photographs and published information on protected sites on the East Lothian coast, and are shown in Tables 7.3 and 7.4. These were then used to derive likely future changes, based on the information discussed in the section on Future Coastal Evolution.
2. Some of the habitat identifications are uncertain (particularly those over which accretion occurred between 1907 and 1999). Boundaries between habitat types are also dynamic and consequently we have not attempted to distinguish between sand beaches and dunes because these habitats grade into each other, both in space and in time.
3. There are several parts of the coast, for example, opposite the harbour at Fisherrow, where comparison of the positions of mean low water of spring tide (MLWS) for 1907 and 1999 suggests that there has been accretion or erosion in the lower inter-tidal area. In many cases, this apparent difference in the positions of MLWS may be a result of differences in the accuracy of the methods of mapping this feature between the 1907 and 1999 maps. As stated above, the mapping errors for the positions of MHWS on the OS maps are  $\pm 6$  m and  $\pm 2.4$  m for the 1907 and 1999 series, respectively. The errors for MLWS are assumed to be similar, but this is not necessarily the case. For this reason, changes in the position of MLWS were not included in the analysis of historical coastal change. For the purpose of identifying the significance of changes for the features on which designations of Special Protection Areas or Ramsar sites were made, however, these changes are potentially very important and must be considered. Consequently, the error is assumed to be unknown, and we have taken a conservative approach to interpreting these differences, only noting them where the width of the area of apparent change is large ( $> c. 100$  m).
4. The significance of identified changes for features of conservation importance have been interpreted with reference to the designations of the sites. We have used information in the management statements and plans for the Sites of Special Scientific Interest and Local Nature Reserves in the area and general information on habitat-use by the bird species on which the SPA designation is based. Conservation objectives for relevant habitats set out in the UK Biodiversity Action Plans (<http://www.ukbap.org.uk/plans/habitats>) and the Regulation 33 package for the Solway Firth SPA (English Nature/Scottish Natural Heritage 2000) were also used.
5. Initial guidance on conservation matters, including the requirements for a Coastal Habitat Management Plan (CHaMP), is provided on the basis of the above analysis. The SPA designation covers the whole Firth of Forth and it is important to note that any future CHaMP will cover the whole site and environs rather than having separate CHaMPs for different parts of the site. Interpretation of the significance of habitat changes for the SPA, and development of management plans to deal with them, will need to consider the whole Firth.

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#### **7.2.2** Change in Habitat Distribution Between 1907-1999

Habitat gains and losses due to accretion are shown in Table 7.3 and losses due to erosion are shown in Table 7.4. These were derived from the maps of changes in the positions of MLWS and MHWS between 1907 and 1999, shown in the Appendix C. Net gains or losses for each habitat type are summarised in Table 7.5 and show the following main points:

- relatively large net loss of inter-tidal sand and mud (c. 130 ha) mainly due to accretion of other habitats, reclamation and apparent erosion of lower inter-tidal areas;
- net loss of inter-tidal rock, mainly due to accretion of other habitats;
- net increase in area of sand beaches/dunes;
- net increase in area of saltmarsh;
- the present extent and past changes in supratidal shingle/sand are unknown - although changes may be small in terms of area, they may of relatively large significance to birds that use these habitats for breeding.

It should be noted that aerial comparisons between past and present habitat types is problematic because of differences between the present study and previous studies in the way habitats are defined and because boundaries between types of habitat (for example, supralittoral sand and sand dunes) are not always distinct.

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**Table 7.3 Areas of accretion and magnitude of change for the East Lothian coastline, showing types of habitats gained and lost**

| Coastal Process Unit | Location                                         | Dates     | Maximum change (m) | Equivalent average yearly change (m/yr) | Habitat gained                 | Habitat lost                                                                                        | Source  |
|----------------------|--------------------------------------------------|-----------|--------------------|-----------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------|---------|
| 1                    | Eastfield                                        | 1907-1999 | 20                 | 0.2                                     | Upper inter-tidal shingle/sand | Inter-tidal shingle/sand/mussel bed                                                                 | OS maps |
| 1                    | Fisherrow Sands                                  | 1907-1999 | 30                 | 0.3                                     | Upper inter-tidal shingle/sand | Inter-tidal shingle/sand/mussel bed                                                                 | OS maps |
| 2                    | Musselburgh - reclaimed land ash lagoons         | 1907-1999 | 750                | 8.2                                     | Supratidal lagoons             | Inter-tidal shingle/sand/mussel bed                                                                 | OS maps |
| 2                    | Prestonpans - reclaimed land of disused workings | 1907-1999 | 220                | 2.4                                     | Supratidal areas               | Loss of inter-tidal shingle/sand/mussel bed apparently balanced by subsequent inter-tidal accretion | OS maps |
| 2                    | Cockenzie - reclaimed land for power station     | 1907-1999 | 290                | 3.2                                     | Supratidal industrial areas    | Inter-tidal shingle/sand/mussel bed, some of loss compensated by subsequent accretion               | OS maps |
| 3                    | Bell's Rock to Port Seton Harbour                | 1907-1999 | 30                 | 0.3                                     | Unknown                        | Inter-tidal rock platform                                                                           | OS maps |
| 3                    | Port Seton - reclaimed land                      | 1907-1999 | 30                 | 0.3                                     | Supratidal urban               | Inter-tidal rock platform                                                                           | OS maps |
| 3                    | Seton Sands to Longniddry                        | 1907-1999 | 80                 | 0.9                                     | Sand beach/dunes               | Inter-tidal sand                                                                                    | OS maps |

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**Table 7.3 Areas of accretion and magnitude of change for the East Lothian coastline, showing types of habitats gained and lost Continued 1**

| Coastal Process Unit | Location                                                       | Dates     | Maximum change (m) | Equivalent average yearly change (m/yr) | Habitat gained             | Habitat lost                           | Source      |
|----------------------|----------------------------------------------------------------|-----------|--------------------|-----------------------------------------|----------------------------|----------------------------------------|-------------|
| 3                    | Green Craig                                                    | 1907-1999 | 20                 | 0.2                                     | Shingle                    | Inter-tidal shingle and rock platform. | OS maps     |
| 3/4                  | Mid Gosford Bay to south end of Aberlady Bay                   | 1907-1999 | 200                | 2.0                                     | Lower inter-tidal sandflat | Subtidal sand                          | OS maps     |
| 4                    | Aberlady Bay - at Kilspindie and southern shore of Peffer Burn | 1907-1999 | 50                 | 0.5                                     | Saltmarsh                  | Upper inter-tidal shingle and mud      | OS maps     |
| 4                    | Aberlady Bay - at Yellow Mires                                 | 1907-1999 | 100                | 1.1                                     | Sand beach/dunes           | Upper inter-tidal sand/saltmarsh       | OS maps     |
| 5                    | Opposite Eyebroughy                                            | 1907-1999 | 40                 | 0.4                                     | Sand beach/dunes           | Rock platform                          | OS maps     |
| 6                    | Longskelly Rocks                                               | 1907-1999 | 20                 | 0.2                                     | Sand beach/dunes           | Upper inter-tidal sand                 | OS maps     |
| 7                    | Broad Sands                                                    | 1907-1999 | 20                 | 0.2                                     | Sand beach/dunes           | Upper inter-tidal sand                 | OS maps     |
| 7                    | Opposite Black Murphies                                        | 1907-1999 | 20                 | 0.2                                     | Sand beach/dunes           | Upper inter-tidal sand                 | OS maps     |
| 7                    | North Berwick Bay                                              | Unknown   | Unknown            | -                                       | Sand beach/dunes           | Upper inter-tidal sand/boulders        | GUARD, 1996 |
| 8                    | Seacliff                                                       | 1907-1999 | 20                 | 0.2                                     | Sand beach/dunes           | Upper inter-tidal sand                 | OS maps     |

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**Table 7.3 Areas of accretion and magnitude of change for the East Lothian coastline, showing types of habitats gained and lost Continued 2**

| <b>Coastal Process Unit</b> | <b>Location</b>                                          | <b>Dates</b> | <b>Maximum change (m)</b> | <b>Equivalent average yearly change (m/yr)</b> | <b>Habitat gained</b>                            | <b>Habitat lost</b>            | <b>Source</b>         |
|-----------------------------|----------------------------------------------------------|--------------|---------------------------|------------------------------------------------|--------------------------------------------------|--------------------------------|-----------------------|
| 9                           | Scoughall Rocks                                          | 1907-1999    | 30                        | 0.3                                            | Sand beach/dunes                                 | Upper inter-tidal rock         | OS maps               |
| 9                           | Bathan's Strand (Ravensheugh Sands)                      | 1907-1999    | 20                        | 0.2                                            | Sand beach/dunes                                 | Upper inter-tidal sand         | OS maps               |
| 10                          | Belhaven Bay - Sandy Hirst spit and northern shore       | 1907-1999    | 230                       | 2.5                                            | Sand beach/dunes and spit, saltmarsh behind spit | Upper inter-tidal sand and mud | OS maps<br>ELDC, 1976 |
| 10                          | Belhaven Bay - Spike Island spit and southern shore      | 1907-1999    | 400                       | 4.3                                            | Saltmarsh, eelgrass, sand beach/dune and spit    | Upper inter-tidal sand and mud | OS maps<br>ELDC, 1976 |
| 10                          | Belhaven Bay - south of inner River Tyne                 | 1907-1999    | 210                       | 2.3                                            | Saltmarsh                                        | Saltmarsh                      | OS maps<br>ELDC, 1976 |
| 10                          | Southern Belhaven Bay (eastern end of Spike Island spit) | 1907-1999    | 200                       | 2.2                                            | Sand beach/dunes and saltmarsh                   | Upper inter-tidal sand         | OS maps<br>ELDC, 1976 |
| 11                          | East Dunbar (western end of East Esplanade)              | 1907-1999    | 10                        | 0.1                                            | Sea defences                                     | Upper inter-tidal rock         | OS maps               |
| 11                          | East of Dunbar at eastern end of golf course (Fluke Dub) | 1907-1999    | 60                        | 0.7                                            | Sand beach/dunes and saltmarsh                   | Upper inter-tidal sand/shingle | OS maps<br>Burd, 1987 |
| 11                          | Lawrie's Den to White Sands                              | 1907-1999    | 20                        | 0.2                                            | Sand beach/dunes                                 | Upper inter-tidal sand/shingle | OS maps               |



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**Table 7.3 Areas of accretion and magnitude of change for the East Lothian coastline, showing types of habitats gained and lost Continued 3**

| <b>Coastal Process Unit</b> | <b>Location</b>                                  | <b>Dates</b> | <b>Maximum change (m)</b> | <b>Equivalent average yearly change (m/yr)</b> | <b>Habitat gained</b>          | <b>Habitat lost</b>                | <b>Source</b>         |
|-----------------------------|--------------------------------------------------|--------------|---------------------------|------------------------------------------------|--------------------------------|------------------------------------|-----------------------|
| 12                          | Barns Ness to Chapel Point                       | 1907-1999    | 30                        | 0.3                                            | Sand beach/dunes and saltmarsh | Upper inter-tidal sand/shingle     | OS maps<br>Burd, 1987 |
| 12                          | Skateraw Harbour                                 | 1907-1999    | 40                        | 0.4                                            | Sand beach/dunes               | Upper inter-tidal sand/shingle     | OS maps               |
| 12/13                       | Torness Point - reclaimed land for power station | 1907-1999    | 310                       | 3.4                                            | Supratidal industrial areas    | Inter-tidal rock platform          | OS maps               |
| 13                          | Dunglass to Reed Point                           | 1907-1999    | 50                        | 0.5                                            | Sand beach/dunes               | Upper inter-tidal rock and shingle | OS maps               |

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**Table 7.4 Areas of erosion and magnitude of change for the East Lothian coastline showing types of habitats lost**

| Coastal Process Unit | Location                               | Dates          | Maximum change (m) | Equivalent average yearly change (m/yr) | Habitat lost                               | Source              |
|----------------------|----------------------------------------|----------------|--------------------|-----------------------------------------|--------------------------------------------|---------------------|
| 1                    | Eastfield-Fisherrow Sands              | 1907-1999      | 300                | 3.0                                     | Lower inter-tidal mussel bed/shingle/sand  | OS maps             |
| 2                    | Musselburgh ash lagoons                | 1907-1999      | 100                | 1.0                                     | Lower inter-tidal mussel bed/shingle/sand? | OS maps             |
| 3                    | Seton Sands                            | 1907-1999      | 100                | 1.0                                     | Lower inter-tidal sandflat                 | OS maps             |
| 3                    | Gosford Bay                            | 1907-1999      | 100                | 1.0                                     | Lower inter-tidal sandflat                 | OS maps             |
| 3                    | Gosford Bay                            | Last 100 years | 5                  | 0.05                                    | Sand beach/dunes                           | GUARD, 1996         |
| 4                    | North Aberlady Bay                     | 1907-1999      | 100                | 1.0                                     | Lower inter-tidal sandflat                 | OS maps             |
| 5                    | South Gullane Bay                      | 1907-1999      | 300                | 3.0                                     | Lower inter-tidal sandflat                 | OS maps             |
| 5                    | Gullane Bay - Gullane Bents dunes      | 1907-1999      | 40                 | 0.4                                     | Sand beach/dunes                           | OS maps, Rose, 1980 |
| 5                    | North Gullane Bay                      | 1907-1999      | 100                | 1.0                                     | Lower inter-tidal sandflats                | OS maps             |
| 7                    | Broad Sands                            | 1907-1999      | 100                | 1.0                                     | Lower inter-tidal sandflat                 | OS maps             |
| 7                    | Broad Sands Golf course                | 1907-1999      | 60                 | 0.7                                     | Sand beach/dunes                           | OS maps             |
| 7                    | North Berwick (Milsey Bay) sandy areas | 1907-1999      | 100                | 1.0                                     | Lower inter-tidal sandflat                 | OS maps             |
| 7                    | North Berwick (Milsey Bay)             | 1907-1999      | 30                 | 0.3                                     | Sand beach/dunes/ (sea defence)            | OS maps             |

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**Table 7.4 Areas of erosion and magnitude of change for the East Lothian coastline showing types of habitats lost (Continued 1)**

| Coastal Process Unit | Location                                          | Dates     | Maximum change (m)   | Equivalent average yearly change (m/yr) | Habitat lost                                           | Source                       |
|----------------------|---------------------------------------------------|-----------|----------------------|-----------------------------------------|--------------------------------------------------------|------------------------------|
| 8                    | Seacliff Bay                                      | Unknown   | Unknown              | -                                       | Upper shore boulder clay                               | GUARD, 1996                  |
| 9                    | Peffer Sands                                      | 1907-1999 | 90 (highly variable) | 1.0                                     | Sand beach/dunes                                       | OS maps                      |
| 9                    | Peffer Sands and Ravensheugh Sands                | Unknown   | Unknown              | -                                       | Inter-tidal sand                                       | GUARD, 1996                  |
| 9                    | St. Baldred's Cradle                              | Unknown   | Unknown              | -                                       | Boulder clay cliffs                                    | GUARD, 1996                  |
| 10                   | Hedderwick Sands - southern shore of Belhaven Bay | 1907-1999 | 60                   | 0.7                                     | Sand beach/dunes                                       | OS maps                      |
| 10                   | Southern Belhaven Bay - Biel Water                | Unknown   | Unknown              | -                                       | Sand beach/dunes                                       | GUARD, 1996                  |
| 10                   | Winterfield Golf Course                           | Unknown   | Unknown              | -                                       | Mud cliffs                                             | East Lothian Council, 1993   |
| 11                   | Dunbar, including East Dunbar beach               | Unknown   | Unknown              | -                                       | Unknown                                                | GUARD, 1996                  |
| 11                   | East sides of bays south of Dunbar                | Unknown   | Unknown              | -                                       | Unknown                                                | Barne <i>et al.</i> , 1997   |
| 12                   | Mill Stone Neuk                                   | 1907-1999 | 20                   | 0.2                                     | Sand beach/dunes                                       | OS maps                      |
| 12                   | Catcraig                                          | 1907-1999 | 30                   | 0.3                                     | Sand beach/dunes                                       | OS maps                      |
| 12                   | Barns Ness to Chapel Point                        | 1907-1999 | 100                  | 1.0                                     | Lower inter-tidal rock platform and shingle            | OS maps                      |
| 12                   | Skateraw Harbour                                  | 1907-1999 | 200                  | -                                       | Loss of inter-tidal rock platform to construct harbour |                              |
| 13                   | Torness to Cockburnspath                          | Unknown   | Unknown              | -                                       | Sandstone cliffs/inter-tidal rock                      | Brazier <i>et al.</i> , 1998 |

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**Table 7.5 Present extent of coastal habitats in East Lothian (from Hutcheon *et al.* 1998), change in extent over past 90 years (1907-1999) and predicted patterns of future change. See text for discussion of changes.**

| Habitat Type               | Habitat Sub-Type | Present Extent        | Change Over Past 90 Yr | Future Change                                                       |
|----------------------------|------------------|-----------------------|------------------------|---------------------------------------------------------------------|
| Inter-tidal mud/sand flats |                  | 14.3 ha<br>(1200 ha)* | -133.0 ha              | Continued erosion at increased rate                                 |
| Sand beach/dunes           | Dune slack       | 5.6 ha                | -                      |                                                                     |
|                            | Dune grassland   | 405.9 ha              | -                      |                                                                     |
|                            | Dune heath       | 1.8 ha                | -                      |                                                                     |
|                            | Dune scrub       | 54.4 ha               | -                      |                                                                     |
|                            | Open dune        | 164.1 ha              | -                      |                                                                     |
|                            | Total            | 631.8 ha              | +58.4 ha               | Decreased accretion or erosion                                      |
| Inter-tidal boulder/rock   |                  | 45.4 ha               | -23.8 ha               | Little change or increase in area as overlying sediments are eroded |
| Saltmarsh                  |                  | 136.3 ha              | +36.6 ha               | Decreased accretion or erosion                                      |
| Maritime cliff             | Hard cliff       | 1.20 km               | -                      | Little change                                                       |
|                            | Soft cliff       | 0.82 km               | -0.3 ha**              | Increased loss of cliff-top habitat due to increased erosion        |
| Coastal grassland          |                  | 55.2 ha               | +2.4 ha                | Decreased accretion or erosion                                      |

\* this value of 14.33 ha, given by Hutcheon *et al.* (1998), does not include several large areas of inter-tidal sand and mud within the East Lothian region, such as Aberlady Bay. We have estimated the total extent of this habitat in the East Lothian region at approximately 1200 ha.

\*\* Hutcheon *et al.* (1998) give a value for length of cliff present, but in the context of conservation of cliff-top habitat, estimates of changes in area are more appropriate.

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#### **7.2.3** Future Habitat Change

Predictions of future habitat change were described in the Section 4.10, Future Coastal Evolution and are subject to several uncertainties, notably rates of sea-level change and changes in sediment supply.

From the analysis of past coastal change, losses or gains of various habitats were as shown in Table 7.5. Likely patterns of future change are derived from Section 4.10 (Future Coastal Evolution). There is a need for accurate estimates of the present extent of some habitats, such as supratidal shingle/sand, against which to assess future change.

#### **7.2.4** Significance of Habitat Change

The significance of predicted future habitat change has been assessed against the likely conservation objectives for the SPA, the UK Biodiversity Action Plans for relevant habitat types (see <http://www.ukbap.org.uk/plans/habitats>) and the management statements and plans for SSSIs and LNRs along the East Lothian coast (produced by Scottish Natural Heritage and ELC).

##### **7.2.4.1** Significance of Change in the Context of the SPA

The Firth of Forth SPA includes extensive inter-tidal flats containing rich assemblages of invertebrates that provide important feeding and roosting areas for waders and waterfowl. These areas include Musselburgh, Gosford Bay and Aberlady Bay. The site qualifies for SPA status by:

- Supporting populations of European importance of the following species listed in Annex 1 of the Birds Directive (79/409/EEC):
  - Sandwich tern (*Sterna sandvicensis*) representing at least 3.8% of the UK population
  - Other Annex 1 birds that breed in the Forth are roseate terns, common terns, and arctic terns.
  - Bar-tailed godwit (*Limosa lapponica*), representing at least 4.9% of the UK wintering population
  - Golden plover (*Pluvialis apricaria*) representing at least 1.2% of the UK wintering population
  - Red-throated diver (*Gavia stellata*) representing at least 1.8% of the UK wintering population
  - Slavonian grebe (*Podiceps auritus*) representing at least 17.8% of the UK wintering population
- Supporting populations of European importance of the following migratory species:
  - Knot (*Calidris canutus*) representing at least 2.3% of the UK wintering population
  - Pink-footed goose (*Anser brachyrhynchus*) representing at least 5.5% of the UK wintering population
  - Redshank (*Tringa totanus*) representing at least 2.5% of the UK wintering population

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- Shelduck (*Tadorna tadorna*) representing at least 1.2% of the UK wintering population
- Turnstone (*Arenaria interpres*) representing at least 1.8% of the UK wintering population
- Regularly supporting at least 20000 waterfowl:
  - Over winter, the area regularly supports 86067 waterfowl (WeBS 1991/2-1995/6) including: curlew, golden plover, bar-tailed godwit, ringed plover, grey plover, lapwing, dunlin, oystercatcher, knot, redshank, turnstone, cormorant, great crested grebe, slawonian grebe, red-throated diver, red-breasted merganser, pink-footed geese, shelduck, mallard, scaup, eider, long-tailed duck, common scoter, velvet scoter, goldeneye, wigeon
- Other faunal interest includes the presence of several species listed in Annex II of the Habitats Directive (92/43/EEC), namely grey and common seals, bottle-nosed dolphins, harbour porpoises and several species of fish, including Atlantic salmon.

The Birds Directive requires that special conservation measures be taken to ensure the survival and reproduction of the Annex 1 species for which the site is designated. The Directive also requires that measures are taken to protect the habitats of regularly occurring migratory species. The following habitats are relevant to birds of the East Lothian coast, including the species listed in the proposal for designation:

- Mud and sandflats
  - waders (feeding and roosting)
  - shelduck (feeding)
  - ducks (roosting/resting)
  - terns feeding at high water
- Shingle/sand inter-tidal
  - oystercatchers, plovers, turnstones and other waders (feeding and roosting)
  - oystercatchers, terns, turnstones and plovers (breeding)
  - ducks (roosting/resting)
- Sand dunes
  - eider, shelduck and gulls (breeding)
  - terns (formerly breeding at Aberlady Bay)
- Rocky shore
  - waders, particularly turnstone and purple sandpiper (roosting)
- Saltmarsh
  - waders, gulls and terns (roosting and high-tide refuge)
  - ducks and geese (feeding)
- Subtidal banks
  - divers, grebes, sea ducks, mergansers, terns (feeding)
- Cliffs and cliff-tops
  - fulmars and house martins (breeding)

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The conservation objectives of the Solway Firth SPA (as set out in English Nature/Scottish Natural Heritage's Regulation 33 package: English Nature/Scottish Natural Heritage, 2000) are used as an illustration of the types of objectives, and the targets proposed to achieve them, that would be relevant to the Firth of Forth SPA, namely:

- Internationally-important populations of Annex 1 bird species:
  - Saltmarsh:*
    - no decrease in extent
    - no change in range of sward heights (important for feeding of grazing ducks and geese)
    - no change in presence and abundance of characteristic food species
  - Inter-tidal mudflats and sandflats:*
    - no decrease in extent
    - no change in presence and abundance of prey species
- Internationally-important migratory waterfowl:
  - Saltmarsh:*
    - no decrease in extent
- Internationally-important assemblages of waterfowl:
  - Saltmarsh:*
    - no change in range of sward heights
  - Subtidal sandbanks:*
    - no decrease in extent (important feeding areas for diving birds)
    - no change in presence or abundance of prey species (important food source for diving birds)

Although the Firth of Forth is not designated or proposed as a SAC, in order to describe the broad conservation context it is relevant to consider habitats listed in Annex 1 of the Habitats Directive (92/43/EEC) that are present in the Firth. The following objectives relate to the preservation Annex I habitats found in the Solway Firth and also in the Firth of Forth:

- Atlantic saltmeadows:
  - no decrease in extent
  - no change in frequency and abundance of characteristic communities
  - no change in range and distribution of varying heights of vegetation
  - no change in frequency and abundance of characteristic species
- Salicornia and other annuals colonising mud and sand:
  - no decrease in extent
  - no alteration of creek patterns
  - no change in sediment characteristics
  - no change in frequency and abundance of characteristic species
  - no increase in the extent of algal mats
- Mudflats and sandflats not covered by seawater at low tide:
  - no decrease in extent
  - no change in sediment characteristics
  - no change in tidal elevation and shore slope
  - no increase in algal mats
  - no change in range of littoral gravel and sand biotopes
  - no change in range of littoral sandy mud communities

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- Sandbanks that are slightly covered by seawater all the time:
  - no decrease in extent
  - no change in sediment characteristics
  - no change in range of infralittoral gravel and sand biotopes

#### **7.2.4.2** Significance of change in the context of existing SSSIs and UK Biodiversity Action Plans

It is likely that most or all of the important examples of habitats that play a significant role in supporting internationally important populations of birds in the Firth of Forth are designated as SSSIs. Much of the coast of East Lothian is designated as SSSI, (Table 7.2).

Features of interest in SSSIs that are relevant in the present context are principally the bird habitats discussed below. The management objectives for the SSSIs in which each habitat occurs include maintenance of the area in favourable condition for key bird species to feed, rest, roost and breed. A further general objective is to “maintain habitats with their associated botanical interest”. All of these habitats are additionally the subject of Habitat Action Plans under the UK Biodiversity Action Plan (UKBAP) programme, and the objectives of these plans have also been included in the following discussion.

#### ***Inter-tidal and shallow subtidal sand and mud flats***

Present in the Musselburgh - Prestonpans, Gosford - Port Seton, Aberlady Bay, North Berwick Coast and Tynninghame Shore SSSIs and used for feeding and roosting by waders. No specific threats to these habitats are mentioned in the SSSI management statements, other than the dumping of rubble on the upper shore at Prestonpans in an attempt to protect the seawall. Over the last 90 years, our estimates suggest that roughly 10% of these habitats have been lost in the East Lothian region (Table 7.5), mainly in the lower inter-tidal area (but see Section 7.1.1 regarding the potential uncertainty associated with estimates of these changes). This pattern is predicted to continue in the future.

The conservation direction in the UKBAP for littoral and inshore sublittoral sediments is to maintain the extent and quality of these habitats, including the full diversity of communities. In the case of estuaries, the quality and extent of these habitats should be enhanced. East Lothian includes several types listed in Annex I of the Habitats Directive, namely ‘sandbanks which are slightly covered by sea water all the time’, ‘mudflats and sandflats not covered by sea water at low tide’ and ‘large shallow inlets and bays’.

#### ***Supratidal shingle/sand***

Present at Musselburgh - Prestonpans, Tynninghame Shore and Barns Ness SSSIs and used by plovers, terns, oystercatchers and turnstones as breeding sites. There are, apparently, no estimates of the extent of these habitats in the East Lothian region, and we did not attempt to distinguish them from areas of sand dunes in terms of estimating changes over the last 90 years. These areas are likely to be limited in extent and vulnerable to coastal squeeze in the event of sea-level rise. Proportional reductions in their area could potentially be quite large and would cause loss of breeding habitat for the birds listed above. Therefore, it would be appropriate to obtain accurate estimates of their present area and to monitor future changes with a view to mitigating any net loss.



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The UKBAP for **supralittoral sediments**, including strandline shingle and sand, lists coastal squeeze and the effects of coastal defences on supply of shingle as factors affecting these habitats. The conservation direction in the plan is to maintain and manage in a natural state the full range of habitats and avoid disrupting dynamic coastal processes and natural coastal sediment transport.

'Annual vegetation of drift lines' and 'perennial vegetation of stony banks' are listed in Annex I of the Habitats Directive.

#### ***Sand beach/dunes***

Present in the Aberlady Bay, Gullane Bay to North Berwick and Tynninghame Shore SSSIs and used by eider, shelduck and gulls for breeding. Terns used to nest in the dunes at Aberlady Bay until 1993. The dune systems in all three SSSIs are dynamic, and the management plans aim to allow changes to occur while monitoring the balance of erosion and accretion. Dune habitats have tended to increase in area over the last 90 years (by about 9%: Table 7.5), but this pattern may change in the future. It should be noted that we have not attempted to distinguish between dunes, wind-blown sand or supralittoral sand when estimating areas of change because these habitats grade into one another in space and time.

The UKBAP for **coastal sand dunes** describes fixed dunes and dune heath as particularly threatened habitats. Few dune systems in the UK are in equilibrium and most in the UK show net erosion due to insufficient sand supply. Factors affecting dunes include coastal defence works, causing decreased sand supply, and sea-level rise, leading to steepening of foreshores and increased wave attack at the base of the dunes. Over-stabilisation of dunes has tended to occur in the UK, resulting in under-representation of mobile dune phases. Management objectives include:

- Protecting existing dunes from further loss to anthropogenic factors, whether caused directly or indirectly;
- Offsetting expected net losses due to natural causes of about 2% of the UK's dune resource (54500 ha) over 20 years by encouraging new dunes to accrete and, where possible, allowing mobile dune systems to move inshore;
- Seeking opportunities to restore dune habitats lost to forestry, agriculture or other human use, with a target of up to 1000 ha by 2010;
- Encouraging natural movement and development of dune systems and control of natural succession to scrub and woodland where necessary;
- Maintaining dune grassland, heath and lichen communities on the majority of dune systems.

'Embryonic shifting dunes', 'shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")', 'fixed dunes with herbaceous vegetation ("grey dunes")', 'dunes with *Hippophae rhamnoides*' and 'humid dune slacks' are among the types of dune habitat present in the East Lothian region and listed in Annex I of the Habitats Directive.

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#### ***Inter-tidal boulder/rock***

Present at Gosford Bay - Port Seton, Gullane Bay – North Berwick, North Berwick Coast and Tynninghame Shore SSSIs and used for roosting, especially by purple sandpipers and turnstones. No threats to this type of habitat from coastal change are listed. Eyebroughy, in the Gullane Bay - North Berwick SSSI, was formerly a breeding site for terns, cormorants and gulls but was abandoned, probably due to human disturbance. The proportionately large reduction in the area of these habitats over the last 90 years (Table 7.5) is probably an artefact caused by differences in the areas included in the two analyses. Future change in these habitats are predicted to be small and are not likely to pose a threat to the maintenance of populations of birds that use them.

The UKBAPs for **littoral, inshore sublittoral and supralittoral rock** describe these habitats as generally robust with few factors affecting them. Soft-rock coastlines may be affected by coastal protection schemes, including preventing the removal of eroded material, to the detriment of animal and plant communities. Conservation directions in the plans aim to maintain the extent and quality of the habitats in the UK, including the full diversity of their communities.

Rocky shore habitats in the East Lothian region include two types listed in Annex I of the Habitats Directive, namely 'large shallow inlets and bays' and 'reefs'.

#### ***Saltmarsh***

Present in Aberlady Bay, Tynninghame Shore and Barns Ness Coast SSSIs and used for roosting and as a high-tide refuge by waders, for breeding by waders, gulls and terns and for feeding by ducks and geese. The small areas of saltmarsh at Barns Ness accrete and erode on a seasonal cycle. Estimates of past changes in the area of this habitat in the East Lothian region suggest a net gain of about 25% over the last 90 years. Future changes may, however, reverse this trend due to increased erosion and coastal squeeze (Table 7.5). This could potentially lead to significant loss of a habitat that is relatively uncommon in Scotland and of importance to wading birds, ducks and geese.

The UKBAP lists **coastal saltmarsh** as a relatively uncommon habitat in Scotland, representing 3% of the Scottish coastline, although transition zones to supralittoral habitat are still a common feature at those sites where saltmarsh occurs (in contrast to England, where much of the transition zone has been lost to coastal defence and land claim). Factors currently affecting saltmarsh include erosion of the seaward edge, reduced sediment supply and coastal squeeze (causing loss of about 100 ha per year in the UK). Objectives include offsetting current losses due to coastal squeeze and erosion in order to maintain the present extent of saltmarsh in the UK (c. 45,500 ha) and restore it to the extent present in 1992. There should be no further net loss, requiring the creation of 100 ha per year for the 15 years of the plan. A further 40 ha per year should be created over 15 years to replace the 600 ha lost between 1992 and 1998. The quality of the existing resource should also be maintained.

Saltmarshes in the East Lothian region contain several habitats listed in Annex I of the Habitats Directive, namely 'Salicornia and other annuals colonising mud and sand', 'Spartina swards (*Spartina maritima*)' and 'Atlantic salt meadows (*Glauco - Puccinellietalia maritima*)'.

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#### ***Maritime cliff***

Cliffs and cliff-tops are present at North Berwick Coast and Dunbar Coast SSSIs and used as breeding sites by fulmars and house martins. There are limited amounts of these habitats in the East Lothian region, and changes in area over the last 90 years have been correspondingly small (Table 7.5). Hard cliffs are not predicted to change much in the future but cliff-top habitats on soft cliffs may suffer the effects of increased rates of erosion, particularly where they are backed by economically-valuable areas.

According to the UKBAP for **maritime cliffs and slopes**, there are no generally accepted definitions of cliffs, in terms of height and slope. Cliff-top habitat extends to the limit of maritime influence. Most maritime cliffs are formed by erosion, 'hard' cliffs being steep or vertical and form on rock resistant to weathering, and 'soft' cliffs being less steep, more vegetated and form on less resistant rock that is prone to slumping or slipping. Factors currently affecting cliffs include erosion, especially of soft cliffs. Cliff-top and cliff-face communities can retreat with the eroding face and erosion is vital for renewing geological exposures and maintaining botanical succession, and may also supply sediment to other parts of the coast. Cliff-top habitat may be lost where it is squeezed against cultivated land or built environments and coastal protection measures on soft cliffs may obscure geological exposures, cause overgrowth of bare soil and early pioneer communities, and can cause sediment-starvation of sites down drift. Objectives in the UKBAP include:

- maintaining the existing cliff resource (slope and top) of approximately 4000 km in the UK;
- maintaining, where possible, the free functioning of coastal physical processes acting on cliffs;
- retaining or, where possible, increasing the amount of cliff and slope habitat unaffected by coastal defence and other engineering work;
- increasing the area of cliff-top, semi-natural habitat by at least 500 ha over 20 years;
- improving, by appropriate management, the quality of at least 30% of maritime cliff and slope habitat, including cliff-top vegetation, by 2010 and as much as possible by 2015.

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#### **7.2.5 Conservation Measures and Coastal Habitat Management Plans**

Future habitat changes that are likely to impact on the features of interest of the SPA are loss of inter-tidal mudflats and sandflats, supratidal shingle/sand, sand dunes and saltmarsh. These habitats, together with cliff-top vegetation, are also of intrinsic value in the context of the conservation objectives of SSSIs and UKBAPs. Consequently, it is likely that creation of new areas of habitat may be required to counteract losses. Prior to this, however, accurate estimates of the present extent of critical habitats will be required. These are already available for some (Hutcheon et al. 1998) but not for others such as supratidal shingle/sand. Monitoring of future patterns of change will then be necessary to identify requirements for habitat creation.

In the case of inter-tidal flats and saltmarsh, this habitat creation may be achieved by allowing the breach of coastal defences in appropriate areas so that coastal habitats can roll back but is dependent on the existence of suitable areas behind the present coastline (relatively low topography, low economic value, etc.). Opportunities for creation of new saltmarsh are limited in the East Lothian region for the same reason that its present distribution is relatively restricted, namely the exposed nature of much of the coast. Options are confined to sheltered sites, such as Aberlady and Belhaven Bays.

Loss of supratidal shingle/sand could potentially represent a significant loss of breeding habitat for several species of birds. Mitigation of this loss may be feasible by creation of shingle banks in areas away from human disturbance.

Opportunities for roll-back of sand dunes may be created by, for example, removal of plantations of trees from adjacent areas, such as at Broad Sands, Belhaven, Ravensheugh Sands and the area south of Eyebroughy. Detailed review of options for habitat restoration or creation is beyond the scope of the present study. Such a review will require more precise estimates of the likely future extent of habitat loss and more detailed identification of those areas of habitat that are of specific importance to the features of interest contained in the SPA designation. As discussed earlier, incorporation of estimates of habitat gain and loss, and measures to compensate, into a ChaMP will need to consider the East Lothian coast in the context of the whole SPA.

#### **7.2.6**            Summary

Increased rates of erosion of inter-tidal sandflats and mudflats, saltmarshes, sand dunes and cliff-tops are likely to have adverse effects on the features of interest on which the SPA designation of the Firth of Forth is based. These features include populations of European importance of species of birds listed in Annex 1 of the EC Birds Directive and of migratory species, and the fact that the Firth regularly supports over 20000 waterfowl. These species use the habitats listed for feeding, roosting, resting and, in some cases, breeding. The habitats, and the biological assemblages that they contain, also form part of the designations of SSSIs and LNRs in the region. Protection of these features of interest in the face of future habitat loss may require a combination of measures. These measures may include:

- allowing habitats to roll back as sea-level changes;
- the restoration of reclaimed or degraded areas;
- the creation of new habitats to compensate for loss elsewhere.

The precise extent of habitat creation required will depend on the extent of habitat loss, and predictions of this are currently very uncertain. To address this uncertainty will require more accurate estimates of the present extent of some critical habitats and monitoring to identify patterns and rates of future change. It will also require more detailed information on the features of interest in terms of their use of particular, critical habitats (specific sandflats, for example) and the likely future change in these. At present, guidance from Scottish Natural Heritage/English Nature on management of SPAs tends to be generic and to assume that loss of any habitat used by those species for which the SPA was designated is detrimental.

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## **8 Economic Assessment**

### **8.1 Introduction**

One of the aims of the Shoreline Management Plan is to consider costs and benefits of various management options for the identified management units. Based on this and other considerations a preferred option for each management unit will be chosen.

This chapter summarises the methodology that has been applied to carry out the cost benefit analysis, although in some cases this has been tailored depending on the characteristics of individual management units. The methodology has been drawn up following the guidance and information given in the literature (MAFF 1995, 1999, 2000a, 2000b; DEFRA 2001; SNH 1997a, 2000a).

### **8.2 Management Options**

DEFRA (2001) identifies five generic policies available to shoreline managers:

- 1 No Active Intervention
- 2 Limited Intervention
- 2 Hold the line
- 3 Advance the line
- 4 Retreat the line

These options can be applied selectively within a management unit and other site specific options may also be identified in the light of local objectives. A detailed cost benefit analysis is not required at SMP level. It is sufficient to calculate outline costs and benefits based on standard rates for each asset type or defence. The benefits of coast protection were estimated as the delay of the loss of land and assets fixed to the land. The benefits of a coast protection scheme option were calculated as the difference in losses between that option and the “no active intervention” option.

When applying cost benefit analysis to coastal erosion problems the following guidelines were applied:

- Cost benefit analysis was applied for a time horizon of 50 years.
- Costs were based on the year 2001.
- Costs and benefits were reduced to present values using the current treasury discount rate for government funded flood and coastal defence schemes: 6%
- Negative costs were assumed to be benefits and negative benefits were assumed to be costs.

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#### 8.3 Costs of Coastal Defence Schemes

The following costs (Table 8.1, Table 8.2) have been derived from previous coastal projects and have not been designed specifically for any Management Units in this SMP. Application of these rates per linear metre of the Management Unit for a chosen type of scheme produces a first order estimate of costs for comparison with the benefits.

**Table 8.1 Estimated Costs of Coastal Defence Works (2001) Rates**

| Type of Construction                                                 | Construction Cost (£/m) |
|----------------------------------------------------------------------|-------------------------|
| Concrete Seawall, including toe protection, apron and crest, precast | 3,800                   |
| Concrete Seawall, including toe protection, apron and crest, in-situ | 2,750                   |
| Rock armour as apron or revetment                                    | 1,500                   |
| Stone / Masonry Revetment                                            | 1,500                   |
| Beach Recharge, sea dredged sand, 100m <sup>2</sup> in section       | 2,400                   |
| Timber Groynes 60m long, 60m spacing                                 | 1,000                   |
| Rock Groynes 100m long at 100m spacing                               | 1,000                   |
| Toe Protection                                                       | 1,000                   |
| Toe Protection for Dunes                                             | 400                     |
| Clay Embankment                                                      | 600                     |
| Gabions                                                              | 500                     |

**Notes:** New Defences are all assumed to have a life of 50 years. Maintenance costs of £1 per metre per year assumed for all types. Design and supervision costs for new defences estimated at 6% of Construction Costs.

**Table 8.2 Estimated Costs of Small Scale or Soft Coastal Defence Works (2001) Rates**

| Type of Construction | Construction Cost (£/m) |
|----------------------|-------------------------|
| Timber Revetment     | 300                     |
| Dune Fencing         | 20                      |
| Dune Planting        | 20                      |
| Re-profiling         | 150                     |

Soft defences will probably only have a practical life of 5 to 10 years, although properly designed and executed planting schemes may be self regenerating. Ongoing maintenance costs may also be high and works may be susceptible to storm damage. For the purposes of a cost benefit analysis it has been assumed that any soft defences will have no maintenance but that complete replacement will be carried out after 10 years.



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#### 8.4 Losses

In a strategy study it is sufficient to calculate losses based on generic asset values. Detailed appraisal of the values of individual assets is not required. The loss of an asset due to coastal erosion is taken as the value of the asset or the replacement cost of the asset. The following asset types (Table 8.3), based on land use, have been identified for the calculation of losses.

**Table 8.3 Estimated Asset Values (2001)**

| Asset Type                | Value £ per Ha |
|---------------------------|----------------|
| Urban                     | 1,400,000      |
| Industrial                | 200,000        |
| High Quality Agricultural | 5,000          |
| Open Areas                | 1,000          |

The value of the urban area is based on the Nationwide Building Society Housing Finance Review (3rd Quarter 2001) and the Halifax Bank Price Index (3rd Quarter 2001) for Scotland. The values assigned above are based on previous projects and advice received from the District Valuer South East Scotland. It should be noted that the unit values for each land use type are base estimates only. They are, however, useful for considering the relative values between Management Units.

#### 8.5 Calculation of Losses

Information on coastal processes and change has been used to estimate the potential for erosion in each management unit. If an erosion rate is available, or can be estimated for a section of coast, it has been used to estimate the potential loss of land over the 50-year period of the Plan. An example of erosion rates and the associated loss of land are given in Table 8.4.

**Table 8.4 Example Erosion Rates for Estimated Erosion Potential**

| Estimated Erosion Potential | Outline Erosion Rate | Distance over 50 years |
|-----------------------------|----------------------|------------------------|
| High                        | 1m/year              | 50m                    |
| Medium                      | 0.5m/year            | 25m                    |
| Low                         | 0.2m/year            | 10m                    |

Once the erosion potential has been identified, the specified erosion rate was applied to frontages identified as being potential erosion sites. The potential losses were calculated based on the area of each asset type at risk. The present value of any losses was calculated assuming uniform loss rate over 50 years.

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#### 8.6 Valuing Environmental and Heritage Losses

One of the difficulties in applying cost benefit analysis is in determining economic values appropriate for environmental and heritage assets, such as SSSI's, SPA's, Scheduled Ancient Monuments, Listed Buildings etc. This is discussed in the guidance produced by MAFF (MAFF 1999, 2000b). Estimation of economic values for such assets is difficult, time consuming and often contentious.

The general guidance available indicates that a lower bound economic value of an environmental or heritage asset can be taken as the lowest of:

- Cost of a similar site elsewhere of equivalent environmental value.
- Cost of relocating asset to another site.
- Cost of local protection.

Detailed investigations of these sorts are not appropriate in high level SMP studies. In carrying out the cost benefit analysis these type of assets at risk were highlighted in the overall discussion and option appraisal and the following values were applied for Sites of National and International Natural Heritage Interest:

|                           |                           |            |
|---------------------------|---------------------------|------------|
| SSSI's, SPA's, RAMSAR etc | High Quality Agricultural | £5,000 /ha |
| Local Wildlife Sites      | Open Areas                | £1,000 /ha |

It should be noted that the value of some natural heritage sites is derived from the fact that they are examples of particular coastal processes. The introduction of defences could cause reduction in the environmental value of the site.

#### Definition

hectare (ha)

The customary metric unit of land area, equal to 100 acres. One hectare is a square hectometer, that is, the area of a square 100 meters on each side: 10,000 square metres or approximately 107 639.1 square feet, 11 959.9 square yards, or 2.471054 acres.

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### 9 Process and Management Units

In order to synthesise the data and information collated and presented in the preceding chapters, this chapter presents each shoreline management unit systematically. The East Lothian shoreline has been split into 13 coastal process units, defined by DEFRA (2001) as 'A length of shoreline (it may include an estuary) in which the physical processes are relatively independent from the processes operating in adjacent coastal process units.'

**Table 9.1 Process Units and Management Units Defined for the East Lothian Coastline**

| PU | PU Boundaries                                     | MU | MU Name                            | Approx Length (km) | NG Reference      |
|----|---------------------------------------------------|----|------------------------------------|--------------------|-------------------|
| 1  | Edinburgh to Musselburgh                          | 1  | Eastfield to River Esk             | 2                  | NT327732 – 346734 |
| 2  | Musselburgh to Cockenzie Power Station            | 2  | Ash Lagoons                        | 3                  | NT346734 – 371739 |
|    |                                                   | 3  | The Cast                           | 1                  | NT371739 – 379741 |
|    |                                                   | 4  | Prestonpans                        | 1.5                | NT379741 – 391750 |
|    |                                                   | 5  | Humlocks & Cockenzie Power Station | 1                  | NT391750 – 397756 |
| 3  | Cockenzie Power Station to Craigielaw Point       | 6  | Cockenzie and Port Seton           | 2                  | NT397756 – 415758 |
|    |                                                   | 7  | Gosford Bay                        | 6                  | NT415758 – 446796 |
| 4  | Craigielaw Point to Gullane Point                 | 8  | Aberlady Bay                       | 5                  | NT446796 – 462831 |
| 5  | Gullane Point to Eyebroughy                       | 9  | Gullane Bay                        | 5                  | NT462831 – 495863 |
| 6  | Eyebroughy to Longskelly Point                    | 10 | Archerfield and Yellowcraig        | 3                  | NT495863 – 522862 |
| 7  | Longskelly Point to North Berwick (Rugged Knowes) | 11 | Broad Sands and West Links         | 3                  | NT522862 – 549854 |
|    |                                                   | 12 | North Berwick                      | 2.5                | NT549854 – 568856 |
| 8  | North Berwick to St Baldred's Boat                | 13 | Tantallon                          | 5.5                | NT568856 – 609845 |
| 9  | St Baldred's Boat to St Baldred's Cradle          | 14 | Ravensheugh                        | 4.5                | NT609845 – 637813 |
| 10 | St Baldred's Cradle to Dunbar Harbour             | 15 | Belhaven Bay                       | 7                  | NT637813 – 662788 |
|    |                                                   | 16 | Winterfield Golf Course            | 1.5                | NT662788 – 671794 |
|    |                                                   | 17 | Dunbar Cliffs                      | 1.5                | NT671794 – 682794 |
| 11 | Dunbar Harbour to Mill Stone Neuk                 | 18 | Dunbar                             | 1.5                | NT682794 – 689785 |
|    |                                                   | 19 | Dunbar Golf Course                 | 2                  | NT689785 – 707779 |
| 12 | Mill Stone Neuk to Torness Point                  | 20 | Barns Ness                         | 5.5                | NT707779 – 744753 |
|    |                                                   | 21 | Torness Power Station              | 1.5                | NT744753 – 752749 |
| 13 | Torness Point to Cockburnspath                    | 22 | Thorntonloch                       | 4.5                | NT752749 – 780722 |

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The coastal process units have been split into 22 management units based on coastal defences, land-use and the human and built environment and the natural environment (Table 9.1). Management unit boundaries were discussed and revised following consultation with the SMP Steering Group and the management units will form the basis for defining and assessing strategic coastal defence options (Figure 9.1).

Management units are described from west to east. A description of the geomorphological form, littoral character, erosional/accretional character, anthropogenic impacts and coastal processes of each process unit precedes the relevant management unit/units. In the absence of detailed field measurements or model outputs, the likely dominant wave directions have been suggested on the basis of fetch lengths and wind frequency (see Section 4.4).

#### **9.1**            PU1: Edinburgh to Musselburgh (River Esk)

The westerly boundary of Process Unit 1 lies west of the East Lothian administrative boundary, indicating that coastal processes and management practises on the adjacent coast may have implications for the East Lothian shoreline. One management unit lies within PU1.

The overall form of the coast in PU1 is linear and northeasterly facing along to Eastfield. From Eastfield to the River Esk, the form of the coast is a shallow embayment measuring 3.5 km, which is north facing. Within the embayment, the beach at Fisherrow Sands is composed of shingle on the upper beach in the east, with sand and shingle in the west (Rose, 1980). The coast is low-lying with wind blown sand and dune grass between Eastfield and Musselburgh (GUARD, 1996). The shoreline is generally eroding or stable (GUARD, 1996), although accretion has occurred at Fisherrow Sands in the last 10 years (Hutchison, 2001), as well as at Eastfield (Table 4.6) and GUARD (1996) suggest that the mouth of the River Esk was probably silting up. The hinterland area is built-up, and covers a raised beach between Eastfield and Musselburgh (GUARD, 1996).

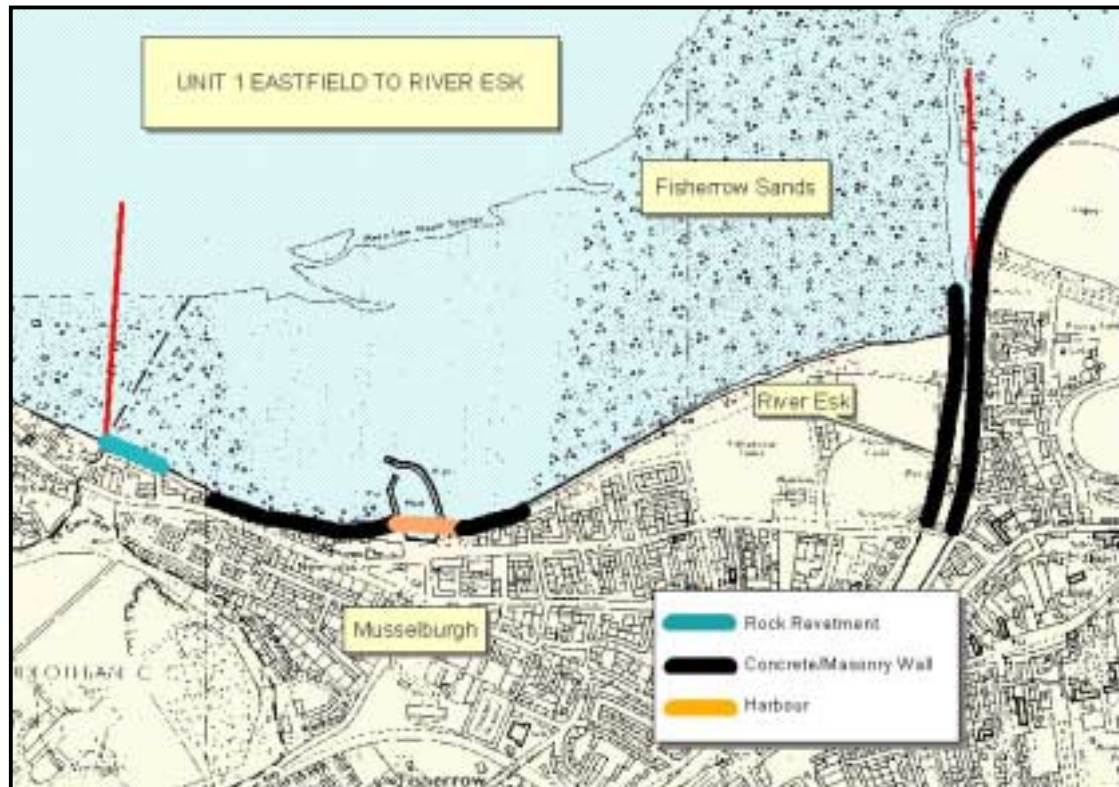
Rose (1980) noted that storm conditions have caused severe damage to seawalls west and east of Fisherrow Harbour. The dominant wave directions for this stretch of coast are likely to be from the northeasterly sector. At the southern end of Portobello beach, the presence of rock reefs at Joppa suggests this may be a sediment drift divide (Ramsay and Brampton, 2000). Results of tidal modelling (HR Wallingford, 1994a cited in Ramsay and Brampton, 2000) suggest a westerly flow along the Portobello frontage and a weak easterly flowing eddy or gyre towards Fisherrow. Beach surveys of Portobello also suggest a westerly drift of material (Ramsay and Brampton, 2000). Refer to Section 4.6 for further details of sediment transport processes.

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## 9.1.1 Management Unit 1, Eastfield to River Esk

MU 1 covers approximately 2km of shoreline from the East Lothian administrative boundary at Eastfield (NT327732) to the mouth of the River Esk (NT346734). The River Esk is within MU1.



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**Table MU1.1 Summary of Attributes of Management Unit 1**

| Coastal Processes           |                                                                                                                                                       |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Stable and localised accretion                                                                                                                        |
| Geomorphology               | Sand beaches, with some shingle. Low-lying coast with wind-blown sand and dune grasses. Mudflats at mouth of Esk.                                     |
| Sediment Drift              | West to east                                                                                                                                          |
| Coastal Defences            |                                                                                                                                                       |
| Type                        | Man-made: Concrete/masonry walls (some of which are property walls), Rock armour, River training works at the River Esk<br>Natural: mudflats, beaches |
| Human and Built Environment |                                                                                                                                                       |
| Land use                    | Residential, Commercial, Harbour                                                                                                                      |
| Sea use                     | Fishing, mussel and bait collection                                                                                                                   |
| Infrastructure              | Minor roads, sewage outfalls                                                                                                                          |
| Recreation and Tourism      | Coastal Path, boating, fishing, bird watching                                                                                                         |
| Historic Environment        | 296 Sites of Cultural Heritage identified                                                                                                             |
| Natural Environment         |                                                                                                                                                       |
| Habitat Types               | Sand, shingle, mud, coastal grassland, woodland, natural grassland                                                                                    |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Provisional Wildlife Site at the mouth of the River Esk                                     |
| Key Interests               | Public concerns relating to amenity, dog mess, litter, flood and coastal defence                                                                      |
| Valuation of Assets         | £201 M                                                                                                                                                |

**Table MU1.2 Screening of Strategic Options with Management Objectives**

| Strategic Option          | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|---------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention    | √                  | √           | •                         | √                         | X           | X                     | X         | X                      | √                   | X         | √             | NA       | X        |
| Limited Intervention      | √                  | √           | •                         | √                         | X           | X                     | X         | X                      | √                   | X         | √             | NA       | X        |
| Selectively Hold The Line | √                  | √           | √                         | •                         | √           | √                     | √         | √                      | •                   | √         | √             | NA       | √        |
| Advance The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:  
 √ Option meets objective  
 X Option does not meet objective  
 • Option meets objective over part of the unit  
 NA Not applicable  
 - Not considered if option is not technically viable

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### ***Coastal Defences***

The coastal edge of MU1 is protected for approximately 800m of its 2km length (Figure 9.2). The western part of the MU1 is protected for most of its length, while the Fisherrow Links area in the east consists of low dunes and formations of wind blown sand.

The sand beach between Eastfield and Fisherrow harbour appeared to be in generally good condition and has experienced recent accretion. A rocky foreshore is evident at the Eastfield end. East of Fisherrow harbour properties back directly on to beach. The beach in this area generally appeared to be at the sill level of gates in these boundary/garden walls at the time of the survey (29/10/01).

#### **Defence No. 1**

Immediately east of Burnstane Burn there is a 120m stretch of protected coast. The defence is rock armour, which is 3m high in places, at the rear of the sandy beach, fronting vegetated dune (Plate 9.1). The crest of this embankment is approximately 1m higher than the road lying to its landward. At the mouth of the burn, PVC coated wire gabions underlie the rock armour. The armour and gabions are in reasonable condition. However, in places older gabions, in poor condition, underlie the rock armour. It should be noted that the armour is randomly, if reasonably, placed, but is nevertheless more by way of a rock dressing over the earlier gabion protection and cannot be described as an engineered rock revetment.

#### **Defence No. 2**

A concrete wall fronts the A199 for a stretch of around 150m. The crest of the low concrete wall is approximately 1m above the beach level, but varies along the beach (Plate 9.2). There is evidence of some cracking in the wall, although generally the wall is in good condition. Drainage holes have been constructed at the base of the wall, indicating that the wall may be subject to some overtopping and wave splash during storm conditions. A wide, sandy beach fronts the wall, thus wave energy appears to be dissipated by this and there is evidence of recent sand accretion at the base of the wall.

#### **Defence No. 3**

East of the concrete wall, a mix of old masonry property walls back the beach. These walls are not designed as coastal defences, but are the garden walls of domestic property and the crest level varies along the beach. There is no apparent evidence of undercutting or failure and the walls are generally in reasonable condition and fronted by the wide sandy beach of Fisherrow Sands.

#### **Defence No. 4**

Immediately west of Fisherrow harbour, a concrete parapet wall extends for approximately 100m and protects the car park area, Quayside Leisure complex and the new 'Mariners Quay' housing development. The wall is designed as a coastal defence with a nominally recurved profile. The crest of the wall is 0.9m above beach level and 0.5m wide. The condition is good and there is no evidence of overtopping. A wide sand beach fronts the defence, providing means of dissipation of wave energy, supporting the impression that the wall may not be prone to routine attack.

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#### Defence No. 5: Fisherrow Harbour

The harbour walls are constructed in masonry. The inner walls are generally in good condition, with original stone copes. There are indications that rudimentary fendering or rubbing strips once featured on these walls but none remain. The western quay is tarmac surfaced, while the cope level of the eastern quay is finished in stone setts. The quay level is approximately 4.4m OD. The outer western wall has a single parapet (350mm wide) approximately 1.1m above the quay level and is pitched stone at the top with irregular rock at the lower reaches. At the harbour mouth there is evidence of some damage to the outer stone pitching, at the interface with the concrete superstructure.

The eastern harbour wall has pitched stone at the top, but irregular rock at the lower reaches, sloping outwards at about 45 degrees. The very steep angle may create a problem if there is erosion at the toe, however there is weed cover to support the perception that it appears stable. There is evidence of one or two concrete repairs in the upper reach of the vertical wall. The eastern outer wall is more exposed to waves (there being a considerable fetch from the East), however the superstructure wall appears in good condition, with good pointing, and there was no apparent evidence of undercutting. The eastern parapet is approximately 1.5m above the quay level and is generally in good condition, although the stonework condition is variable. The harbour mouth has a more recent concrete extension, which is generally in good condition.

A concrete retaining wall protects the head of the harbour. The crest of the wall is 1.3m above the level of the sand beach at the harbour head, but is lower than the surrounding quays. There may therefore be a risk of flooding of the car park area at the harbour head, under onerous conditions of tide and wave penetration.

#### Defence No. 6

To the east of the harbour the beach is backed by a low concrete retaining wall for about 130m. The crest of the wall is at promenade level (ca. 4.3m) and is ca. 1m above beach level (Plate 9.3). A wide sandy beach fronts the wall. A metal tubular handrail surmounts the wall and separates the promenade from the beach here. Steps provide access to the beach. The wall is cracked and unsightly in places. The level of high water impinges the base of the wall (as evidenced by the accumulations of weed and flotsam) and the relatively small freeboard therefore suggests that there is a potential risk of flooding and over-topping of the wall during storms.

Immediately to the east of the promenade retaining wall a low dune separates the sand beach from the road. The dune is well vegetated by marram grass. This low dune formation continues eastward towards the mouth of the River Esk, backing the sand beach and protecting the flat links surface of Fisherrow Links.



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#### Defence No. 7

The mouth of the River Esk is controlled by river training works. On the western side the training works do not extend along the coast, terminating instead perpendicular to it. They do however extend upstream. The river training works are concrete walls, with timber sheet piles visible in places at the toe. These timber piles are in an advanced state of decay and have become detached from the wall. It is not clear from this visual inspection whether these formed an integral component of the permanent works of these walls, but it is noted that the (western) wall above has rotated to tilt toward the river. In places, the wall is sagging and tilting and there is evidence of a settlement problem (NT346733) (Plate 9.4).

Occasional holes on the landward of the western wall have become exposed, perhaps due to settlement and movement of the wall and perhaps influenced by drainage service routes that exit through the wall in that area, also give some cause for concern. Upstream of the weir on the western bank the wall fabric is in poor condition and has lost the front concrete facing and also shows evidence of cracking. The crest of the wall is 2m above the weir level and is at the same level as the Links surface, confirming its dual function of river training structure and retaining wall.

The condition of the western bank wall is considered to be generally very poor and it is noted to have failed in places. Attention is required within the next 5 years, but it is recommended that urgent attention be paid to the voiding noted behind portions of the wall, particularly as public access is not prevented.

The eastern bank protection upstream is in slightly better condition. Additional buttressing on the lower portions of the wall perhaps assists here. The wall is in need of some minor repairs on the upper level, but is generally in reasonable condition. The crest level of the wall is slightly below the road level at Goose Green (ca. 4.5m OD) and here the defences protect private housing. It was noted immediately west of the Ash Lagoons that this wall is of poor quality concrete, with beach material (coarse sand, shingle, shell and beach pebbles) within the exposed concrete matrix. The wall has apparent unprepared lift joints with consequent poor bonding that has been exposed by weathering. The poor condition of the wall here highlights the need for attention within the next 10 years.

The river training works generally are in need of attention. The defences on the eastern side of the Esk continue downstream and merge in to the defences fronting the Ash Lagoons at NT346735.

#### ***Land use***

The land-use in MU1 is predominately urban, with around 90% of the land within the 1km strip of the shoreline classified as Built-up area (Factories & Urban) (Table 9.2). This land-use class is adjacent to the shoreline all the way along MU1 (Figure 9.3), thus it would be this land-use that would potentially be at risk from coastal erosion and/or flooding. The remaining land-use types within MU1 lie over 250m landward of the present shoreline and are thus unlikely to be influenced by coastal change and/or flooding. Fisherrow Links backs the shoreline in the eastern part of MU1 and is a flat, grass recreation area, although classed as a built-up area by MLURI (1988).

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**Table 9.2: Land-use classification in MU1 (source: MLURI 1988)**

| Land-use class       | Domain                                  | Area (ha) |
|----------------------|-----------------------------------------|-----------|
| Factories & urban    | Built-up (area)                         | 168.9     |
| Improved grassland   | Imp. pasture: no rock no farms no trees | 14.9      |
| Arable               | Arable: no rock no farms no trees       | 3.6       |
| Broadleaved woodland | Undiff. broadleaf (area)                | 2.3       |
| TOTAL                |                                         | 189.6     |

## ***Residential Development, Industry, Ports and Harbours***

The hinterland of MU1 is predominately residential, with some areas of local industry and business development. There are no industrial sites close to the shoreline. Fisherrow Harbour (NT334730) is an historic “B” listed harbour and is predominantly used by pleasure craft although a few inshore fishing vessels use the harbour. The East Lothian Local Plan (1998) outlines the Council's commitment to complete the redevelopment and environmental improvement of the harbour edge and esplanade. The Quayside leisure, conference and leisure complex is considered to be an important aspect in this respect. The physical condition of the harbour is described in Section 9.2.2 above.

## ***Recreation and Tourism***

A range of land and water based recreation activities are available within MU1. Results from the public consultation in the area indicated the importance of this section of coastline for recreation activities such as walking/ cycling and the general amenity value of the shoreline was highlighted. A coastal right of way extends from Fisherrow Harbour and crosses the River Esk at NT345730. The River Esk walkway / cycleway extends upstream. The proposed sustainable path network for East Lothian continues west of Fisherrow Harbour, connecting with the Burstane walkway at the Burstane Burn (NT327732). The Harbour is used by a number of pleasure crafts and yachting and sailing are popular pursuits. The Fisherrow Yacht Club is based at Fisherrow Harbour. Bird watching is also an important recreation activity in the area.

East Lothian Council classifies Fisherrow Sands as of amenity value, although it is not formally designated (Ash 1994). The beach is cleaned by the Council once every seven days using a tractor drawn beach-cleaning machine, in addition to hand-picking (Ash 1994).

## ***Fishing Activity***

Fisherrow harbour is still used as a working fishing harbour, although the number of fishing boats has declined in recent years (SPI 2001a). Comments from the public indicated that mussel and bait collection was carried out in the Fisherrow Sands area close to the mouth of the Esk, although it was noted that this activity has declined in recent years, due to the increase in sedimentation in the area (SPI 2001a). Bait digging still occurs in MU1, although this is not managed.

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### ***Agriculture and Forestry***

There is very little agriculture or forestry within MU1 (Table 9.2). A small, 3.6ha area of arable land is present in the south-west corner of the management unit at Newhailes, and two small areas of woodland (2.3ha) are also present in the Newhailes area.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU1.

### ***Water Quality and Pollution***

The coastal water quality in MU1 is classified as Class B (Good) for most of its length (SEPA, 2000). A small section of the shoreline, close to the mouth of the River Esk, falls into Class C (Unsatisfactory) (SEPA 2000). This may be related to river and/or the sewage pumping station located on the eastern side of MU1 (NT345745), which has a sewage outfall pipe crossing the inter-tidal area at Fisherrow Links, immediately west of the mouth of the River Esk.

In 1995/96 there was a problem with the build up of large algal mats (*Enteromorpha*) at Fisherrow Sands (SNH 1998a), which smother the inter-tidal mudflats/sands, reducing the biomass and diversity of invertebrates and preventing waders from feeding on those that remain. SNH (1998a) suggest that this is probably caused by nutrient enrichment of the River Esk, although the exact source has yet to be determined.

The water quality along the Fisherrow to Cockenzie shoreline improved from Class C to Class B between 1999 and 2000 (SEPA 2001). This was the result of the intercepting sewer now reverting via the pumping station, and from improvements that came on-line in 1998 (SEPA 2001).

### ***Archaeology and Built Heritage***

MU 1 is rich in cultural heritage with 296 sites of heritage interest documented (Table 9.3). The Maritime archaeological sites within MU1 include two wrecked steamships at Craigmore rocks (NT328815) and South Craig rocks (NT332817). Of the 27 archaeological sites within MU1 (Figure 9.4) none are located within 500m of the shoreline.

There are 191 Listed Buildings within MU1, of these Fisherrow Harbour and the Harbour office lie within the closest proximity to the shoreline. The RCAHMS dataset also contains a list of sites considered of architectural importance, 75 such sites lie within MU1. This dataset sites comprises some, but not all Listed Buildings, and also includes additional sites of architectural importance.

The Roman Fort and Civil Settlement at Inveresk (NT341721) is the only Scheduled Ancient Monument within MU1, although it is located at the landward limit of the management unit and is almost 1km from the shoreline (Figure 9.4).

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**Table 9.3: Cultural Heritage Within MU1**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 2      | RCAHMS            |
| Archaeological Sites (land)   | 27     | RCAHMS            |
| Scheduled Ancient Monuments   | 1      | Historic Scotland |
| Listed Buildings*             | 191    | ELC               |
| Architecture Sites*           | 75     | RCAHMS            |
| TOTAL                         | 296    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### **Natural Environment**

The inter-tidal area of MU1 is contained within the Musselburgh - Prestonpans section of the Firth of Forth SSSI, which was designated in 1972 for its biological and geological importance (Appendix F). The Musselburgh -Prestonpans SSSI stretches along 7.5km of coastline from the entrance to Eastfield in the west to Cockenzie Power Station in the east (MU4), and consists of the land between MHWS and MLWS. The inter-tidal zone is generally less than 100m wide, although it opens up into a large sand/mudflat area at Fisherrow Sands in MU1. The rocky foreshore at Joppa, west of MU1, is of considerable geological interest and has been designated a Geological Conservation Review site for the exposures of Carboniferous rock present.

The diversity of the shoreline and the adjacent shallow water offshore make the Musselburgh-Prestonpans shoreline of great importance to wintering waders and wildfowl. Species present include red-throated diver, great crested grebe, Slavonian grebe, eider, long tailed duck, velvet scoter, red-breasted merganser, oystercatcher, ringed plover, golden plover, bar-tailed godwit, knot, curlew, redshank and turnstone (SNH 1998a). The scaup and pochard once present in huge numbers no longer use the area as food availability has been reduced, due to the clean up of effluent discharges and distillery waste in the area (SNH 1998a).

The wildfowl and wader population of Musselburgh-Prestonpans SSSI makes a significant contribution to the nationally and internationally important populations of wintering waders and wildfowl in the Firth of Forth. Thus, this site is considered a crucial component of the mosaic of SSSIs that constitute the recently designated Firth of Forth SPA and Ramsar site.

The long-term objective for management of Musselburgh-Prestonpans SSSI is to maintain the site as a roosting and feeding area for wintering waders and wildfowl and to maintain the geological exposures (SNH 1998a). Specific objectives for management relevant to the SMP in MU1 are to:

- Safeguard site by ensuring compliance with all legal and other obligations
- Prevent dumping from covering the remaining inter-tidal area at Black Rocks, stop the use of unsuitable materials and replace the seaward rubble with a standard rock armour revetment.
- Ensure the effluent causing the *Enteromorpha* blooms is suitably treated.
- Prevent any future development from obscuring the geological exposures at Joppa.
- Protect the site from oil pollution incidents

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The entire inter-tidal area of MU1 is part of the Firth of Forth SPA and Ramsar site. This designation confers specific legislative protection to the site, outlined in Section 2, and will affect any development proposal on the site.

SWT have a “provisional” wildlife site at the mouth of the River Esk (NT345734). This has not been notified or surveyed.

The Phase 1 Habitat survey of East Lothian (Hutcheon et al 1998) classified approximately 83ha of land within MU1 (Table 9.4). The remaining 106ha of land in MU1 was unclassified and comprises the urban area (Hutcheon et al 1998). New buildings are classified within the Phase 1 Habitat survey and covers 34ha of MU1. The Fisherrow Links area is classified as amenity grassland covering an area of 21ha. The Phase 1 habitat survey did not extend into the inter-tidal area.

**Table 9.4: Phase 1 Habitats within MU1 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                  | Area (ha) |
|--------------|----------------------------------|-----------|
| A1.1.2       | Broad-leaved, plantation         | 1.3       |
| A1.3.1       | Mixed woodland, semi-natural     | 4.9       |
| A2.1         | Dense scrub                      | 1.2       |
| B2.1         | Neutral grassland, unimproved    | 1.9       |
| B2.2         | Neutral grassland, semi-improved | 5.0       |
| B4           | Improved grassland               | 7.4       |
| F1           | Swamp                            | 0.1       |
| G1           | Standing water                   | 4.6       |
| H8.4         | Coastal Grassland                | 1.2       |
| J1.2         | Amenity grassland                | 21.4      |
| J3.6         | New Buildings, Urban             | 34.4      |
| Unclassified | Urban                            | 106.3     |
| TOTAL        |                                  | 189.3     |

### ***Relevant policies and plans***

The general policy and planning framework within the SMP study area is set out in Chapter 3 and the generic policies within East Lothian described in Chapter 3 apply to MU1. This section discussed specific policies to the local area.

The key policy is Policy EDP23, to improve the harbour area at Fisherrow, which encourages support for any redevelopment and environmental improvements. Other policies include the commitment to develop a sustainable coastal path and cycleway. There are no major planning proposals or applications in MU1 that will substantially impact the management of the shoreline, although there are some proposals for a small housing development in the Fisherrow Links area 100m from the shoreline. There are proposals to extend the Quayside Leisure Development and develop a new housing development adjacent to the Quayside. Both these developments lie within 40m of the shore, although this is already an urban area with coastal protection.

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#### **Key interests**

The written consultation process did not highlight any pertinent issues in MU1. Results from the public consultation process (Appendix B) indicated that public concern was high regarding the condition of the shoreline in the Fisherrow area, with issues concerning amenity, dog mess, litter raised. The public also suggested that improvements to flood and coastal defence within MU1 are required (Appendix B), again highlighting the Fisherrow area.

#### **Valuation of Assets**

In order to assess the costs and benefits of management options, an estimate has been made of the monetary value of the assets in MU1 (Table 9.5) using the values per ha set out in the economic assessment chapter. Over 75% of land in MU1 is classified as urban, thus the estimated value of MU1 is high and is estimated as approximately £201M.

**Table 9.5 Valuation of Assets in MU1**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>   |
|---------------------------|---------------------------|--------------------|
| High Quality Agricultural | 7%                        | 61 780             |
| Open Area                 | 18%                       | 33 907             |
| Urban                     | 76%                       | 200 946 200        |
| <b>Total</b>              |                           | <b>201 041 887</b> |

#### **Option Evaluation**

The coastline of MU1 is protected with hard defences for 800m of its 2km length and defences extend upstream along the banks of the River Esk. All of the coastal defences protect either commercial/domestic property or roads and the main risk is flooding (Appendix D). The shoreline is stable or accreting along MU1, thus the erosion risk is low and the main risk to defences would be due to overtopping or structural failure during onerous tidal and storm conditions. As there are no erosion rates for MU1, the cost-benefit analysis method set out in Chapter 8 is not applicable.

The **No Active Intervention** option would result in the eventual failure of some of the coastal and fluvial defences in MU1, particularly as some of the defences are already in poor condition (e.g. defences at the River Esk). Failure of the defences would lead to flooding of commercial/domestic property or roads. The monetary value of failure and thus flooding of the hinterland is difficult to quantify and is outwith the scope of the present study. The No Active Intervention option is considered unfeasible.

Part of the shoreline of MU1 is natural, with a low dune system separating the sand beach from the road and Fisherrow Links. This part of the shoreline is presently stable or accreting, although it is likely the dunes will undergo some temporary phases of erosion during winter storms. This is a natural coastal process and short-lived phases of erosion should not be considered a problem. Thus the **Hold the Line** option does not apply for the entire management unit.

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The existing defences protect the urban area and roads from flooding, therefore it is recommended that these defences be maintained for the duration of the SMP. Thus **Selectively Hold the Line** is a feasible option for MU1. The structural condition of the defence at the mouth of the River Esk is poor and capital works will be required within the next 10 years (Appendix D). The level of the defences at the mouth of Fisherrow harbour and Fisherrow promenade is relatively low (approximately 4.3m OD) and may have to be raised over the next 50 years to cope with the predicted sea-level rise and increase in storminess. The condition and an estimate of the residual life of the defences in MU1 are given in Appendix D. The property maintenance survey carried out by East Lothian Council (Appendix E) gives no indication of maintenance costs for MU1. Assuming a £1 per metre per year maintenance cost for the defences, the net present value (at 2001) of the cost of maintaining the existing defences in MU1 is £47 000. This is likely to be an underestimate as it does not account for the capital costs of repairing the River Esk defences or raising the height of existing defences to cope with future rises in sea level. A more detailed structural investigation and study would be required to determine the associated costs of specific capital works.

Sediment transport in MU1 is from west to east, although the volumes of sediment transported are relatively low. It is anticipated that the Selectively Hold the Line option in MU1 would have negligible impact on the shorelines of adjacent units. The status quo is maintained, and, as no new coastal defences are proposed, the impact on existing coastal processes in the process unit will be negligible.

**Advance the Line** is not considered a feasible option for MU1, as this will create an artificial line of defence further seaward than the current MHWS and would upset the natural operation of coastal processes, which may have implications for the adjacent shoreline. As the immediate hinterland of the defences in MU1 is urban, removal of the defences would result in considerable flooding and damage to assets. Thus, there are no suitable areas of MU1 where **Retreat the Line**, via removal of the existing defences, is considered a feasible option.

The preferred strategic option for coastal defence in MU1 is to **Selectively Hold the Line**. This involves maintenance of the existing defences only. No new construction of coastal defences is recommended, although capital works may be required at the mouth of the River Esk, Fisherrow Harbour and Fisherrow promenade.

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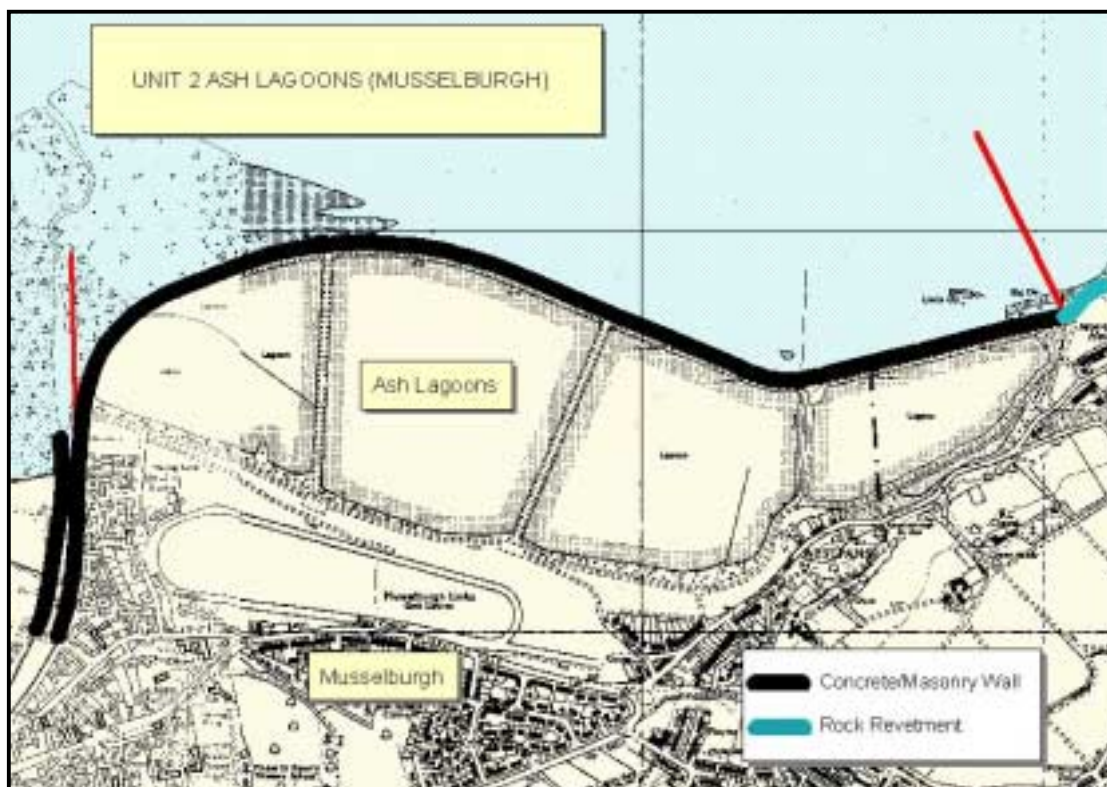
### 9.2 PU2: Musselburgh to Cockenzie (Power Station)

PU2 has been split into 4 management units described from west to east below. This stretch of coast faces northwest and forms a shallow embayment. The coast is composed of a mainly sand foreshore with gravel/rubble also being present (GUARD, 1996). Although being cited as being stable (GUARD, 1996), erosion rates of up to 7 m in 2 years have been cited at Preston Grange (East Lothian Council, 2001d), whilst the mouth of the River Esk has been reported to be silting up (GUARD, 1996). The area is largely defended with substantial reclamation of the inter-tidal area for industrial development having taken place since the mid 19th century, e.g. Musselburgh ash lagoons, Prestonpans and Cockenzie (Table 4.6).

Storms are reported to cause damage to seawalls in the area (GUARD, 1996). The dominant wave directions for this stretch of coast are likely to be from the north-eastern sector. Overall there is a low or moderate westerly drift present into the Forth (Barne et al., 1997). However, a weak anti-clockwise gyre at Musselburgh and Prestonpans is thought to drive easterly littoral transport in this area (Barne et al., 1997). Refer to Section 4.6 for further details of sediment transport processes.

#### 9.2.1 Management Unit 2, Ash Lagoons

The 3km shoreline of MU 2 extends from the eastern bank of the River Esk (NT346734) to Morrison's Haven (NT371739) and covers the frontage of the Musselburgh Ash Lagoons.



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**Table MU2.1 Summary of Attributes of Management Unit 2**

| Coastal Processes                                |                                                                                                      |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Shoreline Evolution                              | Landclaim. Present shoreline position is 750m seaward of 1907 shoreline                              |
| Geomorphology                                    | Narrow inter-tidal, no natural beaches                                                               |
| Sediment Drift                                   | Low to moderate net westerly drift. Localised easterly transport.                                    |
| Coastal Defences                                 |                                                                                                      |
| Type                                             | Man-made: Concrete sea-wall                                                                          |
| Human and Built Environment                      |                                                                                                      |
| Land use                                         | Musselburgh Ash Lagoons, Links, Residential, Racetrack                                               |
| Sea use                                          | -                                                                                                    |
| Infrastructure                                   | -                                                                                                    |
| Recreation and Tourism                           | Walking, Bird watching, boating, Golf, Horse Racing                                                  |
| Historic Environment                             | None adjacent to shoreline (landclaim). 175 sites of heritage interest in MU2                        |
| Natural Environment                              |                                                                                                      |
| Habitat Types                                    | Amenity grassland, coastal grassland                                                                 |
| Designated Sites                                 | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Potential Wildlife Site at the Ash Lagoons |
| Key Interests                                    |                                                                                                      |
| Public concern relating to access to the lagoons |                                                                                                      |
| Valuation of Assets                              |                                                                                                      |
| £90 M                                            |                                                                                                      |

**Table MU2.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | X                         | √                         | √           | X                     | X         | X                      | X                   | X         | X             | NA       | NA       |
| Limited Intervention   | √                  | √           | X                         | √                         | √           | X                     | X         | X                      | X                   | X         | X             | NA       | NA       |
| Hold The Line          | √                  | √           | √                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### **Coastal Defences**

Much of the land in MU2 has been claimed from the sea (as is evident from the position of the 1907 MHWS, View 2, Appendix C) and is defended by a sloping concrete sea wall (Defence No 8). A concrete beam at the base retains a steep concrete-faced slope at ca. 45°, which is ca. 3m high, and surmounted by a vertical concrete wall (Plate 9.5). The wall is in good condition, although it is anticipated that the steep, smooth concrete slope will encourage wave run-up. MHWS impinges the defence and breaking waves over the defences were observed during the site visit. The defence is very exposed to the open Firth of Forth and subject to waves from both the eastern and western approaches. The concrete retaining wall is owned by Scottish Power, and appears to offer a robust defence to that which it protects.

### **Land use**

MLURI (1988) classifies the land-use in MU2 as predominantly built-up area, with around 80% of the land within the 1km strip of the shoreline classified as Factories & Urban (Table 9.6). However, this classification is slightly misleading, as the entire reclaimed area of the Musselburgh Ash Lagoons is classed in this category (Figure 9.3). The Ash lagoons are an extensive area (approximately 120ha) of landclaim on the seaward side of Musselburgh Race Course. Reclamation has taken place by the process of Scottish Power's consents to deposit pulverised fuel ash (PFA), a by-product of their coal-fired power station at Cockenzie. An agreement was reached in 1963 such that the lagoons are to be filled by PFA to an average height of 16m OD, grassed and transferred in Council ownership (East Lothian Local Plan 1998). Substantial planting and surface preparation has been undertaken to realise the recreation potential of the lagoons, although infilling with PFA is still ongoing in the eastern most lagoons (number 6 and 8). Planning issues regarding the lagoons are discussed below. The reclaimed ash lagoons cover the entire frontage of MU2.

The remaining land within MU2 is classified as arable land (55ha), broadleaved woodland and golf course (Table 9.6).

**Table 9.6: Land-use classification in MU2 (source: MLURI 1988)**

| Land-use class       | Domain                            | Area (ha) |
|----------------------|-----------------------------------|-----------|
| Factories & urban    | Built-up (area)                   | 245.2     |
| Arable               | Arable: no rock no farms no trees | 54.4      |
| Recreational land    | Golf course                       | 0.3       |
| Broadleaved woodland | Undiff. broadleaf (area)          | 4.9       |
| TOTAL                |                                   | 304.8     |

### **Residential Development, Industry, Ports and Harbours**

The residential area of Musselburgh lies to the landward of the Ash Lagoon and Musselburgh Race Course. Residential development lies adjacent to the east bank of the River Esk, but is well protected from open coastal processes by the extensive reclaimed area of the lagoons. There are local businesses and small industry within MU2, but none close to the shoreline. However, land claim in the lagoon area using pulverised ash fuel could be described as recent industrial development.

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### ***Recreation and Tourism***

There are several land based recreation activities available within MU2, including the Musselburgh Race Course, the Leverhall Links leisure park and golf course, and the Ash Lagoon area itself, part of which is open to the public as a recreation and open space area. The lagoons are managed as a bird sanctuary with scrapes placed to encourage birds to feed around the open lagoons. The public consultation exercise highlighted the extent to which Leverhall Links adds to the area, with a large number of comments expressing positive aspects of this part of the shoreline. Bird watching is a popular pursuit in this area. Part of the area is used as a boating pond (SPI 2001a).

The coastal path network does not currently extend along the shoreline in MU2. However, there are proposals to develop the coastal path along the entire frontage of the Ash Lagoons (Halcrow Fox 1998) in accordance with the Council's policy to develop a sustainable coastal pathway. Nevertheless, walking and cycling within the accessible area of the lagoons are a popular recreation activity.

The Drummohr Caravan Park (NT372734) is located close to the eastern boundary of MU2, highlighting the recreation potential of the management unit.

### ***Fishing Activity***

There is little fishing activity within MU2. The reclamation of the inter-tidal area along this stretch of shoreline precludes any local bait or mussel collection from the foreshore, although some periwinkles are collected.

### ***Agriculture and Forestry***

Agricultural land is present in the southeast corner of MU2 in the Ravenshaugh area, and is surrounded by two small areas (5.4ha) of woodland. There is no commercial forestry or high-grade agricultural land close to the shoreline.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU2, although the Ash Lagoons have been claimed via the deposition of pulverised fuel ash (PFA) from Cockenzie Power Station (discussed above).

### ***Water Quality and Pollution***

A sewage effluent outfall is located at NT364738. The effluent has been Primary treated at the Wallyford Treatment Works and the maximum consented dry weather flow is 68 250 m<sup>3</sup>/day (JNCC 1997). The course of the Ravenshaugh Burn has been altered due to the reclamation of the lagoon area. There are no reported water pollution problems in MU2.

Coastal water quality along MU2 is classed as Class B (Good) in 2000. This is an improvement on Class C (unsatisfactory) classification in 1999 for this section of coast (SEPA 2001). The improvements are due to sewer improvements in the area (SEPA 2001).

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### **Archaeology and Built Heritage**

175 sites of heritage interest are documented within MU2 (Table 9.7).

There is only one maritime archaeological site within MU2. This is an unassigned wrecked craft at NT360763. 16 unscheduled archaeological sites lie within 1km landward of the shoreline in MU1 (Figure 9.4). Most of these are located away from the shoreline (primarily due to the recent landclaim).

There are 102 Listed Buildings within MU2. The listed buildings are mainly located within the residential area of Musselburgh and away from the shoreline (Figure 9.4). 53 architecture sites are held within the RCAHMS database, although none lie close to the shoreline (Figure 9.4).

There are 3 scheduled monuments within MU2: Westpans Potteries at NT364732; the market cross at Inveresk (NT346727); and Inveresk dovecot, Pinkie Estate (NT350728). None of these lie within 400m of the present shoreline and thus are not at risk to coastal erosion or flooding.

**Table 9.7: Cultural Heritage Within MU2**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 1      | RCAHMS            |
| Archaeological Sites (land)   | 16     | RCAHMS            |
| Scheduled Ancient Monuments   | 3      | Historic Scotland |
| Listed Buildings*             | 102    | ELC               |
| Architecture Sites*           | 53     | RCAHMS            |
| TOTAL                         | 175    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### **Natural Environment**

The entire inter-tidal area of MU2 forms part of the Musselburgh - Prestonpans section of the Firth of Forth SSSI and Firth of Forth SPA/Ramsar Site, described above in MU1 (Section 9.1.1). The description of the natural environment and species present within the Musselburgh - Prestonpans SSSI will not be repeated here. Two of the lagoons within the Ash Lagoons area have also been given SSSI/ SPA status (Figure 7.1 and 7.2). These lagoons are considered of international importance as they provide a roosting area for wintering waders.

The Ash Lagoons lies adjacent to the SSSI/SPA for the remainder of the shoreline, contributing to its value as it provides a roosting area for wintering waders, with wader scrapes built in the redundant lagoons (SNH 1998a). As described in the land use section above, much of the natural environment of MU2 consists of the open planted area of the reclaimed ash lagoons. Some infilling of the lagoon in the eastern part of the site with PFA is ongoing, which has obvious detrimental visual impacts on the natural environment.

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The management objectives for the SSSI are set out in Section 9.1.1. One additional objective for management of the SSSI specifically applies to MU2 (SNH 1998a):

- Maintain and possibly enhance the wader scrapes at Musselburgh ash lagoon and investigate the retention of other roost sites at the lagoons.

Scottish Wildlife Trust is investigating the Musselburgh shore and lagoon area as a potential Wildlife Site. The site has been surveyed and is awaiting assessment.

MU2 contains several important habitats, as identified in the Phase 1 Habitat Survey for East Lothian (Table 9.8, Hutcheon et al 1998). 60ha of land within MU1 was not classified and it is assumed this represents the residential area. Amenity grassland comprises a large part of MU2 (78.3ha). This includes Musselburgh Race Course and the Leverhall Links Leisure Park. The coastal edge is classified as “other habitat” and “coastal grassland”.

**Table 9.8: Phase 1 Habitats within MU2 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 0.7       |
| A1.1.2       | Broad-leaved, plantation            | 34.9      |
| A1.3.1       | Mixed woodland, semi-natural        | 11.2      |
| B4           | Improved grassland                  | 4.9       |
| B6           | Poor semi-improved grassland        | 11.3      |
| F2.2         | Inundation vegetation               | 8.3       |
| G1           | Standing water                      | 19.5      |
| H8.4         | Coastal Grassland                   | 18.6      |
| I2.2         | Spoil                               | 3.4       |
| J1.1         | Arable                              | 45.2      |
| J1.2         | Amenity grassland                   | 78.3      |
| J3.4         | Caravan site                        | 1.2       |
| J3.6         | New Buildings                       | 1.4       |
| J5           | Other habitat                       | 5.5       |
| Unclassified | Urban                               | 60.4      |
| TOTAL        |                                     | 304.8     |

### ***Relevant policies and plans***

East Lothian Council's policy is to support the use of the Ash Lagoons for recreational open space (East Lothian Council 1998). The site will be left for wildlife/recreation given the high conservation importance of the site. The sustainable coastal footpath extends along the frontage of the Ash Lagoons, although it is unlikely to be open until site remediation is complete.

Scottish Power has an application to extract PFA from lagoon No. 6 and their extraction license runs for 15 years from 1995 (Scottish Power 1995). Planning consent has also been given to form a wader roost within the lagoon No. 8.

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There are no other planning applications within 300m of the shoreline of MU2. The closest is the proposal to change the use of part of Drummohr Caravan Park (NT372734) to a site for holiday homes.

#### **Key interests**

No key issues relating to MU2 were highlighted during the written consultation exercise. Results from the public consultation indicated that the Ash Lagoons are viewed as a positive aspect of the shoreline and are valued for their recreation, wildlife and nature conservation value (Appendix B). One of the main concerns raised by the public related to the provision of access to the Lagoons (Appendix B).

#### **Valuation of Assets**

In order to assess the costs and benefits of management options, an estimate has been made of the monetary value of the assets in MU2 (Table 9.9) using the values per ha set out in the economic assessment chapter. Urban assets (which includes the built-up area of Musselburgh, smaller built-up areas and roads) account for most of the asset value, even though urban area covers only 20% of the land area. The value of assets in MU2 is estimated as approximately £90m (Table 9.9).

**Table 9.9 Valuation of Assets in MU2**

| Asset Type                | % Land in Category | Value (£)         |
|---------------------------|--------------------|-------------------|
| High Quality Agricultural | 30%                | 457 150           |
| Industrial                | 1%                 | 682 800           |
| Open Area                 | 49%                | 153 426           |
| Urban                     | 20%                | 88 531 800        |
| <b>Total</b>              |                    | <b>89 825 176</b> |

#### **Option Evaluation**

The shoreline of MU2 is artificial in that it has been formed via landclaim of inter-tidal land by the deposition of pulverised ash fuel (PVA) from Cockenzie Power Station. The 1907 MHWS was some 750m inland of the present coast and reclamation has led to the loss of lower inter-tidal mussel bed/shingle and sand (Table 7.2). Landclaim will have affected natural coastal processes and as the high water mark is now further seaward than its natural position, some form of coastal defence is required to maintain this position.

Erosion of the reclaimed land (and thus the release of PVA to the environment) will have major environmental effects on the adjacent shoreline, water quality and wildlife of the surrounding area and would be unacceptable to SEPA, SNH and other environmental bodies. Thus the strategic options of **No Active Intervention, Limited Intervention** and **Retreat the Line** are considered not feasible for MU2. **Advance the Line** would cause further loss of inter-tidal habitat and would have implications for the SSSI and SPA interests. If the coastal defence line were to be moved seaward they would be subject to increased exposure and wave attack and would influence the operation of natural coastal processes. This option is not considered feasible.

For the cost benefit analysis, one assumes that the **No Active Intervention** option would result in the eventual demise of the coastal defences and subsequent erosion and flooding of

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the reclaimed ash lagoons. This would lead to the loss of the SPA and SSSI interests in the inter-tidal area and on the reclaimed part of the ash lagoons. The deleterious environmental effect of the release of PFA to the Firth of Forth is impossible to quantify and is not within the scope of the present study. For the purposes of the CBA, it is assumed that the entire area of claimed land is lost over a period of 50 years under No Active Intervention. This may be an overestimate of value of land lost given the estimated residual life of the existing coastal defences and can be assumed a worst case scenario. The asset value lost is estimated using the standard values for different asset types (Table 8.3). The results from the CBA analysis are summarised in Table 9.10, and values are discounted to 2001 values.

**Table 9.10 Results of Cost-Benefit Analysis for MU2 (values are discounted to 2001 values)**

| Option                 | Losses    | Benefit   | Cost   | Ratio |
|------------------------|-----------|-----------|--------|-------|
| No Active Intervention | 1,454,962 | -         | -      |       |
| Hold The Line          | 0         | 1,454,962 | 45,110 | 32    |

**Hold the Line** The coastal defences of MU2 have an estimated residual life of >50 years (Appendix D). However, given the predicted rise in sea level and increase in storminess in the future (Section 4.10), it is realistic to expect that some maintenance of the current defence may be required. The level of the defence is considered adequate for the wave and tidal conditions likely to be experienced, however ongoing structural maintenance of the defence and regular inspection and monitoring should be carried out to ensure the structural condition of the defence is maintained. The cost of monitoring and maintaining this defence has been estimated as £2700 per year. This option has been compared to the No Active Intervention option and has a benefit-cost ratio of 32 (Table 9.10). It is anticipated that a Hold the Line policy will have negligible impacts on adjacent management units.

The preferred option for MU2 is **Hold the Line**. This applies to the entire management unit.

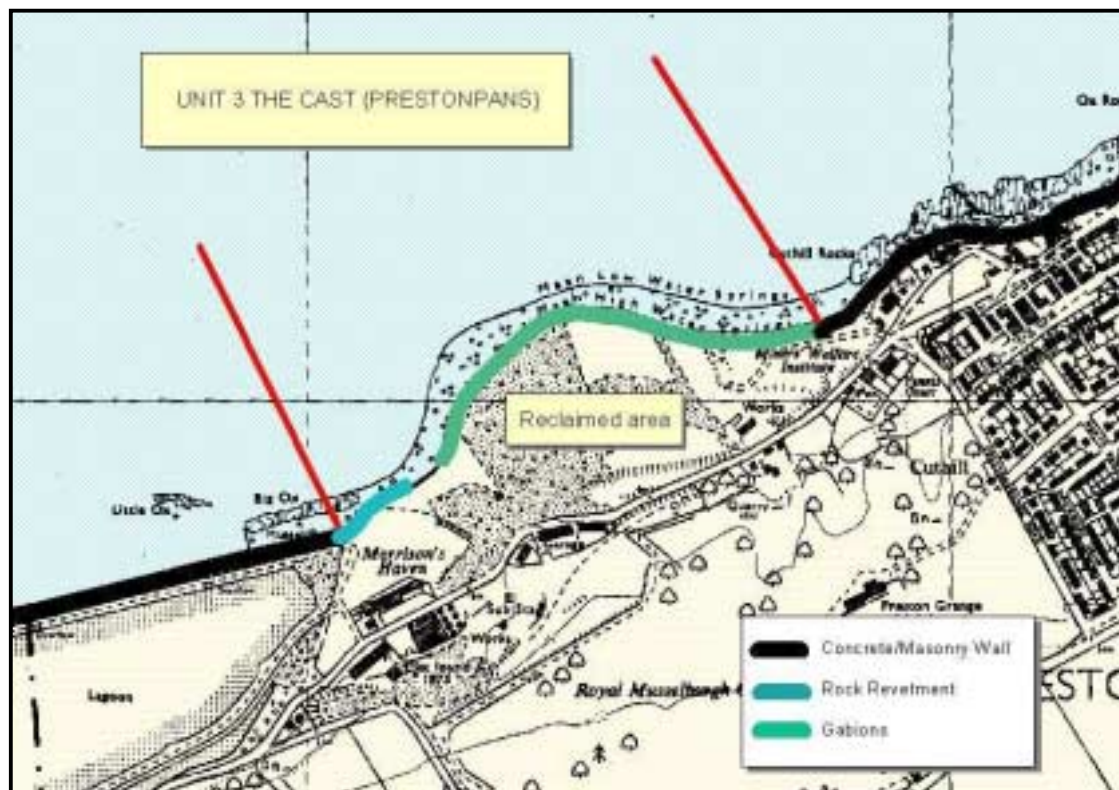


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### 9.2.2 Management Unit 3, The Cast

MU3 covers 1km of the shoreline from the eastern limit of the Ash Lagoons (NT371739) to the built-up area of Prestonpans (NT379741). The area covered by MU3 is known locally as 'The Cast' and is an area of reclaimed land and disused workings, which have been landscaped as part of the coastal trail.



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**Table MU3.1 Summary of Attributes of Management Unit 3**

| Coastal Processes           |                                                                                                                                                         |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Landclaim. Present shoreline position is 220m seaward of 1907 shoreline. Erosion rates of up to 3.5m/yr have occurred, as coastal defences have failed. |
| Geomorphology               | Mixed sand and shingle beach                                                                                                                            |
| Sediment Drift              | Low to moderate net westerly drift. Localised easterly drift.                                                                                           |
| Coastal Defences            |                                                                                                                                                         |
| Type                        | Man-made: Rock revetment (mix of rocks tipped at back of beach), Gabions backed by geotextile matting<br>Natural: Beach                                 |
| Human and Built Environment |                                                                                                                                                         |
| Land use                    | Landscaped open area, Coastal path, Disused industrial works, Golf course                                                                               |
| Sea use                     | Local line fishing and seasonal bait collecting                                                                                                         |
| Infrastructure              | B road                                                                                                                                                  |
| Recreation and Tourism      | Walking, Cycling, Bird watching, Golf, Industrial Heritage Museum                                                                                       |
| Historic Environment        | Rich industrial heritage. 16 <sup>th</sup> Century harbour and village at Morrison's Haven.                                                             |
| Natural Environment         |                                                                                                                                                         |
| Habitat Types               | Shingle, sand, amenity grassland, coastal grassland                                                                                                     |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site                                                                                                  |
| Key Interests               | Public concern related to erosion and poor condition of the coastal defences                                                                            |
| Valuation of Assets         | £9 M                                                                                                                                                    |

**Table MU3.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | √                         | X                         | √           | X                     | X         | X                      | X                   | X         | X             | NA       | NA       |
| Limited Intervention   | √                  | √           | √                         | X                         | √           | X                     | X         | X                      | X                   | X         | X             | NA       | NA       |
| Hold The Line          | √                  | X           | √                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | √                  | √           | √                         | √                         | √           | X                     | X         | X                      | √                   | √         | √             | NA       | NA       |

Key:  
 √ Option meets objective  
 X Option does not meet objective  
 • Option meets objective over part of the unit  
 NA Not applicable  
 - Not considered if option is not technically viable

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### ***Coastal Defences***

The reclaimed land of 'The Cast' is protected for most of its length (Figure 9.2), although the protection is not as robust as that of MU2 to the west. The protection is "ad-hoc" in places, with rubble tipping at the back of the shoreline used to provide protection. The shoreline is unprotected for approximately 150m of the management unit.

East of the concrete defence fronting the Ash Lagoons, there is a section of rock armour, which has been deposited at the back of the beach (Defence No. 9). This armouring is made up of random rocks of different geology and some concrete blocks / rubble. The protection has been tipped in an ad-hoc fashion rather than engineered as coastal defence. This random rubble mix tapers out after about 130m to the east of the Ash Lagoons.

The beach at 'The Cast' is a fairly coarse material of mixed shingle and sand. For a length of ca. 750m, 'gabions' formed from plastic geogrid material tied to form flexible mattresses have been laid along the back of the beach (Defence No. 10). These rock-filled mattresses are in variable condition, depending on the degree of exposure (Plate 9.6, Plate 9.7). The western stretch is in relatively good condition, although some of the gabions appear to have burst as a result of vandalism. Geotextile matting extends landwards of the mattresses and back to the path above. The geotextile is well vegetated with dune grasses, such as marram and sea lyme grass. In general, this stretch of defence is in good condition, although regular inspection should be undertaken (every 2 years) and especially following significant storms.

On the more exposed stretch of coast, east of NT378741, the mattresses have been badly damaged, undercut and are burst in places (Plate 9.7). The plastic has been ruptured and filling material lost. Underlying geofabrics have been exposed, displaced, torn and lost. Erosion has cut back into the grass to the landward and up to 7m of erosion has occurred in 2 years (Hutchison, pers. comm. 2001). In places, the mattresses have been completely removed for intermittent sections of ca. 20m. Toe protection, in the form of large rocks placed seaward of the mattresses, has failed and for some stretches all that remains is remnant toe protection as wave attack has breached this protection and eroded the mattresses behind and above. Closer to Prestonpans, the mattresses have been completely eroded, leaving an erosional cliff edge cut in the grass to the landward. Rubble from the reclaimed area of disused working has been exposed along the eroding coast. Rock armour has been randomly tipped in places in an apparent attempt to control further erosion. This stretch of protection is in very poor condition and requires immediate attention.

### ***Land use***

The main land-use in MU3 is Recreational Land, which covers 40ha of the management unit (Table 9.11). This is the Royal Musselburgh Golf Course. The reclaimed land adjacent to the shore and the industrial heritage around Preston Grange are classified as built-up area by MLURI (1988) (Figure 9.3). It is this land-use class that extends along the shoreline. The reclaimed land has been landscaped, with vegetated slopes and the John Muir walkway extending along the shoreline. Arable land makes up the landward part of MU3 with a small area of broadleaved woodland.

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**Table 9.11: Land-use classification in MU3 (source: MLURI 1988)**

| Land-use class       | Domain                            | Area (ha) |
|----------------------|-----------------------------------|-----------|
| Factories & urban    | Built-up (area)                   | 28.3      |
| Recreational land    | Golf course                       | 40.7      |
| Broadleaved woodland | Undiff. broadleaf (area)          | 2.6       |
| Arable               | Arable: no rock no farms no trees | 25.2      |
| Total                |                                   | 96.8      |

### ***Residential Development, Industry, Ports and Harbours***

There is very little residential development in MU3, with only a few isolated properties set back from the B1348 road. These properties are at least 100m from the present shoreline. There is no current industrial development within MU3, although there is important industrial heritage within MU3, with the Preston Grange colliery and associated workings at NT372736. The importance of the industrial heritage is highlighted by the presence of the mining museum at Preston Grange and the designation of the colliery as a Scheduled Monument.

There are no working harbours or ports within MU3. However, an old harbour at NT371738 was filled in approximately 15 years ago (Jean Squires, pers. comm. 2001). This harbour was presumably used when the Preston Grange colliery was operational. The old harbour can be clearly identified in the 1907 OS map of the area (Appendix C, View 2). East Lothian Council has indicated that they are keen to see the harbour reopened (Jean Squires, pers. comm. 2001) and this will clearly influence the management of the shoreline in MU3.

### ***Recreation and Tourism***

The main tourist activity within MU3 relates to the industrial heritage and the mining museum and associated industrial artefacts at Preston Grange. Other recreational pursuits are walking and cycling along the John Muir walkway, which extends along the coast on the reclaimed land of 'The Cast'. Golfing is also a popular recreational pursuit within MU3, as the Royal Musselburgh Golf Course is within the MU (Figure 9.3).

### ***Fishing Activity***

There is some local fishing activity within MU3, with line fishing for mackerel from the sea front. Mussel-beds are noted on the OS map in the vicinity of Morrison's Haven, where major, but seasonal, bait digging is undertaken. The old harbour (now infilled) may have been used for local fishing and pleasure boats, but this has now ceased due to the harbour closure. Any proposals to reopen the harbour would clearly have implications for fishing.

### ***Agriculture and Forestry***

The landward part of MU3 is cultivated as arable agriculture (Figure 9.3) and covers 21.3ha of the MU. There is no forestry within MU3.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU3.

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#### **Water Quality and Pollution**

The coastal water quality in MU3 has improved since 1999 and is classed as Class B (Good) by SEPA (2000).

A comment raised during the public consultation highlighted a water quality issue from polluted water seeping through onto the road close to Preston Grange Museum, possibly from iron waste buried underground.

#### **Archaeology and Built Heritage**

The industrial heritage of MU3 is rich and many of the identified sites are associated with the areas industrial history (Table 9.12). The Preston Grange colliery, engine and engine house are designated as a Scheduled Ancient Monument (NT372736). Several other industrial sites are Listed Buildings (e.g. the Hoffman Kiln and the old generating house at Preston Grange colliery). Morrison's Haven is the site of the old harbour (NT372737), which is listed as an unscheduled monument. The harbour and village at Morrison's Haven date from the 16<sup>th</sup> Century (GUARD 1996) and the glassworks (NT371737), cists (NT371736) and military artefacts within Morrison's Haven make this a site of great archaeological importance.

The Mining museum at Preston Grange highlights the considerable interest and importance of the cultural heritage within MU3. The other sites of cultural and built heritage within MU3 are set back from the present shoreline and include the A Listed Building of Preston Grange house (NT379737), which is now the golf clubhouse, and the boundary walls of the house, which are also listed.

**Table 9.12: Cultural Heritage Within MU3**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 8      | RCAHMS            |
| Scheduled Ancient Monuments   | 1      | Historic Scotland |
| Listed Buildings*             | 13     | ELC               |
| Architecture Sites*           | 9      | RCAHMS            |
| TOTAL                         | 31     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

#### **Natural Environment**

The entire inter-tidal of MU3 lies within the Musselburgh - Prestonpans section of the Firth of Forth SSSI (Figure 7.1). The biological and geological importance of the SSSI is described in Section 9.1.1 above and will not be repeated here. The SSSI designation confers special protection to the inter-tidal area as outlined in Chapter 2.

The Firth of Forth SPA/ Ramsar site covers the entire inter-tidal area of MU3, which confers further legislative protection on the inter-tidal habitats.

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Only 7.9ha of land within MU3 were not classified in the Phase 1 Habitat survey of East Lothian (Hutcheon et al 1998, Table 9.13). The unclassified land represents the built-up area and roads and thus highlights the amount of open land and habitat within MU3. Amenity grassland covers the largest area, which is made up of the Golf Course and the landscaped reclaimed land close to the coast. An approximately 40m wide strip of land adjacent to MHWS is classified as coastal grassland. Some of the reclaimed land is forested and is classified as broad-leaved plantation (8.6ha) and the semi-natural woodland around the golf course makes up 13.4ha of MU3. The landward part of MU1 is classified as Arable land (21.2ha).

**Table 9.13: Phase 1 Habitats within MU3 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 13.4      |
| A1.1.2       | Broad-leaved, plantation            | 8.6       |
| A2.1         | Dense scrub                         | 0.4       |
| H8.4         | Coastal Grassland                   | 1.5       |
| J1.1         | Arable                              | 21.2      |
| J1.2         | Amenity grassland                   | 41.6      |
| J1.3         | Ephemeral/short perennial           | 2.2       |
| Unclassified | Urban                               | 7.9       |
| Total        |                                     | 96.8      |

### ***Relevant policies and plans***

East Lothian's Heritage Strategy outlines the importance of improved access to sites of archaeological and architectural heritage in East Lothian (Section 2.1.4). In keeping with this strategy, there are proposals to link the John Muir coastal path to the Industrial Heritage Museum at Preston Grange (Halcrow Fox 1998).

The Council are keen to reopen the old harbour at Morrison's Haven. Clearly any such development will have implications for the management of the shoreline of MU3. No planning applications within 100m of the coast have been lodged in MU3. The closest planning applications to the shore all lie landward of the B1348 road and include a small proposed residential development at the western edge of Prestonpans.

### ***Key interests***

No issues relating specifically to MU3 were highlighted in response to the written consultation. However, public concern along the shoreline of MU3 was high with numerous comments relating to the erosion and poor condition of the coastal defences along this stretch of coast (Appendix B). The concerns mainly related to the disintegrated plastic gabion mattresses (Defence No. 10) and the exposures of old brick and coal rubble as the reclaimed land erodes. A few comments noted that erosion in this area had been remarkable in the last 2 years and that the boulders that have been placed as toe protection were moved during severe storms.

There was also some public concern about the travellers who use this area during the summer, creating an eyesore.

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## Valuation of Assets

The hinterland of MU3 is predominantly classified as Open Area and thus the estimated value of the assets within the management unit is relatively low at approximately £9M (Table 9.14). Open Area lies adjacent to the shoreline for the entire management unit.

**Table 9.14 Valuation of Assets in MU3**

| Asset Type                | % Land in Category | Value (£)        |
|---------------------------|--------------------|------------------|
| High Quality Agricultural | 22%                | 107 310          |
| Open Area                 | 71%                | 68 965           |
| Urban                     | 7%                 | 8 981 000        |
| <b>Total</b>              |                    | <b>9 157 275</b> |

## Option Evaluation

The entire shoreline of MU3 is artificial in the sense that it has been reclaimed, via the dumping of disused workings, and subsequently landscaped. The 1907 MHWS lay up to 220m inland of the present shoreline (Appendix C, View 2) and the 1907 MLWS was also located someway inland of the present shoreline. Thus, it is not surprising that this stretch of coast is subject to erosion. The reclaimed area is now used mainly for recreational pursuits, including walking, cycling and bird watching.

The existing coastal defences are in very poor condition (Appendix D) and have a residual life of <5years (Rock armour - Defence No. 9) and <1year (Gabions - Defence No. 10).

For the cost benefit analysis, one assumes that the **No Active Intervention** option would result in the rapid demise of the coastal defences and subsequent erosion of the reclaimed land back to the 1907 MHWS. This would result in the exposure of abandoned mine workings to the environment and may effect the SPA and SSSI interests in the inter-tidal. The monetary value of these losses and environmental impacts are difficult to quantify and beyond the scope of the present study. The No Active Intervention Option assumes that the entire area of reclaimed land is lost (approximately 10ha) over a period of 50 years. The results from the CBA analysis are summarised in Table 9.15.

**Table 9.15 Results of Cost-Benefit Analysis for MU3 (values are discounted to 2001 values)**

| Option                 | Losses | Benefit | Cost    | Ratio |
|------------------------|--------|---------|---------|-------|
| No Active Intervention | 40,847 | -       | -       |       |
| Hold The Line          | 0      | 40,847  | 523,959 | 0.08  |

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The **Hold the Line** option requires capital works to be undertaken to replace/ upgrade the existing coastal defences. For the cost benefit analysis, it is assumed that the gabions are replaced in year 1 of the Plan and the rock armour in year 5 of the Plan. As the coastal defences extend over a long stretch of coast, the capital expenditure and maintenance costs are high (Table 9.15). The costs associated with Hold the Line far exceed the benefits of protecting the reclaimed land and with a benefit to cost ratio of only 0.08 the economic argument for Hold the Line is weak.

**Advance the Line** is not feasible for MU3, as this would require the need for additional defences to protect an artificial shoreline even further seaward of the existing one. Coastal erosion is likely to increase, thus more robust coastal protection would be required if the defence line is moved seaward.

**Retreat the Line**, whereby the defence line is moved back to its more natural position prior to reclamation (approximately at the 1907 MHWS), may be a feasible option for MU3. There would be no loss of the archaeological heritage as all the sites of interest are landward of the natural coastline. Retreat the line would also allow the old historic harbour at Morrison's Haven to be re-opened. However, retreat the line would result in the loss of the landscaped area and the coastal path, which would have to be re-routed. In addition, for this option to be environmentally sound it would have to be managed properly and would generate large volumes of landfill. Depending on the nature of the landfill, this option may generate additional beach sediment (= benefit) and/or waste debris which would require off-site disposal (= cost). A retreat the line option would have short-term impacts on the adjacent shoreline, however as the shoreline would be moved back to its natural position the long-term impacts will be negligible and possibly more sustainable in the future.

The preferred option for MU3 is **Hold the Line**, although this is not necessarily viable in an economic sense. It is recommended that the Council investigate the feasibility of **Retreating the Line** as this may reduce the need for expensive coastal defences and may also allow historic sites of archaeological heritage, such as Morrison's Haven to be re-opened.

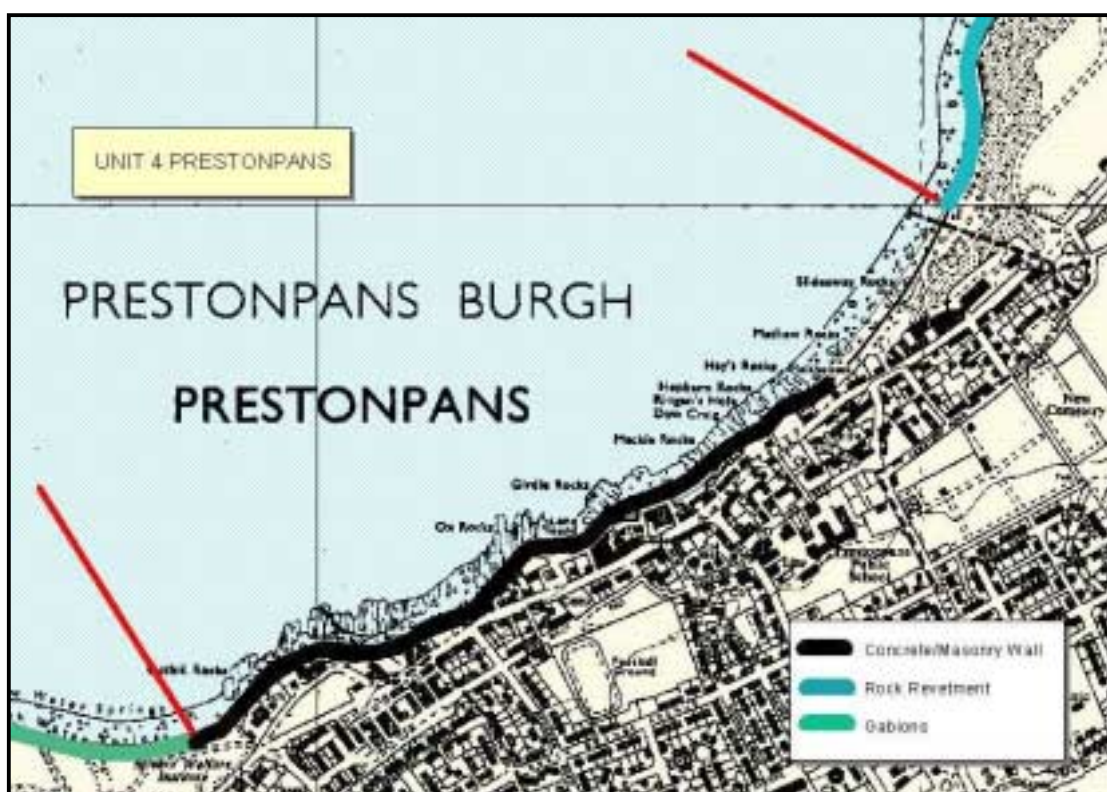


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### 9.2.3 Management Unit 4, Prestonpans

The residential properties of Prestonpans back the shoreline of MU4, which covers approximately 1.5km of the shoreline from Cuthill Rocks (NT379741) to Prestonpans Sailing Centre (NT391750). The shoreline of MU4 is predominantly rocky, although there is a small shingle beach at the eastern end of the management unit, close to the Sailing Centre. Littoral sediment transport is relatively low, with a low or moderate westerly drift of sediment into the Forth Estuary (Barne et al., 1997). However, a weak anti-clockwise gyre at Musselburgh and Prestonpans is thought to drive easterly littoral transport in this area (Barne et al., 1997).



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**Table MU4.1 Summary of Attributes of Management Unit 4**

| <b>Coastal Processes</b>           |                                                                                                                                                                              |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution                | Negligible change recorded for most of the shoreline. The eastern part of the management unit is an area of landclaim, showing signs of localised erosion.                   |
| Geomorphology                      | Rocky foreshore, with pockets of shingle beaches. Shingle beach in east of MU.                                                                                               |
| Sediment Drift                     | Low to moderate net westerly drift. Localised easterly drift.                                                                                                                |
| <b>Coastal Defences</b>            |                                                                                                                                                                              |
| Type                               | Man-made: Masonry or concrete walls (mainly property walls). A wide flat concrete platform covering pipes from the power station fronts the property walls<br>Natural: Beach |
| <b>Human and Built Environment</b> |                                                                                                                                                                              |
| Land use                           | Residential and commercial                                                                                                                                                   |
| Sea use                            | Local line fishing and seasonal bait collecting. Creel fishing for crabs and lobsters                                                                                        |
| Infrastructure                     | B road, outfalls, pipe from Cockenzie Power station runs along shoreline                                                                                                     |
| Recreation and Tourism             | Walking, Sailing, Bird Watching                                                                                                                                              |
| Historic Environment               | 82 sites of cultural heritage identified, most located within Prestonpans Conservation Area                                                                                  |
| <b>Natural Environment</b>         |                                                                                                                                                                              |
| Habitat Types                      | Rocky inter-tidal, shingle beach                                                                                                                                             |
| Designated Sites                   | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site                                                                                                                       |
| <b>Key Interests</b>               | Public concern relating to the state of the concrete platform (used by locals as a walkway) was high. Issues relating to access, safety, litter and pollution.               |
| <b>Valuation of Assets</b>         | £154 M                                                                                                                                                                       |

**Table MU4.2 Screening of Strategic Options with Management Objectives**

| Strategic Option          | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|---------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention    | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | X                   | X         | X             | NA       | NA       |
| Limited Intervention      | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | X                   | X         | X             | NA       | NA       |
| Selectively Hold The Line | √                  | √           | √                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Advance The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

The foreshore at Prestonpans is rocky. Many properties back directly onto the foreshore and have either sandstone masonry or concrete walls demarcating their boundaries. These walls appear to be founded on the bedrock that outcrops on the foreshore. In general there was little sediment on the beach, except in localised areas. A wide flat concrete platform covering pipes from Cockenzie Power Station fronts the property walls over much of this frontage (Plate 9.8), which provides an additional sea defence that would appear to dissipate breaking wave energy and protect the base of the property walls. MHWS is landward of the concrete platform in several places along the Prestonpans shore, and evidence of seaweed colonisation on sections indicates that it is inundated for a significant period of the tidal cycle. Coastal defences 11, 12 and 13 protect 1.2km of the shoreline of MU4 (Appendix D) and are described below.

#### **Defence No. 11**

At high water, waves were observed breaking over the concrete platform and impinging on the vertical, property wall at Inchview (NT380742). Domestic property at Inchview is only around 10m landward of the wall and subject to wave splash and spray. The vertical masonry property wall here is badly corroded and high tides are undermining the wall at lower level. The property maintenance survey carried out by East Lothian Council estimate maintenance works of £20 000 are required along this stretch (Appendix E). This area is at risk to erosion and spray from waves breaking and overtopping the walls.

#### **Defence No. 12**

The wide concrete platform is discontinuous along this short stretch of shoreline, which is fronted by a narrow sand and shingle beach (NT381743). The beach unit provides a level of the defence and is backed by old, sandstone masonry walls. There is some evidence of minor repairs to the walls, but they are generally in good condition along this stretch of shoreline.

#### **Defence No. 13**

Masonry property walls of varying condition, fronted by the concrete platform, protect this eastern section of the Prestonpans shoreline (NT381743 – 388747). In many places the concrete platform is submerged at high water, with wave splash and inundation of the masonry walls. The property maintenance survey carried out by East Lothian Council (Appendix E) indicate that much of the walls are subject to undermining, cracking, water ingress and have poor jointing. The cost of maintenance to this section of property walls is estimated to be £375 000. The elevation of the concrete platform varies along the shore, from 0.3m above beach level at NT384744 to 1.5m above beach level at NT388747. In places, 3m high concrete blocks back the platform, providing additional protection to the masonry walls to the landward (NT384744). At low water, ponding was observed in the lower areas between the platform and the masonry property wall. This section of protection is poor and requires maintenance in the near future.

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The concrete platform, which also acts as a form of coastal defence, stops around the Sir Walter Scott monument (NT388747) and the shoreline from here to the Prestonpans Sailing Centre is unprotected. A wide shingle beach fronts the grass area and path, but there is evidence of erosion as the grass edge is undercut in places. Domestic property is around 40m landward of the eroding grass edge and is approximately 2m higher. Erosion is evident around the slipway at the sailing centre and an undercut grass edge extends along the sailing centre frontage.

### **Land Use**

The built-up area of Prestonpans comprises 80% of MU4 (Table 9.16). There are two small areas of arable land set back from the shoreline and a very small part of the Royal Musselburgh Golf Course falls into MU4 (Figure 9.3).

**Table 9.16: Land-use classification in MU4 (source: MLURI 1988)**

| Land-use class    | Domain                            | Area (ha) |
|-------------------|-----------------------------------|-----------|
| Factories & urban | Built-up (area)                   | 136.0     |
| Arable            | Arable: no rock no farms no trees | 31.5      |
| Recreational land | Golf course                       | 1.8       |
| TOTAL             |                                   | 169.3     |

### **Residential Development, Industry, Ports and Harbours**

Prestonpans is a historic town with a long industrial past, although the majority of its working population is today employed outside the town. The population of Prestonpans was 7051 in 1994 (East Lothian 1998). Residential development backs most of the shoreline of MU4. There remains little industry within Prestonpans today, although there is local employment at the Mid Road Industrial Estate (NT390738) and local services.

### **Recreation and Tourism**

There are some recreational open spaces within Prestonpans and the coastal platform is used for recreational walking along the shoreline of MU4. However, at high water the platform is inaccessible and is often wet and slippery (see above), creating a public safety issue. Wildlife and views are noted as positive aspects of MU4, with seals, cormorants and ducks often roosting on the rocks (SPI 2001a), enhancing the tourist and recreation potential of MU4.

Water based leisure activities are important within MU4, with the Prestonpans Yachting and Boating Club using the slipway and facilities at the Sailing Centre (NT391749). The beach at Prestonpans is considered of amenity value by East Lothian Council and is included in the beach-cleaning contract supervised by the Council (Ash 1994). The Preston Conservation Area (NT390741), which comprises the best-preserved part of the original town, may attract tourists to view the rich architectural and archaeological heritage (see below).

### **Fishing Activity**

There is no commercial fishing activity within MU4, although local line fishing and the collecting of bait or mussels may take place on the rocky foreshore. Creel fishing for crabs and lobsters also occurs within MU4.

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### ***Agriculture and Forestry***

Arable agriculture comprises 31.5ha of MU4, although none is close to the shoreline (Figure 9.3). There is no forestry within MU4.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU4.

### ***Water Quality and Pollution***

Coastal water quality in MU4 is classed as Class B (Good) and has improved in recent years due to sewer improvements (SEPA 2001).

### ***Archaeology and Built Heritage***

The present settlement of Prestonpans is made up of several old villages that have gradually come together. The old village and burgh of Preston is the best-preserved part of the original town and is designated a Conservation area by East Lothian Council (East Lothian Council 1998) conferring special development rights to the area. The majority of the 82 cultural heritage sites identified within MU4 (Table 9.17) lie within the Conservation area (NT390741), which is 600m inland of the shoreline. The 2 scheduled monuments (Preston Mercat Cross and Preston Tower & Dovecots) are also located within the Conservation area.

Several Listing Buildings and unscheduled monuments are located along the coastal strip of MU4 (Figure 9.4). These include the slipway (NT379742), the saltworks (NT381743), the long cist (NT385744), the maltings (NT387746), rock cottage (NT387746) and the war memorial (NT386745). All of these lie within 40m of the present shoreline and thus are potentially at risk from coastal erosion and/or flooding.

**Table 9.17: Cultural Heritage Within MU4**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 21     | RCAHMS            |
| Scheduled Ancient Monuments   | 2      | Historic Scotland |
| Listed Buildings*             | 38     | ELC               |
| Architecture Sites*           | 21     | RCAHMS            |
| TOTAL                         | 82     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### ***Natural Environment***

The environment of MU4 has been modified considerably by humans, with the settlement of Prestonpans making up the majority of the management unit. However, the inter-tidal area of MU4 forms part of the Musselburgh – Prestonpans section of the Firth of Forth SSSI (described in Section 9.1.1) and has been recently designated as part of the Firth of Forth SPA/Ramsar site for its ornithological and wetland importance, thus conferring specific legislative rights to the foreshore.

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Only 35% of MU4 was classified during the Phase 1 Habitat Survey of East Lothian, highlighting the lack of open areas and habitat within the management unit (Table 9.18). The main habitats identified comprise arable land (31.8ha) and amenity grassland (20.8ha). The entire coastal strip is unclassified and thus it can be assumed that the urban area lies adjacent to the shoreline for the entire length of MU4.

The rocky inter-tidal area has also been identified as an important area for wildlife, with seals and other wildlife commonly observed (SPI 2001a).

**Table 9.18: Phase 1 Habitats within MU4 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 1.1       |
| J1.1         | Arable                              | 31.8      |
| J1.2         | Amenity grassland                   | 20.8      |
| J1.3         | Ephemeral/short perennial           | 2.5       |
| J3.6         | New Buildings                       | 3.4       |
| Unclassified | Urban                               | 109.7     |
| Total        |                                     | 169.3     |

#### ***Relevant policies and plans***

The recommended sustainable coastal path along this part of the coastline is along the B1348 through the urban area of Prestonpans (Halcrow Fox 1998) and does not use the coastal platform, which runs seaward of the residential property. This is a sensible option as the platform along the shoreline is inundated at high water and acts as a coastal defence for much of its length (see above).

There are 2 planning applications close to the shoreline of MU4, which may have implications for the SMP. There are proposals for a new housing development at West Seaside (NT385745) which is adjacent the MHWS and would thus require protection. There is also outline planning permission for the erection of a building for food retailing use and associated works at 6 High Street, Prestonpans. This development lies within 50m of the MHWS on the eroding shoreline adjacent to the sailing centre.

#### ***Key interests***

No key issues were highlighted during the written consultation exercise regarding the Prestonpans shoreline. However, public concern regarding the state of the concrete platform (used by locals as a walkway) was high, with issues relating to access, safety, litter and pollution raised (SPI 2001a). The public also observed higher seas in the last 8-10 years with several comments relating to increased flooding and problems of sea spray along the properties on the coastal edge.

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### ***Valuation of Assets***

65% of land in MU4 is classified as Urban (Table 9.19), thus the estimated value of assets within the management unit is high (approximately £155M). The urban area lies adjacent to the shoreline, thus it is this land that is at risk to flooding and/or erosion.

**Table 9.19 Valuation of Assets in MU4**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>   |
|---------------------------|---------------------------|--------------------|
| High Quality Agricultural | 19%                       | 157 245            |
| Open Area                 | 16%                       | 27 746             |
| Urban                     | 65%                       | 154 172 200        |
| <b>Total</b>              |                           | <b>154 357 191</b> |

### ***Option Evaluation***

The analysis of historical OS maps showed negligible change in the position of the 1907 and 1999 MHWS position along most of the shoreline of MU4 (Appendix C, View 3). The MHWS abuts the coastal defences and property walls of the urban area. The 400m section of shoreline in the east of the management unit is unprotected. This is an area of reclaimed land, with a wide shingle beach fronting a low grass area and path. The main risk to property in MU4 is from flooding, although erosion and undermining of the defences is also a risk. There are no rates of erosion for MU4, thus the technique of cost-benefit analysis set out in Chapter 8 is not applicable.

Two of the sections of coastal defences / property walls in MU4 have an estimated residual life of <10years (Defence 11 and 13) and repair costs of £395 000 have been estimated by East Lothian Council, based on one off repair cost undertaken in the financial year 2002/2003 (Appendix E).

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The strategic coastal defence options of **No Active Intervention**, **Limited Intervention** and **Retreat the Line** are not feasible for MU4, as these would result in substantial flooding of domestic property. The monetary value of the loss due to flooding is impossible to quantify, given the lack of data regarding return periods and water levels. However, given the proximity of property to MHWS and the relatively low levels the damage costs associated with the No Active Intervention option are likely to be high.

**Advance the Line** is also considered unfeasible and unsuitable for MU4, as this will incur additional costs as the coastal defence line is moved seaward and more robust coastal defences will be required, due to increased exposure.

**Hold the Line** is a feasible option for the shoreline of MU4, particularly for the urban shoreline, which is currently protected by coastal defences and property walls. In the east, a wide shingle beach fronts the management unit and although there are some signs of limited erosion there is no immediate risk to property. Natural processes should be allowed to continue in this part of the management unit, although monitoring should be carried out to assess future risk.

**Selectively Hold the Line** is the preferred option in MU4. Adoption of such a policy will have negligible impact on adjacent shorelines. The costs of Selectively Holding the Line over the period of the Plan are estimated as £415 000, based on a one-off repair cost and maintenance and monitoring to existing coastal defences for the remaining 50 years. This cost is likely to be less than the benefits associated with the reduced flood risk if No Active Intervention was adopted, given the high value of the assets landward of the existing defences.



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The shoreline of Management Unit 5 is approximately 1km long and extends from the Prestonpans Sailing Centre (NT391750) to Cockenzie Harbour (NT397756). Cockenzie Power Station is the main land-use within MU5. The eastern boundary of MU5 is a process unit boundary and is possibly a littoral drift divide (Figure 4.15), with westerly drift occurring west of the boundary and easterly drift to the east.

UNIT 5 HUMLOCKS AND COCKENZIE POWER STATION

The Humlocks

Cockenzie

Legend:

- Concrete / Masonry Wall
- Rock Revetment
- Harbour

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**Table MU5.1 Summary of Attributes of Management Unit 5**

| Coastal Processes           |                                                                               |
|-----------------------------|-------------------------------------------------------------------------------|
| Shoreline Evolution         | Landclaim. Present shoreline is 290m seaward of 1907 shoreline.               |
| Geomorphology               | Sand and rocky foreshore, with some shingle.                                  |
| Sediment Drift              | Low to moderate net westerly drift in MU5. Eastern boundary is a PU boundary. |
| Coastal Defences            |                                                                               |
| Type                        | Man-made: Rock revetment, Concrete wall, with rock armour protection at toe.  |
| Human and Built Environment |                                                                               |
| Land use                    | Industrial and recreational open area.                                        |
| Sea use                     | -                                                                             |
| Infrastructure              | -                                                                             |
| Recreation and Tourism      | Limited walking and cycling                                                   |
| Historic Environment        | Very little interest                                                          |
| Natural Environment         |                                                                               |
| Habitat Types               | Shingle and cobble beach.                                                     |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site                        |
| Key Interests               | Public concern was raised concerning the visual impact of the Power Station   |
| Valuation of Assets         | £17 M                                                                         |

**Table MU5.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | X                         | √                         | √           | X                     | X         | X                      | X                   | X         | X             | X        | NA       |
| Limited Intervention   | √                  | √           | X                         | √                         | √           | X                     | X         | X                      | X                   | X         | X             | X        | NA       |
| Hold The Line          | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | √        | NA       |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

The entire shoreline of MU5 presently has some form of coastal defence, although the quality of the defence varies depending on location (Figure 9.2, Appendix D). Rock rubble has been randomly dumped to the east of the jetty at the Sailing Centre (Defence No. 14). The randomly placed rock armour varies in elevation and reaches 2-3m high further to the east. Rock armour extends eastwards protecting the car park to the east of the jetty, although there are several gaps in the protection. The rock armour needs attention in places and lies at the back of a shingle and cobble beach.

The rock armour has been concreted in along the more exposed section of shoreline to Cockenzie Power Station (Defence No 15). A concrete toe-beam restrains and protects the base of the concreted rock armour. The toe beam has also been protected to seaward with angular rock armour. The width of rock revetment varies up to about 20m wide. An open, proprietary concrete grid extends above the rock armour and protects the grassed embankment above. The rock armour along this section of coastline appears to have been placed relatively recently and is in very good condition, with no evidence of erosion damage or undercutting. The crest level of the defence is high and extends up to the top of the slope at Preston Links.

An in situ, massive, concrete wall protects Cockenzie Power Station, with rock armour protection at the toe (Defence No 16). The wall is in very good condition and has a residual life of >50 years. The defences at Cockenzie Power Station are regularly monitored and maintained by Scottish Power. The toe of the defences is subject to waves at all stages of the tide.

### ***Land Use***

MLURI (1988) classified most of the land within MU5 as Factories and Urban (Table 9.20). It is this land-use that is adjacent to the shoreline for the entire length of MU5 (Figure 9.3). A small area of MU5 is arable land. The area known as the Humlocks has been classified as factories and urban by MLURI (1988), presumably as this is an area of disused workings, although the land has been landscaped.

**Table 9.20: Land-use classification in MU5 (source: MLURI 1988)**

| Land-use class    | Domain                            | Area (ha) |
|-------------------|-----------------------------------|-----------|
| Factories & urban | Built-up (area)                   | 64.5      |
| Arable            | Arable: no rock no farms no trees | 19.3      |
| TOTAL             |                                   | 83.8      |

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### ***Residential Development, Industry, Ports and Harbours***

There is very little residential development within MU5, although a small part of the residential area of Prestonpans lies just within the 1km boundary of the shoreline. MU5 is predominantly industrial with the Cockenzie Power Station covering most of the coastal land. There is also a small industrial estate at Whin Park containing sixteen starter units (NT398753). The Humlocks area is a grassy open space, although this was formerly an area of disused workings. There are no ports or harbours within MU5, although the jetty at the Power Station (NT394756) allows boat access for industrial use.

### ***Recreation and Tourism***

Recreation and tourism is limited in MU5, due to the presence of the Power Station. However, it is proposed that the sustainable coastal footpath extends along the coast seaward of Cockenzie Power Station (Halcrow Fox 1998). Scottish Power are supportive of general shoreline access by the Power Station, although note that access may be restricted at certain times (Halcrow Fox 1998). East Lothian Council identify the coastal route as a right of way.

The Humlocks area west of the Power Station is classified by East Lothian Council as a recreation, leisure and amenity open space (East Lothian Council 1998) and has certain development restrictions. The area is used for walking and cycling and other recreational uses.

### ***Fishing Activity***

No significant fishing activity takes place from the shoreline of MU5.

### ***Agriculture and Forestry***

Arable agriculture comprises 19.3ha of MU5, although all is set back from the shoreline (Figure 9.3). There is no forestry within MU5.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU5, although the reclaimed area was developed on an area of disused workings.

### ***Water Quality and Pollution***

The coastal water quality in MU5 is classified by SEPA as Class B (Good) and has improved since 1999 due to sewer improvements in the area (SEPA 2001).

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## ***Archaeology and Built Heritage***

There are no scheduled monuments or listed buildings within MU5 (Table 9.21), although RCAHMS hold 4 unscheduled sites within their database. These are Cockenzie Power Station (architectural interest), Prestonlinks Colliery (archaeological and architectural interest), cists and human remains at NT400750 (archaeological interest). Only the Power Station lies close to the existing shoreline.

**Table 9.21: Cultural Heritage Within MU5**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 3      | RCAHMS            |
| Scheduled Ancient Monuments   | 0      | Historic Scotland |
| Listed Buildings*             | 0      | ELC               |
| Architecture Sites*           | 2      | RCAHMS            |
| TOTAL                         | 5      |                   |

\* Note: some architecture sites are also designated as Listed Buildings

## ***Natural Environment***

The environment of MU5 has been heavily modified by humans, with the reclamation of land on the former disused workings and Cockenzie Power Station. However, the inter-tidal area west of the Power Station frontage is within the Musselburgh – Prestonpans section of the Firth of Forth SSSI and is part of the newly designated Firth of Forth SPA/Ramsar Site for its ornithological and wetland interest, conferring special legislative protection to this part of the foreshore.

The coastal strip of MU5 was not classified by the Phase 1 habitat survey of East Lothian. It is assumed this is industrial land. The main habitats identified within MU5 include arable land (18.2ha), amenity grassland (11.7ha) and neutral grassland (4.9ha) (Table 9.22).

**Table 9.22: Phase 1 Habitats within MU5 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat               | Area (ha) |
|--------------|-------------------------------|-----------|
| A1.3.2       | Mixed woodland, plantation    | 0.3       |
| B2.1         | Neutral grassland, unimproved | 4.9       |
| B4           | Improved grassland            | 0.1       |
| J1.1         | Arable                        | 18.2      |
| J1.2         | Amenity grassland             | 11.7      |
| Unclassified | Industrial / urban            | 48.6      |
| Total        |                               | 83.8      |

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### ***Relevant policies and plans***

The land-use on the shoreline of MU5 is covered by policies C2 and NRG1 within the East Lothian Local Plan 1998. Policy C2 applies to the Humlocks area, such that this area of recreation and leisure open space should be retained in such a use and any alternative uses will only be considered when there is no significant loss of amenity or impact on the landscape setting. Policy NRG1 recognises the significant contribution that the power station makes to local employment and safeguards this land for power generation.

The development of the coastal path along the frontage of Cockenzie Power Station is part of East Lothian Council's long-term plan. This potentially will have an impact on shoreline management of the MU.

### ***Key interests***

Scottish Power has interests in the management of MU5. The Company was consulted during the written consultation phase of the SMP development, however no reply was received. Scottish Power regularly monitor and maintain the defences at Cockenzie Power Station.

Several public comments related to the visual impact of the Power station (SPI 2001a), although others enjoyed the views from the coastal pathway and the landscaped area of the Humlocks for walking and recreation.

### ***Valuation of Assets***

Over half of the land in MU5 is industrial and the total value of assets within the management unit is estimated as £17M (Table 9.23). The rates used to calculate the value of assets are standard rates (see Chapter 8) and the valuation of Cockenzie Power Station is likely to be an underestimate.

**Table 9.23 Valuation of Assets in MU5**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>  |
|---------------------------|---------------------------|-------------------|
| High Quality Agricultural | 22%                       | 92 750            |
| Industrial                | 51%                       | 8 592 000         |
| Open Area                 | 20%                       | 16 963            |
| Urban                     | 7%                        | 8 117 200         |
| <b>Total</b>              |                           | <b>16 818 913</b> |

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## Option Evaluation

The entire shoreline of MU5 is artificial in the sense that the land has been claimed and the existing shoreline lies to the seaward of both the 1907 MHWS and MLWS. As the shoreline position has been artificially re-adjusted it is not surprising that this entire section of shoreline requires some form of coastal protection to prevent erosion.

The defences on the outer exposed coast (Defence No's 15 and 16) have an estimated residual life of >50 years (Appendix D), while the rock armour in the western part of the management unit (Defence No 14) has a residual life of <10years.

For the purposes of the cost benefit analysis, it is assumed that if the **No Active Intervention** option is adopted the condition of the defences will deteriorate and eventually fail, resulting in the shoreline migrating landward to the 1907 MHWS. This is considered the worst case scenario and may lead to an overestimate of the monetary value of the losses. The loss of the asset value of this land is used to estimate the potential monetary losses under the No Active Intervention option (Table 9.24). No Active Intervention is not a feasible option for MU5, given the importance of protecting Cockenzie Power Station and the loss of land if this option was adopted. In addition, the environmental impact caused by erosion of the disused workings is also likely to be substantial.

**Retreat the Line** and **Advance the Line** are not feasible options for MU5. The former option would result in loss of the Power Station, which would have to be relocated, whilst the latter would require additional and more robust coastal defences to be constructed seaward of the existing line of defence and would affect natural coastal process of sediment transport.

**Hold the Line** is a feasible option for MU5 and would require maintenance and monitoring of Defences 15 and 16. The rock armour section (Defence No 14) is in poor condition and would have to be replaced in Year 5 of the Plan. The estimated costs of the Hold the Line option are presented in Table 9.24. With a benefit-cost ratio of 9.8, the Hold the Line option is economically viable. It is not anticipated that a Hold the Line policy will effect coastal processes in adjacent management units, as the entire shoreline of MU5 is already defended and the status quo is maintained. This option is also compatible with the general SMP objectives set out in Chapter 1.

**Table 9.24 Results of Cost-Benefit Analysis for MU5 (values are discounted to 2001 values)**

| Option                 | Losses    | Benefit   | Cost    | Ratio |
|------------------------|-----------|-----------|---------|-------|
| No Active Intervention | 3,202,842 | -         | -       |       |
| Hold The Line          | 0         | 3,202,842 | 325,516 | 9.8   |

The preferred option for MU5 is **Hold the Line**

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#### **9.3** PU 3: Cockenzie to Craighielaw Point

Process Unit 3 has been split into two management units (MU6 and MU7) described below. The coast of PU3 faces northwest and is composed of one large bay separated into the two smaller bays of Seton Sands (2.4 km long) and Gosford Bay (1.5 km long) by the rocky promontory of Ferny Ness. Seton Sands is low-lying, composed of a mainly sand upper foreshore with a shingle storm beach at its eastern end and rock platforms at both ends of the beach. Gosford Bay is low-lying, composed of a mainly sand lower foreshore and rocky upper foreshore with shingle. At its northern end, Gosford Bay terminates in the rock promontory of Craighielaw Point (GUARD, 1996).

The hinterland of both bays comprises raised beaches and marine deposits along with blown sand and dunes (GUARD, 1996). Seton Sands is reported to have been stable for 30 years (East Lothian Council, 2001d), although evidence from maps shows overall accretion from at least 1907 (Table 4.6). Accretion is also occurring between Bell's Rock and Port Seton Harbour, and Green Craig (Table 4.6). Erosion is occurring at Gosford Bay, where the coastal defences are being eroded, with an estimated recession rate of 3 - 5 m in last 100 years (GUARD, 1996) (Table 4.7). There is reclaimed land and a sea wall at Port Seton, revetment at Seton Sands and seawall at Gosford Bay (GUARD, 1996).

The dominant wave directions for this stretch of coast are likely to be locally generated from the west. Overall there is low or moderate westerly drift present (Ramsay and Brampton, 2000; Barne et al., 1997). However, a weak anti-clockwise gyre in the bay between Port Seton and Gosford is thought to drive easterly littoral transport in this area (Barne et al., 1997). Refer to Section 4.6 for further details of sediment transport processes.

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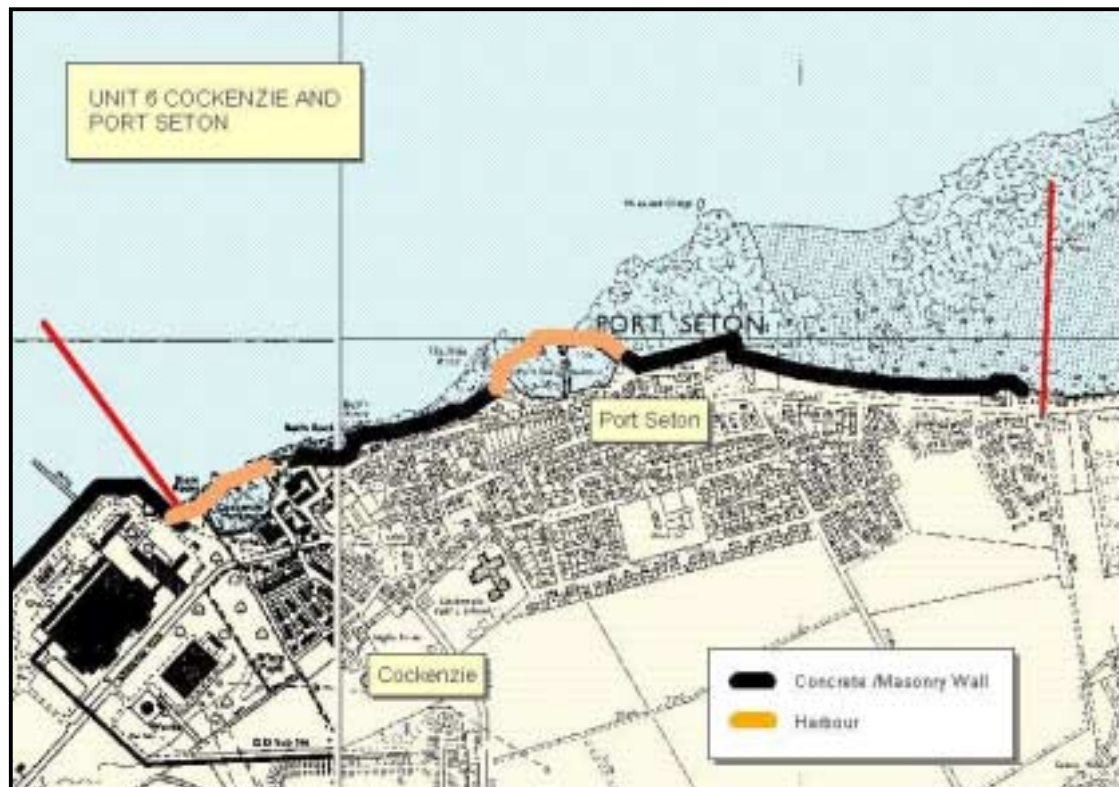
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## 9.3.1 Management Unit 6, Cockenzie and Port Seton

Management Unit 6 covers the residential area of Cockenzie and Port Seton, and extends approximately 2km from Cockenzie Power Station in the west (NT397756) to west of Seton Sands (NT415758). The foreshore is a rock platform for most of the management unit, although there is a short section of sandy beach at the eastern end. The hinterland consists of the built-up area of Cockenzie and Port Seton, built on raised beach and marine deposits (GUARD 1996).



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**Table MU6.1 Summary of Attributes of Management Unit 6**

| Coastal Processes           |                                                                                                |
|-----------------------------|------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Stable or accreting. Small area of landclaim east of Port Seton Harbour                        |
| Geomorphology               | Rocky foreshore, sand beach in east                                                            |
| Sediment Drift              | Low to moderate easterly drift                                                                 |
| Coastal Defences            |                                                                                                |
| Type                        | Man-made: Harbours, Masonry property walls, Concrete walls, Rock armour<br>Natural: Sand beach |
| Human and Built Environment |                                                                                                |
| Land use                    | Residential and commercial                                                                     |
| Sea use                     | Harbours, commercial fishing, yachting                                                         |
| Infrastructure              | Roads                                                                                          |
| Recreation and Tourism      | Yachting, boating, walking and cycling                                                         |
| Historic Environment        | 106 sites of cultural heritage identified, most within the Conservation area                   |
| Natural Environment         |                                                                                                |
| Habitat Types               | Rocky inter-tidal and sand beach                                                               |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site                                         |
| Key Interests               | Public concern related to water quality, pollution and litter issues                           |
| Valuation of Assets         | £141 M                                                                                         |

**Table MU6.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | √                   | X         | X             | NA       | X        |
| Limited Intervention   | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | √                   | X         | X             | NA       | X        |
| Hold The Line          | √                  | √           | √                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | √        |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

Some form of coastal defence or man-made structure extends along the entire shoreline of MU6 (Figure 9.2). These include the two harbours of Cockenzie (NT397756) and Port Seton (NT404759). The defences and structures within MU6 are described below and summarised in Appendix D.

#### **Defence No 17**

Cockenzie Harbour is constructed, at least in part, on an outcrop of bedrock, which becomes exposed in places, particularly in the southwest corner of the harbour. The harbour does not appear to be well used and contained only a few workboats and pleasure craft during the site visit.

The harbour walls are masonry and are generally in reasonable condition, but with occasional voiding. There is evidence of some repairs in the southeastern corner of the harbour. The outer wall of the harbour is vertical and is protected by a natural rock outcrop at the base. Some apparent fly tipping has occurred over the outer wall of the harbour.

Although the original portions of the harbour are of masonry construction, fairly severely weathered in places, the eastern limb of the harbour has a more recent concrete extension. The western limb needs attention, as jointing is exposed on the outer face, leaving masonry units vulnerable. There is some evidence of recent repairs. The eastern parapet wall has some additional buttressing of (now weathered) masonry to strengthen the old masonry wall and some pointing is required. The eastern quay is a rough earthen track and a concrete wall protects the head of the harbour at a level of approximately 5m OD.

#### **Defence No 18**

The shoreline from Cockenzie to Port Seton harbour is mainly bedrock, which protects property to the landward. The Royal British Legion Social Club is built on the rock outcrop and MHWS impinges on the building's outer wall. Some repairs are evident on the outer wall. To the east of the social club, a 20m stretch of rock armour has been placed above the rock outcrop to provide additional protection to an area of public gardens to the landward (NT399757). A low concrete walkway has been constructed along this stretch of the coast, seaward of the property walls. The path is at the back of the beach or rock outcrop and is generally backed by high masonry property walls of varying elevation (Plate 9.9). At NT400758 the walkway is fronted by a 20m stretch of plastic coated wire gabions at the back of the shingle beach.

The walkway is approximately 0.3m above beach level and further west it runs through the bedrock outcrop and has scattered rocks on either side of the path. Landward of the path, 5m high masonry walls protect property. The walls are in reasonable condition as they are well protected by the natural bedrock, although they are likely to be subject to some sea spray.

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Further west, at NT402758, the path is protected by sloping stone pitching, with stonework embedded in concrete sloping down to the small area of sandy beach (Plate 9.10). There is evidence of undercutting and erosion along this section of the coastal trail and it is recommended that this be attended to before the walkway sustains damage. Immediately to the west of Port Seton harbour, there is a short 10m section of rock armour, which has been randomly placed at the back of the sand beach.

#### **Defence No 19**

Port Seton Harbour is a reasonably active working harbour, with a number of fishing vessels in evidence. It has an outer breakwater on the west side separated from the inner harbour by an inner wall. The breakwater is at a relatively low elevation of approximately 4.5m OD and there is evidence of overtopping by waves. This is not an access quay and signs warn against pedestrian access. The breakwater protects the inner harbour from westerly waves. The harbour walls are masonry, although there is a concrete extension at the extremity of the breakwater.

The main harbour berths are in the lee of the inner wall. The head of the harbour is a revetment protected by a combination of setts on the upper part, rock armour in the middle portion and gabions in the lower reaches of the slope (Plate 9.11). A concrete wall provides protection to the road and domestic property to the landward of the harbour. The property is at a level of approximately 7m OD and thus is not at risk to flooding.

The outer harbour wall has a 3.5 high parapet wall, constructed with concrete. The concrete is of poor quality and has been prepared with old beach material (Plate 9.12). The outer wall is vertical and has a rocky base at the east side, which is exposed at low tide. The harbour is generally in a reasonable condition albeit the parapet wall is prone to erosion due to its poor quality matrix.

#### **Defence No 20**

A new seawall has been constructed on large concrete blocks (Plate 9.13) to protect the new housing development and car park to the east of Port Seton Harbour. This development has been constructed on reclaimed land at the site of the former swimming pool. The defence consists of large concrete blocks (approx. 1 x 1.6m) topped by a new concrete seawall. The crest of the defence is approximately 4m above the beach level. A steel parapet rail extends along the top of the seawall for the whole extent.

A shallow bedrock outcrop lies to the seaward of the defences, providing additional protection and dissipating wave energy. In general the defence is in good condition, although some attention may be required to the sub-structure in places. The geometry of this construction would suggest a likelihood of some over-topping and sea-spray during storms: drainage channels have been constructed in the wall to allow for this.

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#### Defence No 21

A wave wall with a notional recurve profile protects the promenade at Port Seton for a stretch of approximately 600m. The crest of the wall is ca. 4.8m OD and the parapet appears to have been constructed on top of an older seawall (Plate 9.14). A few cracks were noted in the parapet and the joint between the parapet wall and lower wall may need attention. The wall is constructed in concrete, with some fire clay intrusions and in places aggregate is exposed at the toe of the structure.

A 50m wide sandy, low gradient, beach fronts the seawall, which will dissipate some of the wave energy. However, there was evidence of erosion to the nosing of the parapet wall. There was notable accretion of sand on the west side of the beach, up against the wall. The crest of the wall is 2.3m higher than the beach level at the eastern side and 1.7m higher, due to sand accretion and higher beach levels, at the west. The property maintenance survey carried out by East Lothian Council indicated that maintenance works of £5000 are required to reface the stepped areas at the promenade, which have corroded (Appendix E).

#### Defence No 22

New housing has been constructed to the east of the Port Seton promenade. This area juts from the shoreline and is protected by a mix of high, masonry property walls of varying elevation. Rock armour of mixed geology and shape has been randomly placed seaward of the property walls to provide additional protection for a 30-40m stretch of shoreline (Plate 9.15). As the walls at the new housing appear relatively low, they may be prone to overtopping or spray under storm conditions, particularly as the protection along this section of shoreline is in poor condition.

### **Land Use**

The main land use within MU6 consists of the built-up area of Cockenzie & Port Seton, with 87.6ha classified as such (Table 9.25). The remaining land within MU6 is arable agriculture.

**Table 9.25: Land-use classification in MU6 (source: MLURI 1988)**

| Land-use class    | Domain                            | Area (ha) |
|-------------------|-----------------------------------|-----------|
| Factories & urban | Built-up (area)                   | 87.6      |
| Arable            | Arable: no rock no farms no trees | 69.7      |
| TOTAL             |                                   | 157.3     |

### **Residential Development, Industry, Ports and Harbours**

The residential area of Cockenzie and Port Seton is within MU6. Cockenzie and Port Seton were originally two separate fishing communities based around their own harbours, which became physically linked by the beginning of the 19<sup>th</sup> Century. The 1994 population of the community was 4319 (East Lothian Council 1998).

There is little industry within MU6. Cockenzie Power Station (MU5), the Whin Park Industrial Estate (MU5) and the marine related sector (fishing, fish processing and boat repairs) are the principal employers. The two harbours of Cockenzie and Port Seton lie within MU6. Port Seton remains an active working harbour with an inshore fishing fleet, Cockenzie is less well used and in need of environmental improvement (East Lothian Council 1998).

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### ***Recreation and Tourism***

The proximity of Cockenzie and Port Seton to the attractive beaches of Seton Sands and some of the areas golf courses make this an important tourist area (East Lothian Council 1998). The harbours are tourist attractions in their own right. Mooring facilities for yachts are available in both harbours, and a few pleasure crafts were observed during the site visit.

East Lothian Council and LEEL have been working to develop the recreational, leisure and economic potential of this part of the coast. This has included environmental improvements at Port Seton Harbour and footpath provision between it and Cockenzie Harbour. The council has also developed the site of the former swimming pool (NT408760) to provide a public space incorporating a footpath/cycleway, play areas, multi-use surfaces for games, seating, paving, new railings and car parking. East Lothian Council and LEEL have jointly funded environmental improvements at the Port Seton Promenade (East Lothian Council 1998). In addition, Cockenzie and Port Seton beach is recognised as of amenity value by East Lothian Council and is cleaned by the Council during the summer months (Ash 1994).

### ***Fishing Activity***

Port Seton Harbour is an active working harbour and supports an inshore fishing fleet. Related industries, such as fish processing and boat repairs, are important economic activities within the Port Seton area. The Cockenzie and Port Seton shoreline is also used for bait collecting for sea angling (JNCC 1997).

### ***Agriculture and Forestry***

The landward part of MU6 is an agricultural area. There is no forestry within MU6.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU6.

### ***Water Quality and Pollution***

The coastal water quality has been classed by SEPA (2000) as Class B (Good) in MU6. This has improved since its 1999 Class C (Unsatisfactory) grade, due to sewer improvements (SEPA 2001).

### ***Archaeology and Built Heritage***

There are 106 sites of cultural heritage in MU6 (Table 9.26). The majority of the listed building and other sites of architectural and archaeological heritage lie in the residential area within 200m of the present shoreline (Figure 9.4).

Both harbours are Listed structures and the harbour area and immediate surroundings form an area of historic and architectural importance. This has been recognised in its Conservation Area status, which means that some permitted development rights have been withdrawn in the area (East Lothian 1998). A large number of the listed buildings lie within the Cockenzie and Port Seton Conservation area. For example, all the property in Wemyss Place, Echo Place and Gosford Road are listed buildings. These terraces form the basis of the “planned” fishing village. Cockenzie High Street also retains much of the small-scale, compact character of a fishing village.



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**Table 9.26: Cultural Heritage Within MU6**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 2      | RCAHMS            |
| Archaeological Sites (land)   | 14     | RCAHMS            |
| Scheduled Ancient Monuments   | 0      | Historic Scotland |
| Listed Buildings*             | 77     | ELC               |
| Architecture Sites*           | 13     | RCAHMS            |
| TOTAL                         | 106    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

Sites of archaeological interest close to the shoreline include the wagon-way, saltpans and boatyard at Cockenzie Harbour (NT398757), the boundary dyke (NT400758), seawalls (NT401758), military defences (NT407759) and the old swimming pool at NT408759.

## **Natural Environment**

Most of the inter-tidal of MU6 is now designated within the Gosford Bay - Port Seton section of the Firth of Forth SSSI (Figure 7.1), with the exception of the two harbours. The shoreline between the harbours was given SSSI status in 2001. Gosford Bay – Port Seton SSSI is designated for its ornithological interest and extends over 317.7ha of inter-tidal area from Cockenzie Harbour (NT398757) in the west to Craigielaw (NT446796) in the east. The entire inter-tidal area of the adjacent management unit (MU7) lies within the SSSI, thus the key characteristics, conservation importance and management implications of Gosford Bay – Port Seton SSSI are discussed below in Section 0. The majority of the foreshore of MU6, with the exception of the two harbours, is also designated within the Firth of Forth SPA/Ramsar site, conferring specific legal protection to development and modification of the inter-tidal area.

**Table 9.27: Phase 1 Habitats within MU6 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat            | Area (ha) |
|--------------|----------------------------|-----------|
| A1.3.2       | Mixed woodland, plantation | 2.0       |
| B4           | Improved grassland         | 1.0       |
| H6.5         | Dune grassland             | 0.2       |
| J1.1         | Arable                     | 47.8      |
| J1.2         | Amenity grassland          | 5.9       |
| J3.6         | New Buildings              | 28.9      |
| Unclassified | Urban                      | 71.5      |
| Total        |                            | 157.3     |

Only 54% of land within MU6 was classified in the Phase 1 Habitat survey of East Lothian (Table 9.27), highlighting the large residential and developed area. Most of the coastal strip is unclassified, with the exception of the small area of amenity grassland landward of the Port Seton promenade and the area of dune grassland adjacent to the shoreline at the eastern limit of MU6.

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### ***Relevant policies and plans***

East Lothian Council has given the Cockenzie and Port Seton Harbour areas Conservation Area Status (East Lothian Council 1998). Local plan policy ENV 10 applies to the area, which seeks to ensure that new development is of an architectural style and is constructed with materials that are compatible with the traditional and attractive qualities of the area. This has implications for any proposed developments or coastal defence schemes proposed in the vicinity.

The proposed sustainable coastal footpath uses the existing footpath network along the shoreline between the harbours and along the Port Seton promenade (Halcrow Fox 1998). However, the report notes that the shoreline path may be unusable during high tides and heavy seas.

### ***Key interests***

No key interests were highlighted in MU6 during the written consultation process. The main public concerns in the Cockenzie – Port Seton area related to water quality, pollution and litter issues. The public also noted increased siltation in the harbour area as a concern. Concern was also raised regarding the increase of seaweed on Port Seton beach, which reduces the amenity value of the beach and also reducing fishing activity (SPI 2001a). The public saw the creation of the coastal footpath and the environmental improvements at the promenade as a positive aspect.

### ***Valuation of Assets***

The total value of assets within MU6 is estimated as approximately £141M (Table 9.28). 64% of the land within MU6 is classified as Urban, leading to the high value of the land. The urban area is adjacent to the shoreline for most of the extent of MU6, with the exception of the open grassed area landward of Port Seton promenade.

**Table 9.28 Valuation of Assets in MU6**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>   |
|---------------------------|---------------------------|--------------------|
| High Quality Agricultural | 30%                       | 239 720            |
| Open Area                 | 6%                        | 9 080              |
| Urban                     | 64%                       | 140 812 000        |
| <b>Total</b>              |                           | <b>141 060 800</b> |

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#### ***Option Evaluation***

MU6 has some form of hard coastal defence along its entire length, in order to protect the urban area from flooding and erosion (Appendix D). There are no estimated rates of erosion along this section of shoreline presumably as the coastal defence structures have been in place for some time. A small section of the shoreline in the vicinity of the former swimming pool has been reclaimed and landscaped, requiring additional protection. As no erosion rates are available the cost benefit analysis technique described in Chapter 8 cannot be applied. Given the available data it is impossible to estimate the monetary value of the damage costs due to flooding if the defences fail.

**Retreat the Line** is not feasible for MU6, due to the proximity of the urban area to the existing shoreline. Managed realignment would result in the loss of residential and commercial property and would not be economically viable. **Advance the Line** is not considered feasible or sustainable for MU6, as this would result in the need for additional coastal protection and would interrupt natural coastal processes.

The existing coastal defences in MU6 are in reasonable condition, although some will require repairs and maintenance to return them to a satisfactory condition. If the **No Active Intervention** or **Limited Intervention** option are adopted, the defences will gradually deteriorate and become undermined in the sensitive areas outlined above. The damage costs associated with the flooding and erosion of property and roads associated with the No Active Intervention option have not been quantified.

**Hold the Line** is the preferred strategic coastal defence option for MU6. The costs associated with this option relate to general maintenance and monitoring costs of existing defences and replacement costs of Defence No 22, at the eastern limit of MU6, are assumed to be required in year 15 of the Plan. As no new defences are recommended, it is anticipated that a Hold the Line policy will have negligible impact on the adjacent shorelines. The costs of Hold the Line are estimated as £104,000 over the Plan period, discounted to 2001 values.

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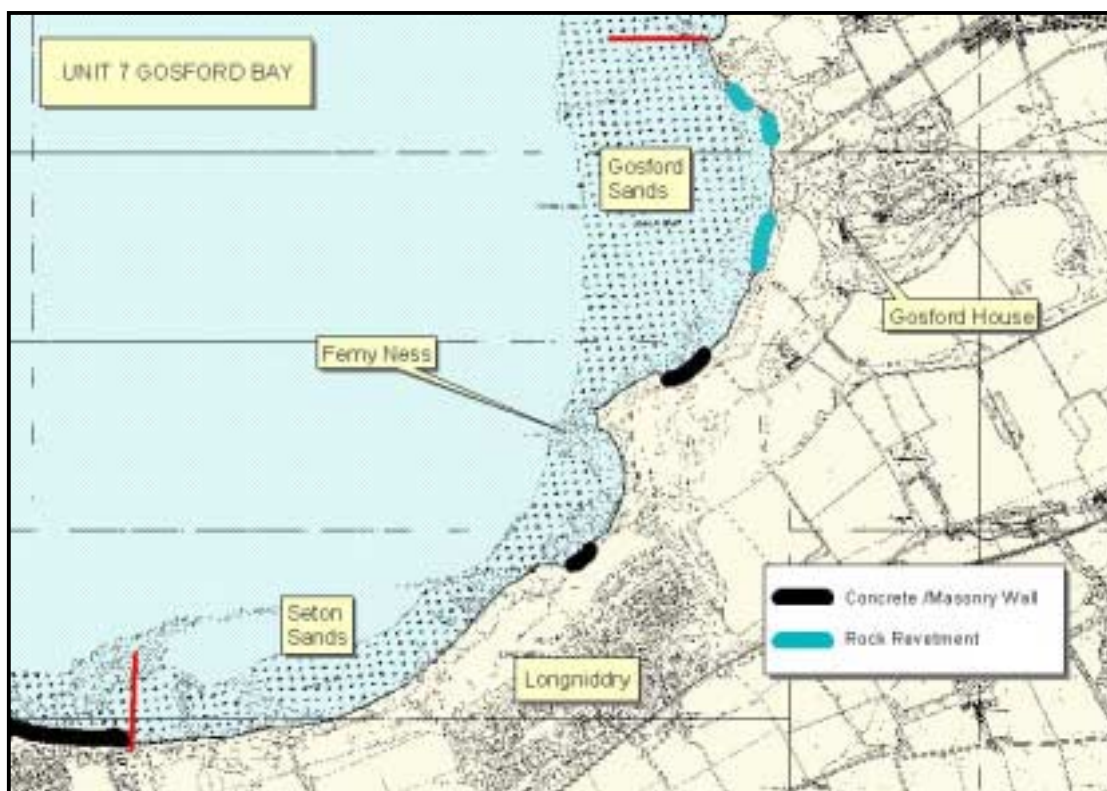
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### 9.3.2 Management Unit 7, Gosford Bay

Management Unit 7 extends along approximately 6km of shoreline from the eastern end of Port Seton (NT415758) to the rocky headland marking the eastern extent of Gosford Sands (NT446796). The entire inter-tidal area of MU7 is designated within the Gosford Bay – Port Seton section of the Firth of Forth SSSI. The coastline is natural for the majority of the management unit, with only 500m of the shoreline protected by human structures.



Seton Sands extends to the east of Port Seton. This is a sandy upper beach with a low rocky foreshore on the lower beach. The beach is backed by low marram vegetated dunes. This stretch of shoreline is generally unprotected and there is little evidence of erosion. Analysis of historic OS maps indicates that accretion of up to 0.9m/yr has occurred on this shoreline over the last 100 years (Table 4.6). In front of Seton Sands Caravan Park the dunes back on to a low wall at the B1348 coast road and there are some abandoned coastal defences (East Lothian Council, pers. comm. 2001)

GUARD (1996) defined the entire extent of MU7 as eroding or stable, and stated that there is clear evidence that the Gosford Sands coastal edge has eroded by 3 - 5m in the last century (Table 4.7 – Erosion). Gosford Bay has been identified as a sand sink (Figure 4.15), with easterly transport east of Cockenzie and westerly transport west of Craigielaw Point contributing sediment to the system.

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**Table MU7.1 Summary of Attributes of Management Unit 7**

| <b>Coastal Processes</b>           |                                                                                                                                                |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution                | Variable. Western part of Gosford Bay stable. Eastern part is erosional.                                                                       |
| Geomorphology                      | Rocky foreshore and sandy beach backed by vegetated dunes.                                                                                     |
| Sediment Drift                     | Sand sink. Easterly transport east of Cockenzie and westerly transport west of Craigielaw Point.                                               |
| <b>Coastal Defences</b>            |                                                                                                                                                |
| Type                               | Man-made: Masonry sea wall with gabions, Rock revetment (consisting of tank traps and tipped rubble)<br>Natural: Sand beach and rock platforms |
| <b>Human and Built Environment</b> |                                                                                                                                                |
| Land use                           | Agriculture and woodland. Residential area of Longniddry set back from shoreline.                                                              |
| Sea use                            | Windsurfing, sailing, fishing, commercial bait digging and shellfish collection                                                                |
| Infrastructure                     | B Road, pipe outfall                                                                                                                           |
| Recreation and Tourism             | Caravan Park, watersports, walking, cycling, golf and horse-riding                                                                             |
| Historic Environment               | 128 sites of cultural heritage identified. Important finds in Longniddry dunes.                                                                |
| <b>Natural Environment</b>         |                                                                                                                                                |
| Habitat Types                      | Rocky inter-tidal and sand beach                                                                                                               |
| Designated Sites                   | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Provisional SWT Wildlife Site                                                        |
| <b>Key Interests</b>               | Public concern related to water quality, pollution and litter issues                                                                           |
| <b>Valuation of Assets</b>         | £205 M                                                                                                                                         |

**Table MU7.2 Screening of Strategic Options with Management Objectives**

| Strategic Option          | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|---------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention    | √                  | √           | √                         | √                         | √           | X                     | X         | √                      | √                   | X         | X             | NA       | NA       |
| Limited Intervention      | √                  | √           | √                         | √                         | √           | X                     | X         | √                      | √                   | X         | X             | NA       | NA       |
| Selectively Hold The Line | √                  | √           | X                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Advance The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

There are 4 short sections of coastal defences in MU7, which are primarily in place to protect the coast road (Figure 9.2). In addition, there are abandoned coastal defences front Seton Sands Caravan Park.

The coast road is protected for 110m at NT439769 by a sloping defence (Defence No 23A), the crest of which is at road level. The wall is constructed with concreted masonry blocks and is at an angle of approximately 60° up to the crest at 5.5m OD. The beach level is higher at the eastern end of the defence, protecting the toe. At the western end, the toe is exposed and has failed in places (Plate 9.16). The western part of the defence is in poor condition and will require maintenance to the toe in the near future.

Another 220m length of masonry wall protects the coast road, east of the rocky headland of Ferny Ness (Defence No 23B). The eastern part of the wall has been recently repointed and is in better condition, with new gabion baskets at its eastern flank. The west and central part of the masonry wall is in poorer condition and shows some evidence of undercutting. The wall is 2.5 – 3m high and is fronted by a narrow shingle beach. MHWS impinges the base of the wall for most of its length.

Defence No 24 fronts the road embankment in the vicinity of Gosford House (NT448784). The defence consists of former tank traps, which have been placed at the back of the beach fronting the road. The defence has failed and wave attack has occurred landward of the protection, causing erosion of the road embankment and slumping (Plate 9.17). Extensive rabbit warrens, which have been burrowed through the dunes, are adding to the problem here. In places, the road is only 3-4m landward of the eroding face and slumping embankment. This stretch of defence requires immediate attention. The narrow beach immediately fronting this defence is steep and predominantly of shingle and its wide bay location exposes it to wave attack from both the east and west. However, low tide exposes a wide shallow foreshore that would be anticipated to do much toward attenuating incident wave action.

“Ad hoc” rubble tipping and various sections of masonry blocks (Defence No 25) have been used to protect the coastal path in the vicinity of Greencraigs Hotel. The defence is of varying age and appears to have been randomly placed at the erosional edge of the beach in an ad hoc manner. A line of tank-traps extend along this section of the beach and show evidence of coastal erosion, as the tank traps are now exposed on the foreshore and being eroded in situ. The tank traps do not form any coastal defence function and rubble has been placed landward of the line of tank traps to prevent further erosion. This defence is unsightly and is in poor condition, and is no longer maintained as a coastal defence.

### ***Land Use***

Almost half of the land in MU7 (305ha) is classified as Arable, Table 9.2. Mixed woodland and built-up areas cover approximately 137 ha and 120ha, respectively. The residential area of Longniddry is set back from the shoreline, with the golf course and the coast road lying seaward of the built-up area. Most of the coastal strip is classified as smooth grassland, Figure 9.3, with the exception of the built up area of Seton Sands Caravan Park.

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**Table 9.29: Land-use classification in MU7 (source: MLURI 1988)**

| Land-use class       | Domain                                   | Area (ha) |
|----------------------|------------------------------------------|-----------|
| Arable               | Arable: no rock no farms no trees        | 304.7     |
| Mixed woodland       | Undiff. mixed woodland (area)            | 136.7     |
| Factories & urban    | Built-up (area)                          | 119.3     |
| Recreational land    | Golf course                              | 47.7      |
| Smooth grassland     | Smooth grass/low scrub: no rock no trees | 22.8      |
| Improved grassland   | Imp. pasture: no rock no farms no trees  | 2.8       |
| Broadleaved woodland | Undiff. broadleaf (area)                 | 2.9       |
| Quarries             | Quarries (area)                          | 0.3       |
| TOTAL                |                                          | 637.2     |

## ***Residential Development, Industry, Ports and Harbours***

The residential area of Longniddry is within MU7, although the built up area is set back from the shoreline. There is very little industry in MU7, with a high proportion of the workforce of Longniddry commuting out of East Lothian for employment (East Lothian Council 1998). There are no ports or harbour within MU7.

## ***Recreation and Tourism***

Seton Sands and Gosford Sands and the surrounding rocky headlands are very important sites for recreation and tourism in East Lothian, attracting approximately 600,000 visitors a year (SNH 1998b). The area has been associated with the holiday industry for many years, with the Seton Sands complex (NT419758) providing holiday accommodation for visitors. Longniddry Golf course provides an additional recreation and tourist attraction to the area. Sailing and windsurfing are important leisure activities within MU7, with Ferny Ness being a very popular location for windsurfers (SPI 2001a).

The two sand beaches in MU7, Seton Sands and Gosford Sands, are recognised by East Lothian Council as of amenity value (Ash 1994). Seton Sands is included in the Council's summer beach-cleaning schedule.

## ***Fishing Activity***

Commercial bait digging and shellfish collection occurs in the inter-tidal area of MU7. This is a seasonal activity, but occurs on a relatively large scale. In addition, some non-commercial cockle and periwinkle collection also occurs (SNH 1998b). Some limited salmon netting may also be carried out within MU7.

## ***Agriculture and Forestry***

A large area of MU7 is farmed (Figure 9.3). The arable land is set back from the shoreline, and is surrounded by areas of mixed woodland. Gosford Estate contains a large area of mixed woodland (Figure 9.3), but there is no commercial forestry within MU7.

## ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU7, although Blindwells Opencast Mines lie just inland of the 1km strip of MU7.



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#### **Water Quality and Pollution**

Seton Sands / Longniddry is a Designated Bathing Beach, which means it has to comply with the EC Bathing Water Directive's standards for bathing water quality. All designated bathing beaches are monitored by SEPA to determine compliance with the Directive. Seton Sands achieved Mandatory compliance with the Directive for the 2000 and 2001 bathing seasons. Guideline compliance has never been achieved at Seton Sands. The coastal water quality along the Seton Sands shoreline has been classed by SEPA (2000) as Class C (Unsatisfactory). The remaining length of shoreline of MU7 is classed as Class B (Good).

#### **Archaeology and Built Heritage**

MU7 is rich in cultural heritage with 128 sites of cultural heritage identified (Table 9.30). Many of Listed structures in MU7 lie within the grounds of Gosford Estate, the house and gardens of which are designated as a "designed landscape". The majority of the remaining Listed Buildings are located within the residential area of Longniddry and are set back from the shoreline.

**Table 9.30: Cultural Heritage Within MU7**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 36     | RCAHMS            |
| Scheduled Ancient Monuments   | 3      | Historic Scotland |
| Listed Buildings*             | 70     | ELC               |
| Architecture Sites*           | 19     | RCAHMS            |
| TOTAL                         | 128    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

There are 36 unscheduled archaeological sites within MU7. A number of these sites lie close to the coastal edge (Figure 9.4), including a bronze ring (NT420760); anti-tank blocks (NT433763 and NT442778); a roman coin (NT440778); an excavation in the Longniddry dunes (NT442770) with finds of cinerary urns, beakers, cists and a long cist cemetery; cist barrows and long cists (NT440780); culvert (NT448780); building (NT449787); copper ring and bronze terret in the Gosford Bay inter-tidal (NT440790); and a wall (NT448792). The 19 unscheduled architecture sites are set back from the shoreline and are located mainly in residential areas.

There are 3 scheduled ancient monuments within MU7, although none lie within 500m of the shoreline (Figure 9.4). The scheduled monuments are Seton Collegiate Kirk (NT418751), Seton Mains, enclosure and ring ditch (NT428755) and Seton Mains, enclosure (NT424753).

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## ***Natural Environment***

Approximately 80% of the land within MU7 was classified during the Phase 1 Habitat survey of East Lothian (Table 9.31). Arable land made up the largest habitat class, with mixed woodland making up the second largest category.

**Table 9.31: Phase 1 Habitats within MU7 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 10.5      |
| A1.1.2       | Broad-leaved, plantation            | 28.5      |
| A1.2.2       | Coniferous plantation               | 3.2       |
| A1.3.1       | Mixed woodland, semi-natural        | 11.5      |
| A1.3.2       | Mixed woodland, plantation          | 92.9      |
| A2.1         | Dense scrub                         | 1.1       |
| B1.2         | Acid grassland, semi-improved       | 0.6       |
| B2.1         | Neutral grassland, unimproved       | 7.4       |
| B4           | Improved grassland                  | 35.6      |
| B5           | Marshy grassland                    | 0.3       |
| C1.1         | Continuous bracken                  | 0.7       |
| C3.1         | Tall ruderal                        | 2.9       |
| F2.2         | Inundation vegetation               | 0.1       |
| G1           | Standing water                      | 2.7       |
| H1.3         | Coastal-Inter-tidal                 | 0.5       |
| H6.5         | Dune grassland                      | 9.6       |
| H6.7         | Dune scrub                          | 7.8       |
| H6.8         | Open dune                           | 0.3       |
| H8.4         | Coastal Grassland                   | 0.2       |
| J1.1         | Arable                              | 217.1     |
| J1.2         | Amenity grassland                   | 44.0      |
| J3.4         | Caravan site                        | 18.1      |
| J3.6         | New Buildings                       | 1.9       |
| J4           | Bare ground                         | 0.1       |
| Unclassified | Urban                               | 139.6     |
| Total        |                                     | 637.2     |

The entire inter-tidal area of MU7 is designated within the Gosford Bay – Port Seton section of the Firth of Forth SSSI, which is designated for its ornithological interest and extends over 317.7ha from Port Seton Harbour (NT405760) in the west to Craigielaw (NT446796) in the east (Figure 7.1). The SSSI covers a 6.5km stretch of inter-tidal sand, mud and rocks varying from 200 – 1000m in width, and extends approximately 1km into MU6. MHWS and MLWS form the landward and seaward boundaries, respectively. The coastal edge immediately landward of the SSSI consists of narrow marram grass dunes, mixed buckthorn/hawthorn dune scrub and species rich dune grassland.

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Wintering wildfowl and waders are the primary interest of the site, which use the inter-tidal habitat for feeding and roosting. The site thus forms a crucial component of the populations that constitute the Firth of Forth SPA (SNH 1998b). The most important species are red-throated diver, great crested grebe, red-necked grebe, Slavonian grebe, cormorant, eider, long-tailed duck, common scoter, velvet scoter, goldeneye, red-breasted merganser, oystercatcher, golden plover, grey plover, bar-tailed godwit and turnstone.

The long-term objective for management of the SSSI and the Firth of Forth SPA/Ramsar site is to maintain the area in a suitable condition to allow for the continued feeding, resting and roosting of all the key bird species (SNH 1998b). There is a provisional SWT Wildlife Site at Longniddry Bents (Ferry Ness) (NT440777), although this has not been designated.

#### ***Relevant policies and plans***

Planning permission has been granted for the provision of a high quality, golf-based leisure and hotel development at Gosford Estate and Craighielaw, between Aberlady and Longniddry, in association with the restoration of the historic designed landscape around Gosford House (East Lothian Council 1998). The proposed area for development is set back from the shoreline, so will not have immediate coastal defence implications. However, the erosional nature of this part of the coastline should be taken into consideration when processing future planning applications at the coast.

The Council raised concerns about access from Seton Sands Caravan Park to the beach, which involves crossing the B1348 road (J. Squires, pers. comm. 2001). It was stipulated that that management recommendation made in the SMP should not make this situation worse.

The proposed sustainable coastal footpath uses paths through the beach and dunes in MU7, and then runs inland at North Wood (NT450790) towards Aberlady (Halcrow Fox 1998).

#### ***Key Interests***

No written replies were received relating to interests within MU7. The SMP public consultation indicated that the main public concern in MU7 related to litter and the requirement for the provision of more bins (Chapter 4). Water quality issues and pollution were also raised, with Seton Sands and Seton Mains identified as key problem areas. The public also raised concerns about erosion and an increase in the amount of seaweed on the beaches in MU7.

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### **Valuation of Assets**

The urban area of MU7 comprises 22% of the land area, but accounts for the largest proportion of the total asset value of MU7 (approximately £205M) (Table 9.32). The coast road falls within the urban classification and this is the only part of the urban area that lies close to the existing shoreline.

**Table 9.32 Valuation of Assets in MU7**

| Asset Type                | % Land in Category | Value (£)          |
|---------------------------|--------------------|--------------------|
| High Quality Agricultural | 40%                | 1 264 525          |
| Open Area                 | 38%                | 239 240            |
| Urban                     | 22%                | 204 017 800        |
| <b>Total</b>              |                    | <b>205 521 565</b> |

### **Option Evaluation**

Given the high nature conservation value of MU7, any coastal defence strategy should be compatible with the SSSI/SPA interests and should not involve modification or disruption to the inter-tidal area. Over 85% of the shoreline of MU7 is natural, with only 700m protected by man-made structures.

**Retreat the Line** is not considered for MU7, as it is not considered viable to move the existing coastal defences landward, as this would result in erosion and undermining of the coastal road. **Advance the Line** is also not considered a viable option for MU7, as this would necessitate modification of the inter-tidal area and provision of additional coastal defences to maintain an artificial shoreline position.

Several of the defences in MU7 are in very poor condition (e.g. Defence 24) and ongoing coastal erosion is threatening the stability of the coast road in the vicinity of Gosford House. The **No Active Intervention** and **Limited Intervention** options would result in further deterioration of the defence and erosion and subsidence of the coast road. GUARD (1996) suggest that erosion of up to 5m has occurred in the last 100 years in Gosford Bay, an average rate of 0.05m/yr (Table 4.7). However, discussions with East Lothian Council indicate that erosion has increased in this area in the last decade. For the purposes of the cost-benefit analysis it is assumed that if the No Active Intervention is followed, the entire road will be undermined within the next 50 years over a 300m stretch in front of Gosford House.

Defences 23A and 23B are in poor condition and toe failure has occurred in the western section of the defence (23A). If this defence is not repaired, the defences are likely to become undermined and fail, potentially causing subsidence problems on the coast road. For the cost-benefit analysis the damage costs of the No Active Intervention are estimated as the value of the land lost, assuming a 10m wide section of road is lost along the length of the failed defences. However, this is likely to be an underestimate of losses, as it does not take into account the cost of disruption to traffic, re-routing of a new road and the associated construction costs. Estimation of such costs is out with the scope of the present study.

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As the shoreline in MU7 is mainly natural, with the hinterland comprised of sand dunes overlaying raised beach deposits (Figure 4.15), it is likely to undergo short-lived phases of erosion, within a long-term trend of accretion along much of the management unit. Thus a **Hold the Line** strategic option should not be adopted for the entire management unit, as this will permit the natural operation of coastal processes. There is little evidence of a threat to the rich archaeological heritage in the Longniddry dunes, as the long-term trend is one of accretion (Figure 4.15).

**Table 9.33 Results of Cost-Benefit Analysis for MU7 (values are discounted to 2001 values)**

| Option                    | Losses  | Benefit | Cost    | Ratio |
|---------------------------|---------|---------|---------|-------|
| No Active Intervention    | 299,868 | -       | -       |       |
| Selectively Hold The Line | 0       | 299,868 | 616,298 | 0.49  |

**Selectively Hold the Line** is the preferred strategic coastal defence option for MU7. In order to prevent further erosion and eventual failure of the coast road in the vicinity of Gosford House, it is recommended that the existing defence be replaced with a more robust structure, such as an engineered rock revetment at the back of the beach. Stabilisation of this section of the coast will potentially have implications for the downdrift coast, as a source of sediment is effectively sterilised. The impact will be within the PU and may result in erosion elsewhere (e.g. Seton Sands). Further Strategy Studies will be required prior to any works being undertaken.

For the purposes of the cost-benefit analysis, it is assumed that construction of new defences is carried out in year 1 of the Plan extending along a 300m section of shoreline. In addition, the toe of Defence No 23A at Longniddry requires to be replaced to prevent undermining of the defence and possible subsidence of the road. It is recommended this be undertaken in year 3 of the Plan.

Defence No 23B is in better condition but will require maintenance and possibly additional toe protection in Year 25 of the Plan. Maintenance costs of these defences have also been taken into account in the cost-benefit analysis (Table 9.33). The benefit-cost ratio is low, although it is likely that the monetary value of the losses under the No Active Intervention option is an underestimate.

The defence at Greencraigs Hotel is unsightly and in very poor condition. It is recommended that these are not maintained as they appear to be having limited effect. Removal of the remaining scattered rubble along this stretch should be considered, allowing natural coastal processes to operate.

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#### **9.4** PU4: Craigielaw Point to Gullane Point

Consideration of the boundaries for this process unit was partially influenced by the observation by the IOE (1995) that sediment is likely to move south at Craigielaw Point and is unlikely to move north at Gullane Point.

This stretch of coast faces northwest. The coast forms the deeply incised, low-lying embayment of Aberlady Bay Local Nature Reserve and includes the tidal estuary of Peffer Burn. The unit contains a sandy beach, has extensive mudflats exposed at low tide, and is bordered by saltmarsh at the high water mark. The saltmarsh is backed by older blown sand dunes covered with marram grass, raised beach and marine deposits (GUARD, 1996). There is an offshore sand bank (East Lothian Council, 2001d).

Gullane Point is cliffed, over 5 m high, with a rock platform foreshore and a blown sand hinterland (GUARD, 1996). The shoreline has been stable/accreting over the last 30 years and represents the largest sand sink on the East Lothian coast (GUARD, 1996). A long sand spit south of Jophies Neuk, which has been accreting in a southwesterly direction from the dunes since 1960, is evidence of stability and accretion, with dune erosion occurring in localised positions only (GUARD, 1996). Accretion is occurring at Kilspindie, the southern shore of Peffer Burn and Yellow Mires (Table 4.6). This process unit forms a distinct management unit (MU8), described below.

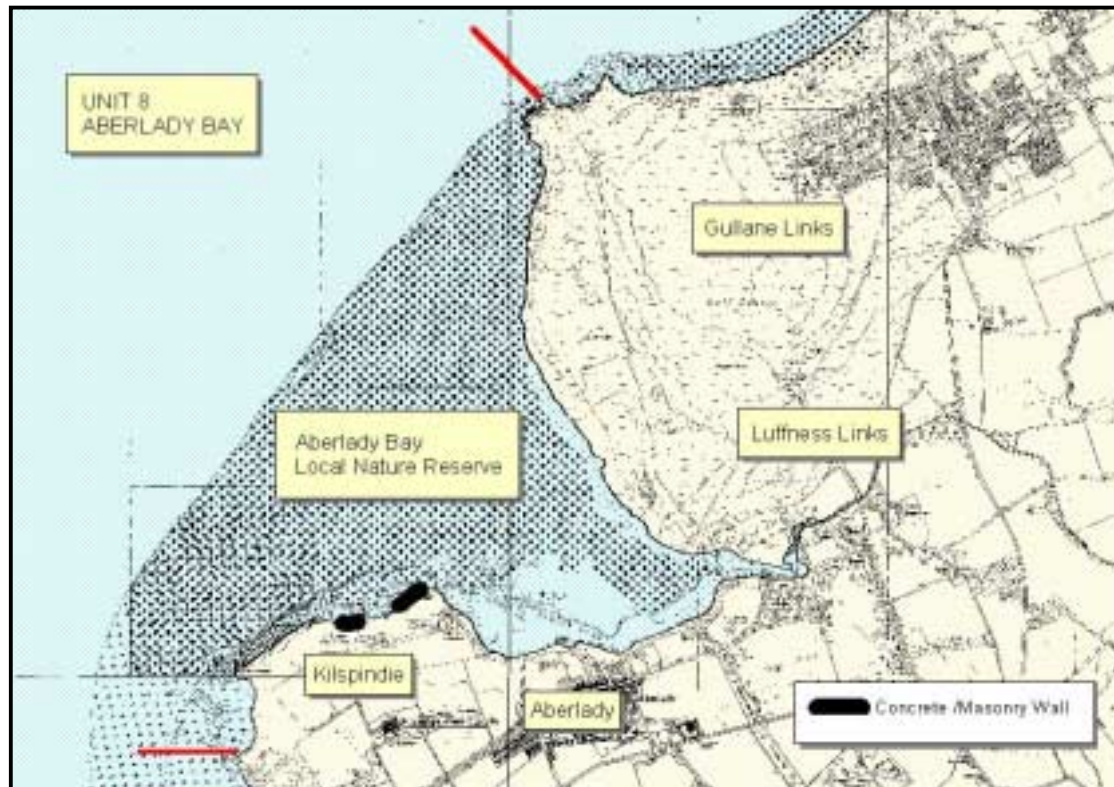
The dominant wave directions for this stretch of coast are likely to be locally generated from the west and southwest. Overall there is low or moderate westerly drift present (Barne et al., 1997), with Aberlady Bay acting as a sink for beach material (Ramsay and Brampton, 2000). Refer to Section 4.6 for further details of sediment transport processes.

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## 9.4.1 Management Unit 8, Aberlady Bay

Aberlady Bay is bounded by the rocky headlands of Craighielaw and Gullane Point. The boundary of the management unit/process unit also encloses Aberlady Bay LNR, and thus accounts for nature conservation /management interests as well as geomorphology. MU 8 extents for approximately 5km around Aberlady Bay.



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**Table MU8.1 Summary of Attributes of Management Unit 8**

| Coastal Processes           |                                                                                        |
|-----------------------------|----------------------------------------------------------------------------------------|
| Shoreline Evolution         | Generally stable or accreting. Localised dune erosion in places.                       |
| Geomorphology               | Sandy beach, mudflats, saltmarsh, vegetated sand dunes, raised beach deposits, estuary |
| Sediment Drift              | Sand sink. Low or moderate westerly drift                                              |
| Coastal Defences            |                                                                                        |
| Type                        | Man-made: Concrete, masonry wall<br>Natural: Beaches, saltmarshes, mudflats            |
| Human and Built Environment |                                                                                        |
| Land use                    | Local Nature Reserve, Recreation, Golf Courses                                         |
| Sea use                     | Bait digging, fishing and shellfish gathering, wildfowling in inter-tidal              |
| Infrastructure              | -                                                                                      |
| Recreation and Tourism      | Watersports, walking, cycling, golf, bird-watching                                     |
| Historic Environment        | 169 sites of cultural heritage identified. 10 shipwrecks in nearshore area.            |
| Natural Environment         |                                                                                        |
| Habitat Types               | Saltmarsh, mudflat, dune, coastal grassland                                            |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Local Nature Reserve         |
| <b>Key Interests</b>        | Golf Courses concerned about Right of Way issues and erosion.                          |
| <b>Valuation of Assets</b>  | £87 M                                                                                  |

**Table MU8.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention   | √                  | √           | √                         | X                         | √           | √                     | √         | √                      | √                   | X         | √             | NA       | NA       |
| Hold The Line          | √                  | X           | X                         | X                         | √           | √                     | √         | √                      | X                   | X         | √             | NA       | NA       |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:  
 √ Shading indicates the Preferred Option  
 Option meets objective  
 X Option does not meet objective  
 • Option meets objective over part of the unit  
 NA Not applicable  
 - Not considered if option is not technically viable



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## **Coastal Defences**

MU8 consists of beach, sand dunes and salt marshes, which perform a natural coastal defence function. The only hard defences in MU8 are those at Kilspindie Golf Course (Defence No 26), which consists of two separate sections. A short 100m section of approximately 3m high concrete seawall, with a recurved cope, fronts the historic renovated building at NT452803. This section is in relatively good condition and requires little attention. Immediately east of the seawall there is an unprotected section of coast for approximately 200m.

The hinterland geology is part of the Lower Limestone Formation, covered in deposits of blown sand, and is showing evidence of active erosion. Further east, the eroding coast has been protected by a section of sloping masonry blocks for approximately 100m. This defence is in very poor condition and has failed in places, with extensive undercutting and toe failure. The defence has a residual life of <5 years. Immediately east of the sloping masonry, the defence merges with an old concrete and masonry seawall that has been undercut at the toe in places and is in poor condition.

## **Land Use**

Over 45% of land within MU8 is classed as arable by MLURI 1988 (Table 9.34). Golf courses comprise 25% of land, with the 4 golf courses of Kilspindie, Luffness Links, Gullane Golf Course and Craighelaw within the management unit. The village of Aberlady is the only built-up area within MU8 and comprises 27.5ha of land. Other land-uses include smooth grasslands, dunelands, maritime grasslands, coniferous plantations, improved grasslands and mixed woodlands (Table 9.34). The coastal edge is mainly classified as dunes or grasslands, with the exception of Kilspindie Golf Course, which makes up the coastal edge from Kilspindie (NT456805) to the western limit of the management unit (Figure 9.3).

The inter-tidal area and the approximately 500m wide coastal strip of dune and grassland form the Aberlady Local Nature Reserve, which is managed by East Lothian Council.

**Table 9.34: Land-use classification in MU8 (source: MLURI 1988)**

| Land-use class               | Domain                                  | Area (ha) |
|------------------------------|-----------------------------------------|-----------|
| Arable                       | Arable: no rock no farms no trees       | 293.6     |
| Arable                       | Arable: no rock no farms trees          | 38.6      |
| Recreational land            | Golf course                             | 184.2     |
| Smooth grassland             | Smooth grass/low scrub: no rock trees   | 26.7      |
| Smooth grassland             | Undiff. smooth grass.: no rock no trees | 34.8      |
| Duneland                     | Dune lands: unstabilized dunes          | 11.6      |
| Maritime grasslands & heaths | Maritime grassland: no trees            | 14.0      |
| Coniferous plantation        | Coniferous (plantation - area)          | 10.6      |
| Improved grassland           | Imp. pasture: no rock no farms trees    | 15.9      |
| Improved grassland           | Imp. pasture: no rock no farms no trees | 7.7       |
| Mixed woodland               | Undiff. mixed woodland (area)           | 48.0      |
| Factories & urban            | Built-up (area)                         | 27.5      |
| TOTAL                        |                                         | 713.2     |

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### ***Residential Development, Industry, Ports and Harbours***

The residential area of Aberlady lies within MU8. Aberlady is an historic and attractive village, located on the coast close to a number of golf courses and the local nature reserve, making it a popular visitor attraction. The 1994 population of Aberlady was 851 (East Lothian Council 1998). There is very little industry or business in MU8 and there are no ports or harbours.

### ***Recreation and Tourism***

Recreation and tourism are very important in MU8 with Aberlady Bay Local Nature Reserve attracting many visitors. Informal, passive recreation giving visitors the opportunity to appreciate the natural heritage of the Reserve is encouraged by East Lothian Council. The three golf courses within MU8, set in landscapes of outstanding natural beauty, also contribute to the tourist potential and attract visitors to the area.

Wildfowling occurs within the inter-tidal area of MU8 (which is within the SSSI and LNR boundary) although this is strictly limited. A rotating permit system is in operation and the Reserve Warden carries out random checks of wildfowling permits. A maximum of 30 permits are given each year and the wildfowling season is restricted to 1<sup>st</sup> September to the 20<sup>th</sup> February.

### ***Fishing Activity***

All bait digging, fishing and shellfish gathering, both for sport and commercial reasons, are prohibited within the boundaries of the Local Nature Reserve (which includes the entire inter-tidal area of MU8).

### ***Agriculture and Forestry***

In MU8, approximately 332ha of land around Aberlady and Craigielaw is farmed for arable agriculture (Figure 9.3). There are a few small pockets of coniferous plantation, around Luffness, covering approximately 10ha of land.

### ***Quarrying and Landfill***

There are no major coastal quarries or landfill sites within MU8. A small (0.1ha) area of Luffness Links was classified by the Phase 1 Habitat survey as a quarry Table 9.39).

### ***Water Quality and Pollution***

The coastal water quality in Aberlady Bay south of Yellow Mires (NT461818) has been classed by SEPA (2000) as Class B (Good). North of this point, towards Gullane Point, the water quality improves and is classed as Class A (Excellent). A sewage treatment works is located within MU8, with a sea outfall located just to the east of the sand spit (SNH 1998c).

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### **Archaeology and Built Heritage**

There are 169 sites of cultural and built heritage within MU8, 10 of which are maritime (Table 9.35). The majority of the maritime archaeological sites are located in the inter-tidal area (Figure 9.4) and include a submarine (NT452814), a craft (NT457804) and sub-marine anti-tank blocks (NT448816 and NT447818).

42 unscheduled archaeological sites are recorded within MU8, several of which lie close to the coastal edge (Figure 9.4), including cists (NT452802), a fort (NT449802), cave (450803), a building (NT452803), anti-tank blocks and pillboxes (several locations along the coast), mooring stage (NT453804), seawall at Kilspindie (NT457804), Roman brooches (NT460800), a stone axe and bronze dagger at Gullane Point (NT461830).

There are 5 scheduled ancient monuments within MU8 (Figure 9.4). These are Kilspindie Castle (NT461799), the fort at Kilspindie Golf Course (NT449802), Aberlady market cross (NT464799), Luffness Convent (NT471801) and Craighelaw Enclosures (NT455796). The castle and, in particular, the fort are located very close to the shoreline. The majority of the 77 Listed buildings within MU8 are located in the historic settlement of Aberlady, and are thus set back from the coast (Figure 9.4).

**Table 9.35: Cultural Heritage Within MU8**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 10     | RCAHMS            |
| Archaeological Sites (land)   | 42     | RCAHMS            |
| Scheduled Ancient Monuments   | 5      | Historic Scotland |
| Listed Buildings*             | 77     | ELC               |
| Architecture Sites*           | 35     | RCAHMS            |
| TOTAL                         | 169    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### **Natural Environment**

The conservation importance of the natural environment in MU8 is recognised by its designation as a Local Nature Reserve (LNR). The area is also designated within the Aberlady Bay section of the Firth of Forth SSSI for its botanical, ornithological and geological importance (Table 9.36) and is a Nature Conservation Review Grade 1 site. Due to its outstanding ornithological interest, the inter-tidal area of Aberlady Bay SSSI has been designated within the Firth of Forth SPA under the EC Birds Directive and is a designated Ramsar site under the Ramsar Convention on Wetlands of International Importance as a waterfowl habitat (SNH 1998c).

Aberlady Bay SSSI covers 866ha and includes the entire inter-tidal area of MU8 and extends inland to include the dunes and links of Gullane and Luffness Links (Figure 7.1). This inland area is not designated as SPA/Ramsar (Figure 7.2). Aberlady Bay LNR covers the same area as the SSSI, with the exception of the golf courses.

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**Table 9.36 Aberlady Bay section of the Firth of Forth SSSI Summary Description/Evaluation**

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Botanical      | Aberlady Bay SSSI contains the most extensive complex of sand dune, saltmarsh and mudflat in South-east Scotland with a particularly wide range of associated habitats such as grassland and freshwater marsh. Some of these habitats are the largest and most representative of their type in East Lothian. The site supports an unusually large number of higher plants with many Scottish and local rarities, such as frog orchids. There are also several rare mosses, liverworts and fungi including a near-threatened red data book lichen. |
| Ornithological | The ornithological interest of the SSSI is mainly comprised of roosting and feeding wildfowl and waders and is of national importance for Pinkfooted geese, Knot and Bar tailed godwit. It has also been an important breeding site for Terns, which have not bred in recent years (SNH 1998c), and for breeding Eider and Shelduck.                                                                                                                                                                                                              |
| Geological     | There is a sequence of fossil-rich Carboniferous Limestone at Kilspindie, a low level raised beach and a number of large erratic boulders in the inter-tidal. At Gullane Point and Hummel Rocks there are Carboniferous Teschenite sills, showing a number of rare features of petralogical interest.                                                                                                                                                                                                                                             |

The above designations confer special protection and legislative rights to the area and detailed management plans have been prepared for the LNR (East Lothian Council 1977, 1997) and SSSI (SNH 1998c).

**Table 9.37 Management objectives for Aberlady Bay section of the Firth of Forth SSSI (source SNH 1998c)**

| Objective | Detail                                                                                                                                                                    |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | To maintain the natural heritage interest of the SSSI keeping it in a favourable condition to allow the continued feeding and roosting of all key bird species            |
| 2         | The saltmarsh, grassland, dune and inter-tidal habitats with their associated botanical interest are all to be maintained.                                                |
| 3         | To protect the geological features of the site.                                                                                                                           |
| 4         | Exotic plant species should be monitored and controlled where damage to natural heritage interests is identified.                                                         |
| 5         | Changes which occur within the dune system should not be prevented, but aerial monitoring should be carried out to keep track of the extent of dune erosion and accretion |
| 6         | The use of the site by universities for individual and group research should be encouraged and maintained                                                                 |

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SNH (1998c) outline the long-term objectives for management of the Aberlady Bay section of the Firth of Forth SSSI, which are summarised in Table 9.37. One of the key factors of importance in relation to the SMP is that the coastal dunes of Aberlady Bay are undergoing natural processes of erosion and accretion, with a current net gain of sand to the system (SNH 1998c). As the habitats provided by this dune system are not static, management must make allowance for the occurrence of natural change (SNH 1998c). Thus, managing change and allowing the natural coastal processes to operate unimpeded may be an important management strategy within Aberlady Bay. Monitoring of natural processes and coastal changes should continue. The management objectives set out below will be taken into consideration when developing the preferred strategic management option for MU8.

East Lothian Council manage the LNR and employ a Reserve Warden and host an advisory management committee, comprised of interested parties, to steer the overall management objectives for the Reserve. The 1977 Management Plan for Aberlady Bay LNR has been superseded by the 1997-2001 Plan, which outlines the current management objectives (Table 9.38) and gives a detailed prescription for management. In addition to nature conservation and the maintenance of existing features of interest, there is also a provision for visitor management and use of the Reserve for education and research purposes.

**Table 9.38 Management objectives for Aberlady Bay LNR (source East Lothian Council 1997)**

| Objective | Detail                                                                                                                                                                         |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | To maintain and enhance the role of the Bay as a feeding and roosting area for wildfowl and waders                                                                             |
| 2         | To maintain and enhance the role of the reserve as a suitable breeding area for birds deemed to be special in relation to agreed criteria                                      |
| 3         | To conserve the naturally developing dune system                                                                                                                               |
| 4         | To conserve plants communities which are deemed to be special                                                                                                                  |
| 5         | To ensure that the geological exposures within the Reserve are conserved in the interest of geology and education                                                              |
| 6         | To retain the sense of space                                                                                                                                                   |
| 7         | To maintain and enhance the status of the tern colony                                                                                                                          |
| 8         | To maintain the Marl Loch as an area of open water and open water transition mire suitable for the continued presence of the plant and animals communities associated with it. |
| 9         | To keep education and recreational use of the Reserve at such a level and in such areas that the Aim and the other management objectives are not prejudiced.                   |

The Phase 1 Habitat Survey of East Lothian covers part of the inter-tidal area of MU8 (Table 9.39). Arable land makes up the largest habitat classified in MU8 at 260ha, although this is largely located inland around Aberlady and Craigielaw. The habitats of saltmarsh, 69ha, open dune, 27ha, inter-tidal mud/sand (12ha) and dune grassland (189ha) form most of the coastal edge of MU8.

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**Table 9.39: Phase 1 Habitats within MU8 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 0.3       |
| A1.1.2       | Broad-leaved, plantation            | 14.3      |
| A1.2.2       | Coniferous plantation               | 1.0       |
| A1.3.2       | Mixed woodland, plantation          | 45.6      |
| A2.1         | Dense scrub                         | 4.5       |
| B2.1         | Neutral grassland, unimproved       | 31.8      |
| B2.2         | Neutral grassland, semi-improved    | 14.8      |
| B4           | Improved grassland                  | 53.7      |
| C3.1         | Tall ruderal                        | 0.2       |
| G1           | Standing water                      | 3.4       |
| H1.1         | Coastal- inter-tidal mud/sand       | 12.3      |
| H2.6         | Saltmarsh – continuous              | 69.0      |
| H6.4         | Dune slack                          | 1.4       |
| H6.5         | Dune grassland                      | 189.4     |
| H6.7         | Dune scrub                          | 3.9       |
| H6.8         | Open dune                           | 27.4      |
| H8.1         | Maritime hard cliff                 | 0.5       |
| H8.4         | Coastal Grassland                   | 0.8       |
| I2.1         | Quarry                              | 0.1       |
| J1.1         | Arable                              | 260.2     |
| J1.2         | Amenity grassland                   | 5.0       |
| J3.6         | New Buildings                       | 13.7      |
| J4           | Bare ground                         | 1.5       |
| J5           | Other habitat                       | 1.9       |
| Unclassified | Urban / Roads                       | 60.7      |
| Total        |                                     | 817.4     |

### ***Relevant policies and plans***

The main policies and plans relevant to MU8 relate to the natural heritage importance of the area and are discussed above. There is a planning application to create a golf course and clubhouse at Craighielaw (NT454796). The present land use of the proposed area is agricultural and as the land is approximately 400m inland from the coast, the change of use will have little impact on the recommendations of the SMP.

The preferred route of the sustainable coastal path runs inland along MU8 through the village of Aberlady (Halcrow Fox 1998).

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### **Key interests**

There are three golf courses within MU8, all of which were consulted during the early stages of development of the SMP. Luffness Golf Course responded in writing and outlined that their main priority was to avoid any encroachment of the sea onto the golf course.

Wemyss and March Estates own and manage the land at Kilspindie Golf Course. The only concern raised by the Secretary of Kilspindie Golf Course related to Rights of Way issues. The Secretary of Gullane Golf Course noted that they do not have any erosion problems and again their main concern is related to Rights of Way issues and the potential implications of the new "Rights to Roam" legislation.

Only a few public concerns were raised relating to Aberlady Bay (Appendix B) and these mainly related to concerns about water quality/pollution, although a concern about erosion at Kilspindie was raised (SPI 2001a).

### **Valuation of Assets**

For the purposes of economic valuation of assets within MU8, a large part of the land is valued as High Quality Agricultural land, given its natural heritage designations as SSSI. The assets within the management unit have an estimated value of £87M (Table 9.40).

**Table 9.40 Valuation of Assets in MU8**

| Asset Type                | % Land in Category | Value (£)         |
|---------------------------|--------------------|-------------------|
| High Quality Agricultural | 75%                | 2 650 440         |
| Open Area                 | 17%                | 123 231           |
| Urban                     | 8%                 | 84 296 800        |
| <b>Total</b>              |                    | <b>87 070 471</b> |

### **Option Evaluation**

The OS map analysis indicated that much of the shoreline of Aberlady Bay has undergone accretion between 1907 and 1999 (Table 4.6, Appendix C, View 7). Average rates of 1.1m/yr of dune accretion at Yellow Mires have been recorded. However, the long-term net gain of sediment may be punctuated by short-lived phases of dune erosion. As the habitats provided by this dune system are not static, management must make allowance for the occurrence of natural change (SNH 1998c).

During the site visit, erosion was observed on the rocky headland at Aberlady Point to Craighielaw Point. However, map evidence does not substantiate a long-term trend in erosion, as there has been negligible change in the position of MHWS between 1907 and 1999 (Appendix C, View 6 and 7). Here the coast comprises low rock cliffs, composed of Carboniferous Limestone, and overlain with raised beach deposits and blown sand. As there are no erosion rates for this stretch of the coast the amount of land lost under the **No Active Intervention** option is likely to be negligible and the value of this loss has not been estimated for the purposes of the cost benefit analysis.

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A policy of **Hold the Line** would effectively sterilise the natural, dynamic coastal system of Aberlady Bay and thus would have a detrimental effect on the conservation and natural heritage interests of the site. The saltmarsh, beach and dune system should be left to operate naturally and short-lived phases of dune erosion should be allowed to continue. However, a policy of **Selectively Hold the Line** may be applicable, where the defences at Kilspindie are maintained (Defence No 26). Complete replacement of the sloping masonry and old seawall would be required in Year 5 of the Plan, together with continual maintenance of the remaining defence. For the purposes of the cost-benefit analysis, we have assumed a rock revetment would be constructed to replace the existing defence. Over the 50 years of the Plan period it is estimated that this option would cost £180,000 (NPV). The benefits are negligible (as rates of natural land loss are low) and thus this option is not economically feasible. In addition, Aberlady Bay SSSI has been designated for its geological interests at Kilspindie, thus any major coastal defence works may detract from the geological interest and exposures.

**Advance the Line** is naturally occurring along parts of the shoreline of Aberlady Bay, due to natural process of accretion (e.g. at Yellow Mires). However, there should be no attempt to stabilise this by constructing coastal defences. There are no locations within MU8 where **Retreat the Line** is a feasible option.

**No Active Intervention** is the preferred option for MU8. Erosion is not causing a significant threat to assets anywhere in the management unit. This strategy of management is consistent with that advocated by SNH (1998c) and East Lothian Council (1997), who state that natural changes in the dune system should be allowed to continue.

As the long-term trend in the dunes at Aberlady is one of accretion, the No Active Intervention approach is unlikely to create significant problems in the long-term and will have no impact on adjacent shorelines. However, adoption of this option should be consonant with a policy of monitoring the natural changes by either repeat fixed photography, aerial photography or beach surveys. The first two monitoring strategies are preferred, as these will be less disruptive to sensitive dune habitats.

However, adoption of the No Active Intervention option would result in the eventual deterioration of the coastal defences at Kilspindie Golf Course. The defences here (Defence No 26) are already in poor condition and have an estimated residual life of 5 years (Appendix D). However, the potential loss of land is likely to be negligible given the low rates of erosion recorded on this stretch of coast.



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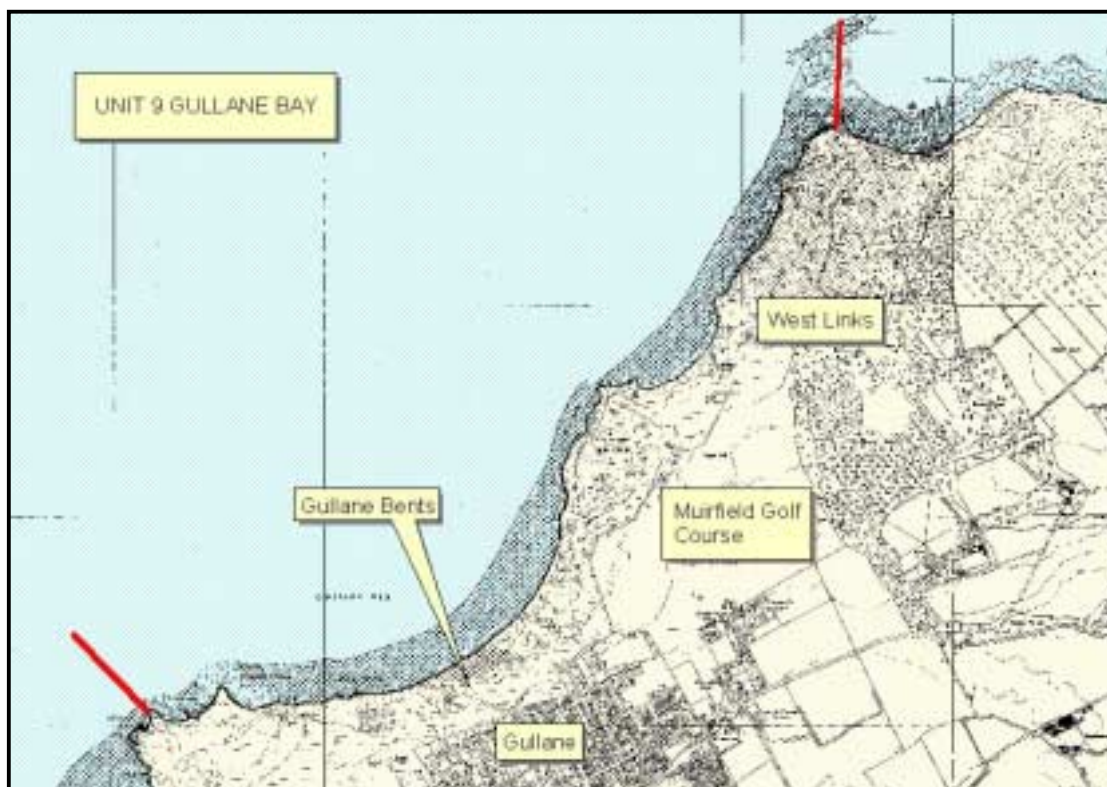
## 9.5 PU5: Gullane Point to Eyebroughy

This stretch of coast faces northwest from Gullane Point to the headland opposite the island of Eyebroughy, a distance of approximately 5km. The coast is composed of two slight embayments at Gullane Bay and West Links, separated by the Black Rocks promontory. Gullane Bay is low-lying with a sandy foreshore backed by an extensive dune system and blown sand hinterland (see Section 4.5.4). At West Links, there is a rock platform and cliffs over 5 m in height at Black Rocks. The foreshore is composed of sand, with a low-lying blown sand and dune hinterland (GUARD, 1996).

The active dunes of Gullane Bay, Gullane Bents, are presently stable but have a long history of erosion superimposed on a seasonal cycle of erosion and deposition (Table 4.7). Anthropogenic influences include World War II military exercises at Gullane (Cawkwell, 1997). Storms are documented as causing seasonal beach changes at Gullane (Coulson, 1995). The dominant wave directions for this stretch of coast are likely to be from the west, southwest and northeast. Sediment transport is believed to be from east to west for this section of coast (Barne et al., 1997). Refer to Section 4.6 for further details of sediment transport processes.

### 9.5.1 Management Unit 9, Gullane Bay

Management Unit 9 comprises the entire coastline of process unit 5, described above.



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**Table MU9.1 Summary of Attributes of Management Unit 9**

| Coastal Processes           |                                                                                                                                          |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Long history of erosion, superimposed on a seasonal cycle of erosion and deposition                                                      |
| Geomorphology               | Sand beach, backed by an extensive dune system. Rock outcrops.                                                                           |
| Sediment Drift              | Low or moderate westerly drift                                                                                                           |
| Coastal Defences            |                                                                                                                                          |
| Type                        | Man-made: None, although the dunes have been heavily modified and stabilised in the 1960s and 1970s.<br>Natural: Sand beach              |
| Human and Built Environment |                                                                                                                                          |
| Land use                    | Recreation, Golf Courses, Residential area of Gullane set-back from the shore                                                            |
| Sea use                     | Windsurfing, sailing                                                                                                                     |
| Infrastructure              | Gas pipeline laid through dunes                                                                                                          |
| Recreation and Tourism      | Watersports, walking, cycling, golf, bird-watching, horse-riding, orienteering                                                           |
| Historic Environment        | 97 sites of cultural heritage identified. Sand dunes of Gullane Links, Gullane Bents and West Links are rich in archaeological heritage. |
| Natural Environment         |                                                                                                                                          |
| Habitat Types               | Sand beach, dunes, coastal grassland                                                                                                     |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site                                                                                   |
| Key Interests               | Golf Courses concerned about Right of Way issues. Dune erosion a public concern                                                          |
| Valuation of Assets         | £101 M                                                                                                                                   |

**Table MU9.2 Screening of Strategic Options with Management Objectives**

| Strategic Option               | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|--------------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention         | √                  | √           | √                         | √                         | X           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention           | √                  | √           | √                         | √                         | X           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line (or Selectively) | √                  | X           | X                         | X                         | √           | √                     | √         | X                      | X                   | X         | √             | NA       | NA       |
| Advance The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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#### **Coastal Defences**

There are no hard coastal defences in MU9. However, the dune system at Gullane has been heavily modified (Table 4.5 and Section 4.5.4). Military operations in the 1940's caused major destabilisation and erosion of the dune system. Blowing sand became a major problem and a dune stabilisation and visitor management programme was carried out in the 1960's and 1970's. This comprised of a combination of dune fencing, to assist in the construction of the foredune, which was bulldozed up and re-profiled, and the planting of stabilising vegetation, predominately Sea Buckthorn.

Today, the backdunes have been stabilised and the landward side of the foredunes is fixed by dune fencing. Re-profiling of the foredune was carried out approximately 10 years ago, marram grass was re-planted on the foredune and gaps were filled in with sea lyme grass (N. Clark, pers. comm. 2002). A wooden fence was constructed along the foredune to encourage stabilisation and signs were put up prohibiting visitors climbing on the sensitive foredune. Prior to the re-shaping, the dune had a steep eroded edge at its seaward edge. There was evidence of erosion of the foredune during the site visit on 28/01/02.

In order to manage the spread of Sea Buckthorn at Gullane Bents, East Lothian Council manage the vegetation by removing it periodically. This is estimated to cost approximately £7000 per year (N. Clark, pers. comm., 2002). The aim of sea buckthorn management is to define the correct level in natural dune habitats and manage the spread of the species.

#### **Land Use**

Golf courses form the largest category of land use within MU9 (Table 9.41). Gullane Golf Course and Muirfield Golf Course both lie within MU9. The residential area of Gullane lies within MU9, although the built-up area is separated from the sea by the dunes and grasses of Gullane Bents (Figure 9.3). There is no arable land within MU9 and the remaining land is classified as grasslands (74ha), woodlands/plantations (60ha) and unstabilised dunes (68ha).

**Table 9.41: Land-use classification in MU9 (source: MLURI 1988)**

| Land-use class        | Domain                                  | Area (ha) |
|-----------------------|-----------------------------------------|-----------|
| Improved grassland    | Imp. pasture: no rock no farms no trees | 10.0      |
| Smooth grassland      | Smooth grass/low scrub: no rock trees   | 64.7      |
| Mixed woodland        | Undiff. mixed woodland (area)           | 35.2      |
| Factories & urban     | Built-up (area)                         | 84.2      |
| Recreational land     | Golf course                             | 164.4     |
| Coniferous plantation | Coniferous (plantation - area)          | 25.4      |
| Duneland              | Dune lands: unstabilized dunes          | 67.8      |
| TOTAL                 |                                         | 451.7     |

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## ***Residential Development, Industry, Ports and Harbours***

The village of Gullane is residential in character with a tourism-based economy, primarily based on golfing. The population of the village was 2202 in 1994 (East Lothian Council 1998) and its population profile is weighted particularly heavily towards the elderly, reflecting its attractions as a retirement location. There is no industry within MU9 and there are no ports or harbours.

## ***Recreation and Tourism***

Recreation and tourism are very important in MU9. Gullane Beach and Bents are popular tourist attractions and the two outstanding golf courses, also contribute to the tourist and recreation potential and attract visitors to the area. The naturalness and ruggedness of the coastline is attractive to walkers, cyclists and horse-riders for recreational pursuits. The beach at Gullane Bents is recognised by East Lothian Council as of amenity value and is included in the Council's summer beach cleaning schedule (Ash 1994). The beach is also a designated Bathing Beach, and thus has to meet the requirements of the EC Directive for bathing water quality.

Windsurfing is also an important recreational pursuit in MU9. Orienteering clubs occasionally used the West Links dune system, subject to permission from SNH as the dunes are within Gullane to North Berwick section of the Firth of Forth SSSI.

## ***Fishing Activity***

There is no commercial fishing activity within MU9.

## ***Agriculture and Forestry***

There is no agricultural land within MU9 (Figure 9.3). There is a coniferous forestry plantation at Broad wood covering an area of 25ha and two areas of mixed woodlands covering 35ha.

## ***Quarrying and Landfill***

There are no coastal quarries within MU9. A former refuse tip, covering 0.7ha of land, is located at the western end of Gullane Links (NT472830).

## ***Water Quality and Pollution***

The coastal waters of MU9 achieved a Class A (Excellent) status in 2000 (SEPA 2000). In 1999 the coastal waters only achieved a Class B (Good) and the recent water quality improvement is due to sewer improvements to the Gullane North outfall (SEPA 2001). Gullane is a designated Bathing Beach and obtained a Guideline pass of the EC Bathing Water Directive in 2000 and 2001.

## ***Archaeology and Built Heritage***

There are 97 sites of cultural heritage identified within MU9 (Table 9.42). The sand dunes of Gullane Links, Gullane Bents and West Links are rich in archaeological heritage and many of the unscheduled archaeological sites lie within the dunes (Figure 9.4). These include findings such as copper cauldrons, middens, roman coins, cairns, walls, flint arrowheads, long cists, enclosures, glazed pottery and military trenches and anti-tank traps. Several of these archaeological finds lie close to the present coastline.

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There are two scheduled ancient monuments within MU9: St Patrick's Chapel, Muirfield (NT482843) and St Andrews Kirk, Gullane (NT480827). St Patrick's is a medieval chapel, located approximately 20m from the coast at Black Rocks. St Andrews Kirk is 700m landward of the coast in the built-up area of Gullane.

The 37 Listed buildings within MU9 are all located within the built-up area of Gullane. The 39 unscheduled sites of architectural importance are also located mainly in Gullane. The shipwreck of HMS Chester II lies at a depth of 20m in the offshore area of MU9 (NT458868).

**Table 9.42: Cultural Heritage Within MU9**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 1      | RCAHMS            |
| Archaeological Sites (land)   | 18     | RCAHMS            |
| Scheduled Ancient Monuments   | 2      | Historic Scotland |
| Listed Buildings*             | 37     | ELC               |
| Architecture Sites*           | 39     | RCAHMS            |
| TOTAL                         | 97     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### **Natural Environment**

The conservation importance of the natural environment in MU9 is recognised by its SSSI, SPA and Ramsar designation. Two parts of MU9 are designated within the Firth of Forth SSSI: the shoreline and hinterland to the west of Gullane village is within Aberlady Bay section of the SSSI, while the area east of Black Rocks is within Gullane to North Berwick section of the SSSI (Figure 7.1). The inter-tidal area of both sections are included within the newly designated Firth of Forth SPA and Ramsar site (Figure 7.2). The 1km section of shoreline at Gullane Bents is the only undesignated part of the coast in MU9 (Figure 7.1).

The botanical, ornithological and geological importance of the Aberlady Bay section of the SSSI has been discussed above (Section 9.4.1) and will not be repeated here. The Gullane to North Berwick section of the SSSI has also been notified for its botanical, ornithological and geological interests, summarised in Table 9.43. Due to the high ornithological interest, the inter-tidal of both SSSI's are included in the Firth of Forth Special Protection Area (SPA) under the terms of the European Community Directive 79/409/EEC on the Conservation of Wild Birds and form part of the Ramsar site (for Waterfowl Habitat).

The dune system within the SSSI may have been affected by sand blow and deposition resulting from the erosion of adjacent Gullane Bents, which has suffered massive erosion through the latter half of this century as a result of recreational overuse in the 1930s and of heavy vehicle training during World War Two (SNH 1999a). Additionally, in 1980 a gas pipeline was laid through these dunes and vegetation recovery was poor due to inadequate restoration (SNH 1999a).

Management objectives for Aberlady Bay section (Table 9.37) and Gullane to North Berwick section of the Firth of Forth SSSI (Table 9.44) apply to the western and eastern parts of MU9, respectively, and will be taken into account when assessing strategic management options.

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**Table 9.43 Gullane to North Berwick section of the Firth of Forth SSSI Summary Description/Evaluation**

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Botanical      | The southwestern terrestrial part of the SSSI between the Black Rocks and Eyebroughty comprises the largest and most complex sand dune system in the Lothian region and contains Scottish and locally rare plants. The grasslands to the east of Yellowcraig beach are semi-improved and are separated from the inter-tidal area by a narrow strip of dunes. The grasslands are managed as a golf course but contain localised patches of base-enriched, unimproved grassland and base-enriched, marshy grassland with a good diversity of vascular plants. These vascular plants include one nationally rare species and many locally rare species. There are also a number of nationally scarce and locally rare invertebrates to be found in both the east and west dune grassland systems.                                                                         |
| Ornithological | The inter-tidal area comprises a mixture of sandy and rocky shores and Eyebroughy - a rocky promontory - is situated halfway along the shore. This area is of importance as a roosting and feeding site for wintering waders (including turnstone and purple sandpiper) and the offshore waters are used by wintering wildfowl. This stretch of coast is also of major importance in the summer for moulting eider.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Geological     | There are many accessible igneous and sedimentary geological exposures throughout the inter-tidal area; the Geological Conservation Review has identified three "Single Interest Locality" (SIL) sites. The first of these is the North Berwick Coast SIL, which includes part of Gullane – Broadsands SSSI, the whole of the North Berwick Coast SSSI and a small non-SSSI section. This SIL contains extensive exposures of early Carboniferous volcanic rocks, which were formed between 360 and 320 million years ago. The second SIL - the Cheese Bay Shrimp Beds SIL - is found within Gullane-Broadsands SSSI and contains unique fossil fish and crustacea also from the early Carboniferous period. The third, and final, SIL is Weak Law (again within the SSSI) where there are well-preserved fossilized plants, dating to the early Carboniferous period. |

**Table 9.44 Management objectives for Gullane to North Berwick section of the Firth of Forth SSSI (source SNH 1999a)**

| Objective | Detail                                                                                                                                                                                                        |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | To maintain the inter-tidal habitat of Gullane – North Berwick SSSI, keeping it in a favourable condition for the continued feeding and roosting of all key bird species (as identified by the EC Directive). |
| 2         | To maintain the botanical interest for which Gullane – North Berwick has also been notified a SSSI. To do this viable populations of rare plants (both Scottish and local rarities) must be sustained.        |
| 3         | To maintain the geological exposures and to ensure that they are not damaged or obscured.                                                                                                                     |
| 4         | The use of the site by universities for individual and group research should be encouraged and maintained.                                                                                                    |

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The habitats of MU9 are summarised in Table 9.45. Dune grassland, scrub and open dunes are the main habitats within the management unit, covering an area of approximately 200ha. Only 59ha was not classified in the Phase 1 Habitat Survey. This is the built-up area of Gullane.

**Table 9.45: Phase 1 Habitats within MU9 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                  | Area (ha) |
|--------------|----------------------------------|-----------|
| A1.1.2       | Broad-leaved, plantation         | 4.6       |
| A1.2.2       | Coniferous plantation            | 22.4      |
| A1.3.2       | Mixed woodland, plantation       | 34.0      |
| A2.1         | Dense scrub                      | 0.4       |
| B2.1         | Neutral grassland, unimproved    | 63.2      |
| B2.2         | Neutral grassland, semi-improved | 12.1      |
| B4           | Improved grassland               | 31.5      |
| C1.1         | Continuous bracken               | 1.1       |
| H1.1         | Coastal- inter-tidal mud/sand    | 2.1       |
| H6.5         | Dune grassland                   | 94.6      |
| H6.7         | Dune scrub                       | 15.3      |
| H6.8         | Open dune                        | 84.8      |
| H8.1         | Maritime hard cliff              | 0.2       |
| H8.4         | Coastal Grassland                | 0.2       |
| I2.4         | Refuse tip                       | 0.7       |
| J1.2         | Amenity grassland                | 10.4      |
| J3.6         | New Buildings                    | 13.6      |
| J4           | Bare ground                      | 1.5       |
| J5           | Other habitat                    | 0.9       |
| Unclassified | Urban / Roads                    | 58.1      |
| Total        |                                  | 451.7     |

### **Relevant policies and plans**

The main policies and plans relevant to MU9 relate to the natural heritage designations outlined above. However, there are proposals to develop a golf course complex and luxury housing development at Archerfield Estate. Most of the area affected by the proposal lie within the adjacent management unit (MU10) and the details of the proposal are discussed therein. A small part of the proposed Archerfield development is within MU9 and impinges on Broadwoods woodland area, landward of the West Links dune system.

### **Key interests**

No key concerns were raised within MU9 during the written consultation part of the SMP process. The golf courses were consulted and Gullane Golf Course expressed concerns to Rights of Way issues on the golf course and the potential implications of the new "Rights to Roam" legislation. Muirfield Golf course did not wish to input to the SMP process.

During the public consultation exercise, Gullane Bents was the locality in which there was most public concern (Appendix B). Dune erosion at Gullane Bents was noted specifically as

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a concern, however the past attempts at managing the erosion (via sea buckthorn planting) was seen as one of the positive aspects of the shore (SPI 2001a).

#### ***Valuation of Assets***

A large part of the immediate coastal hinterland is classified as High Quality Agricultural land for the purposes of the economic assessment, due to its natural heritage designations. The remaining undesignated part of the coastline, comprising the heavily modified Gullane Bents, is classified as Open Area for the economic assessment. The total value of the assets within MU9 is estimated as £101M (Table 9.46).

**Table 9.46 Valuation of Assets in MU9**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b> |
|---------------------------|---------------------------|------------------|
| High Quality Agricultural | 39%                       | 887 185          |
| Open Area                 | 45%                       | 203 062          |
| Urban                     | 16%                       | 100 179 800      |
| <b>Total</b>              |                           | 101 270 047      |



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### ***Option Evaluation***

OS map analysis indicated that the dune system at Gullane Bay has undergone erosion between 1907 and 1999 (Section 4.7.2, Table 4.7) with an average rate of 0.4m/yr recorded over the period. However, management practices carried out in the 1960's and 1970's have largely stabilised the dunes. Negligible change was recorded along the rest of the shoreline of MU9 between 1907 and 1999 (Appendix C, View 8 and 9), however SNH (1999a) note that the West Links dune system may have been affected by sand blow and deposition resulting from the erosion of adjacent Gullane Bents.

The future evolution of dune systems on the East Lothian coastline, under rising sea levels and an increase in storm incidence and magnitude, is likely to be erosion and onshore migration, with blowouts and wash-overs possibly breaching the foredune barrier (Section 4.1.3.2).

**Advance the Line** and **Retreat the Line** are not feasible options for MU9.

**No Active Intervention** would permit the natural coastal processes of dune erosion and accretion to continue. However, in the long-term there may be increased erosion of the dunes, which would naturally migrate landward through time (see above). The potential risk to assets under No Active Intervention is minimal, as the built-up area is set back from the existing shoreline. However, adoption of this option may result in sites of archaeological interest being exposed within the eroding dunes and some loss of the seaward edge of the dunes.

**Hold the Line** is not a feasible option for the entire shoreline of MU9, as the dynamic dune hinterland and its associated habitats are of outstanding botanical interest and key to the scientific interest of the SSSI. Any policy to artificially stabilise the dunes by providing coastal defences may be detrimental to the natural environment interests. In addition, such a policy is not necessary, given that most of the shoreline is not subject to erosion.

**Selectively Holding the Line** at Gullane Bents may be a feasible option. Gullane Bents is not part of the designated SSSI and has been artificially stabilised since the 1960's and 1970's. For the cost-benefit analysis, it is assumed in order to hold the line at Gullane Bents, dune fencing along the 1km shoreline will have to be replaced every 10 years to stabilise the foredune. It is assumed that the fencing will be initially constructed in Year 5 of the Plan and Years 15, 25, 35 and 45 thereafter. The cost of **Selectively Holding the Line** at Gullane has a NPV of £34,000 (Table 9.47). However, such an option is not economically viable as the benefits of this option have a NPV of £835 over the Plan period, which has been estimated based on the value of the land that would be lost under No Active Intervention. In addition, complete stabilisation of the dunes at Gullane will prevent the operation of natural coastal processes, remove the natural dynamism of the dune system and may have implications for adjacent shorelines as the supply of sediment is reduced.

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**Table 9.47 Results of Cost-Benefit Analysis for MU9 (values are discounted to 2001 values)**

| Option                    | Losses | Benefit | Cost   | Ratio |
|---------------------------|--------|---------|--------|-------|
| No Active Intervention    | 835    | -       | -      |       |
| Selectively Hold The Line | 0      | 835     | 33,926 | 0.03  |

A policy of **Limited Intervention** is the preferred strategic coastal defence option in MU9, where visitor management and management of sea buckthorn is continued. Limited Intervention will permit the operation of natural processes, but will result in a continuation of natural erosion of the dune system, particularly at Gullane Bents. Visitor management will attempt to slow down the rate of natural erosion.

It is not economically viable to prevent further erosion in the long term and it is recommended that Gullane Bents be managed with this in mind. However, natural rates of dune erosion may be reduced if visitors are kept off the eroding foredune, and East Lothian Council should continue to encourage this. Fixed photographs or surveys should be established to monitor the changes in the dune system, however this should be carried out to ensure minimal disturbance to the dunes

Management of the spread of the Sea Buckthorn in the backdune area should be continued, and the correct levels of the species for optimum dune habitats should be defined and maintained, if possible. Management of the backdune area at Gullane Bents currently costs approximately £7000 per year.

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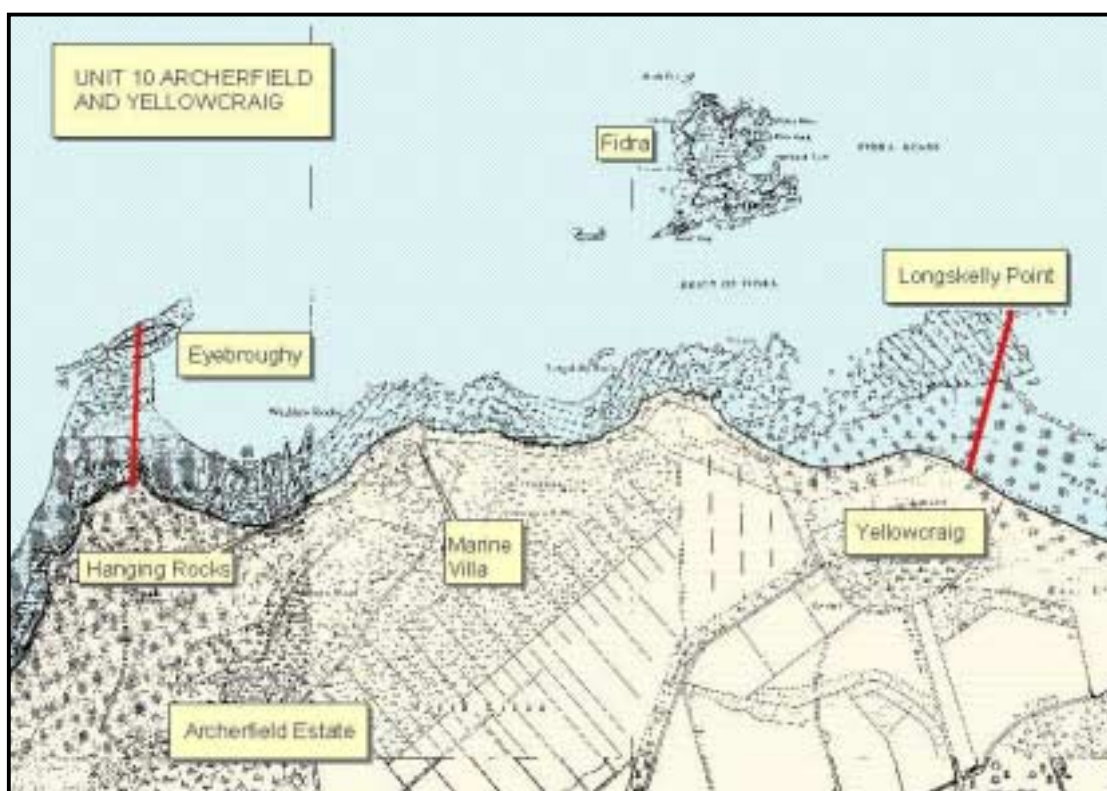
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## 9.6 PU6: EYEBROUGHY TO LONGSKELLY POINT

This process unit forms a distinct management unit (MU10). This stretch of coast faces north, from the headland opposite the island of Eyebroughy to the Longskelly Point headland. The coast is composed of a rock platform foreshore, cliffs over 5m at Hanging Rocks, and a low-lying hinterland of blown sand elsewhere. The island of Fidra is located offshore. Accretion is occurring opposite Eyebroughy and at Longskelly Rocks (Table 4.6), with accretion of up to 0.4m/yr recorded from analysis of historical OS maps. The dominant waves for this stretch of coast are likely to be from the sector between west-northwest and east-northeast. Sediment transport is believed to be from east to west for this section of coast (Ramsay and Brampton, 2000; Barne et al., 1997). Refer to Section 4.6 for further details of sediment transport processes.

### 9.6.1 Management Unit 10, Archerfield and Yellowcraig

The shoreline of MU10 is of outstanding natural beauty, the western part of MU10 has been largely untouched by human activity, as access is difficult, while the eastern part comprises Yellowcraig, a busy recreational site. Fidra is a 13.4 ha volcanic island composed of basalt, rising to 33m at its highest point and comprising maritime grassland, rocky coastline and cliffs up to 17m high. This MU is approximately 3km long.



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**Table MU10.1 Summary of Attributes of Management Unit 10**

| Coastal Processes           |                                                                                                                                          |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Stable and accreting                                                                                                                     |
| Geomorphology               | Rocky foreshore, cliffs, shingle pocket beaches and a blown sand hinterland                                                              |
| Sediment Drift              | Low or moderate westerly drift                                                                                                           |
| Coastal Defences            |                                                                                                                                          |
| Type                        | Man-made: None identified<br>Natural: Shingle beach                                                                                      |
| Human and Built Environment |                                                                                                                                          |
| Land use                    | Forestry, agriculture, recreation at Yellowcraig. Future land-use will change with a golf course and housing development at Archerfield. |
| Sea use                     | -                                                                                                                                        |
| Infrastructure              | -                                                                                                                                        |
| Recreation and Tourism      | Limited informal recreation over most of MU. High recreation use at Yellowcraig                                                          |
| Historic Environment        | 32 sites of cultural heritage identified, including 1 Scheduled Ancient Monument.                                                        |
| Natural Environment         |                                                                                                                                          |
| Habitat Types               | Rocky inter-tidal, shingle habitats, dunes, coastal grassland                                                                            |
| Designated Sites            | Firth of Forth SSSI<br>Forth Islands SSSI<br>Firth of Forth SPA/ Ramsar Site<br>RSPB Reserve                                             |
| Key Interests               | Development at Archerfield will impact future shoreline management, as the proposed development is adjacent to the coast                 |
| Valuation of Assets         | £3 M                                                                                                                                     |

**Table MU10.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention   | √                  | √           | √                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line          | √                  | X           | X                         | X                         | √           | √                     | √         | X                      | X                   | X         | √             | NA       | NA       |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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## ***Coastal Defences***

No hard coastal defences were identified in MU10. East Lothian Council expressed concern regarding coastal erosion and defences at Marine Villa (NT502860). During the site visit on 21/11/01, no hard defences were observed although it is reported that there are timber defences in MU10 (SNH, pers. comm. 2002). There was evidence of the rocky cliffs being undercut, although this is not threatening property. The walled garden of Marine Villa is set back approximately 30m from a 20m wide shingle beach, composed of basaltic gravel.

The beach is of uniform lithology and extends 100m along the shoreline (Plate 9.18). Storm ridges were evident on the upper beach indicating the severity of the wave climate on this exposed section of coast. The shingle beach extends further east around to the Brigs of Fidra. The beach provides a coastal defence function and it is possible it may have been artificially placed here, as the uniform geology looks unusual and out of place along the East Lothian shoreline. However, geological maps show outcrops of basaltic rocks in the immediate vicinity, indicating a localised source of beach material. Nevertheless, the beach operates as a natural coastal defence for Marine Villa.

## ***Land-use***

Coniferous plantation covers almost half (108.6ha) of the total area of MU10 (Table 9.48). The second largest land-use is arable, which covers 88ha of land. A very small proportion of MU10 comprises built-up area (3.6ha) and this is set well back from the coast. The hinterland immediately adjacent to the coast is classified as either mixed woodland or dunelands.

**Table 9.48: Land-use classification in MU10 (source: MLURI 1988)**

| Land-use class        | Domain                                  | Area (ha) |
|-----------------------|-----------------------------------------|-----------|
| Mixed woodland        | Undiff. Mixed woodland (area)           | 4.4       |
| Smooth grassland      | Undiff. smooth grass.: no rock no trees | 3.2       |
| Duneland              | Dune lands: unstabilized dunes          | 25.5      |
| Coniferous plantation | Coniferous (plantation - area)          | 108.6     |
| Factories & urban     | Built-up (area)                         | 3.6       |
| Improved grassland    | Imp. pasture: no rock no farms no trees | 0.2       |
| Arable                | Arable: no rock no farms no trees       | 88.0      |
| TOTAL                 |                                         | 233.5     |

## ***Residential Development, Industry, Ports and Harbours***

There is very little residential development in MU10. The only residential properties are Marine Villa and Marine Cottage at NT502860. There is no industry or harbours within MU10. There is a landing jetty on the island of Fidra.

## ***Recreation and Tourism***

Most of the shoreline of MU10 is remote, with few access points. However, a public right of way extends along the shoreline from Gullane Bents in the west to Yellowcraig in the east (East Lothian Council GIS theme). The proposed sustainable coastal footpath does not use this right of way and it is proposed that the path runs inland through Gullane Bents and along farm tracks through Archerfield Estate (Halcrow Fox 1998).

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Some passive recreation activities take place in MU10, such as walking and bird watching. Fidra and the rocky promontory of Eyebroughy are included in the RSPB's Forth Islands Reserve, thus the ornithological interest in this area is high. During the summer months, regular boat trips take visitors to Fidra.

Yellowcraig, an attractive coastal open space of woodland, foreshore and dunes, lies in the eastern part of MU10. Yellowcraig is owned and managed by East Lothian Council and recreational use of the area is high, attracting 280,000 visits per year (East Lothian Council 2000c). A touring caravan park and a car park have been established at Yellowcraig.

Typical recreational activities include: walking; jogging; picnics; sunbathing; nature watching; beach games; dog walking; swimming/paddling; educational school groups; guided nature walks; windsurfing; canoeing/boating; water skiing; orienteering; various events; caravan rally; barbecues; and film crews (Ash 1985). The beach at Yellowcraig is considered of high amenity value and is included in East Lothian Council's summer beach cleaning scheme. (Ash 1994)

There are proposals to develop a golf course complex and luxury houses at Archerfield Estate along the coastal frontage. The development extends close to the shore and a management plan for the site has been prepared including a sea-buckthorn barrier and hedgerow along most of frontage to restrict access to the coastline. The planning application contains details of archaeology, traffic assessment and environmental assessments. Clearly, if such a development goes ahead, the influx of tourists and numbers of visitors to the mainly secluded coast of MU10 will increase. A 5 year management plan for Archerfield/Yellowcraig has been prepared by East Lothian Council, with assistance from SNH, the recommendations of which will be taken into account for shoreline management planning.

### ***Fishing Activity***

The Archerfield/Yellowcraig management plan prohibits all bait digging, fishing and shellfish gathering, both for sport and commercial reasons (East Lothian Council 2000c).

### ***Agriculture and Forestry***

A large part of MU10 comprises a coniferous plantation (108ha) and other areas of mixed woodland (4ha). Woodland management is an integral part of the 5-year management plan at Archerfield/Yellowcraig. Woodlands are to be managed to ensure a continuous cover of mixed age structure in order to sustain the particular landscape character and qualities of the area. Arable agriculture covers 88ha of the management unit, although this land-use does not impinge the shoreline.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU10.

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### ***Water Quality and Pollution***

The coastal waters of MU10 achieved a Class A (Excellent) status in 2000 (SEPA 2000). The water quality has improved since 1999, when it only achieved a Class B (Good). Yellowcraig is a designated Bathing Beach and obtained a Guideline pass of the EC Bathing Water Directive in 2000 and 2001.

### ***Archaeology and Built Heritage***

A round burial cairn, recently discovered at Whiteknowe (NT506857) has been considered worthy of scheduling as an Ancient Monument and indicates the archaeological significance of the area. A human tooth, found at the cairn, is in the possession of the Royal Museum of Scotland.

Historical evidence and archaeological discoveries within Eldbotle Wood (NT501856) suggest the presence of an early medieval site of great significance and high archaeological potential. 25 archaeological sites have been identified and recorded in the National Monuments Record (Table 9.49) including finds of pottery, tools and other artefacts suggesting early Bronze Age settlement in the area. Several of the finds lies close to the shoreline including the Iron Age caves on the coast at Hanging Rocks (NT499857); long cists, military battery and enclosures at Marine Villa (NT502859); medieval pottery, a nunnery and a church at NT510860; and long cists in the Yellowcraig dunes.

The island of Fidra contains several sites of archaeological importance, including a battery (NT512869); The ruined chapel of St Nicholas Church and burial ground (NT513869); a cave with finds of pottery and Castle Tarbet at NT514867. The ruined chapel is a proposed Scheduled Ancient Monument (SNH 1998d). Fidra Lighthouse and Fidra houses and walls (NT512870) are C Listed buildings. Marine Villa and Marine Villa Cottage are also Listed Structures.

**Table 9.49: Cultural Heritage Within MU10**

| <b>Category</b>               | <b>Number</b> | <b>Source</b>     |
|-------------------------------|---------------|-------------------|
| Maritime Archaeological Sites | 0             | RCAHMS            |
| Archaeological Sites (land)   | 25            | RCAHMS            |
| Scheduled Ancient Monuments   | 1             | Historic Scotland |
| Listed Buildings*             | 4             | ELC               |
| Architecture Sites*           | 2             | RCAHMS            |
| <b>TOTAL</b>                  | <b>32</b>     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

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## ***Natural Environment***

The Phase 1 habitat survey classified all the land within MU10 (Table 9.50). The land adjacent to the coast is classified as dune grassland, dune scrub, open dune or coastal grassland.

**Table 9.50: Phase 1 Habitats within MU10 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                  | Area (ha) |
|--------------|----------------------------------|-----------|
| A1.1.2       | Broad-leaved, plantation         | 1.1       |
| A1.2.2       | Coniferous plantation            | 1.7       |
| A1.3.2       | Mixed woodland, plantation       | 19.8      |
| A2.1         | Dense scrub                      | 1.2       |
| B2.1         | Neutral grassland, unimproved    | 11.7      |
| B2.2         | Neutral grassland, semi-improved | 20.0      |
| B4           | Improved grassland               | 26.4      |
| H6.5         | Dune grassland                   | 5.7       |
| H6.7         | Dune scrub                       | 1.0       |
| H6.8         | Open dune                        | 3.2       |
| H8.4         | Coastal Grassland                | 0.4       |
| J1.1         | Arable                           | 93.4      |
| J1.2         | Amenity grassland                | 32.9      |
| J3.6         | New Buildings                    | 22.0      |
| J4           | Bare ground                      | 0.9       |
| J5           | Other habitat                    | 1.4       |
| Total        |                                  | 242.8     |

The outstanding conservation importance of the natural environment in MU10 is emphasised by its designation within the Gullane to North Berwick section of the Firth of Forth SSSI, the Forth Islands SSSI and its status as a SPA/Ramsar site. Archerfield Estate is a provisional SWT Wildlife Site, although this has not been formally designated.

The Gullane to North Berwick section of the SSSI has been designated for its botanical, ornithological and geological interest (Table 9.43). Gullane Bents and Yellowcraig dune systems lie within the SSSI boundary (Figure 7.1). The boundary along the remainder of the management unit runs adjacent to the shoreline, approximately 40m landward of MHWS. The Firth of Forth SPA/Ramsar site covers the inter-tidal area of MU10 (Figure 7.2).

The island of Fidra forms part of the Forth Islands SSSI, which comprises the three islands of Fidra, The Lamb and Craighleith (Appendix F). The conservation importance of the Forth Islands SSSI is described below. Fidra is also a Nature Conservation Review Site (Grade 2) and forms part of the Forth Islands RSPB Reserve.



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A range of seabirds breed on the Forth Islands: fulmar, cormorant, shag, eider, lesser black-backed gull, herring gull, great black-backed gull (very small numbers), kittiwake, guillemot, razorbill and puffin. Between them, these three islands contain regionally significant breeding populations of all the seabird species present with nationally important populations ( $\geq 1\%$ ) of cormorant, shag, eider, lesser black-backed gull and herring gull. In combination with the other seabird populations of the Forth Islands SPA, the Forth Islands SSSI colonies of cormorant, shag, lesser black-backed gull, kittiwake, guillemot, razorbill and puffin are of European importance. Additionally, the coastal waters between Fidra and Eyebroughy are the core of an area stretching from Aberlady to North Berwick that is used by around 5,000 moulting eiders in July and August. This represents approximately 6% of the UK eider population (SNH 1998d). From approximately the 1960s, the populations of all these species on the Forth Islands SSSI have increased significantly, as they have throughout the Firth of Forth.

In contrast to this general increase in seabird numbers, tern populations have declined dramatically, as they have at most sites in the Firth of Forth. Sandwich, roseate, common and arctic terns all nested on Fidra, peaking in the 1960s - early 1970s. Their disappearance coincided with the rapid expansion of the island's gull population. Culling of gulls took place between 1972-82 in an effort to maintain the tern colonies but no terns have nested on Fidra since 1986 (SNH 1998d). However, the island is still regarded as a potential breeding site for these birds. The long-term objective for management of the Forth Islands SSSI is to maintain the breeding seabird populations.

### ***Relevant policies and plans***

The land-use within MU10 is likely to change within the timescale of the SMP, as there are proposals to develop a luxury golf course and housing development at Archerfield. The details of the development are currently being negotiated with the Council, however the 2001 application is to develop 2 golf courses, construct a luxury hotel, 50 golf cottages, 100 houses and golf clubhouse, and restore Archerfield House. The proposed development lies adjacent to the SSSI boundaries and extends right to the existing shoreline along much of the management unit.

The Archerfield/Yellowcraig 5 year management plan has been formulated to minimise disturbance to the natural environment and manage future use of the shoreline and the adjacent area. The objectives of the management plan are:

1. To conserve and enhance the wildlife habitats and the associated flora and fauna, geological exposures and geomorphological features;
2. To maintain and enhance the area for feeding, roosting and moulting wildfowl and waders;
3. To maintain and enhance the site as a suitable nesting area for rock/ground nesting birds and sea duck;
4. To provide appropriate facilities which will enhance visitor enjoyment and understanding of Yellowcraig and encourage visitors to remain at Yellowcraig;
5. To conserve and enhance the specific landscape character and quality of the area and;
6. To preserve the archaeological remains in the specified areas.

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Of key relevance to the SMP is the requirement to establish and maintain an impenetrable barrier of fence and sea-buckthorn along the shoreline, with the objective of preventing occupiers and visitors to the Archerfield development gaining easy access to the remote shoreline (East Lothian Council 2000c). Visitors will be encouraged to access the shore via Yellowcraig, rather than using the adjacent shore.

#### **Key interests**

No key issues were highlighted in MU10 during the written consultation phase. Public concern was raised regarding the proposals for new development at Archerfield, with specific concerns expressed regarding increasing access to this relatively unspoilt section of shoreline.

#### **Valuation of Assets**

The monetary value of the land within MU10 is estimated as £3M, based on the existing land-use (Table 9.51). Land-use classification for economic assessment has been carried out as set out in Chapter 8. Land designated as SSSI/SPA has been classified as High Quality Agricultural to account for the higher value of this land.

**Table 9.51 Valuation of Assets in MU10**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b> |
|---------------------------|---------------------------|------------------|
| High Quality Agricultural | 46%                       | 539 875          |
| Open Area                 | 53%                       | 124 134          |
| Urban                     | 1%                        | 2 497 600        |
| <b>Total</b>              |                           | <b>3 161 609</b> |

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### ***Option Evaluation***

The shoreline of MU10 is natural and there is evidence of accretion over the last 100 years (Table 4.6). A wide shingle beach, composed of basaltic gravels, provides a natural defence to the properties of Marine Villa and Marine Cottage. The remaining shoreline is composed of a rock shore platform, backed by a hinterland of blown sand deposits. The entire inter-tidal area is designated as SPA/Ramsar and a strip of land adjacent to the shore is designated as SSSI, conferring legal protection to minimise disturbance to the natural environment.

**No Active Intervention** is a technically feasible option for MU10. As there is no evidence of an erosion problem in MU10 adoption of this option will cause no risk to existing land or property. The natural coastal processes operating in MU10 will not be interrupted and thus there will be no impact on adjacent shorelines. This option is the preferred option in terms of minimal disruption to the natural environment. As erosion is not a problem in MU10, adoption of No Active Intervention will not pose a threat to the rich archaeological and natural heritage of MU10. In addition, the No Active Intervention option has no monetary cost.

The **Hold the Line** option may be feasible for short stretches of MU10, such as the frontage of Marine Villa and Marine Cottage. These properties are situated on raised land 30-50m landward of MHWS and are under no immediate risk of erosion and flooding. The apparent accretion trend on this shoreline and the presence of the shingle beach minimises the threat of erosion / flooding. As there is no real risk, adoption of Hold the Line option is not viable in an economic sense. In addition, construction of hard coastal defences in MU10 would be detrimental to the natural environment and conservation importance of the area and would effect the operation of natural coastal processes. If required, a fixed survey network of beach profiles should be established to monitor trends of beach change on the shingle beach. Undercutting of the low rock cliffs is unlikely to present any problems, as rates are likely to be low.

**Advance the Line** and **Retreat the Line** are not considered for MU10, as there is no defence line currently in place. The defence line is natural and should remain so.

The preferred option for MU10 is **No Active Intervention**. If the new development at Archerfield goes ahead, it should be set well back from the existing shoreline, by at least 50m. This will avoid tying future generations into the need for inflexible and expensive coastal defences, which will certainly be detrimental to the natural environment. This should be taken into consideration during the planning and construction phase of the Archerfield development.

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#### **9.7 PU7: LONGSKELLY POINT TO NORTH BERWICK (RUGGED KNOWES)**

PU7 has been split into two management units, based on land-use. MU11 extends along the more undeveloped and natural shoreline of Broad Sands Bay and MU12 comprises the built-up shoreline of North Berwick.

This stretch of coast has a series of one large (Broad Sands) and three small bays (immediately east of Broad Sands, North Berwick Bay and Milsey Bay), which are separated by rock headlands at Longskelly Point and Rugged Knowes at the eastern edge of North Berwick. The coast is essentially north facing, although the bays are orientated to the northeast. The beaches are composed of sand, with boulders present on the upper beach at North Berwick Bay (East Lothian Council, 2001d). The hinterland is low-lying and mostly built-up, along with raised beach and marine deposits, and blown sand (GUARD, 1996). The islands of Lamb and Craigleith are located offshore.

Accretion is occurring at Broad Sands, North Berwick Bay (in the lee of the harbour) and parts of Milsey Bay (GUARD, 1996) (Table 4.6). Analysis of historical OS maps indicates that part of Milsey Bay (in the vicinity of Tantallon Terrace and Marine Parade have eroded by a maximum of 30m since 1907 (Appendix C, View 12, Table 4.7). Broad Sands has high active dunes, which show seasonal erosion. There is also erosion at West Links Golf Course at the eastern end of Broad Sands beach (Gilchrist, 1996, 1998) (Table 4.7), although OS map evidence suggests this is limited to the mouth of the burn (Appendix C, View 11). GUARD (1996) notes that there are coastal defences from Cowton Rocks to North Berwick.

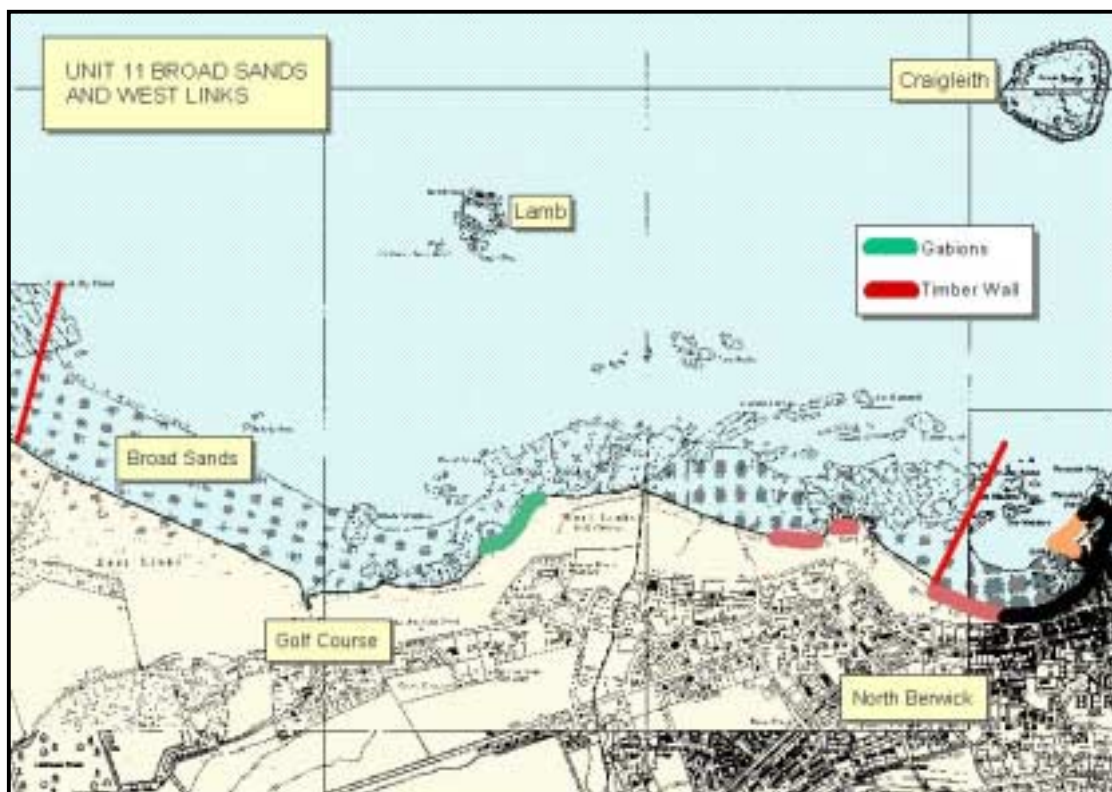
Storms cause seasonal damage to beaches and damage to North Berwick harbour (East Lothian Council, 2001d). The dominant wave directions for this stretch of coast are from the sector between west-northwest and east-northeast. Sediment transport is believed to be from east to west for this section of coast (Ramsay and Brampton, 2000; Barne et al., 1997). Refer to Section 4.6 for further details of sediment transport processes.

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## 9.7.1 Management Unit 11, Broad Sands and West Links

This management unit is bounded by the rock headland of Longskelly Point in the west (NT522862) and extends eastwards to the limit of the defended shoreline of North Berwick, in the middle of North Berwick Bay (NT549854) - A distance of approximately 3km. The immediate hinterland of the management unit is comprised of wind-blown sand on raised beach deposits, on which North Berwick West Links Golf Course has been developed. The islands of Craigleith and The Lamb, which lie 600m and 1000m offshore, are also within MU11.



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**Table MU11.1 Summary of Attributes of Management Unit 11**

| Coastal Processes           |                                                                                              |
|-----------------------------|----------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Relatively stable, but undergoing short-lived phases of erosion                              |
| Geomorphology               | Sand beach, backed by high active dunes at Broadsands. Rock outcrops on foreshore.           |
| Sediment Drift              | Low or moderate westerly drift                                                               |
| Coastal Defences            |                                                                                              |
| Type                        | Man-made: Gabions, Timber wall<br>Natural: Sand beach                                        |
| Human and Built Environment |                                                                                              |
| Land use                    | Golf Course, Residential                                                                     |
| Sea use                     | -                                                                                            |
| Infrastructure              | -                                                                                            |
| Recreation and Tourism      | Golf, walking, bird-watching                                                                 |
| Historic Environment        | 103 sites of cultural heritage identified                                                    |
| Natural Environment         |                                                                                              |
| Habitat Types               | Rocky inter-tidal, sand beach, dunes, coastal grassland                                      |
| Designated Sites            | Firth of Forth SSSI<br>Forth Islands SSSI<br>Firth of Forth SPA/ Ramsar Site<br>RSPB Reserve |
| Key Interests               | West Links Golf Course are concerned about coastal erosion                                   |
| Valuation of Assets         | £135 M                                                                                       |

**Table MU11.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | √                         | √                         | √           | X                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention   | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line          | √                  | X           | X                         | X                         | √           | √                     | √         | √                      | X                   | X         | √             | NA       | NA       |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

North Berwick West Links Golf Course is situated on a dune coastline, which shows evidence of seasonal erosion. The beach is backed by 10m high eroding dune faces at Broadsands, at the western end of the course, and further east the lower dunes protecting the fairway also show evidence of recent erosion. However, analysis of historic OS maps do not indicate any long-term trends of erosion along this management unit (Appendix C, View 11).

Localised erosion of 60m at the mouth of the Eil Burn entering Broad Sands Bay (NT529854) has occurred between 1907 and 1999, although this is compensated by accretion of the beach to the east. The change in position of MHWS between 1907 and 1999 for the remaining length of shoreline is negligible, indicating that the recent erosion is not part of a long-term trend.

Attempts have been made in the past to arrest the erosion of high dunes backing Broad Sands Bay, using chespole fencing and brushwood sand traps (Gilchrist 1996). However, the defence had failed by 1996 (Gilchrist 1996) and there was no evidence of any form of coastal defence/ dune protection during the site visit on 21/11/01.

Further east, the low dunes at the back of the beach are erosional. Gilchrist (1996, 1998) reports that an earlier gabion defence originally protected the 14<sup>th</sup> green, although by 1996 it was reported that this has partly failed. During the site visit there was no evidence of the gabion structure.

A stretch of the shoreline is protected by what is defined as “coastal slope” on the OS Landline Maps (Defence No 28). The field inspection revealed that this is an artificially enhanced slope backed with railway sleepers and protected at the toe with plastic gabions, which have been exposed for a 50m section and are broken in places (Plate 9.19). The crest of the slope is 5-6m high and is well vegetated and extends approximately 230m along the coast.

Further east, two sections of timber wall protect the erosional low dunes alongside the fairway (Defence No 29, Plate 9.20). Immediately west of this defence, the low dunes show serious signs of erosion for a 10m stretch of the fairway (Plate 9.21) and there are signs warning golfers of coastal erosion. Gilchrist (1996, 1998) also noted the erosional problem at this locality and noted that undercutting of the fairway was causing a hazard for golfers. They recommended a gabion box and mattress for this section of shoreline, although it appears this has not been carried out.

The timber defences are constructed with timber sleepers placed vertically and banded together. Some jointing is exposed. The western section of timber wall is approximately 2m high and extends for approximately 100m and its toe is protected with rock armour consisting of loose boulders randomly placed at the base of the wall. The second stretch of timber wall further east is shorter and extends for approximately 50m, protecting a raised tee.

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### ***Land-use***

Arable land forms the largest land-use class of MU11 (Table 9.52), although none lies adjacent to the shoreline (Figure 9.3). West Links Golf Course forms the immediate hinterland of the management unit for most of its length, with the exception of the small stretch of land classed as unstabilised dunelands in the west at Yellowcraig. The residential area of North Berwick covers 95ha of the management unit, although this is set back from the shoreline by at least 100m.

**Table 9.52: Land-use classification in MU11 (source: MLURI 1988)**

| Land-use class        | Domain                                  | Area (ha) |
|-----------------------|-----------------------------------------|-----------|
| Duneland              | Dune lands: unstabilized dunes          | 9.5       |
| Recreational land     | Golf course                             | 53.9      |
| Coniferous plantation | Coniferous (plantation - area)          | 13.5      |
| Factories & urban     | Built-up (area)                         | 95.1      |
| Improved grassland    | Imp. pasture: no rock no farms no trees | 17.8      |
| Mixed woodland        | Undiff. mixed woodland (area)           | 4.0       |
| Arable                | Arable: no rock no farms no trees       | 122.1     |
| Total                 |                                         | 315.9     |

### ***Residential Development, Industry, Ports and Harbours***

There are no ports or harbours within MU11, however the busy harbour of North Berwick lies in MU12 to the east. 95ha of the residential area of North Berwick lies within MU11. West Links Golf Course is seaward of the residential area, thus there is no flooding or erosion risk to residential properties in MU11.

### ***Recreation and Tourism***

Yellowcraig, an attractive coastal open space of woodland, foreshore and dunes, lies immediately west of MU11. This area attracts large number of visitors for recreational activities (Section 9.6.1) who often spill onto Broad Sands beach (Ash 1985). The high usage of the beach and dunes at Broad Sands may be contributing to the dune erosion that is present today. North Berwick Bay attracts numerous visitors, who use the wide attractive sandy beach for recreational purposes. Walkers utilise the entire length of the attractive shoreline of MU11, although use is most intensive in the west and east of the management unit, at access points.

The other main recreational use of the shoreline in golf, the course at West Links lies adjacent to the shoreline, with steps at several locations through the dunes providing access to the foreshore.

### ***Fishing Activity***

There is limited fishing activity within MU11.



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### ***Agriculture and Forestry***

Agricultural activities are important in MU11, covering a large area of the landward part of the management unit. There is very little forestry within MU11, although two small areas of coniferous plantations are present in the western part of the management unit. Neither impinge the shoreline.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU11.

### ***Water Quality and Pollution***

Yellowcraig (Broad Sands) is a designated Bathing Beach and obtained a Guideline pass of the EC Bathing Water Directive in 2000 and 2001. North Berwick Bay is also a designated Bathing Beach and achieved a Guideline Pass in 2001. This is an improvement on the water quality in 2000, where only a Mandatory Pass of the Directive was achieved. The western part of coastal waters of MU11 achieved a Class A (Excellent) status in 2000 (SEPA 2000), while the eastern part around North Berwick Bay only achieved a Class B (Good). The entire coastline was Class B in 1999. There were no reported water pollution incidents in MU11.

### ***Archaeology and Built Heritage***

Management unit 11 is rich in cultural heritage with over 103 sites of archaeological or architectural importance identified (Table 9.53), although all but two of the identified sites lie over 150m from MHWS and thus are at no immediate risk from coastal erosion (Figure 9.4). The wreck of the destroyer HMS Ludlow lies just below MLWS off the coast of Broad Sands, near Longskelly Point (NT523860).

**Table 9.53: Cultural Heritage Within MU11**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 1      | RCAHMS            |
| Archaeological Sites (land)   | 21     | RCAHMS            |
| Scheduled Ancient Monuments   | 1      | Historic Scotland |
| Listed Buildings*             | 41     | ELC               |
| Architecture Sites*           | 39     | RCAHMS            |
| TOTAL                         | 103    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

The North Berwick Nunnery, located in the heart of the residential area of North Berwick (NT546849) is the only scheduled monument within MU11. The unscheduled archaeological sites in MU11 include cists, urns, beakers, coins, stone axes, pottery, bronze spearheads, human remains and cairns highlighting the historical importance of the North Berwick area. The only archaeological sites close to the coast include bait-holes at Strong's Hole, Cowtown Rocks (NT539858) and the possible Enclosure on Lamb Island (NT534866). There are 41 Listed Buildings and 39 architectural sites of importance within MU11 (Table 9.53), all of which lie in the built-up area of North Berwick and lie at least 200m landward of the existing shoreline.

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## ***Natural Environment***

Phase 1 habitats have been classified for all but the residential area of MU11. The largest habitat type is Arable (93ha) (Table 9.54). Land adjacent to the shoreline is classified as dune grasslands, open dunes or dune scrub.

**Table 9.54: Phase 1 Habitats within MU11 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                  | Area (ha) |
|--------------|----------------------------------|-----------|
| A1.1.2       | Broad-leaved, plantation         | 1.1       |
| A1.2.2       | Coniferous plantation            | 1.7       |
| A1.3.2       | Mixed woodland, plantation       | 19.8      |
| A2.1         | Dense scrub                      | 1.2       |
| B2.1         | Neutral grassland, unimproved    | 11.7      |
| B2.2         | Neutral grassland, semi-improved | 20.0      |
| B4           | Improved grassland               | 26.4      |
| H6.5         | Dune grassland                   | 5.7       |
| H6.7         | Dune scrub                       | 1.0       |
| H6.8         | Open dune                        | 3.2       |
| H8.4         | Coastal Grassland                | 0.4       |
| J1.1         | Arable                           | 93.4      |
| J1.2         | Amenity grassland                | 32.9      |
| J3.6         | New Buildings                    | 22.0      |
| J4           | Bare ground                      | 0.9       |
| J5           | Other habitat                    | 1.4       |
| Unclassified | Urban                            | 73.1      |
| Total        |                                  | 315.9     |

The shoreline of MU11 lies within the Gullane to North Berwick section of the Firth of Forth SSSI, designated for its botanical, ornithological and geological interests (described above, Table 9.43). The SSSI covers the entire inter-tidal area, but extends inland in the western part of the management unit, covering the high dunes and links hinterland of Broad Sands Bay (Figure 7.1). The eastern part of the SSSI, which comprises the inter-tidal area seaward of West Links Golf Course, was notified as SSSI in 2001 and is also part of the newly designated Firth of Forth SPA/Ramsar site (Figure 7.2). The entire inter-tidal area of MU10 has been designated as part of the SPA/Ramsar site.

The offshore islands of Craigleith and The Lamb are designated as part of the Forth Islands SSSI and SPA for outstanding ornithological interest, described in Section 9.6.1. The Lamb is also a RSPB Reserve. East Lothian Council has also been notified the western part of the management as an area of Great Landscape Value.

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### **Relevant policies and plans**

There are no existing planning applications lodged with East Lothian Council within MU11 that will have an impact on shoreline management, as all applications lie within the residential area, set back from the shoreline. However, the proposed golf course and housing development at Archerfield (MU10) is likely to lead to an increase in the number of users of the shoreline at Yellowcraig and on Broad Sands beach. This potential increase in use should be properly managed, as human disturbance to the dunes may be a causal factor of the dune erosion at Broad Sands. In addition, the sustainable coastal corridor path proposed by Halcrow Fox (1998) is adjacent to the shoreline right along MU11, again leading to an increase in users of the beach.

### **Key interests**

North Berwick Golf Club (West Links) is the main party with key interests in MU11. Two representatives from the club attended the public meeting in North Berwick and the Club submitted a response to the written consultation process (Table 3.2). The golf club have commissioned two reports into the coastal erosion problem affecting the golf course (Gilchrist 1996, 1998), which estimate that the minimum work required to arrest erosion is around £85 000 (North Berwick Golf Club, 2001).

The principal areas of concern identified are the 3<sup>rd</sup> Tee, 14<sup>th</sup> Green and the Eil Burn outfall area (North Berwick Golf Course 1997). Gilchrist (1998) recommend that a gabion mattress coastal defence be constructed along a 40m section on the 1<sup>st</sup> hole, a 108m section on the 2<sup>nd</sup> hole and around the 14<sup>th</sup> green and provide sketches of the proposed design of such works in their report. Gilchrist (1996) also recommended that annual monitoring of the coastline should be undertaken to establish the rate of erosion and suggest establishing fixed monitoring stations. We are not aware if such monitoring has been carried out.

The public raised concerns relating to dune erosion at Broadsands and West Links Golf Course (SPI 2001a). Other concerns related to problems of access along the coast from Yellowcraig to North Berwick. Concern was also raised regarding the increased pedestrian use of Yellowcraig and suggestions such as planting sea-lyme grassing or using dune fencing to arrest dune erosion were suggested.

### **Valuation of Assets**

Almost half of the land within MU11 is classified as High Quality Agricultural (48%) for the purposes of economic assessment (Table 9.55). This accounts for the higher value of the open dune land designated as SSSI. The residential area of North Berwick and roads comprise 30% of the MU area, which has a total estimated value of approximately £135M.

**Table 9.55 Valuation of Assets in MU11**

| Asset Type                | % Land in Category | Value (£)          |
|---------------------------|--------------------|--------------------|
| High Quality Agricultural | 48%                | 767 990            |
| Open Area                 | 21%                | 67 656             |
| Urban                     | 30%                | 134 556 800        |
| <b>Total</b>              |                    | <b>135 392 446</b> |

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### **Option Evaluation**

With the exception of erosion in the immediate vicinity of the mouth of Eel Burn, analysis of historic OS maps did not indicate any long-term erosion trend in MU11 (Appendix C, View 11). Thus, it is likely that the recent erosional nature of the coast is seasonal. Natural coastal processes result in phases of upper beach erosion during winter storms coupled with upper beach accretion in the generally calmer summer conditions. As no erosion rates have been measured along this shoreline and appear to be negligible over a 100-year timescale, the cost of any potential loss of land due to erosion under **No Active Intervention** is impossible to quantify.

The costs associated the **Hold the Line** option are estimated based on the construction cost of the gabion and mattress defences as recommended by Gilchrist (1996, 1998) along 188m of the shoreline and maintenance costs thereafter. Maintenance costs of the existing defences (Defence no's 28 and 29) are also included, giving a total cost of £89 700 at NPV for the Hold the Line option. The benefits of Hold the Line are impossible to quantify as the long-term erosion rate is negligible, thus the reduction in the amount of land lost under this option is likely to be minimal. Other possible benefits of **Hold the Line** may be a cost saving of not having to relocate greens/ tees away for the eroding shore and an increase in public safety, although quantification of these are out with the scope of the present study.

Adoption of **Hold the Line** along a naturally adjusting shoreline, which appears to be undergoing cycles of short-lived phases of erosion and accretion, would result in a series of fixed stretches of the coast, which will effectively starve the downdrift shoreline of sediment, transferring the erosion problem elsewhere. Construction of defences would also potentially have an impact on the SSSI and SPA interests of the management unit.

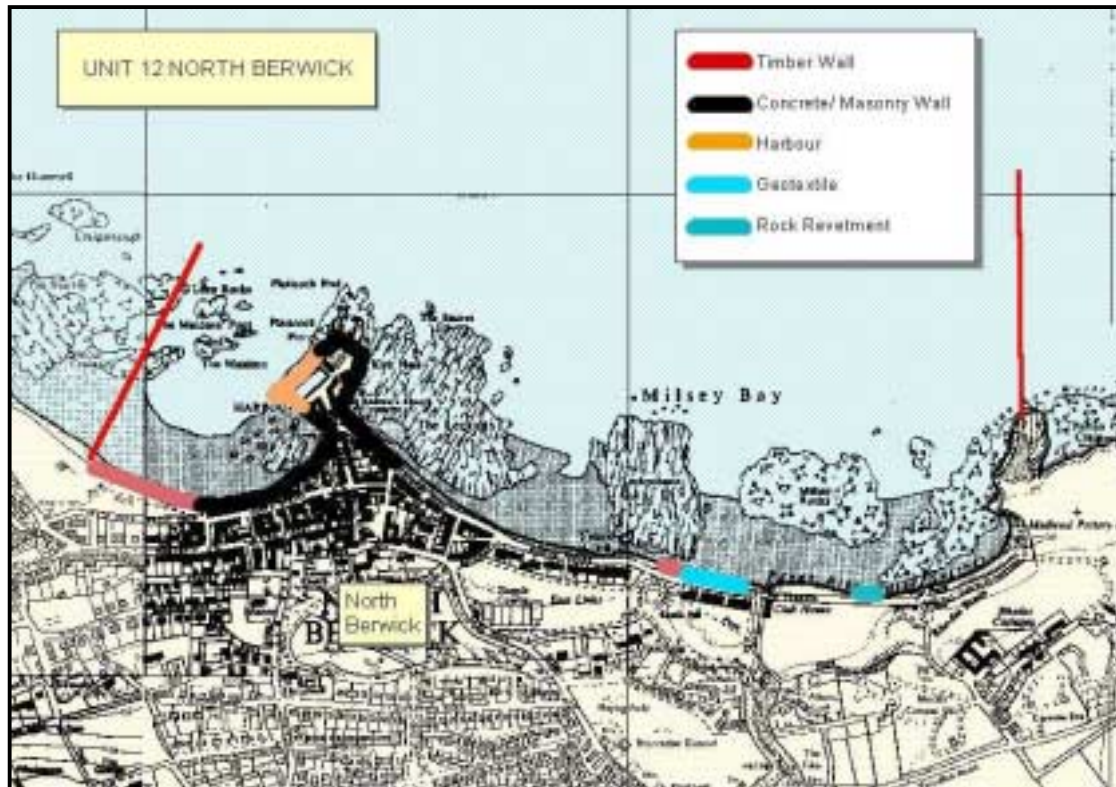
**Advance the Line** is not a feasible option for MU11, as there would be a need for construction of coastal defences to protect the new reclaimed land, which would be detrimental to the natural environment interests. There are no locations in MU11 where **Retreat the Line** is a feasible option.

**Limited Intervention** is the preferred management option for MU11. Dune erosion of Links courses in Scotland is a common problem and the current thinking is that this erosion should be managed as an acceptable natural processes and coastal defence is not a long-term sustainable option and will merely transfer the problem downdrift to another part of the shoreline.

Consideration to the relocation of tees / greens away from the shoreline should be considered, together with establishing a monitoring programme to assess future changes. In terms of user management of Yellowcraig and the dunes at Broadsands, the Council should consider methods such as dune fencing and planting to keep visitors off the eroding dunes, with an aim to reduce the amount of human induced erosion.

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Management Unit 12 extends along the 2.5km shoreline of the built-up area of North Berwick and forms the eastern part of process unit 7.



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**Table MU12.1 Summary of Attributes of Management Unit 12**

| Coastal Processes           |                                                                                                                             |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Alternate phases of erosion and accretion. East Milsey Bay (erosion). West Milsey Bay (accretion).                          |
| Geomorphology               | Sand beaches backed by dunes, rocky headland                                                                                |
| Sediment Drift              | Low or moderate westerly drift                                                                                              |
| Coastal Defences            |                                                                                                                             |
| Type                        | Man-made: Timber wall, concrete/masonry walls, harbour, geotextile, rock revetment (tipped rocks)<br>Natural: Sand beach    |
| Human and Built Environment |                                                                                                                             |
| Land use                    | Residential, Golf Course                                                                                                    |
| Sea use                     | Fishing, Yachting, Boating trips                                                                                            |
| Infrastructure              | Roads, pipes                                                                                                                |
| Recreation and Tourism      | Bathing, bird-watching, walking, historic interest                                                                          |
| Historic Environment        | 209 sites of cultural heritage identified, including 3 scheduled ancient monuments                                          |
| Natural Environment         |                                                                                                                             |
| Habitat Types               | Rocky coast, sand beach, dunes, coastal grassland                                                                           |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site                                                                      |
| Key Interests               |                                                                                                                             |
|                             | Public concerns relate to litter issues. Erosion of East Beach and sand deposition on the road and sea spray was a concern. |
| Valuation of Assets         |                                                                                                                             |
|                             | £145 M                                                                                                                      |

**Table MU12.2 Screening of Strategic Options with Management Objectives**

| Strategic Option          | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|---------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention    | √                  | √           | √                         | √                         | •           | X                     | X         | X                      | √                   | √         | √             | NA       | X        |
| Limited Intervention      | √                  | √           | √                         | √                         | •           | X                     | X         | X                      | √                   | √         | √             | NA       | X        |
| Selectively Hold The Line | √                  | √           | √                         | •                         | √           | √                     | √         | √                      | •                   | √         | √             | NA       | √        |
| Advance The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

Some form of coastal defence protects the shoreline of MU12 for approximately 1.5km of its length. These are described from west to east below and summarised in Appendix D.

#### **Defence No 30**

A well-constructed timber wall backs the wide sand beach of North Berwick Bay for approximately 200m. The crest of this low wall is 1.3m above beach level and protects the putting green area on the landward side. The wall is constructed with timber sleepers, and is 5 sleepers high with timber buttresses embedded into the beach to offer support (Plate 9.22). The protection appears in generally good condition although occasional decay was noted, as would be anticipated given the material and environment. A narrow shingle upper beach at its western end protects the toe. Towards the west, the wall becomes obscured by sand accretion on the upper beach and merges into sand dunes further east. A sewage pipe is exposed in places along the back of the beach. The property maintenance survey carried out by East Lothian Council (Appendix E) noted various rotting timbers in the wall.

#### **Defence No 31**

The properties at North Berwick Bay are protected by original property walls, which back the wide, low gradient sandy beach. The walls are of varied elevation and are constructed mainly in masonry. There is little evidence of undermining, as the walls are well protected by the wide sandy beach and low sand dunes. However, it is likely that during storms some of the property walls will be subject to spray.

#### **Defence No 32**

A low masonry wall protects the area immediately to the west of North Berwick harbour (Plate 9.23). The crest of the wall appears to be at a very low elevation (approximately 3m OD) and the row of properties may consequently be at risk of flooding during storms and high spring tides. The wall itself is in reasonable condition but may need to be raised in future to cope with rising sea levels and/or increased storminess, albeit shelter afforded by the adjacent harbour may historically have reduced the risk of flooding in this area.

#### **Defence No 33**

North Berwick Harbour is founded on bedrock. Nevertheless there is evidence of some past settlement within the wall construction. In general, this traditional harbour can be described as being in reasonable condition and the harbour is well used, mainly by pleasure craft (Plate 9.24). The harbour entrance is to the west.

The harbour is constructed with masonry blocks, apparently largely mortar-free within the harbour. There is evidence of some erosion in places (NT553856). The outer wall has been rebuilt on the seaward side and there is also a newer concrete section, which has been fronted with rock armour. A large number of timber wedges in the joints were retaining individual masonry pieces in place prior to work progressing on the seaward face of the outer wall (Plate 9.25).

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#### **Defence No 34**

The remains of an old concrete swimming pool is north of the harbour. This has been filled in and is currently used to store small sailing boats. Low concrete walls, fronted by rock armour, surround this area. The Seabird Centre is at the eastern side of the rock headland and is protected by low masonry walls fronted by rock armour. The armour is approximately 20m wide and keyed into the bedrock. Masonry walls continue round to the east and adjoin the walls behind the sand beach on the East Links. This defence is generally in good condition and is protected by bedrock.

#### **Defence No's 35, 36, 37 & 38**

A low concrete seawall backs the western side of East Links beach for 150m (Defence 35). The wall is approximately 1m above the beach level and protects the road and promenade from flooding. The wall is generally in good condition and is well protected from waves by the wide sandy beach and the paddling pool in the lower foreshore.

East of the seawall, vegetated sand dunes back the wide sandy beach for the entire extent of East Links, providing protection to the road and houses behind. A ca. 0.5 - 1.5m high concrete wall runs along the back of the dunes providing additional protection to the road. The dunes are well vegetated and healthy along most of the shoreline, although there are localised areas of erosion, with ad-hoc protection, described below.

At the car park in front of Castle Hill erosion of the dune face was observed, probably due to human pressure accessing the beach from the parking area. Dune erosion has exposed about 20m of old concrete railway sleepers, which have been laid on the face of the dunes to provide protection (Defence 36).

Further east, seaward of Tantallon Terrace at NT 562851, geotextile matting has been placed to encourage vegetation of the dune face (Defence 37). The geotextile matting has been eroded in places, although in general the dunes are well vegetated.

At NT565852, there is evidence of localised dune erosion (Defence 38). The 1m high dune face is erosional for around 40m and has been protected by large rocks of random geology and shape. The defence has failed and all that remains are the large rocks at the toe of the dunes (Plate 9.26). The coastal defences along this stretch were put in place in 1997 (M Hutchison, pers. comm. 2001) and require immediate attention.



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## ***Land-use***

Over 60% of land within MU12 comprises the built-up area of North Berwick (Table 9.56). The built-up area is adjacent to the shoreline for most of the extent of MU12. Golf courses back the shoreline in the west and east of the management unit (Figure 9.3). Arable land covers 44ha of land in the landward part of MU12.

**Table 9.56: Land-use classification in MU12 (source: MLURI 1988)**

| Land-use class     | Domain                                   | Area (ha) |
|--------------------|------------------------------------------|-----------|
| Recreational Land  | Golf course                              | 8.1       |
| Factories & urban  | Built-up (area)                          | 141.0     |
| Smooth grassland   | Undiff. smooth grass.: no rock no trees  | 1.7       |
| Smooth grassland   | Smooth grass/low scrub: no rock no trees | 12.2      |
| Smooth grassland   | Undiff. smooth grass.: rock trees        | 3.5       |
| Improved grassland | Imp. pasture: no rock no farms no trees  | 11.1      |
| Arable             | Arable: no rock no farms no trees        | 44.3      |
| Total              |                                          | 221.9     |

## ***Residential Development, Industry, Ports and Harbours***

The residential area of North Berwick, with a population of 5808 (in 1994), lies in MU12 (East Lothian Council 1998). The town has a relatively large retired population, and because of its railway link with Edinburgh is also attractive to commuters. North Berwick harbour (described above) lies within MU12, although it is mainly used for pleasure crafts.

## ***Recreation and Tourism***

Tourism makes an important contribution to North Berwick's economy with numerous recreation and tourist activities attracting visitors to the town. The beaches of North Berwick Bay and Milsey Bay both attract large numbers and are designated Bathing beaches under the EEC Bathing Water Directive and are recognised by East Lothian Council as of amenity value (Ash 1994). The Council, using a tractor to remove seaweed and litter, cleans both beaches during the summer months.

The Harbour, esplanade and headland are popular attractions for residents and visitors. The Scottish Seabird Centre has recently been developed on the site of the Old Pavilion, close to the Harbour. The Centre is a significant educational resource as well as a major tourist attraction, which is expected to attract 56,000 visitors per year (East Lothian Council 1998). Boat trips to Bass Rock and Fidra Island operate from North Berwick during the summer, for bird and seal watching as well as the historic interest of these sites (Barne et al 1997).

The outdoor swimming pool in North Berwick has recently closed. The site, adjacent to the harbour, has been concreted over and is currently used to store boats. The Council have a long-term commitment to develop the site, although the type of development has not yet been confirmed (J. Squires, pers. comm. 2001).

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The historical interest of North Berwick also attracts visitors to the area. In particular, the North Berwick Law fort and the castle on Castle Hill, both of which are scheduled ancient monuments, are important attractions.

The two golf courses of North Berwick also attract large number of visitors to the area. East Lothian Yacht Club operates from North Berwick harbour, thus water-based recreation is important within the management unit. There is a caravan park in North Berwick (NT564846).

#### ***Fishing Activity***

A number of small working fishing boats were observed in North Berwick harbour, but the importance of this activity to the local economy is likely to be relatively limited.

#### ***Agriculture and Forestry***

There is no forestry within MU12 and a small area of agricultural land (44ha) lies on the landward boundary of the management unit.

#### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU12.

#### ***Water Quality and Pollution***

The water quality in MU12 is generally good, with both the Bathing beaches of North Berwick Bay and Milsey Bay achieving Guideline Passes of the EEC Directive in 2001.

Milsey Bay also achieved a Guideline Pass in 2000, whereas North Berwick Bay only managed a Mandatory Pass of the Directive. The waters of North Berwick Bay and Milsey Bay were classified as Class B (Good) and Class A (Excellent), respectively, by SEPA in 2000.

#### ***Archaeology and Built Heritage***

There are three scheduled ancient monuments within MU12: St Andrew's Church on the headland close to the Seabird Centre (NT554855); North Berwick Law, which has a fort, hut, circles and enclosures (NT556842) and the castle on Castle Hill, East Links (NT560851), none of which are threatened by coastal erosion.

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Fifty other unscheduled archaeological sites have been identified in MU12 (Table 9.57) indicating the rich and interesting historical past of the area. A number of the archaeological sites are located on the harbour headland (e.g. an excavation in the vicinity of the Scottish Seabird Centre, grave slabs and burial ground near the remains of St Andrew's Church). All of the other archaeology sites are set back from the shoreline, with the exception of the old military trenches at the eastern end of Milsey Bay (NT568853)

**Table 9.57: Cultural Heritage Within MU12**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 50     | RCAHMS            |
| Scheduled Ancient Monuments   | 3      | Historic Scotland |
| Listed Buildings*             | 111    | ELC               |
| Architecture Sites*           | 45     | RCAHMS            |
| TOTAL                         | 209    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

There are 111 Listed Buildings in MU12, most of which are located within the North Berwick Conservation Area, which encompasses the original core of the town that developed south of the Harbour on a skewed grid pattern in the 18<sup>th</sup> and early 19<sup>th</sup> centuries (East Lothian Council 1998). The Council propose to extend the Conservation area to include West Links Golf Course and the beach above MLWS (East Lothian Council 1998). As the status confers special development rights onto the designated area, it has planning implications for proposals for coastal defence works in the area.

### **Natural Environment**

91 ha of land within MU12 was unclassified during the Phase 1 habitat survey of East Lothian. This represents the built-up area of North Berwick and roads. A narrow strip of dunes and unimproved grassland runs adjacent to the coastline at the eastern end of the management unit, the remainder of the shoreline is backed directly by the urban area or roads.

The coastline of MU12 has been recently designated as part of the Firth of Forth SSSI. The inter-tidal west of the harbour is within the Gullane – North Berwick section and east of the harbour is within the North Berwick Coast section of the SSSI. The natural environment interests of each are described in Table 9.43 and Table 9.62, respectively. The inter-tidal area also forms part of the Firth of Forth SPA and Ramsar site (Figure 7.2), important for ornithological and wetland interests.

North Berwick Law, which lies approximately 800m landward of the shoreline has been designated a SSSI for its botanical interest, however this is unlikely to be affected by shoreline management. North Berwick Law is also a Scottish Wildlife Trust Wildlife Site.

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**Table 9.58: Phase 1 Habitats within MU12 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 2.8       |
| A1.1.2       | Broad-leaved, plantation            | 1.9       |
| A1.3.2       | Mixed woodland, plantation          | 0.3       |
| A2.1         | Dense scrub                         | 1.1       |
| B1.1         | Acid grassland, unimproved          | 4.5       |
| B2.1         | Neutral grassland, unimproved       | 1.5       |
| B2.2         | Neutral grassland, semi-improved    | 8.2       |
| B4           | Improved grassland                  | 16.7      |
| B6           | Poor semi-improved grassland        | 6.3       |
| F1           | Swamp                               | 1.1       |
| H6.5         | Dune grassland                      | 1.0       |
| I1.4.2       | Rock exposure, acid/neutral         | 0.0       |
| J1.1         | Arable                              | 38.0      |
| J1.2         | Amenity grassland                   | 36.7      |
| J3.4         | Caravan site                        | 0.8       |
| J3.6         | New Buildings                       | 7.5       |
| Unclassified | Urban                               | 93.5      |
| Total        |                                     | 221.9     |

### ***Relevant policies and plans***

Potential plans that may impact the SMP include the Council's plan to develop the site of the old outdoor swimming pool at North Berwick and the plan to convert the red sandstone warehouse, close to the pool site, to flats (Table 2.7). This site is already well protected by robust coastal defences (Defence No 34) and any change in use is unlikely to have a significant impact on coastal defence needs.

The proposed extension of the North Berwick Conservation Area to include the beach on either side of the harbour headland may have an impact on proposals for future coastal defence works here. There may be a requirement to design them with consideration of the local environment and conservation needs.

### ***Key interests***

The interests of West Links Golf Course were discussed in MU11 (Section 9.7.1). These interests also apply to a short section of the western part of MU12. No other written comments relating to MU12 were received during the consultation. Public concerns regarding MU12 relate mainly to issues of general litter on the beaches and the need for more bins. Problems of erosion of East Beach were noted and concern was expressed regarding sand deposition on the road and sea spray on the houses during northerly storms. Other comments suggest that the erosion on East Beach is cyclical and note that in recent years there has been accretion of sand in the western part of the beach (SPI 2001a).

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### **Valuation of Assets**

The urban area comprises almost half the area of MU12 (Table 9.59), giving a high estimated valuation of the assets in the management unit (approximately £145M). Urban land-use lies adjacent to the shoreline for a large stretch of the unit.

**Table 9.59 Valuation of Assets in MU12**

| Asset Type                | % Land in Category | Value (£)          |
|---------------------------|--------------------|--------------------|
| High Quality Agricultural | 31%                | 349 350            |
| Open Area                 | 23%                | 52 144             |
| Urban                     | 46%                | 144 487 000        |
| <b>Total</b>              |                    | <b>144 888 494</b> |

### **Option Evaluation**

Natural coastal changes in MU12 appear to be cyclical with alternate phases of erosion and accretion (East Lothian Council 2001d). The beach level at North Berwick Bay has been observed to vary by as much as 1m during the year. Problems created by the accretion of sand in Milsey Bay were alleviated by the Council during the winter of 2000/2001 who removed sand to prevent it clogging drains and blocking the roads (East Lothian Council 2001d). At the same time erosion in the eastern part of the Bay was occurring, causing the coastal defences (Defence No 38) to fail. As sediment transport is believed to be from east to west in this process unit, it is postulated that erosion of the eastern part of Milsey Bay is fuelling accretion in the west, where the sediment builds up due to the natural obstruction of the rocky headland. GUARD (1996) classified the entire shoreline of the management unit as accreting or stable.

The hinterland of MU12 is built-up, with roads and housing adjacent to the shoreline, potentially at risk to erosion or flooding. However, as North Berwick is built on raised beach deposits (GUARD 1996) and is thus at higher elevation the real threat is minimal. **Advance the Line** and **Retreat the Line** options are not considered feasible for MU12.

As there are no long-term erosion rates for this management unit, estimation of the monetary value of potential losses under the **No Active Intervention** option is impossible. As the beach changes appear to be cyclical, it is recommended that a policy of minimal intervention to the natural shoreline should be followed. Erosion of a section of beach/dune may be short-lived and may be compensated by a subsequent period of accretion, such that the overall change is negligible. Thus, a **Hold the Line** option for the entire management unit is not feasible and natural coastal processes should be allowed to operate as far as is practicable.

There are certain sections in MU12 where the defence line should be maintained to avoid risk of land and property. Thus, it is recommended that a **Selectively Hold the Line** option is pursued. The property walls backing the shoreline of North Berwick Bay (Defence No's 31 and 32) and the Harbour and Seabird Centre defences (Defence No's 33 and 34) should be maintained. Defence 31 consists of a mix of property walls, which are well protected for extreme waves by the wide sand beach, although sea-spray may be a problem.

The low masonry wall (Defence No 32) is at a very low level (approximately 3m OD) and may need to be raised in the future to cope with the predicted rise in sea level over the next 50 years. The outer harbour wall is currently undergoing ongoing maintenance and repairs to jointing (Plate 9.25), while defences at the Seabird Centre currently offer robust protection (Appendix D). The promenade wall at East Links (Defence No 35) should also be maintained.

It is recommended that a series of fixed monitoring stations be established to monitor the erosion/accretion trends in Milsey Bay. Short-term solutions to localised erosion is not practicable and often do not solve the problem (e.g. the failure of Defence 38, Plate 9.26 has resulted in a series of unsightly large rocks at the toe of the dunes serving no coastal defence solution). Dune erosion that is not causing a threat to roads or property should be allowed to continue, as this is a natural process, which may be short-lived. However, if beach monitoring indicates that coastal erosion is threatening the integrity of the road, soft coastal defences should be considered to help stabilise the dunes and encourage vegetation.

The geotextile matting at Tantallon Terrace (Defence 37) appears to have been successful in encouraging vegetation of the dune face and this type of defence should be given priority over hard defences such as rock armour. Consideration should also be given to the recycling of sand removed from the road in the western part of Milsey Bay (discussed above) back to the eroding sections of beach in the eastern part of the Bay, instead of removing sediment from the system. In addition, it is recommended that the remainder of Defence No 38 be removed from the toe of the dunes.

The cost of the Selectively Hold the Line option, assuming that some of the existing defences are maintained and that the remainder of the shoreline is monitored is approximately £42 000 (NPV 2001) over the 50 years of the Plan period. The monetary benefits of Selectively Hold the Line have not been estimated for reasons outlined above. A policy of Selectively Hold the Line is anticipated to have negligible impact on adjacent shorelines.

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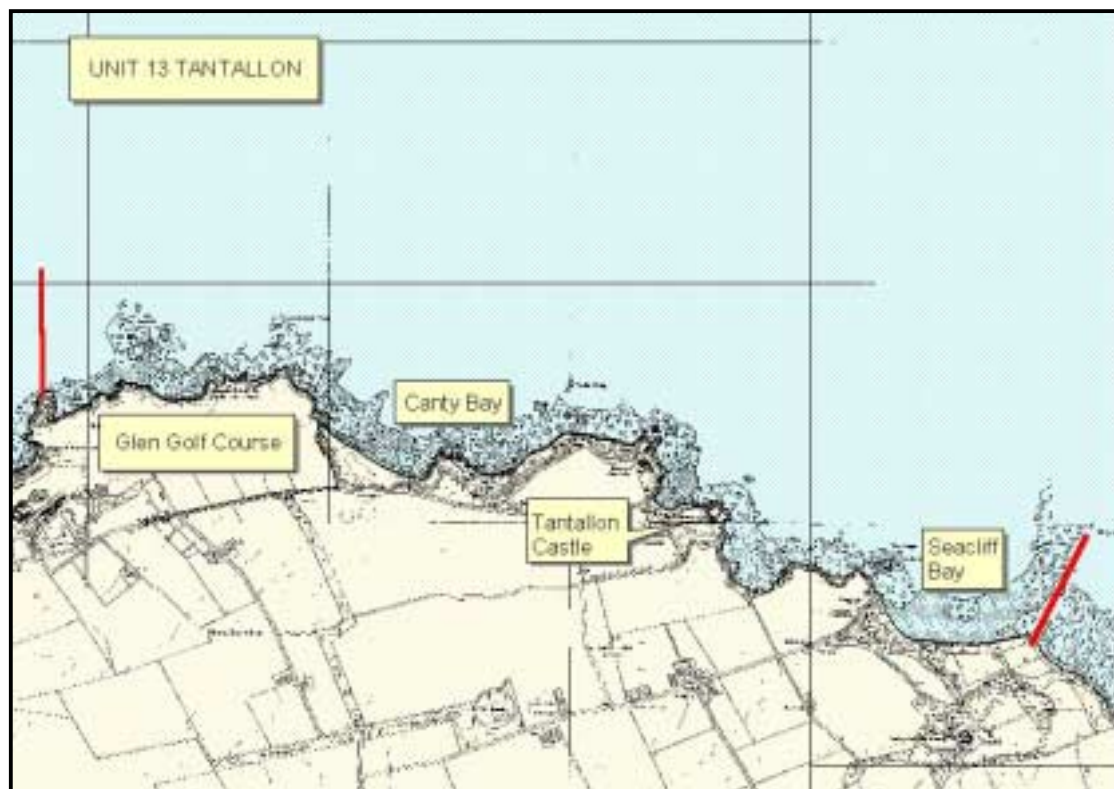
## 9.8 PU8: NORTH BERWICK TO ST. BALDRED'S BOAT

PU8 forms one distinct management unit (MU13). This rocky stretch of coast is northerly facing, from the headlands of Rugged Knowes to St. Baldred's Boat. The coast comprises high (up to 30 m) sandstone cliffs in places with rocky foreshores; whilst other areas are low-lying sandy bays with a blown sand hinterland (GUARD 1996). Localised accretion has occurred at Canty Bay between 1907 and 1999 (Table 4.6). The sandstone cliffs are being undermined at their base by wave action along much of this shoreline (GUARD 1996).

The dominant wave directions for this stretch of coast are likely to be from the sector between west-northwest and east-northeast. Sediment transport is believed to be from east to west for this section of the coast (Barne et al., 1997). Refer to Section 4.6 for further details of sediment transport processes.

### 9.8.1 Management Unit 13, Tantallon

Management Unit 13 covers approximately 5.5km of shoreline from Rugged Knowes in the west (NT568856) to St Baldred's Boat in the east (NT609845). The offshore island of Bass Rock is approximately 2km offshore the coast of MU13, and is included in the management unit as it lies within the 20m depth contour.



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**Table MU13.1 Summary of Attributes of Management Unit 13**

| Coastal Processes                                                                                                                                     |                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution                                                                                                                                   | Generally stable. Localised accretion (Canty Bay). Undercutting of sandstone cliffs.                                                                                          |
| Geomorphology                                                                                                                                         | Sandstone cliffs, rocky foreshore, sand beaches                                                                                                                               |
| Sediment Drift                                                                                                                                        | Low or moderate westerly drift                                                                                                                                                |
| Coastal Defences                                                                                                                                      |                                                                                                                                                                               |
| Type                                                                                                                                                  | Natural: Sand beach                                                                                                                                                           |
| Human and Built Environment                                                                                                                           |                                                                                                                                                                               |
| Land use                                                                                                                                              | Golf course, agriculture                                                                                                                                                      |
| Sea use                                                                                                                                               | Boat trips to Bass Rock, fishing                                                                                                                                              |
| Infrastructure                                                                                                                                        | -                                                                                                                                                                             |
| Recreation and Tourism                                                                                                                                | Bird-watching, walking, historic interest                                                                                                                                     |
| Historic Environment                                                                                                                                  | Tantallon Castle is a scheduled ancient monument, a Category A Listed Building and is managed by Historic Scotland. 55 other sites of cultural heritage have been identified. |
| Natural Environment                                                                                                                                   |                                                                                                                                                                               |
| Habitat Types                                                                                                                                         | Rocky coast, sand beach, dunes, coastal grassland                                                                                                                             |
| Designated Sites                                                                                                                                      | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Forth Islands SSSI/SPA/Ramsar Site                                                                                  |
| Key Interests                                                                                                                                         |                                                                                                                                                                               |
| Glen Golf Course expressed concern regarding erosion of the course. Concern about long-term integrity of archaeology sites on eroding coastal cliffs. |                                                                                                                                                                               |
| Valuation of Assets                                                                                                                                   |                                                                                                                                                                               |
| £ 32M                                                                                                                                                 |                                                                                                                                                                               |

**Table MU13.2 Screening of Strategic Options with Management Objectives**

| Strategic Option               | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|--------------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention         | √                  | √           | √                         | √                         | •           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention           | √                  | √           | √                         | √                         | •           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line (or Selectively) | √                  | X           | X                         | X                         | √           | √                     | √         | X                      | X                   | X         | √             | NA       | NA       |
| Advance The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable



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### ***Coastal Defences***

No coastal defences were identified in MU13. As most of this shoreline consists of sandstone cliffs with a rocky foreshore, erosion rates are likely to be relatively low.

### ***Land-use***

The principal land-use within MU13 is Arable Land, which comprises almost 80% of the management unit (Table 9.60). North Berwick Glen Golf course covers 37ha of land in the western part of the management unit. All of the immediate coastal hinterland is classified as smooth grassland, with the exception of a small area of mixed woodland that forms the hinterland of Seacliff Bay (Figure 9.3). Only 2.6ha of MU13 is classed as built-up area (Table 9.60) and is located landward of the Glen Golf Course, thus it is not at risk from erosion or flooding.

**Table 9.60: Land-use classification in MU13 (source: MLURI 1988)**

| Land-use class     | Domain                                  | Area (ha) |
|--------------------|-----------------------------------------|-----------|
| Arable             | Arable: no rock no farms no trees       | 359.5     |
| Factories & urban  | Built-up (area)                         | 2.6       |
| Smooth grassland   | Undiff. smooth grass.: no rock no trees | 32.5      |
| Recreational land  | Golf course                             | 37.0      |
| Mixed woodland     | Undiff. mixed woodland (area)           | 19.8      |
| Improved grassland | Imp. pasture: no rock no farms no trees | 1.6       |
| Total              |                                         | 453.0     |

### ***Residential Development, Industry, Ports and Harbours***

There is no industry, ports or harbours within MU13. A very small part of the residential area of North Berwick lies in the western part of the management unit.

### ***Recreation and Tourism***

Tantallon Castle (NT595850) is a major tourist attraction within MU13, attracting over 25,000 visitors a year (SNH 1999b). Most of these visitors remain in the Castle and the amenity grassland area adjacent to the castle. They cannot access the inter-tidal area due to the steep cliff section.

Informal recreation is fairly low-key over most of MU13, primarily due to access difficulties. There is a small car park at the western end of the management unit and from this walkers can either follow the shoreline or the "cliff-top" path. However, not many venture more than a few hundred metres (SNH 1999b).

There is a caravan park within MU13, located at NT572850. Glen Golf Course lies seaward of the park and also provides a recreation facility within the management unit.

Seacliff beach is privately owned and access to this remote and attractive beach is controlled. However heavy visitor pressure in the summer months may have led to the demise of a small tern colony at St Baldred's Boat and it may also continue to affect the breeding success of eider, ringed plover and oystercatcher (SNH 1999b).

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### ***Fishing Activity***

There is no commercial fishing activity within MU13.

### ***Agriculture and Forestry***

Agriculture is the main economic activity within MU13. The agricultural land lies close to the shoreline for a large part of the management unit, although a narrow strip of smooth grassland separates it from the coast (Figure 9.3).

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites in MU13.

### ***Water Quality and Pollution***

The coastal water quality was classified as Class A (Excellent) in 2000 for the entire shoreline of MU13 (SEPA 2000). There are no designated bathing beaches in MU13. There is a long sea outfall within MU13, which is located approximately 700m offshore of Leckmoran Ness (NT578864) (SNH 1999b).

### ***Archaeology and Built Heritage***

The rocky shoreline of MU13 contains a large number of sites of cultural heritage, many of which lie very close to the shoreline (Figure 9.4). Tantallon Castle is a scheduled ancient monument and a Category A Listed Building and is afforded further protection as it is in Guardianship and is managed by Historic Scotland on-site. The 16<sup>th</sup> century house of Auldham (NT602846), traditionally known as St Baldred's House, is also a scheduled ancient monument, although a recent survey suggests it is in very poor condition and as it stands on the edge of a slope with little vegetation cover to stabilise it, it is potentially vulnerable to erosion (GUARD 1996).

**Table 9.61: Cultural Heritage Within MU13**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 5      | RCAHMS            |
| Archaeological Sites (land)   | 26     | RCAHMS            |
| Scheduled Ancient Monuments   | 2      | Historic Scotland |
| Listed Buildings*             | 14     | ELC               |
| Architecture Sites*           | 9      | RCAHMS            |
| TOTAL                         | 56     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

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31 other archaeological sites of interest have been identified within MU13, 5 of which are maritime sites (Table 9.61). The maritime sites are 5 shipwrecks: one at Bass Rock (NT601875), three at Great Carr Rocks (NT610850) and one off the cliffs at Tantallon Castle (NT597852). Many of the unscheduled archaeological sites lie close to the existing shoreline including caves, burial site and bronze brooch at Leckmoram Ness (NT575856); an enclosure on the cliff-top at Canty Bay (NT585852); military defence at Gin Head (NT591853); field boundary and harbour, Castleton (NT595851); rock-cut ditch at Seacliff (NT597848); remains of a deserted medieval village at Auldham (NT602846); a midden with various finds at The Gegan, Seacliff (NT603848); and a cave at St Baldreds Cove (NT605849).

There are 14 Listed Buildings, of which only Tantallon castle lies within 200m of the shoreline. The lighthouse on Bass Rock is a C class listed building.

### ***Natural Environment***

The inter-tidal area of MU13 is within the North Berwick Coast section of the Firth of Forth SSSI, which extends along a 9km stretch of coast from North Berwick Harbour (NT552855) to Pepper Sands (NT622829) and has been notified for its botanical, ornithological and coastland geological interests (Table 9.62). It is also part of the Firth of Forth SPA and Ramsar site for its ornithological interest. It is an almost entirely inter-tidal site, up to 150m wide and largely rocky with occasional small sandy coves and also a larger sandy beach (at Seacliff). Above the high tide mark (and close to the border of the SSSI), the landward boundary comprises steep, grass-covered slopes and small sections of cliffs about 10-30m high. Around Tantallon Castle there is a longer 1km, 30m high, stretch of cliff.

Scottish Natural Heritage have developed the following long-term objectives for management of this section of the SSSI, which will be taken into consideration while developing the SMP options:

1. To maintain North Berwick Coast SSSI's inter-tidal habitat, keeping it in a favourable condition for the continued feeding and roosting of all key bird species (as identified by the EC Directive).
2. To maintain the botanical interest for which North Berwick Coast has now been notified a SSSI. To achieve this, populations of rare plants (both Scottish and local rarities) must be sustained.
3. To maintain the geological exposures and to ensure that they are not damaged or obscured.
4. The use of the site by universities for individual and group research should be encouraged and maintained. This research, when carried out responsibly, is a low impact activity and provides important data on the geology and ecology of coastal sites. It could also help to highlight any environmental changes taking place in these areas.

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**Table 9.62 Summary of the botanical, ornithological and geological interests of North Berwick Coast section of the Firth of Forth SSSI (source SNH 1999b)**

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Botanical interest      | Mineral-enriched grassland is found on the cliff tops close to the SSSI boundary. This is an unusual habitat for East Lothian and contains some rare plants (both Scottish and local rarities).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Ornithological interest | During winter the inter-tidal area is important as a roosting and feeding site for over-wintering waders (including turnstone) and wildfowl. During summer the cliffs around Tantallon Castle provide a nesting area for important breeding colonies of fulmar and house martin. Due to its ornithological interest North Berwick SSSI forms part of the Firth of Forth Special Protection Area (SPA) under the terms of the European Community Directive 79/409/EEC on the Conservation of Wild Birds. It is also a Ramsar site (for Waterfowl Habitat) under the Ramsar Convention on Wetlands of International Importance                                                                                                                              |
| Geological interest     | There are many accessible igneous and sedimentary geological exposures throughout the inter-tidal area; the Geological Conservation Review has identified two "Single Interest Locality" (SIL) sites. The first of these is the North Berwick Coast SIL, which comprises the whole of North Berwick Coast SSSI, part of Gullane - Broadsands SSSI and a non-SSSI section between the two. This SIL contains extensive exposures of early Carboniferous volcanic rocks, which were formed between 360 and 320 million years ago. The second SIL is Oxroad Bay, which actually lies within the former SIL (and North Berwick Coast SSSI) and has been designated for its well-preserved, fossilized plants, again dating to the early Carboniferous period. |

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The Phase 1 habitat survey of East Lothian classified 318ha of land within MU13 as Arable (Table 9.63). The coastal habitats comprise open dunes, dune scrub, dune grassland, coastal grassland, broad-leaved plantations, and the amenity grassland area at Tantallon Castle. The Bass Rock is also a designated SSSI and forms part of the Forth Islands SPA. The Bass Rock is an island formed from the remains of volcanic plugs and is 110m high with sheer cliffs dropping into the sea on three sides. The main interest of the site is its huge gannet colony with at least 34,000 breeding pairs making it the second largest British and European gannetry. This represents 15%, 12% and 9% of the British, European and world gannet populations respectively. The gannets mainly nest on the top of the island above the cliffs and the colony is currently increasing at a rate of 5.3-7.0% per annum (SNH 1997b). On the cliffs below the gannets a variety of other seabird species (kittiwakes, guillemots, fulmar, razorbills and shags) nest although none in such great numbers.

The number of visitors to The Bass Rock is low, visited only by small groups of tourists, occasional researchers and lighthouse maintenance personnel. Management objectives are to safeguard the site ensuring compliance with EC Habitats and Birds Directives obligations and continue to monitor the seabird species (SNH 1997b).

**Table 9.63: Phase 1 Habitats within MU13 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 6.0       |
| A1.1.2       | Broad-leaved, plantation            | 4.3       |
| A1.2.2       | Coniferous plantation               | 0.8       |
| A1.3.2       | Mixed woodland, plantation          | 10.9      |
| B2.1         | Neutral grassland, unimproved       | 7.4       |
| B2.2         | Neutral grassland, semi-improved    | 0.2       |
| B4           | Improved grassland                  | 12.1      |
| B6           | Poor semi-improved grassland        | 1.4       |
| C3.1         | Tall ruderal                        | 0.3       |
| G1           | Standing water                      | 0.2       |
| H6.5         | Dune grassland                      | 4.6       |
| H6.7         | Dune scrub                          | 1.4       |
| H6.8         | Open dune                           | 1.6       |
| H8.4         | Coastal Grassland                   | 6.1       |
| J1.1         | Arable                              | 318.4     |
| J1.2         | Amenity grassland                   | 40.3      |
| J3.4         | Caravan site                        | 8.6       |
| J4           | Bare ground                         | 0.3       |
| Unclassified | Urban                               | 28.1      |
| Total        |                                     | 453.0     |

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### ***Relevant policies and plans***

The preferred coastal corridor route proposed by Halcrow Fox (1998) is 1-2km inland of the shoreline on this section of coast, along existing rights of way. This would reduce visitor pressure on the shoreline. An alternative route runs along the cliff-top trail, although this is subject to access agreements (Halcrow Fox 1998).

### ***Key interests***

Glen Golf Course expressed concern regarding erosion on the 13<sup>th</sup>/14<sup>th</sup> holes (K. Fish, pers comm. 2001). There only specific request was that monitoring be carried out professionally so problems can be properly assessed. There is also concern about the threat of coastal erosion to the archaeological interests in the management unit (GUARD 1996). Many of the archaeological sites are very close to the edge of the high cliffs (e.g. Tantallon Castle) and there are concerns about their long-term integrity.

During the public consultation exercise, concern was raised regarding localised erosion at Canty and Seacliff Bays. Comments were also made regarding the increase in seaweed on the rocks at Canty Bay and the increase in rotting seaweed on Seacliff beach (SPI 2001a).

### ***Valuation of Assets***

The estimated value of the assets within MU13 is £32M (Table 9.64), based on the land values set out in Chapter 8. However, this takes no account of the value of the archaeological heritage (e.g. Tantallon Castle), which has been classified, as part of the open area.

**Table 9.64 Valuation of Assets in MU13**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b> |
|---------------------------|---------------------------|------------------|
| High Quality Agricultural | 70%                       | 1 591 210        |
| Open Area                 | 25%                       | 115 838          |
| Urban                     | 5%                        | 30 457 000       |
| <b>Total</b>              |                           | 32 164 048       |

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### ***Option Evaluation***

Over the last 90 years analysis of historic map information has shown that the position of the MHWS has remained generally unchanged along the rocky coast of MU13 (Appendix C, View 14). Future increases in sea-level and increased storminess would not be expected to substantially impact cliffs and rock platforms, although a reduction in inter-tidal width under SLR could lead to the potential loss of sand beaches seaward of the cliffs (Chapter 4). However, historical map analysis indicates that there has been recent accretion at Canty Bay and Seacliff Bay. East Lothian Council Countryside Rangers indicated that any localised erosion of the dunes at Seacliff is likely to be caused by human disturbance (East Lothian Council 2001d). During the site visit in August 2001, there was no evidence of erosion at Seacliff beach.

**Hold the Line** is not viable for MU13. The coastline is natural and of high nature conservation interest. Rates of erosion of the rocky shoreline are negligible and attempts to provide defences along this shore would be extremely costly, unnecessary and detrimental to the environmental and conservation interests of the coastline. **Advance the Line** and **Retreat the Line** are not considered feasible options for MU13, as the line of defence along the management unit is natural and there are no man-made defences in place.

**No Active Intervention** is the preferred option for MU13. Following this policy, the potential loss of land due to erosion in the next 50 years is likely to be negligible, given the lack of past changes along the shoreline. Future increases in sea-level and increased storminess will have minimal effect on cliffs and rock platforms, although there may be a loss of sand beaches seaward of the cliffs.

The cost implications (in terms of loss of land) of the No Active Intervention option are likely to be negligible. No Active Intervention is also compatible with the nature conservation objectives of the management unit, as this will cause minimal disturbance to the rare botanical interests and breeding bird population of the shoreline and will have negligible impacts on adjacent shorelines.

However, it is recommended that fixed monitoring stations be set up at sensitive locations (e.g. Glen Golf course and potentially threatened sites of archaeological interest) in order to establish the rates and trends of coastal erosion. This will enable future decisions to be made with a much better understanding of the problem.

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#### **9.9 PU9: ST. BALDRED'S BOAT TO ST. BALDRED'S CRADLE**

PU9 forms one distinct management unit (MU14). St. Baldred's Boat has been utilised as a process unit boundary on the basis of Firth et al. (1995) describing the headland as a littoral divide, with material moving both to the west and south east.

This stretch of northeasterly facing coast contains the bay of Peffer Sands and Ravensheugh Sands located between two rocky promontories at St. Baldred's Boat and St. Baldred's Cradle. This 2km long wide sandy beach has a steep profile and is backed by low-lying hinterland of dunes, blown sand and raised beach. During the site visit in July 2001, the low dunes appeared to be well vegetated with marram grass and in general the dunes appeared to be fairly stable, although localised active areas may have been present in places.

Analysis of historical maps indicated that there are localised areas of accretion at Scoughall Rocks and Bathan's Strand (Ravensheugh Sands) (Table 4.6), however on the whole there has been little change in the MHWS position along this management unit (Appendix C, View 15). St. Baldred's Cradle has cliffs 5 - 7 m high, which are eroding due to the till hinterland overlying bedrock. The foreshore is composed of rock platforms (GUARD, 1996). Anthropogenic influences include historical sand extraction in the area of Ravensheugh Sands (East Lothian District Council, 1976). Rubble coastal defences at Peffer Sands are covered/uncovered on a seasonal timescale due to beach level changes, which are highly variable (East Lothian Council, 2001d). Seasonal profile changes also occur at Ravensheugh Sands (GUARD, 1996).

The dominant wave directions for this stretch of coast are from the sector between north and east. There is some dispute over the general direction of sediment transport for this section of coast. Although sediment transport is reported to be in a southeasterly direction (Firth et al., 1995), some other workers report sediment transport being from east to west for this section of coast (Barne et al., 1997). However, the actual amounts of longshore transport are likely to be small since most of the beach systems in this area are believed to be largely self-contained in terms of sediment movements (Ramsay and Brampton, 2000). Refer to Section 4.6 for further details of sediment transport processes.

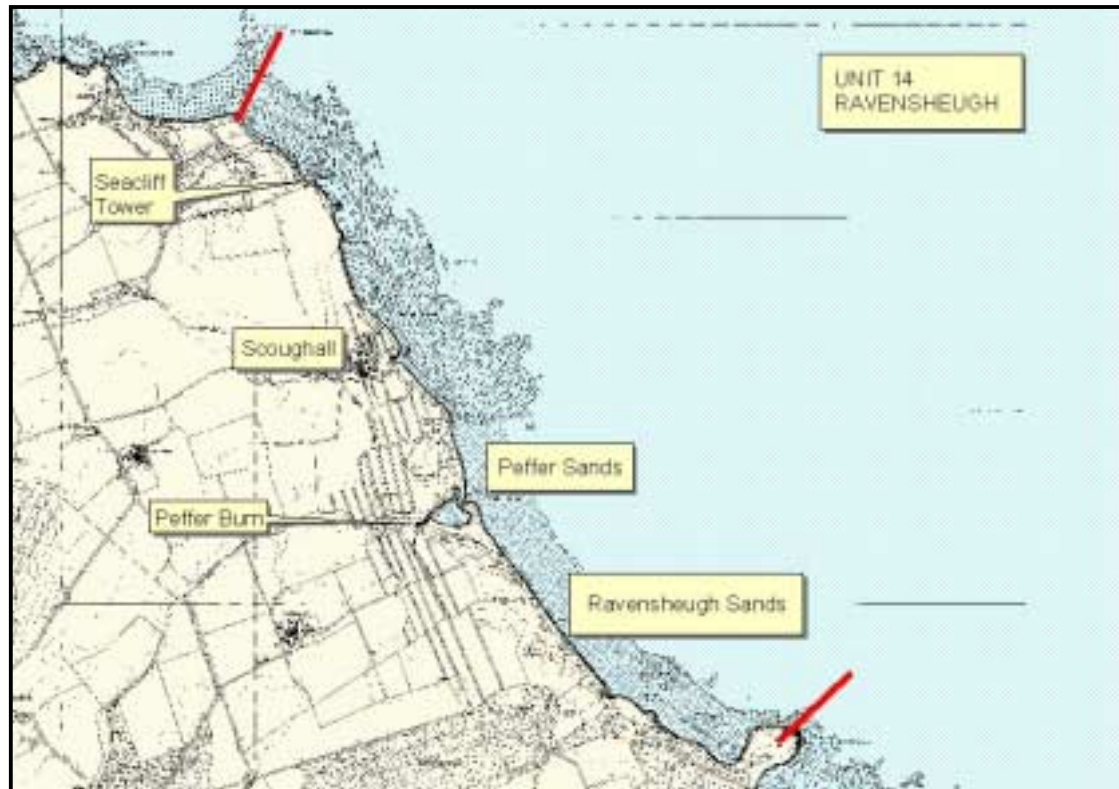


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## 9.9.1 Management Unit 14, Ravensheugh

Management Unit 14 covers approximately 4.5km of shoreline from St. Baldred's Boat in the west to Ravensheugh Sands in the east.



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**Table MU14.1 Summary of Attributes of Management Unit 14**

| Coastal Processes           |                                                                                                                                                         |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Generally stable. Localised areas of accretion and erosion.                                                                                             |
| Geomorphology               | Rocky headlands, sand beach, low-lying hinterland of dunes, blown sand and raised beach                                                                 |
| Sediment Drift              | Low or moderate southeasterly drift                                                                                                                     |
| Coastal Defences            |                                                                                                                                                         |
| Type                        | Man-made: Small areas of dune fencing<br>Natural: Sand beach                                                                                            |
| Human and Built Environment |                                                                                                                                                         |
| Land use                    | Agriculture                                                                                                                                             |
| Sea use                     | Limited sea fishing, wildfowling in inter-tidal area                                                                                                    |
| Infrastructure              | -                                                                                                                                                       |
| Recreation and Tourism      | Bird-watching, walking, horse-riding, historic interest                                                                                                 |
| Historic Environment        | 2 scheduled ancient monuments (Seacliff Tower and settlement) are located close to the coast. 29 other sites of cultural heritage have been identified. |
| Natural Environment         |                                                                                                                                                         |
| Habitat Types               | Rocky coast, sand beach, dunes, coastal grassland                                                                                                       |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Part of John Muir Country Park                                                                |
| Key Interests               | -                                                                                                                                                       |
| Valuation of Assets         | £ 22M                                                                                                                                                   |

**Table MU14.2 Screening of Strategic Options with Management Objectives**

| Strategic Option               | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|--------------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention         | √                  | √           | √                         | √                         | •           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention           | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line (or Selectively) | √                  | X           | X                         | X                         | √           | √                     | √         | X                      | X                   | X         | √             | NA       | NA       |
| Advance The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

No hard coastal defences were identified in MU14. However, localised rubble coastal defences have been placed at the toe of the dunes fronting the Scripture Union Summer camp, which are covered/uncovered on a seasonal timescale due to beach level changes (East Lothian Council 2001d). These were not observed during the site visit and are unlikely to be engineered coastal defences. Small areas of Dutch fencing and marram grass have been planted to deal with local erosion (East Lothian Council 2001d). Local erosion is likely due to human disturbance, although there are reports of north-easterly storms causing undercutting of the dunes (East Lothian Council 2001d).

### ***Land-use***

Only 4.5ha of land within MU14 is classified as built-up area (Table 9.65), this is the buildings at Scoughall (NT616833) close to the existing shoreline. The main land-use within MU14 is Arable, which covers 253ha of land. A large area of unstabilised dunes (32ha) form the immediate hinterland of Peffer and Ravensheugh Sands (Figure 9.3).

**Table 9.65: Land-use classification in MU14 (source: MLURI 1988)**

| Land-use class        | Domain                                  | Area (ha) |
|-----------------------|-----------------------------------------|-----------|
| Smooth grassland      | Undiff. smooth grass.: no rock no trees | 16.5      |
| Mixed woodland        | Undiff. mixed woodland (area)           | 15.1      |
| Factories & urban     | Built-up (area)                         | 4.5       |
| Improved grassland    | Imp. pasture: no rock no farms no trees | 72.1      |
| Duneland              | Dune lands: unstabilized dunes          | 31.5      |
| Coniferous plantation | Coniferous (plantation - area)          | 29.1      |
| Arable                | Arable: no rock no farms no trees       | 253.2     |
|                       |                                         | 422.0     |

### ***Residential Development, Industry, Ports and Harbours***

There is little residential development in MU14, with only a number of scattered buildings and farmhouses in the area. There is no industry, ports or harbours within the management unit.

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### ***Recreation and Tourism***

Informal recreation is fairly low key in the north-western half of the management unit, due primarily to access difficulties. South-east of the Peffer Burn, the coast is within John Muir Country Park (JMCP), which has been managed by East Lothian Council since 1977. The adjacent management units (MU15 and MU16) to the south also lie within the boundaries of John Muir Country Park (Figure 9.5). The northern part of the Park, within MU14, generally has less visitor pressure than the Belhaven Bay area (MU15), which is promoted to sustain a level of recreation that would be detrimental to the conservation interests in the north (East Lothian Council 2000d).

JMCP operate a permit system for wildfowling, which is permitted in the inter-tidal area south of Peffer Burn. Other recreational activities include walking and horse riding (also operated on a permit system and on designated routes only).

The beaches of Peffer and Ravensheugh Sands attract some recreational use during the summer months and the Scottish Scripture Union Summer Camp is located in MU14, who have carried out localised coastal protection works in the area (East Lothian Council 2001d).

### ***Fishing Activity***

There is no commercial fishing activity within MU14, although some small-scale sea fishing may take place off the rocks.

### ***Agriculture and Forestry***

Agriculture forms a large part of the hinterland of MU14. This land use lies adjacent to the shoreline at Scoughall Rocks, but along the remainder of the management unit is set back from the shoreline. The two areas of Browning Wood and Links Wood are coniferous plantations covering an area of approximately 29ha.

### ***Quarrying and Landfill***

There are no major quarries or landfill sites in MU14. However, there has been localised extraction of sand from the Loch-house Links area (NT623821), used in the process of manufacturing glass (SNH 1999c).

### ***Water Quality and Pollution***

There are no designated bathing beaches within MU14. The coastal water quality along the entire length of MU14 is Class A (Excellent)(SEPA 2000).

### ***Archaeology and Built Heritage***

There are two scheduled ancient monuments within MU14. The 16<sup>th</sup> Century Seacliff Tower (NT613842) sits right at the edge of cliffs, which are composed of Devensian raised beach deposits and fronted by the rocky foreshore of Car Rocks. GUARD (1996) noted that blocks of dressed sandstone were visible at the base of the cliff immediately below the tower, indicating that active erosion was taking place and attempts were being made to arrest it.

Seacliff settlement, midden, cists and burial site (NT612842) is a scheduled ancient monument. This site of this ancient settlement is also located on the raised beach cliff, 500m north of Seacliff Tower. Coastal erosion has recently revealed a crouched inhumation within a partially slab built cist, which was excavated in 1990 (GUARD 1990).

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15 unscheduled archaeological sites have been recorded on the land in MU14, most of which lie close to the shoreline or in the inter-tidal area (Figure 9.4). These include a range of military defences, such as pillboxes (NT620829) and anti-tank blocks/ trenches (NT626818, NT631814, NT36813, NT617834); walls (NT616835, NT626818); possible enclosures (NT629813, NT636813) and a chapel (NT615838).

There are 5 maritime archaeological sites within the management unit, all of which are shipwrecks and include the wrecks of a steamship and schooner off Scoughall Rocks (NT619839); a steamship off Carr Rocks (NT618845); an unknown craft at NT634819 and a barquentine at (NT653824). The 4 Listed buildings within MU14 all lie over 150m landward of the cliff-top, and are thus not under threat from coastal erosion.

**Table 9.66: Cultural Heritage Within MU14**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 5      | RCAHMS            |
| Archaeological Sites (land)   | 15     | RCAHMS            |
| Scheduled Ancient Monuments   | 2      | Historic Scotland |
| Listed Buildings*             | 4      | ELC               |
| Architecture Sites*           | 5      | RCAHMS            |
| TOTAL                         | 31     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### ***Natural Environment***

The entire inter-tidal area of MU14 is designated within the Firth of Forth SSSI. The area north of Peffer Sands is within North Berwick Coast section of the SSSI, described above (Table 9.62), while the southern part of the management unit is within the Tynninghame Shore section of the SSSI, designated for its botanical and ornithological interest (Table 9.67). The inter-tidal area is also part of the newly designated Firth of Forth SPA and Ramsar site (Figure 7.2). The SSSI boundary extends inland to include the mouth of the Peffer Burn and the dunes landward of Ravensheugh Sands (Figures 7.1)

SNH have defined the following six long-term objectives for management of this section of the SSSI:

1. To maintain the natural heritage interest of the site keeping it in a favourable condition for the continued feeding, resting and roosting of all key bird species.
2. To maintain the saltmarsh, grassland, heathland, dune and inter-tidal habitats with their associated botanical interest.
3. To monitor and control exotic or invasive plant species.
4. To encourage and maintain the use of the site by universities for individual and group research.
5. Changes that occur within the dune system should not be prevented, but aerial monitoring should be carried out to keep track of the extent of dune erosion and accretion.
6. To continue visitor management as agreed in the East Lothian Council Management Plan for John Muir Country Park.

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Objective 5 is of direct relevance to the Shoreline Management Plan, cognisance of which will be taken when developing the strategic options for coastal defence.

**Table 9.67 Summary of the botanical and ornithological interests of Tynninghame Shore section of the Firth of Forth SSSI (source SNH 1999c)**

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Botanical interest      | Tynninghame Shore is one of the two largest areas of saltmarsh in the Forth Estuary. Associated with the saltmarsh are mudflats, shingle, sand dunes and rocky shores. The site contains representative examples of mineral enriched grassland and coastal heathland, both of which are unusual habitats in East Lothian, the latter being particularly rare. There is, therefore, a considerable diversity of habitats within the site and these support a large number of flowering plants, mosses, lichens, fungi and algae including Scottish and local rarities. In particular, the coastal heathland contains these notable species: stag's-horn clubmoss, crowberry and heath rush.              |
| Ornithological interest | Due to its high ornithological interest Tynninghame Shore SSSI has recently been identified as meeting the criteria for inclusion within the Firth of Forth Special Protection Area under the terms of the European Community Directive 79/409/EEC on the Conservation of Wild Birds. It is also a Ramsar site under the Ramsar Convention on Wetlands of International Importance as a Waterfowl Habitat. This ornithological interest arises because of the site's national importance for breeding Terns and wildfowl and waders (including Oystercatcher, Ringed plover, Grey plover, Sanderling, Dunlin, Curlew, Redshank, Greenshank, Red-throated Diver, Mute Swan, Wigeon, Teal and Goosander). |

The southern part of MU14 lies within John Muir Country Park, which is managed by East Lothian Council. The overall management aspiration for John Muir Country Park is "to manage public recreation and conserve the geomorphology, geology and landscape, and sustain the biodiversity of the Country Park" (East Lothian Council 2000d). Management objectives set to achieve this aim (Table 9.68) have been translated into detailed prescriptions and action plans.

**Table 9.68 Management objectives for John Muir Country Park (source: East Lothian Council 2000d)**

| Objective | Detail                                                                                                                                                      |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | To provide those recreational facilities which will enhance visitors' enjoyment of the Country Park consistent with the aim.                                |
| 2         | To maintain and enhance the role of the estuary as a feeding and roosting area for wildfowl and waders                                                      |
| 3         | To conserve the mosaic of geomorphological features within the Country Park                                                                                 |
| 4         | To conserve habitats, communities and species and in particular those that are deemed special in relation to agreed criteria                                |
| 5         | To conserve the geological integrity of the Country Park                                                                                                    |
| 6         | To maintain and enhance the Country Park as a suitable breeding area for birds and in particular those deemed to be special in relation to defined criteria |
| 7         | To conserve the landscape and character of the Country Park                                                                                                 |

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The present management of the Park involves enhancing recreational usage, whilst still maintaining conservation interest. To achieve this the Park has been zoned into two areas (Figure 9.5); MU14 lies within Area 2 of the Park:

- Area 1 can be promoted for recreation use, as it is able to sustain a level of public recreation that would be detrimental to Area 2.
- Area 2 is not promoted in order to conserve its natural interests.

**Table 9.69: Phase 1 Habitats within MU14 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 0.1       |
| A1.1.2       | Broad-leaved, plantation            | 11.6      |
| A1.2.2       | Coniferous plantation               | 28.9      |
| A1.3.2       | Mixed woodland, plantation          | 11.0      |
| B2.1         | Neutral grassland, unimproved       | 0.4       |
| B2.2         | Neutral grassland, semi-improved    | 14.3      |
| B4           | Improved grassland                  | 34.9      |
| B6           | Poor semi-improved grassland        | 2.7       |
| C1.1         | Continuous bracken                  | 1.3       |
| C3.1         | Tall ruderal                        | 0.6       |
| F1           | Swamp                               | 0.1       |
| G1           | Standing water                      | 1.2       |
| H2.6         | Saltmarsh – continuous              | 20.2      |
| H6.4         | Dune slack                          | 2.4       |
| H6.5         | Dune grassland                      | 14.3      |
| H6.6         | Dune heath                          | 0.4       |
| H6.7         | Dune scrub                          | 5.6       |
| H6.8         | Open dune                           | 0.4       |
| J1.1         | Arable                              | 255.3     |
| Unclassified | Urban                               | 16.3      |
| Total        |                                     | 405.7     |

Arable land is the largest category of habitat type identified in MU14 in the Phase 1 Habitat Survey of East Lothian (Table 9.69). Various dune and grassland habitats form the coastal edge for most of the management unit.

### ***Relevant policies and plans***

It is proposed that the sustainable coastal path runs inland of MU14, although a route agreement has yet to be defined.

East Lothian Council (2000b) have a specific policy with respect to coastal protection in JMCP and state that “coastal protection is only required where erosion leads to serious loss of amenity. Natural erosion is accepted in most areas. Coastal erosion of the cliffs at Dunbar and Shore Road will continue to be monitored.” SNH (1999c) also advocate that natural changes within the dune system should not be prevented and aerial monitoring should be carried out to keep track of the extent of dune erosion and accretion.

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## Key interests

No specific interests relevant to MU14 were expressed during the written consultation phase. The public noted that mudslides occur at Car Rocks due to heavy rainfall (SPI 2001a), although generally erosion is not considered a problem on this stretch of coast (East Lothian Council 2001d; SPI 2001a)

## Valuation of Assets

Assets in MU14 are valued at £22M (Table 9.70). 68% of land is valued as High Quality Agricultural to account for the natural heritage importance and the large area of Agricultural land.

**Table 9.70 Valuation of Assets in MU14**

| Asset Type                | % Land in Category | Value (£)         |
|---------------------------|--------------------|-------------------|
| High Quality Agricultural | 68%                | 1 464 320         |
| Open Area                 | 28%                | 121 068           |
| Urban                     | 2%                 | 20 090 000        |
| <b>Total</b>              |                    | <b>21 675 388</b> |

## Option Evaluation

There are no locations within MU14 where **Advance the Line** and **Retreat the Line** are considered viable options.

**Hold the Line**, by constructing coastal defences, would be detrimental to the natural environment of MU14 and would interfere with the operation of coastal processes, for which the site is considered important. Dune erosion is a natural process and is not considered detrimental to the natural heritage interest of the site (SNH 1999c; East Lothian Council 2000d). In addition, very few assets were identified within MU14 that are at risk from coastal erosion, as the built-up area is setback from the shoreline. However, GUARD (1996) suggest that the archaeological interests at Seacliff may be at risk from coastal erosion.

**Limited Intervention** is the preferred option for MU14. This would allow continuation of the natural processes and would not detract from the natural heritage interests of the site. The outstanding landscape of the management unit would not be compromised. As there is no evidence of long-term erosion along MU14, the monetary value of land lost under this option is negligible.

Ad-hoc coastal protection, such as that put in place by the Scottish Scripture Union Summer Camp, should be discouraged in future. It is been suggested that localised dune erosion is caused by human pressure (East Lothian Council 2001d), thus management practices aimed to encourage visitors to stay off the dunes in sensitive areas should be considered (such as dune fencing, signs etc.). It is also recommended that a series of fixed monitoring stations be established to monitor rates of cliff erosion at Seacliff to determine the nature of the problem and to assess the need for future coastal defence, such as toe protection at the base of the cliff.



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#### **9.10** PU10: ST. BALDRED'S CRADLE TO DUNBAR HARBOUR

Process Unit 10 has been split into three management units; management practices in each will affect the wider process unit in terms of operation of natural processes. MU15 covers the natural and highly dynamic shoreline of Tynninghame/ Belhaven Bay, MU16 comprises the shoreline of Winterfield Golf Course and MU17 extends along the rocky shoreline from the western edge of Dunbar to Dunbar Harbour (Figure 9.1).

The coast of Process unit 10 faces northeast between the rocky headlands at St. Baldred's Cradle and the western edge of Dunbar, comprising the extensive infilled estuary of Tynninghame Bay/ Belhaven Bay. The coastline is rocky and faces north from the western edge of Dunbar to Dunbar Harbour. The estuary has an area of 5.1 km<sup>2</sup> and a tidal channel length of 5.9 km, (Brazier et al., 1998). The low-lying bay comprises the sedimentary delta of the River Tyne and Biel Water in a smaller bay to the east, separated by sand dunes. Extensive sand and mudflats are present along with saltmarsh, dunes, blown sand and raised beach and till deposits in the hinterland. Two sand spit features, Sandy Hirst and Spike Island, are located at the mouth of the estuary (GUARD 1996). From Winterfield to Dunbar Harbour, the coast comprises a rocky platform and gravel foreshore with sandstone cliffs over 5 m and till hinterland (GUARD, 1996).

Accretion is occurring in the following areas (Table 4.6):

- Sandy Hirst spit;
- behind Sandy Hirst spit;
- south of the inner River Tyne;
- Spike Island spit;
- the southern shore of the bay;
- southern Belhaven Bay (east of Spike Island spit) (GUARD, 1996).

Erosion is occurring in the following areas (Table 4.7):

- southern part of the bay (Hedderwick Sands) forming sand and mud cliffs up to 3 m high (GUARD, 1996);
- southern Belhaven Bay at the mouth of Biel Water;
- Sandstone cliffs between Winterfield and Dunbar Harbour (GUARD, 1996);
- Winterfield Golf Course (East Lothian District Council, 1993).

Golf course erosion at Winterfield is attributed to a number of factors, including attack from the sea, weathering and poor placement of coast protection measures (East Lothian District Council, 1993). Some reclamation of land has occurred in the inner Tyne estuary at Buist's Embankment (GUARD, 1996).

The dominant wave directions for this stretch of coast are from the sector between north and east. Although sediment transport is believed to be from east to west for this section of coast (Barne et al., 1997), most of the beach systems are believed to be largely self-contained in terms of sediment movements (Ramsay and Brampton, 2000) and the orientation of the spits indicate localised drift in both directions. Refer to Section 4.6 for further details of sediment transport processes.

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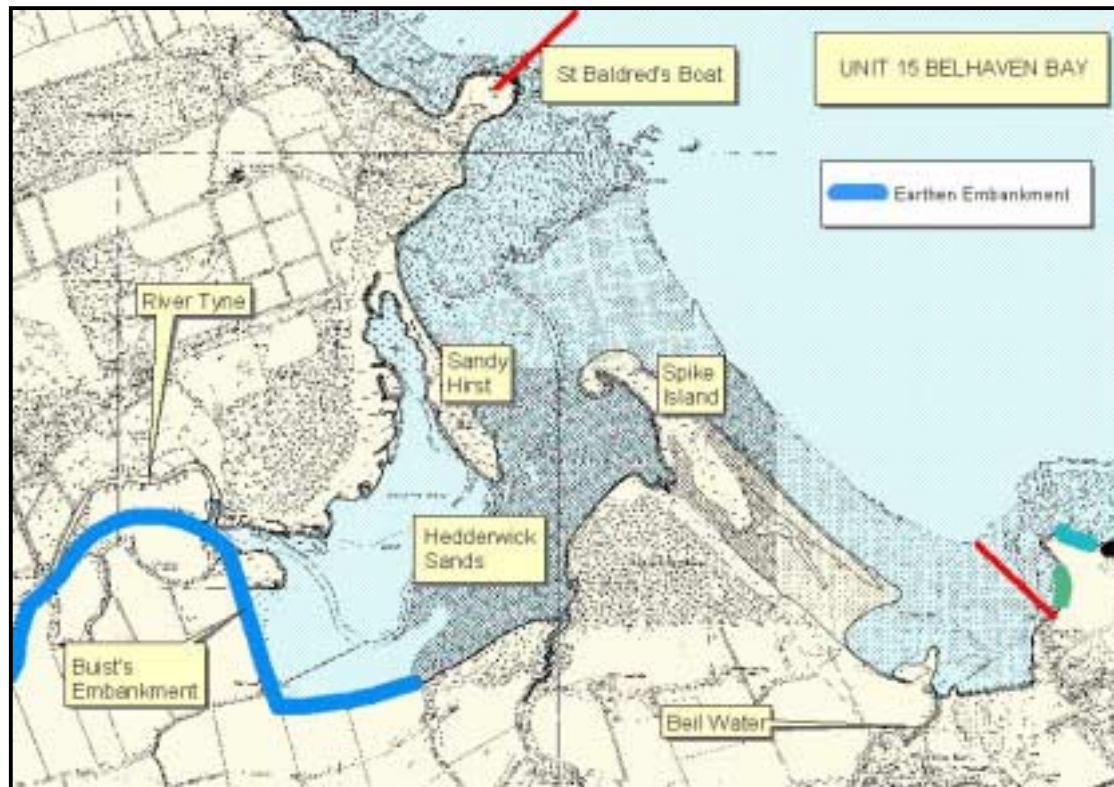
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## 9.10.1 Management Unit 15, Tynninghame/ Belhaven Bay

Management Unit 15 extends from the rocky headland of St Baldred's Cradle (NT637813) in the west to Winterfield Golf Course (NT662788) in the east, a distance of approximately 7km. The eastern boundary of the management unit is also the boundary between the Tynninghame Shore section of the Firth of Forth SSSI to the west and the Dunbar coast section to the east. MU15 lies within Tynninghame Shore part of the Firth of Forth SSSI.



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**Table MU15.1 Summary of Attributes of Management Unit 15**

| Coastal Processes           |                                                                                                                              |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Highly dynamic natural system. Accretion of spits. Localised erosion at Hedderwick Sands and at the mouth of Biel water.     |
| Geomorphology               | Saltmarsh, mudflats, shingle, sand beaches, dunes and rocky shores                                                           |
| Sediment Drift              | Low or moderate net westerly drift, but generally a self-contained system with localised drift in both directions            |
| Coastal Defences            |                                                                                                                              |
| Type                        | Man-made: Earthen embankment, masonry wall.<br>Natural: Sand beach, saltmarsh, mudflat                                       |
| Human and Built Environment |                                                                                                                              |
| Land use                    | Country Park, agricultural, caravan park and residential                                                                     |
| Sea use                     | Limited sea fishing, wildfowling in inter-tidal area                                                                         |
| Infrastructure              | -                                                                                                                            |
| Recreation and Tourism      | Managed for public recreation, bird-watching, walking, horse-riding                                                          |
| Historic Environment        | 136 sites of cultural heritage identified                                                                                    |
| Natural Environment         |                                                                                                                              |
| Habitat Types               | Saltmarsh, mudflats, shingle, sand beaches, coastal grassland, rocky shores                                                  |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Part of John Muir Country Park<br>3 provisional SWT Wildlife Sites |
| Key Interests               | Public concern relating to water quality and pollution in the Belhaven Bay                                                   |
| Valuation of Assets         | £ 105M                                                                                                                       |

**Table MU15.2 Screening of Strategic Options with Management Objectives**

| Strategic Option               | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|--------------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention         | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention           | √                  | √           | √                         | X                         | √           | √                     | √         | √                      | X                   | √         | √             | NA       | NA       |
| Hold The Line (or Selectively) | √                  | X           | X                         | X                         | √           | X                     | √         | X                      | X                   | X         | √             | NA       | NA       |
| Advance The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line*              | √                  | √           | √                         | •                         | √           | X                     | √         | √                      | √                   | √         | √             | NA       | NA       |

Key:

- √ Shading indicates the Preferred Option
- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable
- \* Further studies are required to determine feasibility

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## ***Coastal Defences***

There is evidence of a number of historical defences relating to the reclamation of tidal flats for agricultural purposes (East Lothian Council 2001d). Buist's embankment, a 2m high, 3m wide earthen embankment, was constructed in the 1820's and extends for approximately 2km south of the River Tyne, protecting agricultural land from flooding. Old sea walls have been identified on the eastern side of the rocky promontory of St Baldred's Cradle (GUARD 1996). The walls now lie below the MHWS indicating that 5-7m of land has been lost in the past 100 years or so (GUARD 1996). The path that runs along the shore at St Baldred's Cradle has been diverted inland at several locations. A masonry sandstone wall extends along the shoreline north of Seafield Pond, West Barns. This defence is relatively old (ca. 40-50 years old).

## ***Land-use***

Arable land-use covers 520ha of land in MU15 (Table 9.71). This type of land-use lies adjacent to the shoreline south of the River Tyne at Buist's embankment (Figure 9.3). The built-up area comprises 46ha of land within MU15. This includes the residential area of West Barns, which lies over 200m inland of the existing shoreline, and the western part of the town of Dunbar.

**Table 9.71: Land-use classification in MU15 (source: MLURI 1988)**

| <b>Land-use class</b> | <b>Domain</b>                            | <b>Area (ha)</b> |
|-----------------------|------------------------------------------|------------------|
| Arable                | Arable: no rock no farms no trees        | 520.8            |
| Improved grassland    | Imp. pasture: no rock no farms trees     | 84.8             |
| Coniferous plantation | Coniferous (plantation - area)           | 67.4             |
| Improved grassland    | Imp. pasture: no rock no farms no trees  | 62.3             |
| Mixed woodland        | Undiff. mixed woodland (area)            | 59.0             |
| Factories & urban     | Built-up (area)                          | 45.9             |
| Duneland              | Dune lands: unstabilized dunes           | 43.5             |
| Salt marsh            | Undiff. salt marsh: no trees             | 39.6             |
| Recreational land     | Caravan parks                            | 16.4             |
| Coarse grassland      | Undiff. Nardus/Molinia: no rock no trees | 12.0             |
| Smooth grassland      | Undiff. smooth grass.: no rock no trees  | 11.2             |
| Smooth grassland      | Undiff. smooth grass.: no rock trees     | 9.9              |
| Water                 | Water (area)                             | 2.8              |
| Recreational land     | Golf course                              | 0.2              |
| <b>Total</b>          |                                          | <b>975.8</b>     |

## ***Residential Development, Industry, Ports and Harbours***

There are no ports or harbours within MU15. Residential development is limited to the small settlement of West Barns, on the western outskirts of Dunbar, the buildings of Tynninghame Estate and a few farms. Belhaven Brewery (NT665783) is located in the eastern part of the management unit, 500m from the shoreline. There is local concern relating to the discharges from the Brewery to Belhaven Bay (SPI 2001a).

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## ***Recreation and Tourism***

The entire shoreline of MU15 lies within John Muir Country Park (Figure 9.5), which extends into the adjacent management units MU14 and MU16. East Lothian Council have developed a Management Plan for JMCP setting out management objectives for the park (discussed in Section 9.9.1 above). The south-eastern part of MU15 lies within Area 1 of JMCP, which is promoted and managed to encourage public recreation of the shoreline. Thus visitor pressure is likely to be high in the vicinity of Linkfield and Shore Road car parks, primarily around Belhaven Beach. Wildfowling and horse-riding are permitted within the park under a Permit system managed by the Council. The beaches of JMCP are included in the summer beach cleaning schedule by East Lothian Council (Ash 1994).

The Belhaven chalet site / caravan park is located on the shores of Belhaven Bay within Area 1 of JMCP again resulting in relatively high visitor pressure on this part of the shoreline.

## ***Fishing Activity***

There is no commercial fishing in MU15, although some small scale sea-fishing may take place.

## ***Agriculture and Forestry***

Agricultural land makes up a large part of the hinterland of MU15 (520ha). Reclamation of the inter-tidal area, south of the Tyne, in the early 19<sup>th</sup> century increased the land area available for agriculture. A coniferous forestry plantation covers 38ha of land on Hedderwick Hill and approximately 30ha in Tynninghame Estate (Figure 9.3).

## ***Quarrying and Landfill***

There are no quarries or landfill sites within MU15.

## ***Water Quality and Pollution***

Belhaven Beach is a designated Bathing Beach, thus it is subject to the requirements of the EEC Directive 76/160 concerning the quality of bathing water quality. Belhaven achieved a Guideline Pass of the Directive in 2001 and 2000. Coastal water quality in the north-western part of MU15 is Class A (Excellent) whereas the south-eastern shoreline, east of Hedderwick Burn, was classified as Class B (Good) in 2000 (SEPA 2000).

During the public consultation exercise, several members of the public expressed concern regarding the poor water quality in Belhaven Bay and, in particular, discharges from Seafield Pond, the Caravan Park and Belhaven Brewery caused concern (SPI 2001a).

## ***Archaeology and Built Heritage***

There are 136 sites of cultural heritage identified within MU15 (Table 9.72). These include 3 scheduled ancient monuments (enclosures at Thistly Cross, NT656775, and Hedderwick, NT632775, and St Baldred's Kirk, NT619797), although all are setback from the existing shoreline and are not under threat of erosion or flooding. However, many unscheduled archaeological sites of importance lie within 200m of the existing shoreline (Figure 9.4), thirteen of which are old military relicts including pill-boxes, observation posts, anti-tank traps, trenches, buildings, shooting butts and anti-glider posts. The other archaeological sites close to the shoreline include a cairn (NT637813); cross-incised stone (NT635811); fish trap (NT636808); tracks (NT635806); enclosures (NT633784); numerous finds at the mouth of

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Hedderwick Burn including a cist, pottery, flints, macehead, axes, whorls, whetstones and lead bullets (NT638788); long cist cemetery (NT663790); long cist (NT664792) and old sea defences (NT657785).

The sites of architectural importance, including the 63 Listed buildings, all lie within the residential areas of MU15 and are setback from the shoreline. A number of Listed structures lie within the grounds of Tynninghame Estate (NT621800) and the Belhaven Conservation Area, at the western edge of Dunbar (NT663785).

The two maritime archaeological sites include the shipwrecks of the barque, Hiram, in the sands in the lee of Sandy Hirst spit (NT633802) and the brigantine, Lucy and Andrew, off the tip of Spike Island (NT640800).

**Table 9.72: Cultural Heritage Within MU15**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 2      | RCAHMS            |
| Archaeological Sites (land)   | 36     | RCAHMS            |
| Scheduled Ancient Monuments   | 3      | Historic Scotland |
| Listed Buildings*             | 63     | ELC               |
| Architecture Sites*           | 32     | RCAHMS            |
| TOTAL                         | 136    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### ***Natural Environment***

The outstanding importance of the natural environment of MU15 is recognised in its designation within the Tynninghame Shore section of the Firth of Forth SSSI (described in Section 9.9.1 above, (Table 9.67). The SSSI covers the inter-tidal area, but also extends above MHWS to include the two spits (Sandy Hirst and Spike Island) and the saltmarsh and dune system fringing the shoreline. The headland of St Baldred's Cradle also lies within the SSSI boundary. The inter-tidal area of MU15 has recently been designated as part of the Firth of Forth SPA/Ramsar site, for its ornithological and wetland importance. The SPA/Ramsar designation excludes land above MHWS.

East Lothian Council also recognise the landscape value of a large part of MU15, including the hinterland, which is designated as an Area of Great Landscape Value (AGLV), which is subject to special protection in the Local Plan (East Lothian Council 1998).

Three sites within MU15 have been identified as provisional SWT Wildlife Sites:

1. Biel Water (NT657785)
2. River Tyne (NT625793)
3. Tynninghame Estate (NT621800)

These sites are provisional only and have not been surveyed or confirmed as Wildlife sites.

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79.4ha of land in MU15 was not classified during the Phase 1 Habitat Survey of East Lothian (Table 9.73). The urban areas and roads are unclassified, however a large area of saltmarsh in the lee of Spike Island was also not classified. Approximately 46ha of saltmarsh is located at the mouth of the River Tyne and in the lee of Sandy Hirst spit. Open dunes, dune scrub and other dune habitats form the immediate hinterland of MU15 and the spits of Spike Island and Sand Hirst also support important dune habitats.

**Table 9.73: Phase 1 Habitats within MU15 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                  | Area (ha) |
|--------------|----------------------------------|-----------|
| A1.1.2       | Broad-leaved, plantation         | 29.2      |
| A1.2.2       | Coniferous plantation            | 47.0      |
| A1.3.2       | Mixed woodland, plantation       | 82.2      |
| A2.1         | Dense scrub                      | 2.9       |
| B2.1         | Neutral grassland, unimproved    | 2.3       |
| B2.2         | Neutral grassland, semi-improved | 7.5       |
| B4           | Improved grassland               | 119.4     |
| B5           | Marshy grassland                 | 1.1       |
| B6           | Poor semi-improved grassland     | 13.0      |
| C1.1         | Continuous bracken               | 0.3       |
| C3.1         | Tall ruderal                     | 0.9       |
| G1           | Standing water                   | 3.9       |
| H2.6         | Saltmarsh – continuous           | 45.9      |
| H6.4         | Dune slack                       | 0.1       |
| H6.5         | Dune grassland                   | 3.5       |
| H6.6         | Dune heath                       | 1.5       |
| H6.7         | Dune scrub                       | 11.1      |
| H6.8         | Open dune                        | 30.3      |
| H8.4         | Coastal Grassland                | 0.2       |
| J1.1         | Arable                           | 471.1     |
| J1.2         | Amenity grassland                | 21.7      |
| J3.6         | New Buildings                    | 1.0       |
| Unclassified |                                  | 79.4      |
| Total        |                                  | 975.5     |

### ***Relevant policies and plans***

The policies of direct relevance to MU15 relate to the natural heritage and recreation importance of the shoreline. The management objectives and detailed action plan for John Muir Country Park (East Lothian Council 2000d) should be adhered to when developing the strategic coastal defence option for MU15. In addition, the management objectives developed by SNH for Tynninghame Shore SSSI (SNH 1999c) should also be considered. Both documents advocate that natural changes in the dune system should be allowed and a system of monitoring should be established in sensitive areas (see discussion in Section 9.9.1).



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### **Key interests**

No key interests in MU15 were highlighted during the written consultation phase of the SMP. Public concern was mainly related to water quality and pollution in the Belhaven Bay area and litter in JMCP (SPI 2001a). One comment mentioned erosion problems in Belhaven Bay, at the bridge over the Biel Burn, and stated that sand had been replenished by the Council, but had subsequently been washed away (SPI 2001a).

### **Valuation of Assets**

The monetary value of the land within MU15 is estimated as £105M (Table 9.74). Over 70% of land within the management unit is valued as High Quality Agriculture, this includes the land above MHWS classified as SSSI.

**Table 9.74 Valuation of Assets in MU15**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b> |
|---------------------------|---------------------------|------------------|
| High Quality Agricultural | 72%                       | 3 498 200        |
| Open Area                 | 21%                       | 207 694          |
| Urban                     | 7%                        | 101 068 800      |
| <b>Total</b>              |                           | 104 774 694      |

### **Option Evaluation**

Tynninghame/ Belhaven Bay is a highly dynamic and constantly changing natural system, with some areas experiencing accretion and others erosion (see above). It is the operation of these natural geomorphic processes that has created the dynamic mosaic of saltmarsh, mudflats, shingle, sand dunes and rocky shore habitats, which make the area of such outstanding natural heritage value. Any attempt to stabilise the system by constructing coastal defences will be detrimental to the natural heritage interests, with knock-on effects on habitats and thus potentially ornithological interests. East Lothian Council (2000b) and SNH (1999c) state that natural erosion should be accepted in most areas and coastal protection is only required where erosion leads to serious loss of amenity. Both documents suggest monitoring should be carried out to assess the rates of coastal change in the area.

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The **No Active Intervention** approach would allow natural coastal processes to operate unimpeded. There is no evidence that erosion is causing any significant threat to amenity anywhere in the management unit, thus the potential monetary value of the loss of land/amenity under this option is negligible. The public expressed concern about erosion at the mouth of the Biel Burn, however historical OS map analysis indicates that this area has experienced net accretion since 1907 (Appendix C, View 18). The inter-tidal channel of the burn is highly dynamic, and has changed position over the tidal flats of Belhaven Bay by up to 200m. The property maintenance audit (Appendix E) observed that the bridge spanning Biel Water is too short and it was estimated that the bridge span could be widened at a cost of £5,000.

A system of monitoring natural changes should be instigated, either by establishing a record of aerial surveys/ fixed photographs or by setting up a series of fixed monitoring stations. East Lothian Council (2000b) and SNH (1999c) both recommend a monitoring system be established, however we are not aware whether this has been carried out.

**Hold the Line**, by constructing coastal protection, would result in the stabilisation of a natural and highly dynamic estuarine system and would be detrimental to the natural heritage and conservation interests of the site. Coastal defences to prevent localised erosion would effectively sterilise the downdrift supply of sediment, transferring the problem elsewhere in the process unit. As no risks to amenity were identified under the No Active Intervention, the potential monetary benefits of Hold the Line are negligible. Thus, the monetary costs associating with Hold the Line would outweigh the benefits.

**Advance the Line** is not a feasible option for MU15.

MU15 contains a large area of reclaimed inter-tidal land, south of the River Tyne, which is now agricultural land protected from tidal inundation by Buist's embankment. Thus, **Retreat the Line**, via removing or retreating the tidal defences (managed realignment) and allowing the former inter-tidal area to revert to saltmarsh/mudflat is feasible in MU15. This option would create additional important habitat within the Firth of Forth and could be used if habitat compensation were required for any other proposed schemes that result in habitat loss. If this option were to be pursued a detailed Feasibility/Strategy Study would be required to assess the technical and economic feasibility of managed realignment at this site. Retreat the line would affect the hydrodynamics of the process unit and potential impacts on the adjacent shoreline would have to be investigated.

The preferred option for MU15 is **No Active Intervention**, combined with the establishment of monitoring strategy to assess future changes.

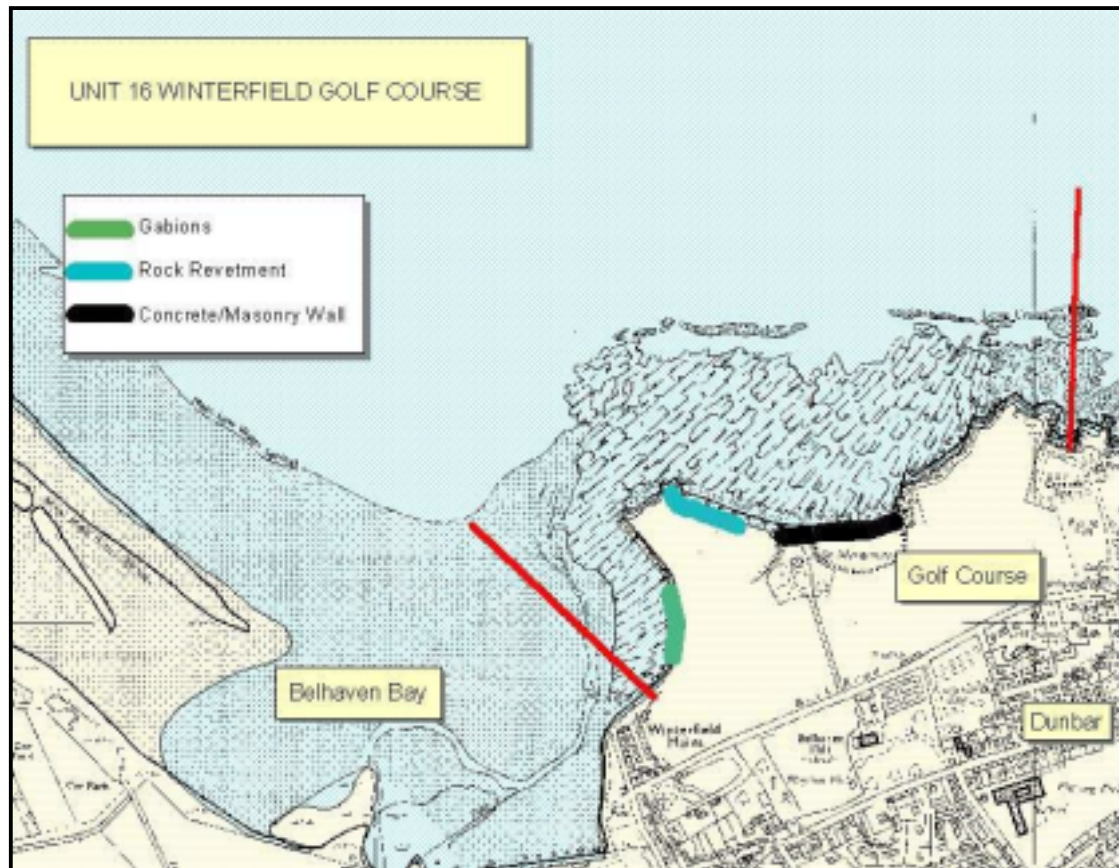
**Retreat the Line** is feasible in part of the management unit, although further investigation is required if this option is to be adopted.

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### 9.10.2 Management Unit 16, Winterfield Golf Course

Management Unit 16 is small and covers the approximately 1.5km shoreline of Winterfield Golf Course (NT662788 –NT671794), on the western edge of Dunbar.



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**Table MU16.1 Summary of Attributes of Management Unit 16**

| Coastal Processes           |                                                                                                                                        |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Generally stable, with localised erosion on western and northern shores                                                                |
| Geomorphology               | Rocky platform and gravel foreshore. There are important exposures of raised marine platforms formed under higher relative sea levels. |
| Sediment Drift              | Low or moderate net westerly drift                                                                                                     |
| Coastal Defences            |                                                                                                                                        |
| Type                        | Man-made: Gabions, rock revetment (consisting of anti-tank traps), masonry wall.<br>Natural: Rock outcrops                             |
| Human and Built Environment |                                                                                                                                        |
| Land use                    | Golf course, residential area of Dunbar setback from shore                                                                             |
| Sea use                     | Limited sea fishing and bait collecting                                                                                                |
| Infrastructure              | -                                                                                                                                      |
| Recreation and Tourism      | Managed for public recreation, golf                                                                                                    |
| Historic Environment        | 25 sites of cultural heritage identified                                                                                               |
| Natural Environment         |                                                                                                                                        |
| Habitat Types               | Rocky shores, coastal grassland                                                                                                        |
| Designated Sites            | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site<br>Part of John Muir Country Park<br>GCR Site for Quaternary interest           |
| Key Interests               | Erosion and coastal defences at Winterfield Golf Course                                                                                |
| Valuation of Assets         | £36 M                                                                                                                                  |

**Table MU16.2 Screening of Strategic Options with Management Objectives**

| Strategic Option          | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|---------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention    | √                  | √           | √                         | √                         | √           | X                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention      | √                  | √           | √                         | √                         | √           | X                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Selectively Hold The Line | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Advance The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line*         | √                  | √           | •                         | •                         | √           | •                     | √         | √                      | √                   | √         | √             | NA       | NA       |

Key:

- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable
- \* Further studies are required to determine feasibility

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### **Coastal Defences**

The east side of Belhaven Bay fronts Winterfield Golf Course and has a wide rock shelf in front of an eroding cliff. The bay is shallow with sand flats extending approximately 1km offshore. Ad-hoc defences have been placed on the face of the natural embankment to prevent erosion of the golf course. The defences consist of approximately 30m of 3.5m high seawall comprising 3 layers of gabion baskets overlying 2 layers of anti-tank blocks in a step-like fashion (Defence No. 39, Plate 9.27). The defence continues south as approximately 100m of anti-tank blocks. The defence is unsightly and appears to be enhancing erosion of the raised beach deposits on the former wave cut platform for a 50m section to the north. This exposure forms one of the main geological interests of the Dunbar Coast section of the Firth of Forth SSSI and it has been noted that it is important that the exposure remains (SNH 1996b).

The northerly facing section of coastline is protected by randomly placed anti-tank blocks and rubble for approximately 150m (Defence No 40). Anti-tank blocks have been placed on the upper part of a steep gradient sand/shingle beach (Plate 9.28). There is evidence of some erosion of the grass face landward of the protection.

An old masonry seawall (Defence No 41) protects the base of the banking of the Winterfield Golf Clubhouse. The rubble masonry wall is exposed for a length of approximately 50m and is in very poor condition (Plate 9.29). The wall was erected around 1910 has been damaged and breached by wave action. Anti-tank blocks were placed in the breaches in the 1970's on at least 2 occasions (East Lothian Council 1993). During the field inspection, the defence was observed to be undercut and erosional in places and will require attention to ensure its long-term stability.

The Haugh, to the east of the Winterfield clubhouse, is an area of reclaimed land, which was protected in around 1910 by a random rubble and masonry wall (East Lothian Council 1993). By 1975 around 80% of the wall had become dilapidated and dangerous, although at the time there was no indication of erosion in the area (East Lothian Council 2001d). The Council removed the remains of the wall in 1978 and carried out grading works on the reclaimed land (East Lothian Council 1993). Erosion is ongoing in this area and there is evidence of the remnants of the masonry wall on the foreshore (Defence No 42).

### **Land-use**

Winterfield Golf Course forms the immediate hinterland of MU16, covering an area of 29ha (Table 9.75). The built-up area of Dunbar is landward of the golf course and a small area of arable land forms the landward boundary of the management unit (Figure 9.3).

**Table 9.75: Land-use classification in MU16 (source: MLURI 1988)**

| Land-use class    | Domain                            | Area (ha) |
|-------------------|-----------------------------------|-----------|
| Factories & urban | Built-up (area)                   | 37.6      |
| Recreational land | Golf course                       | 28.8      |
| Arable            | Arable: no rock no farms no trees | 5.5       |
| Total             |                                   | 71.9      |

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### ***Residential Development, Industry, Ports and Harbours***

There are no ports or harbours within MU16. The urban area of Dunbar lies in the hinterland of MU16, setback from the shoreline.

### ***Recreation and Tourism***

Dunbar has been a popular seaside holiday resort since Victorian times, although this role has declined in more recent years (East Lothian Council 1998). However, there are signs of growing tourist numbers, particularly from abroad in the last few years, and the town is seeking to establish itself in the day trip and short stay tourist market (East Lothian Council 1998). The shoreline and golf course of the management unit is within Area 1 of John Muir Country Park (Figure 9.5) and is thus heavily used for recreation (Section 9.10.1).

### ***Fishing Activity***

There is no commercial fishing activity within MU16, although some small scale sea-fishing and bait collection may take place on the rocky foreshore.

### ***Agriculture and Forestry***

Agriculture and Forestry are limited within MU16. A small area (5.5ha) of agricultural land is located at the landward extent of the management unit.

### ***Quarrying and Landfill***

There are no quarries or landfill sites within MU16.

### ***Water Quality and Pollution***

Coastal water quality in MU16 was classified as Class B (Good) by SEPA (2000). Belhaven Bay is a designated bathing beach and achieved a Guideline Pass of the EEC Directive in 2000 and 2001.

### ***Archaeology and Built Heritage***

The archaeological interests within MU16 are relatively limited, with only 9 sites of archaeological importance recorded, none of which are scheduled (Table 9.76). Of these, 5 are within 150m of the existing shoreline including the military relicts of observation posts (NT662791) and trenches (NT669793) and long cists at NT663790, NT664792 and NT668791. The former long cists sites are located on eroding shorelines, protected by Defence No 39 and 40, respectively. The sites of architectural importance are all within the built-up area of Dunbar and as they are well setback from the existing shoreline are under no threat of erosion or flooding.

**Table 9.76: Cultural Heritage Within MU16**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 9      | RCAHMS            |
| Scheduled Ancient Monuments   | 0      | Historic Scotland |
| Listed Buildings*             | 13     | ELC               |
| Architecture Sites*           | 3      | RCAHMS            |
| TOTAL                         | 25     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

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## **Natural Environment**

The entire inter-tidal area and hinterland of Winterfield Golf Course is within the Dunbar Coast section of the Firth of Forth SSSI notified for its geological and biological interests summarised in Table 9.77. The SSSI extends inland to include the semi-natural grassland area adjacent to Winterfield Golf Course, where Primrose, Cowslip, Early Purple Orchid and Common Twayblade are monitored. Grassland management commenced here few years ago and the area is regularly strimmed. Since then, there has been a ten-fold increase in the orchids, a three-fold increase in Primrose and Cowslip and a small but important increase in Common Twayblade (SNH 2000b).

The SSSI is also designated as a Geological Conservation Review Site (GCR) for its Quaternary interest and is designated as an Area of Great Landscape Value within the Structure Plan. Dunbar Coast SSSI extends eastwards into the adjacent management unit (MU17) to Dunbar Harbour (NT678794). The SSSI also forms parts of the newly designated Firth of Forth SPA/Ramsar Site for ornithological and wetland interest.

**Table 9.77 Summary of the geological and biological interests of the Dunbar Coast section of the Firth of Forth SSSI (source SNH 2000b)**

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Geological interest | This site has the best examples of marine rock platforms and associated landforms in eastern Scotland. Four marine rock platforms have been cut in response to changing sea levels in the recent geological past. Three of the platforms occur at or above sea level, while the fourth, part of the main Lateglacial Shoreline in south-east Scotland, occurs offshore and is believed to correlate with a similar feature on the west coast of Scotland. This is a key locality for demonstrating former sea level fluctuations and phases of marine erosion. |
| Biological interest | The site contains a variety of coastal habitats including rocky shore, cliff and cliff top grassland. There are a few nationally and locally rare plants, including Sea Wormwood, Rough Clover, Kidney Vetch, Lesser Hawkbit, Sea Campion, Cowslip and Primrose. Several species of orchid also occur including Common Twayblade and Northern Marsh Orchid. The harbour holds the only mainland Kittiwake colony on the Forth.                                                                                                                                 |

SNH (2000b) note that there is likely to be on-going coastal protection work within the SSSI as erosion threatens amenities such as the cliff-top trail and the golf course, however they stress that any retention features will take account of the geological exposures and should not affect geological interest. The long-term objectives for management of the SSSI are:

1. To maintain the biological interests (coastal habitats, plant species and the Kittiwake colony) for which the SSSI has been notified.
2. To maintain the geological exposures and access to them.
3. To promote the educational and recreational use of the SSSI.

Any strategy for coastal defence recommended within the SMP should not conflict with these objectives.

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Over half the land within MU16 was classified as Amenity grassland (43.1ha)(Table 9.78). The urban area, roads and buildings were unclassified, covering 24.4ha of the management unit.

**Table 9.78: Phase 1 Habitats within MU16 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat   | Area (ha) |
|--------------|-------------------|-----------|
| J1.1         | Arable            | 4.1       |
| J1.2         | Amenity grassland | 43.1      |
| J3.6         | New Buildings     | 0.3       |
| Unclassified | Urban             | 24.4      |
| Total        |                   | 71.9      |

### ***Relevant policies and plans***

The Council policies regarding management of John Muir Country Park applies to MU16 (East Lothian Council 2000d), which state that natural erosion should be accepted in most areas and coastal protection is only required where erosion leads to serious loss of amenity. Erection of sea defences or coast protection works have been noted as an operation likely to damage the features of special scientific interest of the Dunbar Coast section of the Firth of Forth SSSI.

### ***Key interests***

Winterfield Golf Course has key interests in MU16, however no response was obtained from the golf course during the SMP consultation exercise, despite several attempts to contact them (Table 3.2).

East Lothian Council manage the golf course shoreline and reported that erosion was occurring at five locations in 1993 (East Lothian Council 1993) (Table 9.79). The report stated that urgent and necessary coastal engineering works were required (East Lothian Council 1993) and also noted that the anti-tank concrete blocks had not been successful for coastal defence, as they concentrate wave action thus enhancing erosion rates.

Defence No.39 has been constructed since the 1993 report, without the appropriate consents from SNH (SNH 1996b). This type of operation is subject to consent from SNH as it is located on the Dunbar Coast SSSI. Hard engineering structures placed along this shoreline result in the reduction or loss of exposure of the raised beach deposits resting on the wave cut platform underlying the golf course, which are of local or regional interest (SNH 1996b). The geological exposures for which the SSSI has been designated generally consist of 100-150cm of raised beach sediments (interbedded shingle, sand and shell layers), overlain by 50-100cm of soil and resting on a 50-100cm high rock platform (SNH 1996b) and SNH stress the importance of retaining at least one exposure of the wave cut rock platform, the best of which is at NT66337899. Any future coastal defences that are proposed along this stretch of coastline should take account of these natural heritage interests.



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**Table 9.79 Areas of Coastal Erosion in 1993 and Coastal Protection at Winterfield Golf Course, Dunbar (source: East Lothian Council 1993)**

| No. | Location                                             | Type of Protection | Approx. Date of Construction |
|-----|------------------------------------------------------|--------------------|------------------------------|
| 1   | 13 <sup>th</sup> fairway and 14 <sup>th</sup> tee    | Defence No. 39     | Post 1993                    |
| 2   | 14 <sup>th</sup> fairway and green                   | No protection      | N/a                          |
| 3   | 15 <sup>th</sup> tee and fairway                     | Defence No. 40     | Pre 1993                     |
| 4   | Base of banking below the Clubhouse and St Margarets | Defence No. 41     | 1910                         |
| 5   | Wilkie's Haugh                                       | Defence No. 42     | 1910                         |

Public concern relating to the shoreline of MU16 is relatively high. Four comments were raised relating to the erosion problem on Winterfield Golf course, while one specifically noted the unsightly coastal defences at Winterfield (SPI 2001a). Other comments related to lack of access through the golf course, even though it is a public right of way. However, the proposed coastal corridor footpath utilises the existing track along the shoreline of the golf course (Halcrow Fox 1998).

## **Valuation of Assets**

The monetary value of the assets within MU16 has been estimated at £36M (Table 9.80).

**Table 9.80 Valuation of Assets in MU16**

| Asset Type                | % Land in Category | Value (£)         |
|---------------------------|--------------------|-------------------|
| High Quality Agricultural | 44%                | 159 560           |
| Open Area                 | 20%                | 14 138            |
| Urban                     | 36%                | 36 264 200        |
| <b>Total</b>              |                    | <b>36 437 898</b> |

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### ***Option Evaluation***

Analysis of historical OS maps did not identify any long-term trends of erosion along the shoreline of Winterfield Golf Course, with most of the shoreline showing negligible change (Appendix C, View 18). However, a short section of the west facing shoreline at NT663790 has locally retreated by approximately 10-20m between 1907 and 1999. This coincides with the section of coastal protection along this part of the shoreline (Defence No. 39). In addition, the northern facing shoreline of MU16 fronting the clubhouse (NT666792) has retreated by approximately 10m since 1907.

Adoption of the **No Active Intervention** option may result in the continued erosion and deterioration of the coastal defences at the base of the Clubhouse (Defence No 41), and may eventually lead to destabilisation and slope failure. The coastal defences here were constructed in 1910 and are in very poor condition and have a residual life of <10 years (Appendix D).

No Active Intervention would also result in the continued deterioration and undermining of the “ad-hoc” coastal defences, which have been place to prevent localised erosion along the eastern shoreline of Belhaven Bay (Defences 39 and 40). However, there is a suggestion that the poor design of such defences (using anti-tank traps) have actually enhanced erosion in these areas by locally concentrating wave action (East Lothian Council 1993). In addition, there is evidence that the gabions (Defence No 39) may be enhancing erosion on the adjacent shoreline (SNH 1996b). Thus, there is a case for removal of these defences, although this may result in an increase in the area of land lost as erosion is allowed to continue, although erosion at the flanks of the defence may be reduced.

**Hold the Line** by constructing coastal defences and/or maintaining existing defences is not a feasible option for the entire management unit, as this would lead to loss of exposure of the geological sections of interest for which the site has been notified. Coastal defence options for this shoreline must ensure that at least one exposure of the wave cut platform and associated raised beach deposits remains (SNH 1996b). In addition, this option would be expensive and would not make economic sense given that rates of erosion of the golf course are relatively low and amenity loss is minimal. However, there are certain stretches of shoreline, which may require protection to avoid asset loss.

**Selectively Hold the Line** is considered a feasible option for MU16, whereby the defence protecting the clubhouse (Defence 41) is maintained and repaired to prevent erosion of the base of the slope, which could lead to eventual slope failure and destabilisation of the clubhouse. The remaining defences (Defences 39, 40 and 42) within MU16 are poorly designed and unsightly and appear to be enhancing erosion elsewhere in the management unit. It is recommended that East Lothian Council consider their removal. However, this may result in the continual erosion of Winterfield Golf Course, albeit at a relatively low rate.

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In the long-term relocation of tees and greens away for the eroding shore and accepting that localised erosion of this stretch of coast may occur is the most sustainable approach to coastal defence in this area. The cost of constructing and maintaining toe protection along a 100m section at the base of the slope fronting the golf clubhouse is estimated as £100,000 (2001 NPV). Under No Active Intervention, if this is not completed it is assumed that failure of the slope will lead to loss of the clubhouse and adjacent land, an estimated monetary value of £118,000 (2001 NPV) giving a benefit-cost ratio of 1.2. Adopting a policy of Selectively Holding the Line, as outlined above, is unlikely to adversely impact natural coastal processes or adjacent shorelines.

**Advance the Line** is not a feasible option for MU16, as this would result in the loss of the geological exposures of interest and would not make economic sense, as robust coastal defence structures would have to be constructed to maintain an artificial shoreline position.

The reclaimed area of land known as the Haugh may be an area where **Retreat the Line** is a feasible option, although a more detailed study would be required to assess the technical feasibility of this option. However, this would reduce the need for future protection and would allow the coastline to revert back to its natural position prior to reclamation. East Lothian Council removed a dilapidated seawall in this area in 1978 (East Lothian Council 1993), although remnants of the seawall were identified on the foreshore during the site visit (Defence 42)

The preferred option for MU16 is to **Selectively Hold the Line**. It is recommended that a properly engineered coastal defence to protect the toe of the slope at the clubhouse be constructed to replace the dilapidated seawall (Defence No 41).

It is also recommended that the “ad hoc” coastal defences preventing localised erosion of the raised beach deposits of Winterfield Golf Course be removed.

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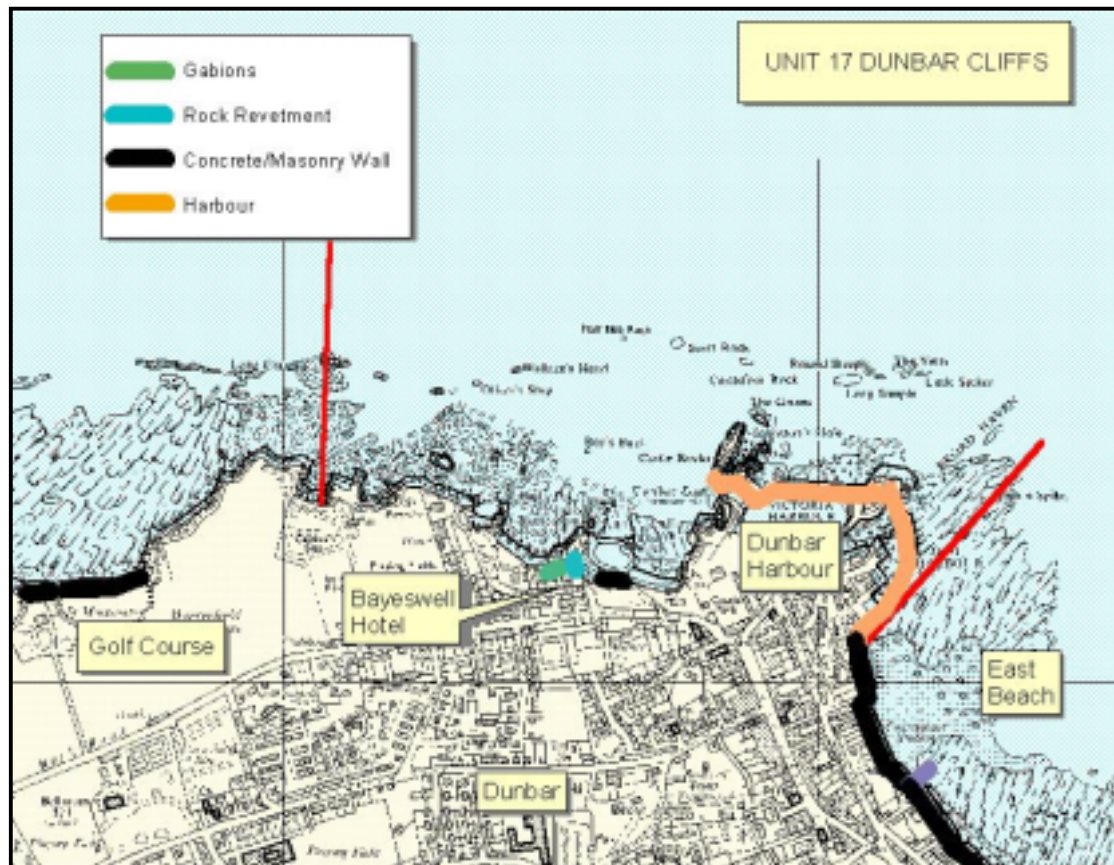
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### 9.10.3 Management Unit 17, Dunbar Cliffs

This management unit extends from the eastern limit of Winterfield Golf Course (NT671794) to Dunbar Harbour (NT682794) and comprises approximately 1.5km of highly indented sandstone cliff coastline of Dunbar, with actively eroding cliffs and stacks. Dunbar Harbour and Dunbar Castle are both in MU17.



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**Table MU17.1 Summary of Attributes of Management Unit 17**

| Coastal Processes                                                        |                                                                                                                                                     |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution                                                      | History of erosion and landslips. Rates of retreat are low.                                                                                         |
| Geomorphology                                                            | Rock platform, gravel foreshore, high sandstone cliffs                                                                                              |
| Sediment Drift                                                           | Low or moderate net westerly drift                                                                                                                  |
| Coastal Defences                                                         |                                                                                                                                                     |
| Type                                                                     | Man-made: Gabions, rock revetment, concrete walls, harbour<br>Natural: Rock outcrops                                                                |
| Human and Built Environment                                              |                                                                                                                                                     |
| Land use                                                                 | Residential and commercial, Harbour                                                                                                                 |
| Sea use                                                                  | Commercial sea fishing and harbour access                                                                                                           |
| Infrastructure                                                           | Roads                                                                                                                                               |
| Recreation and Tourism                                                   | Walking, historic interest, yachting and boating                                                                                                    |
| Historic Environment                                                     | 103 sites of cultural heritage identified, most within Dunbar conservation area. 3 scheduled ancient monuments, including the ruin of Dunbar Castle |
| Natural Environment                                                      |                                                                                                                                                     |
| Habitat Types                                                            | Rocky shores                                                                                                                                        |
| Designated Sites                                                         | Firth of Forth SSSI<br>Firth of Forth SPA/ Ramsar Site                                                                                              |
| Key Interests                                                            |                                                                                                                                                     |
| Erosion and landslipping of coastal trail, Dunbar harbour, Dunbar Castle |                                                                                                                                                     |
| Valuation of Assets                                                      |                                                                                                                                                     |
| £61 M                                                                    |                                                                                                                                                     |

**Table MU17.2 Screening of Strategic Options with Management Objectives**

| Strategic Option          | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|---------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention    | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | √                   | X         | √             | NA       | X        |
| Limited Intervention      | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | √                   | X         | √             | NA       | X        |
| Selectively Hold The Line | √                  | √           | √                         | •                         | •           | √                     | √         | √                      | √                   | √         | √             | NA       | √        |
| Advance The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line          | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

The cliffs to the west of Dunbar harbour are sandstone and are gradually eroding and being undercut, resulting in localised landslips. Several sections of the cliffs have been protected, as described below. A cliff-top trail extends along the top of the cliffs and properties, hotels and gardens sit atop the steep slope. The war memorial (NT673793) had to be moved back from the cliff-top in c.1990, due to the risk of landslips.

A ca. 15m high eroding sandstone cliff fronts the grassy terrace area, where the war memorial is presently sited. At the time of the site visit, there was no evidence of protection here but there was evidence of recent landslips. Further east at NT675792, the cliff-top path is protected by 4 layers of PVC coated wire gabions for a stretch of ca. 50m (Defence No 43, Plate 9.30). The gabions apparently protect the support to the path but do not extend down to the beach level.

Some rubble blocks have been placed at the back of the beach in order to minimise erosion and prevent undercutting, which could result in slipping and failure of the gabions. The structure was constructed in 1999 to stabilise the coastline and reopen the footpath, as a landslide the previous year caused closure of the path (SNH 2000b). The defence still appears to be in generally good condition, but should be maintained to avoid undercutting and slipping. It is further recommended that, given the steepness of the coastline here and the role of any defences in maintaining the support of the public walkway above, and the history of slips nearby, this area be monitored regularly and particularly following significant storms.

The rocky bay, west of Dunbar Castle, is topped by terraced public gardens (NT676792). The old open-air swimming pool was removed from the bay in 1985 and the coastline restored with sand, gravel and cobbles (SNH 2000b). A path provides access down the cliffs and a concrete retaining wall is present for about 50m in the centre of the bay at the base of the slope (Defence No 45). The wall has been subject to settlement and possibly land slippage in the past, resulting in a pronounced bulge in the centre. The wall is also undercut at the base and damaged and cracked in places.

In general, the wall is in poor condition and has a limited residual life. Plastic vegetation matting is present at the base of the wall. This too is in very poor condition and has been undercut, exposing rocks and earth beneath. Rock armour has been placed at the western end of the bay for ca. 20m (Defence No 44), presumably in a bid to prevent erosion of the cliff-top path. The armour has been placed on top of a seaward dipping rock-face and the toe support has been lost in several places.

Dunbar harbour (Defence No 46) consists of the Old Harbour to the east and the newer Victoria Harbour on the western side. Both harbours now share the same entrance, the Old Harbour now forming an inner harbour to Victoria Harbour. Both harbours are constructed on a bedrock headland, and thus are solidly founded. Rocks and rubble have been used to block off the original harbour entrance at Broad Haven (NT682793), presumably to reduce the problem of NE swells entering the harbour. Swells of over 4.5m are common at the harbour mouth (David Johnstone, pers. comm. 2001) creating problems with mooring.

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The new harbour entrance is to the northwest and was blasted through the rocky headland at Dunbar castle during the construction of Victoria Harbour in 1842. The Old Harbour appears to be used mainly by pleasure vessels, which enter via Victoria Harbour, while Victoria Harbour is used mainly by fishing vessels and workboats, although it was noted that smaller fishing vessels also accessed the Old Harbour.

Victoria Harbour is in good condition (Plate 9.31). The inner walls are masonry block walls, with good joint work. In places, the red sandstone masonry walls have voids, loose stones and battered faces. Concreting has replaced the original inner walls in some places. The southern and northern quays are surfaced with large stone setts and have original stone copes. The eastern quay, which contains the drawbridge between Victoria Harbour and Old Harbour, is surfaced in tarmac. The land level rises landward of the harbour (5.2m OD at Harbour View) so that any flooding would tend to drain back into the harbour.

The outer sea wall of Victoria Harbour is mainly constructed of large masonry units with an undressed face. The vertical outer wall is supported by massive concrete buttresses at staggered positions and appears sound and in good condition. The outer harbour wall is very exposed to the northeast and the crest is at a level of approximately 9.5m OD. The north parapet wall is very high (approximately 5m above quay level) and in good condition. It is constructed with blocks of sandstone, and a section of about 100m long has been reconstructed in concrete, with concrete buttressing every 4m. In places, the parapet wall of this concrete arrangement showed evidence of spalling, caused by corrosive expansion of the steel reinforcement within the concrete.

The path along the north side of the harbour entrance is subject to deep undercutting and erosion (Plate 9.32). This may be a public safety issue and could lead to failure of the path in the future. North of the harbour entrance, there is a large sandstone masonry mound, which was presumably constructed to reduce NE swell and waves at the mouth.

The Old Harbour sea wall is constructed mainly of sandstone masonry (Plate 9.33). The vertical sea wall is founded on rock and is very exposed. Individual masonry units are very eroded and there is evidence of ongoing repairs to the wall. The cope level of the outer harbour is undulating and at the northern tip there have been concrete repairs to improve stability. The inner wall is a mortared masonry face with stone patchwork.

The mouth of the Old Harbour has rough vertical slots, perhaps for a former gate (stop log), which is no longer in use, and the inner quay wall here is in very poor condition. There is evidence of repair work on the inner harbour wall and the quay is at a low level. During the visit, part of the quay (NT6812 7291) showed signs that it may become inundated at high water. This may pose a risk to the new domestic property to the landward of the Old Harbour, although wave penetration would not be anticipated here.



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### **Land-use**

The principal land-use in MU17 comprises the built-up area of Dunbar, which covers over 85% of the hinterland (Table 9.81).

**Table 9.81: Land-use classification in MU17 (source: MLURI 1988)**

| Land-use class        | Domain                            | Area (ha) |
|-----------------------|-----------------------------------|-----------|
| Factories & urban     | Built-up (area)                   | 57.7      |
| Arable                | Arable: no rock no farms no trees | 6.0       |
| Coniferous plantation | Coniferous (plantation - area)    | 2.0       |
| Total                 |                                   | 65.7      |

### **Residential Development, Industry, Ports and Harbours**

Part of the residential area of Dunbar is located in MU17. Dunbar is a historic Scottish burgh whose origins lie in both fishing and as the market town for the surrounding area. Dunbar has been a popular tourist resort since Victorian times and some of the larger hotels and guesthouses are located in the immediate hinterland of MU17, overlooking the cliffs. Dunbar Harbour (described above) is within MU17. The harbour retains a small fishing fleet and a processing factory, in addition to leisure craft. The Council supports the fishing industry at Dunbar and has a policy to give preference to uses that are related to the fishing industry (East Lothian Council 1998). However, they will also consider alternative tourist or visitor related uses provided that they do not conflict with fishing interests.

### **Recreation and Tourism**

The Dunbar cliff-top trail runs along the coastline of MU17 and is used for recreation. Trail interpretation signs describe the geology and other natural heritage interests. The path is part of the JMPC and is managed by East Lothian Council for recreation (Section 9.10.1) and also forms part of the proposed sustainable coastal walkway (Halcrow Fox 1998).

Tourism is important to the economy of Dunbar and the town is seeking to establish itself in the day trip and short stay tourist market. The opening of the Dunbar Leisure Pool in MU17 (NT678792) was a significant investment in that market. Dunbar has a tourist information centre, caravan parks, two golf courses and the historical interest of Dunbar, in particular the harbour area and Dunbar Castle, make the area an important tourist attraction. Water based recreation activities are also important in MU17, with Dunbar Sailing Club operating from Dunbar Harbour and yacht berths are provided in the harbour and anchorage offshore at Castle Rocks (Barne et al 1997).

### **Fishing Activity**

A commercial fishing industry operates from Dunbar Harbour, with ancillary support industries being important in the local area.

### **Agriculture and Forestry**

Small areas of agriculture and forestry (Table 9.81) are limited to the extreme landward extend of MU17.

### **Quarrying and Landfill**

There are no quarries or landfill sites within MU17.

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### **Water Quality and Pollution**

The coastal water quality in MU17 was classified as Class B (Good) by SEPA (2000).

### **Archaeology and Built Heritage**

MU17 is rich in cultural heritage, with over 100 sites of interest recorded (Table 9.82). The majority of sites are of architectural importance including 75 Listed buildings, most of which are located in the Dunbar Conservation Area. Dunbar is a well-preserved example of an historic Scottish burgh, which still contains many typical features including: a wide 18<sup>th</sup> Century High Street; the 17<sup>th</sup> Century Tolbooth (town-house); the Parish Church and Lauderdale House at the north end of the High Street; and evidence of town walls and the many former industries such as maltings, granaries, warehouses and cottages around the harbours. The historic buildings within the Conservation Area are protected within the Local Plan (East Lothian Council 1998).

**Table 9.82: Cultural Heritage Within MU17**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 1      | RCAHMS            |
| Archaeological Sites (land)   | 7      | RCAHMS            |
| Scheduled Ancient Monuments   | 3      | Historic Scotland |
| Listed Buildings*             | 75     | ELC               |
| Architecture Sites*           | 17     | RCAHMS            |
| TOTAL                         | 103    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

There are 3 scheduled ancient monuments within MU17 including Dunbar Castle and Fort (NT678793); Dunbar Castle Park, which includes settlements, burials and defences (NT678792); and the Dovecot at Red Friars Monastery (NT677788). The ruins of Dunbar Castle, a 12<sup>th</sup> Century fort in which Mary Queen of Scots sought sanctuary after the murder of her second husband, lies at the entrance to Victoria Harbour. The Castle was partially destroyed during the construction of Victoria Harbour in 1842 and is currently closed to the public because of the danger of collapse and crumbling masonry (GUARD 1996). Large blocks of masonry were visible in the small bay to the west of the castle and the entire structure is in a poor state of preservation and at risk of further erosion (GUARD 1996; Scotsman 2001).

East Lothian Council have estimated that repair work at the castle would cost in the order of millions of pounds and have no plans to do carry out any works at present (J. Squires, pers. comm. 2001), although some safety work was carried out in 1992 (SNH 2000b). The Council support proposals for a commercial or tourist related development on the south side of Victoria Quay if it enables the former Castle Vaults to be opened up to public view (East Lothian Council 1998). Other archaeological sites of interest close to the shoreline of MU17 include the harbour walls of both Victoria and the Old Harbour and the Battery at Lamer Island, which was erected in 1781. The Battery is also a B Listed structure. The wreck of a minor warship, HMS Fox, lies near the rocks off Dunbar Harbour (NT683796).

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### ***Natural Environment***

The inter-tidal, cliff-top and part of the hinterland of MU17 is within the Dunbar Coast section of the Firth of Forth SSSI, notified for its geological and biological interests (Table 9.77). The inter-tidal area also forms part of the Forth SPA / Ramsar site for ornithological and wetland interests. The coastal landforms, essentially the assemblage of actively eroding rock features, such as cliffs and stacks, and the evidence of past and present wave cut platforms make this shoreline of considerable earth science interest (SNH 1996b). The Kittiwake colony, which is located on the Castle walls, has been studied and monitored for several years (SNH 2000b). Bird ringing is carried out and long term studies are looking into nesting and breeding patterns of the birds.

A large area (41ha) of MU17 was not classified during the Phase 1 Habitat survey of East Lothian; this constitutes the built-up area of Dunbar. The other habitats include amenity grassland, arable land, mixed woodland and coniferous plantation (Table 9.83).

**Table 9.83: Phase 1 Habitats within MU17 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat            | Area (ha) |
|--------------|----------------------------|-----------|
| A1.2.2       | Coniferous plantation      | 1.1       |
| A1.3.2       | Mixed woodland, plantation | 1.1       |
| J1.1         | Arable                     | 9.1       |
| J1.2         | Amenity grassland          | 13.1      |
| Unclassified | Urban                      | 41.3      |
| Total        |                            | 65.7      |

### ***Relevant policies and plans***

The proposed route for the East Lothian coastal path runs along the existing cliff-top path in MU17 (Halcrow Fox 1998). However, ongoing erosion and landslips along this section of coast has resulted in the need for repairs to the path in recent years. There may be a case to re-locate the path away from the cliff-top, both to minimise future coastal defence costs and in the interests of public safety.

### ***Key interests***

The historical and natural heritage interests of MU17 are high. Historic Scotland are concerned about the state of Dunbar Castle, which appears to be falling into the sea (Scotsman 2001). The natural heritage interests are protected by the SSSI, SPA and Ramsar status of the shoreline.

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The Harbour Master of Dunbar Harbour responded to the SMP consultation, informing us of the poor condition of the North Wall of Victoria Harbour, which has deteriorated with age and is badly in need of remedial work, as some of the stones have become very loose (R Brunton, pers. comm. 2001). Dunbar Harbour is no longer the responsibility of the Council, but is managed by Dunbar Harbour Trust. An engineering report on the condition of the walls is currently being prepared and funding is required before further work can be carried out (East Lothian Council 2001f). East Lothian Planning department also noted that the old barrage at Broadhaven is approximately 20 years old and, as this floods during spring tides, they are aware that this needs to be rebuilt (Table 3.7).

The public concerns were mainly related to coastal erosion and landslip problems along the cliff-top path (SPI 2001a). One member of the public noted that one of the gardens at Baywell Park is disappearing (SPI 2001a) and others noted that the 1893 promenade is being undercut and is not safe. East Lothian Council noted that the entire cliff-top trail is either subsiding, cracked or falling away due to erosion (Appendix E).

#### **Valuation of Assets**

As a large part of MU17 comprises the urban area of Dunbar, the estimated asset value is high (£61M, approx. £900,000 per ha).

**Table 9.84 Valuation of Assets in MU17**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>  |
|---------------------------|---------------------------|-------------------|
| High Quality Agricultural | 18%                       | 58 460            |
| Open Area                 | 15%                       | 10 051            |
| Urban                     | 67%                       | 61 425 000        |
| <b>Total</b>              |                           | <b>61 493 511</b> |

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### ***Option Evaluation***

Analysis of historical map information showed that the position of the MHWS has remained predominantly unchanged over the last 90 years (Chapter 4). However, there is documented evidence that the coast in MU17 is subject to erosion and undercutting, causing landslips and rock-falls. While retreat rates of the sandstone cliffs are likely to be low, the main problem is caused by toe erosion destabilising the coastal slope, causing failure of the cliffs above. Future increases in sea-level and storminess are predicted to reduce inter-tidal width, which could lead to the potential loss of beaches at the base of cliffs (Chapter 4). This may cause an increase in the amount of toe erosion and undercutting occurring in locations such as MU17, as beaches will no longer protect the cliff toe from wave attack. It follows that there is likely to be an increase in the amount of erosion and landslipping occurring in MU17 in the future.

The options **Advance the Line** and **Retreat the Line** are not feasible for the cliff coastline of MU17.

**No Active Intervention** would result in the eventual failure of the defences at the base of the cliffs, which are protecting the coastal path and stabilising the cliffs from further land-slipping. As properties and hotels are located on the cliff-top, adoption of the No Active Intervention option is clearly not feasible. In addition, Dunbar Harbour lies on a very exposed headland and on-going maintenance and repairs are required to maintain the integrity of the harbour walls. In the long term a No Active Intervention approach would eventually lead to potential problems of breaches of the harbour wall and is not recommended.

However, there are certain sections of the shoreline of MU17 where cliff erosion is not a threat to amenity (e.g. at the grassland area to the west of the management unit). The Dunbar cliffs are naturally eroding at a very slow rate. A policy of **Hold the Line** for the entire management unit is not feasible, as this would be extremely costly requiring extensive engineering works and would also be detrimental to the natural heritage interests. Such a policy would also create visual /landscape impacts. In addition, such a policy is not economically feasible, as threat to property/amenity under existing conditions is minimal.

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**Selectively Hold the Line** is the preferred option for coastal defence in MU17. The gabion baskets (Defence No 43), which support the coastal path and stabilise the slope seaward of Bayeswell Hotel should be maintained, as destabilisation could potentially result in further slips. No additional construction is required but the defences should be inspected regularly. Dunbar Harbour walls (Defence No 46) appeared to be in relatively good condition during the site visit, but it is recommended that the walls are regularly inspected and repaired when required. An engineer's report on the condition of the harbour walls is currently being prepared (East Lothian Council 2001f). The rock rubble that has been used to block off the old harbour entrance at Broad Haven will have to be upgraded in the future.

As coastal erosion is likely to continue in MU17, it is recommended that the coastal walkway be moved back from the cliff edge and relocated. This will reduce the need for increasingly robust coastal protection in the future and will minimise potential public safety issues. The path at NT676792 should be set back from the shoreline, thus reducing the need to continue to maintain the old concrete retaining wall, which is sagging and in very poor condition. It is also recommended that a series of fixed monitoring stations be established along the shoreline of MU17.

Monitoring, such as measuring the distance from the cliff top to the fixed marker and/or taking photographs from fixed locations should be carried out on a monthly basis to establish erosion rates. The base of the cliffs should also be inspected regularly to establish rates of undercutting and identify areas potentially at risk of landslips. A policy of Selectively Hold the Line will have negligible impact on adjacent shorelines.

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### **9.11 PU11: DUNBAR HARBOUR TO MILL STONE NEUK**

For the purposes of shoreline management, PU11 has been split into two management units. Management Unit 18, Dunbar, extends along 1.5km of coast from the Harbour in the west (NT682794) to the end of Dunbar Promenade in the east (NT689785) and is protected by some form of coastal defence along its entire length. Management Unit 19 covers the more natural coastline to the east, where the immediate hinterland is Dunbar Golf Course.

The overall form of the coastline of PU11 is north-northeasterly facing and comprises a slight embayment between the headlands at Dunbar Harbour and Mill Stone Neuk. The coast is predominantly rocky platforms with a small sandy beach at East Beach, Dunbar. Dunbar has the best examples of marine rock platforms and raised beach platforms in eastern Scotland (East Lothian District Council, 1984). Analysis of historical OS maps show accretion is occurring at the Fluke Dub and Lawrie's Den to Mill Stone Neuk (Table 4.6, Appendix C, View 19). Erosion is occurring at East Beach, Dunbar (GUARD, 1996) and Mill Stone Neuk (Table 4.7). The hinterland is built-up over raised beach and glacial drift deposits with a defended coast edge along the built-up area of Dunbar.

Storms are documented as causing damage to sea walls along this shoreline (East Lothian Council, 2001e). The dominant wave directions for this stretch of coast are from the sector between north and east. Although sediment transport is believed to be from east to west for this section of coast (Barne et al., 1997), recent analysis (ABP Research, 2001) indicates the potential for easterly sediment transport within bays under waves approaching from the northern sectors. However, most of the beach systems are believed to be largely self-contained in terms of sediment movements (Ramsay and Brampton, 2000). Refer to Section 4.6 for further details of sediment transport processes.

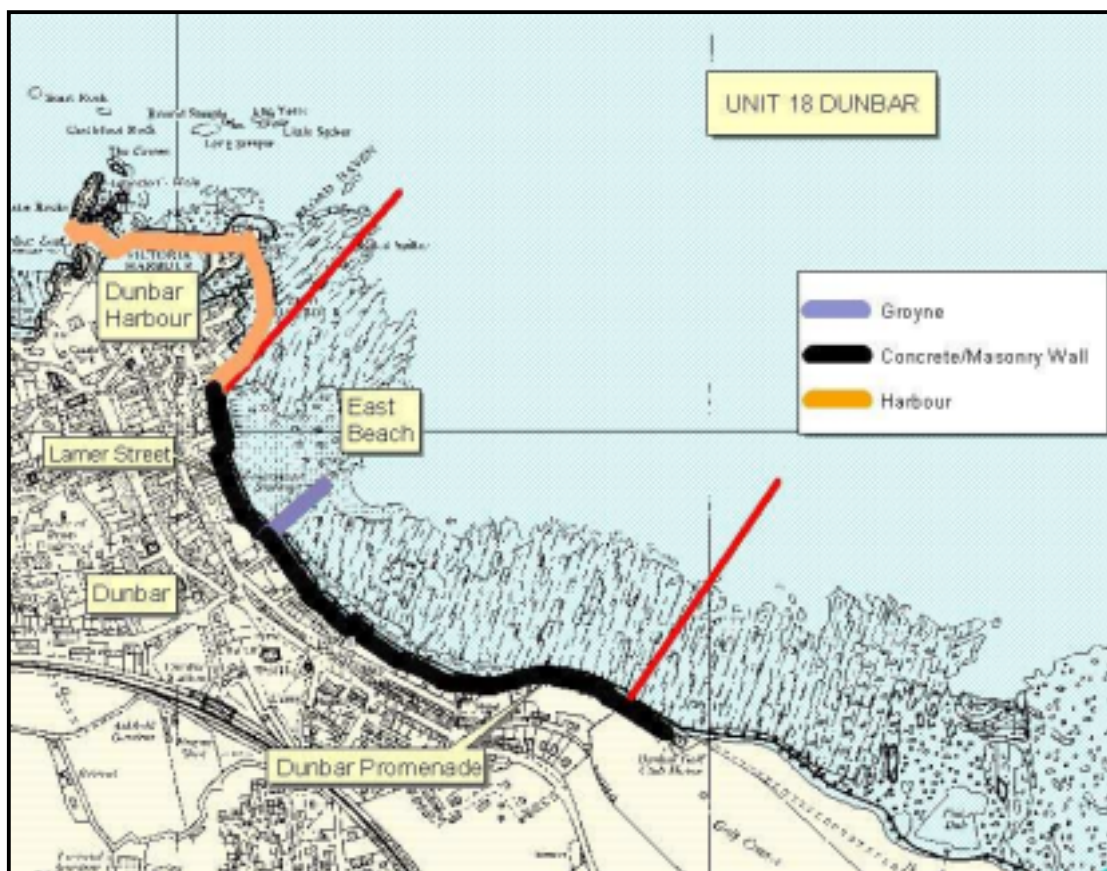
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Management unit 18 contains the shoreline of Dunbar East Beach, which has recently been the focus of more detailed studies. Babbie Group associated with specialist consultants: ABP Research and Scottish Participatory Initiatives (SPI) carried out a study of various problems experienced at Dunbar East Beach. ABP Research carried out a study into the causes of sand loss and seaweed accumulation on the beach (ABP 2001). SPI organised and carried out a public consultation exercise in Dunbar (SPI 2001b) and Babbie Group prepared an Action Plan for East Beach (Babbie Group 2001). For more detailed information on the management issues facing this part of the East Lothian coastline refer to the above reports.



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**Table MU18.1 Summary of Attributes of Management Unit 18**

| Coastal Processes           |                                                                                                                        |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | No net shoreline trend. Localised erosion at East Beach and damage to sea walls during storms.                         |
| Geomorphology               | Rock platform with a small sand beach                                                                                  |
| Sediment Drift              | Low or moderate net westerly drift, easterly drift also occurs                                                         |
| Coastal Defences            |                                                                                                                        |
| Type                        | Man-made: Concrete, masonry walls, groyne<br>Natural: Rock outcrops, sand beach                                        |
| Human and Built Environment |                                                                                                                        |
| Land use                    | Residential and commercial                                                                                             |
| Sea use                     | Fishing and boat access via slipway                                                                                    |
| Infrastructure              | Roads, Sewage pipe along beach                                                                                         |
| Recreation and Tourism      | Walking, dog-walking, tourist beach                                                                                    |
| Historic Environment        | 156 sites of cultural heritage identified, most within Dunbar conservation area.                                       |
| Natural Environment         |                                                                                                                        |
| Habitat Types               | Rocky shores, sand beach                                                                                               |
| Designated Sites            | -                                                                                                                      |
| Key Interests               | Public concerns are related to sand loss, erosion, sewage pipe; seaweed and kelp flies; litter; sewage and dog fouling |
| Valuation of Assets         | £86 M                                                                                                                  |

**Table MU18.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | X                   | X         | X             | NA       | X        |
| Limited Intervention   | √                  | √           | √                         | √                         | X           | X                     | X         | X                      | X                   | X         | X             | NA       | X        |
| Hold The Line          | √                  | √           | X                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | √        |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:  
 √ Option meets objective  
 X Option does not meet objective  
 • Option meets objective over part of the unit  
 NA Not applicable  
 - Not considered if option is not technically viable

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### ***Coastal Defences***

The 1.5km shoreline of MU18 is protected along its entire length. The coastal defences are described below and summarised in Appendix D.

At the eastern extent of the Old Harbour a cobbled slipway provides access to Dunbar East Beach (Plate 9.34). The level of the properties landward of the slipway is low (< 4m OD) and they are at risk to flooding during high spring tides and under storm conditions. There is evidence that suggests a gate may have once extended across the slipway, thus providing a means of flood defence to the property and land behind. A new floodgate would be worthy of consideration here to combat the present flooding problem.

Dunbar East Beach is protected along its full extent by a mix of concrete and masonry property and seawalls. The maintenance audit compiled by East Lothian Council has estimated a cost of £50 000 for repairs at East Beach (Appendix E). The defences at East Beach are discussed in three sections:

- Northern end from the harbour to the groyne.
- Groyne to the start of the Promenade at the south
- Promenade frontage.

Defence No 47: Northern end from the harbour to the Groyne

A high masonry seawall extends along the back of the beach from the slipway at the western end. At Lamer Court, the wall is constructed with large stone units in the lower reaches and a mix of smaller stones in the upper reach. The vertical wall is approximately 8m above the beach level at this point and shows evidence of re-pointing work through the wall. Some of the joints have been plucked out at the toe and have scoured out a hole about 1m long (Plate 9.36). There have been local repairs to the wall (e.g. concreting at the base where undercutting has been a problem). One 10m long length close to the ramp has been patched with a concrete panel that stands proud of the wall. This panel has been undercut and evidence of wave erosion was also visible in the sandstone along the lower third of the wall. This section of the wall is in poor repair and will require maintenance work.

At the Lamer Street steps, the old masonry wall has been dressed in concrete and the pedestrian access ramp is undercut by about 150mm and the toe of the wall at this point is visible. West of the Lamer Street steps, there is timber piling, which is in very poor condition and does not appear to be supporting the wall.

The wall fronting Lamer Street has been constructed with a mix of very low grade, poor quality concrete and masonry, which has been repaired in places with old brickwork (Plate 9.37). The crest of the wall is about 3.5 - 4m above the beach level (approximately 6.4m OD) and there is no parapet wall fronting Lamer Street. An erosional notch in the seawall provides visual evidence that beach levels may have been approximately 0.5m higher (Plate 9.37). This level would also correlate with the base of the Lamer Street steps.

The upper beach here is sandy and deposits of kelp are present above the tidemark. There are cobbles on the lower beach and an extensive rocky foreshore that appears to be well covered with growing seaweed. During the site inspection on 30/10/01, the sand level was visibly higher at the eastern side of the beach.

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A concrete interceptor sewer runs across the back of the beach, drawings provided by EoSW date this to 1991. The top is exposed by about 100mm at the north end and becomes covered approximately 100m before the groyne. Standing water was present behind the sewer and there was evidence of kelp build up landward of the sewer pipe, perhaps trapped there as the tide falls.

A timber groyne extends approximately 120m out to the low water mark at NT682788 (Defence No 48, Plate 9.38). The dilapidated groyne is constructed with timber sleepers. It is incomplete and in a very poor condition. The groyne was originally constructed to retain sand on the Lamer Street side of East Beach (M Hutchison, pers. comm. 2001), however it now rests on the rocky foreshore. Sand is present for approximately 5m on the upper beach only. The groyne does not appear to be retaining sediment at present.

Defence No's 49, 50, 51 & 52: Groyne to the start of the Promenade at the south  
The beach to the east of the groyne is sandy with a rocky foreshore. An irregular masonry wall extends along the back of this section of the beach of varying elevation and condition. Immediately east of the groyne, the outer wall of domestic property backs the beach and appears to be in reasonable condition (Defence No 49), albeit lower reaches of this structural wall may be more exposed than they have at times in the past.

Further east, several access steps break the wall and there is evidence of a beach level drop at the steps at Woodbrush Court (NT68207879), where the underside of the stairway is visible. The section of seawall between the two access steps is in poor condition and there are concrete repairs at the toe (Defence No 50). A recurved cope has been added to the parapet at the top of the wall and the crest of the seawall is approximately 7m above the beach level. The rough dressed concrete repairs at the toe are in poor condition and will need inspection within 5 years. The upper reaches of the wall also require inspection for safety.

At NT68257872, there is a low access point and steps at the back of the beach. Properties landward of this low point may be at risk to flooding, as evidenced by the bricked up gate at one of the properties. East of this point, the seawall consists of a mix of old garden walls of varying elevations and condition (Defence No 51). The section of wall at NT68277870 is in very poor condition and in need of repair (Plate 9.39). Further east, there is evidence of beach level drop of approximately 0.5m since the wall was constructed and the concrete wall shows evidence of past movement (cracks and concrete repairs).

East of the steps at NT68347865, a 1.5m concrete toe protects the base of the masonry wall for a stretch of 30m. The new flat development further east is protected by a 4m high masonry wall, which is in good condition and has been recently pointed (Defence No 52, Plate 9.40). The upper sand beach at this location is healthy and sand levels appear higher and there is no evidence of the toe of the wall. The masonry wall lowers towards the promenade to the east and is approximately 2m above beach level. A wide, healthy sand beach fronts the wall, protecting it from direct wave action, although there is evidence of some erosion of the sandstone blocks. These may need attention in the near future.

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A new penetration has been formed in the wall at the new housing. Access through this to the beach is by an open pattern gate, which offers no defence against the potential ingress of water should wave and tidal conditions prevail.

The interceptor sewer is not visible east of the groyne, except for the manhole access points, which can be up to 400mm above the current sand level.

#### Defence No 53 Dunbar Promenade

A wide rocky foreshore, with large amounts of seaweed growth, fronts the promenade at the eastern end of east beach. The promenade is approximately 2m above the rocky foreshore at a level of approximately 4.4m OD and is supported by a masonry sea wall, which is undercut in places (NT686785). MHWS abuts the promenade and there is evidence that the promenade is overtopped at high water. A low, 1.5m high, masonry wall backs the promenade, providing additional protection to the housing and golf course which lie at higher levels behind. There is evidence of a few concrete repairs and some poor jointing at the base of the promenade in places, although it is generally in a good condition.

#### **Land-use**

The built-up area of Dunbar comprises over 60% of the land area of MU18 (Table 9.85). The built-up area lies adjacent to the shoreline for the entire management unit, thus it is this asset is potentially at risk from flooding or erosion. Agricultural and Forestry lies to the landward of the area.

**Table 9.85: Land-use classification in MU18 (source: MLURI 1988)**

| Land-use class        | Domain                            | Area (ha) |
|-----------------------|-----------------------------------|-----------|
| Factories & urban     | Built-up (area)                   | 74.4      |
| Coniferous plantation | Coniferous (plantation - area)    | 12.5      |
| Arable                | Arable: no rock no farms no trees | 34.6      |
| Recreational land     | Golf course                       | 0.3       |
| Total                 |                                   | 121.8     |

#### **Residential Development, Industry, Ports and Harbours**

The residential area of Dunbar lies within MU17. There is some fishing related industry, together with numerous small businesses and commercial enterprises within the management unit. Dunbar Harbour is to the west of MU18.

#### **Recreation and Tourism**

Dunbar has been a popular tourist resort since Victorian times. Tourism is important to the economy of Dunbar and the town is seeking to establish itself in the day trip and short stay tourist market. However, the popularity of Dunbar East Beach for bathing and recreation has declined in recent years, due to the perception that the beach has lost sand and the amount of seaweed deposited on the beach has increased (SPI 2001b). The problems and solutions of Dunbar East Beach are currently under investigation as a separate commission. Nevertheless, the beach and shoreline in MU18 are used for passive recreation activities such as walking, dog-walking etc.

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### ***Fishing Activity***

There is some fishing activity and related industry in MU18, due to the proximity of Dunbar Harbour to the west. The slipway at the western end of the management unit also provides access for local boats.

### ***Agriculture and Forestry***

Agriculture and forestry are limited to the landward part of MU18.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU18.

### ***Water Quality and Pollution***

Dunbar East Beach is designated as a Bathing Water under the EC Bathing Water Directive (EEC Directive 76/160) and has consistently achieved a Guideline Pass of the Directive since 1996. The water quality along the entire shoreline of MU18 is classified as Class B (Good) by SEPA (2000).

### ***Archaeology and Built Heritage***

Dunbar is a well-preserved example of an historic Scottish Burgh, hence a large number of buildings are Listed Buildings. There are 156 listed structures in MU18 (Table 9.86), most of which situated in the Dunbar conservation area. The Old harbour quays and piers are also listed, protecting their conservation interests. All the sites of architectural heritage are set back from the shoreline by around 50m and lie landward of the coastal defences.

There are no scheduled ancient monuments within MU18, although 16 archaeological sites of interest have been recorded. These sites include a number of long cists and urns, several excavations, coins and gravestones, although most lie over 50m landward of the coastal defences and are not perceived to be under threat of erosion or flooding.

**Table 9.86: Cultural Heritage Within MU18**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 16     | RCAHMS            |
| Scheduled Ancient Monuments   | 0      | Historic Scotland |
| Listed Buildings*             | 127    | ELC               |
| Architecture Sites*           | 13     | RCAHMS            |
| TOTAL                         | 156    |                   |

\* Note: some architecture sites are also designated as Listed Buildings

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#### ***Natural Environment***

The Dunbar shoreline in MU18 has no formal natural heritage designations. The hinterland is developed and the inter-tidal area has a small sandy beach at East Beach, a rocky foreshore outcropping.

The Phase 1 habitat survey classified 69ha of land within MU18 (Table 9.87), with the remaining area comprising the built-up area. Arable land is the principal habitat type within MU18, with other habitats comprising woodlands, grasslands, tall ruderal, swamp and new buildings making up the remaining area.

**Table 9.87: Phase 1 Habitats within MU18 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 0.8       |
| A1.3.2       | Mixed woodland, plantation          | 12.9      |
| B2.2         | Neutral grassland, semi-improved    | 0.7       |
| B6           | Poor semi-improved grassland        | 1.7       |
| C3.1         | Tall ruderal                        | 0.6       |
| F1           | Swamp                               | 0.2       |
| J1.1         | Arable                              | 33.5      |
| J3.6         | New Buildings                       | 7.7       |
| Unclassified | Urban                               | 52.8      |
| Total        |                                     | 121.8     |

#### ***Relevant policies and plans***

There are no existing planning applications that may have an impact on shoreline management within MU18, however the Council expressed that they are keen on any plans to redevelop/regenerate Dunbar (Table 3.7).

#### ***Key interests***

No responses were received during the written consultation phase of the SMP relating to MU18. However, public concern regarding the condition of Dunbar East Beach is high (SPI 2001a, 2001b), such that the East Beach Regeneration Group has been set up by the local residents and interested parties. The main concerns identified by the Council are related to Sand Loss, Building Erosion, Sewage Pipe; Seaweed and Kelp Flies; Litter; Sewage and Sewage Related Debris; Dog Fouling and Oil. These have been investigated in a separate commission (ABP 2001, Babbie Group 2001).

#### ***Valuation of Assets***

Assets in MU18 have an estimated monetary value of £86M (Table 9.88). As the urban area lies adjacent to the shoreline for the entire management unit, it is this asset that is potentially under threat of erosion/flooding if the existing defences fail.

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**Table 9.88 Valuation of Assets in MU18**

| Asset Type                | % Land in Category | Value (£)         |
|---------------------------|--------------------|-------------------|
| High Quality Agricultural | 27%                | 167 045           |
| Open Area                 | 22%                | 27 188            |
| Urban                     | 50%                | 85 589 000        |
| <b>Total</b>              |                    | <b>85 783 233</b> |

### ***Option Evaluation***

Analysis of historical OS maps has shown that MHWS abuts the base of the seawall in both the 1907 and 1999 mapping (Appendix C, View 19). Thus, there is no available data to estimate natural erosion rates, as the seawall has prevented natural beach response to coastal processes. However, it is clear that wave action does impinge on the coastal defences in MU18, as there is evidence of wave damage and undercutting of the walls (see above). If the coastal defences within MU18 are not maintained there is a threat to property and roads, particularly around Lamer Street. Further undercutting and erosion, with no maintenance could result in the eventual failure of the defences causing flooding and subsidence of the roads and property that they protect. The rate that such damage may occur is impossible to predict and not within the scope of the present study. Thus, the monetary value of the potential losses under the No Active Intervention option have not been quantified, although these are likely to be high.

We understand that damage occurred to the Lamer Street Wall and that a section of the road subsided in late April of 2002. We understand that the damage was subsequently repaired by the Council. Ongoing monitoring and maintenance of the walls along Lamer Street will be necessary to maintain the current line.

**No Active Intervention** is not feasible for MU18, as this would result in considerable loss/damage to property and roads. Some sections of the seawall in MU18 have an estimated residual life of <10 years (Appendix D, Defences 47, 50 and 51) and thus require immediate attention in the near future. If such maintenance works are not carried out, damage costs to the hinterland are likely to be high.

**Advance the Line** and **Retreat the Line** are not feasible options in MU18. Advance the Line would increase the need for increasingly robust coastal defences to defend an artificial shoreline position and would further disturb the operation of coastal processes. To pursue Retreat the Line in MU18 would require urban land-use to be substituted for inter-tidal area. This is clearly not practical.



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**Hold the Line** is the preferred option for coastal defence in MU18. The survey of existing structures identified several areas where attention is required in the short term (see below). The estimated cost of Hold the Line is £75,000 over the 50 years of the Plan period. This assumes that repairs are carried out to the seawall and access steps in Year 1 of the Plan, a floodgate is installed in Year 5 of the Plan and general maintenance and monitoring of the defences are carried out every year for 50 years. The cost of investigating the sand loss issue and providing solutions is not included. Measures to reduce the amount of sand loss from MU18 may have implications for adjacent shorelines, as a potential source of sediment will be reduced.

The benefits of Hold the Line have not been quantified, for reasons outlined above, however it is likely that the damage costs, due to erosion and subsidence of property and roads if No Active Intervention is adopted, would significantly exceed the estimated costs associated with Hold the Line.

| Defence                     | Location          | Risk                  | Attention Required                                                                            | Estimated Cost                                              |
|-----------------------------|-------------------|-----------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| East Beach Seawall          | Defences 47,50,51 | Erosion/ undercutting | Maintenance and Repairs                                                                       | £50,000                                                     |
| Access Steps (Lamer Street) | NT68097899        | Erosion/ undercutting | Repairs                                                                                       | £4,000                                                      |
| Cobbled Slipway             | NT68117909        | Flooding              | New Floodgate                                                                                 | £10,000                                                     |
| Groyne                      | Defence 48        | Sand loss             | Groyne is no longer retaining sand. Investigation to assess the need to remove/replace groyne | Refer to Babbie Group (2001) ABP (2001) for further details |

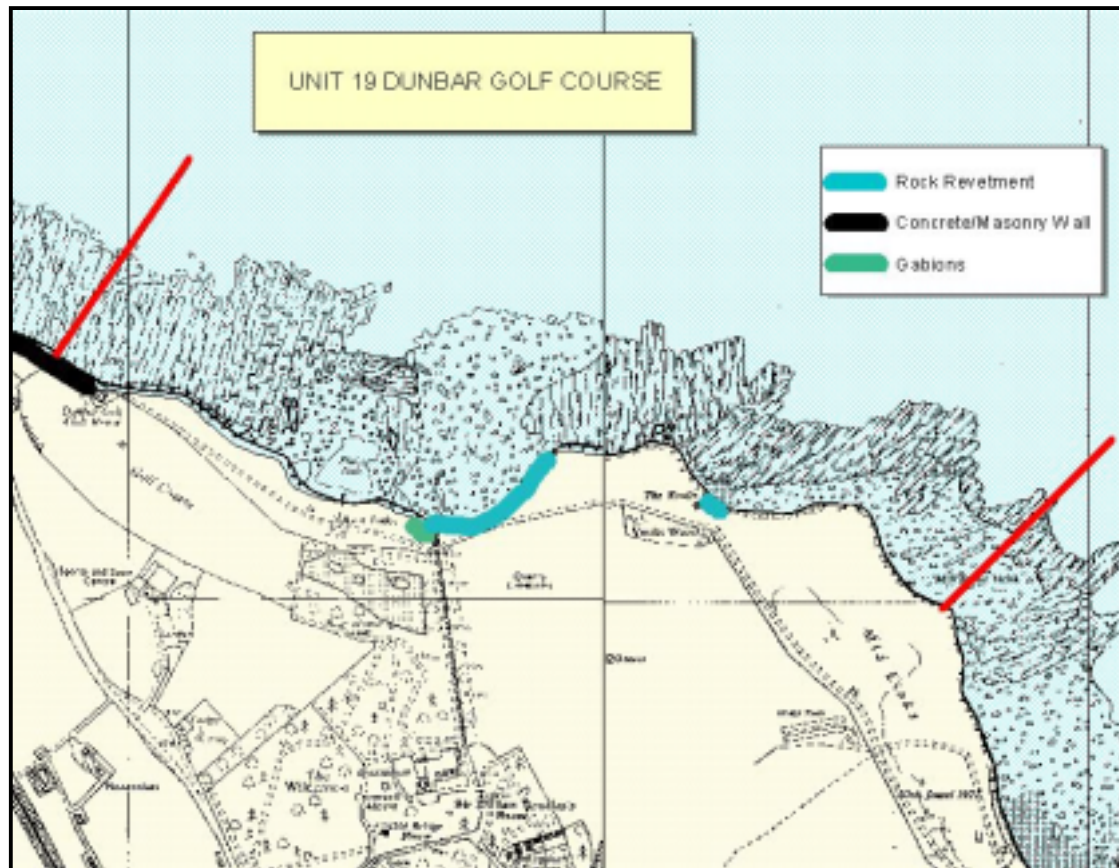
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Management unit 19 lies to the east of the built-up shoreline of Dunbar and extends along approximately 2km of shoreline at Dunbar East Links Golf Course (NT689785 – NT707779).



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**Table MU19.1 Summary of Attributes of Management Unit 19**

| Coastal Processes           |                                                                                                          |
|-----------------------------|----------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Stable or accreting. Seasonal, short-term erosion.                                                       |
| Geomorphology               | Rock outcrops with a small pockets of sand and shingle beaches                                           |
| Sediment Drift              | Low or moderate net westerly drift.                                                                      |
| Coastal Defences            |                                                                                                          |
| Type                        | Man-made: Masonry wall, gabions, rock revetment (tipped rocks)<br>Natural: Rock outcrops, pocket beaches |
| Human and Built Environment |                                                                                                          |
| Land use                    | Golf course                                                                                              |
| Sea use                     | -                                                                                                        |
| Infrastructure              | -                                                                                                        |
| Recreation and Tourism      | Walking, dog-walking, golf.                                                                              |
| Historic Environment        | 31 sites of cultural heritage identified                                                                 |
| Natural Environment         |                                                                                                          |
| Habitat Types               | Rocky shores, coastal grassland habitat, shingle pocket beaches                                          |
| Designated Sites            | Barns Ness Coast SSSI<br>GCR Site<br>Provisional SWT Wildlife site                                       |
| Key Interests               | Dunbar Golf Club wish to protect their golf course from coastal erosion                                  |
| Valuation of Assets         | £23 M                                                                                                    |

**Table MU19.2 Screening of Strategic Options with Management Objectives**

| Strategic Option               | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|--------------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention         | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention           | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line (or Selectively) | √                  | √           | X                         | X                         | √           | √                     | √         | √                      | X                   | X         | √             | NA       | NA       |
| Advance The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- X Option meets objective
- Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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## **Coastal Defences**

The defences in MU19 are in private ownership (East Lothian Council 2001f) and all relate to attempts to protect the golf course. At the western boundary of the management unit, a masonry wall (Defence No 54) extends eastwards from the end of Dunbar promenade for approximately 100m, protecting the footpath. The wall is in reasonable condition and an old farmhouse wall is landward of the footpath.

The mouth of Brox Burn, which flows through the golf course, is protected by PVC coated wire gabions, which are well integrated with the shingle upper beach (Defence No 55). The gabions are in good condition and extend along the shoreline for approximately 40m.

East of the Brox Burn random rocks and rubble extend along the back of the shingle beach back to the margin of the 17<sup>th</sup> fairway (Defence 56, Plate 9.41). The 3-4m wide defence has failed in places and is mixed in with the shingle beach. The defence is unsightly and unnatural and is within the SSSI. Dunbar East Golf Course expressed their plan to place boulders and/or gabions along this stretch of coast to protect it from future erosion and flooding (Section 3.1). The unprotected stretch of coast to the east showed visible evidence of erosion, with an erosional upper face cut in the 15<sup>th</sup> fairway, although OS map analysis indicates accretion (Appendix C, View 19). The Golf Course plan to erect a man-made barrier around the 15<sup>th</sup> tee and along the 15<sup>th</sup> fairway to combat erosion (Dunbar Golf Course, correspondence, 3<sup>rd</sup> October 2001)

A 30m stretch of rock rubble has been placed at the top of the beach at NT702782 (Defence 57). The rubble is having limited effect and is in poor condition. Dunbar Golf Course are concerned about erosion at the 14<sup>th</sup> green, which is situated on a natural promontory at NT705782. They propose to move the large rocks around to the shoreline adjacent to the 14<sup>th</sup> green to prevent further erosion. During the site visit on 30/10/01, there was evidence of minor erosion at the 14<sup>th</sup> green and no defences were present.

## **Land-use**

The golf course comprises 32.9ha of land within MU19 (Table 9.89) and forms the immediate hinterland for the entire shoreline of the management unit (Figure 9.3). Arable land and improved grassland forms the majority of the remaining area of the management unit.

**Table 9.89: Land-use classification in MU19 (source: MLURI 1988)**

| Land-use class        | Domain                                  | Area (ha) |
|-----------------------|-----------------------------------------|-----------|
| Factories & urban     | Built-up (area)                         | 0.7       |
| Water                 | Water (area)                            | 2.4       |
| Arable                | Arable: no rock no farms no trees       | 61.8      |
| Recreational land     | Golf course                             | 32.9      |
| Improved grassland    | Imp. pasture: no rock no farms no trees | 32.6      |
| Improved grassland    | Imp. pasture: no rock no farms trees    | 19.8      |
| Mixed woodland        | Undiff. mixed woodland (area)           | 1.3       |
| Coniferous plantation | Coniferous (plantation - area)          | 24.3      |
| Quarries              | Quarries (area)                         | 9.1       |
| Total                 |                                         | 184.9     |

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### ***Residential Development, Industry, Ports and Harbours***

There is no residential development, industry, ports or harbours in MU19.

### ***Recreation and Tourism***

Golf is the principal recreation activity in MU19, although Dunbar sports and social centre is located within the management unit (NT690779).

The inter-tidal shoreline, east of Brox Burn forms part of the Barns Ness Coast section of the Firth of Forth SSSI, which extends eastwards to Torness Power Station (NT749757). Barns Ness Coast SSSI has a long history of recreational use with visitors attracted by the sites natural features and quiet peaceful nature. It is popular with particular specialist interest groups including ornithologists, botanists and geologists and is a good educational resource. At present, there is no right of way along the shoreline of MU19, although the proposed coastal corridor extends along the coast (Halcrow Fox 1998), potentially increasing the number of recreational users of the shoreline.

### ***Fishing Activity***

There is no commercial fishing activity within MU19.

### ***Agriculture and Forestry***

Agricultural land forms the landward part of the management unit, the main use of which is grazing. A small coniferous plantation (24ha) has been developed along the course of the Brox Burn.

### ***Quarrying and Landfill***

A small part (9.1ha) of White Sands quarry is at the eastern boundary of MU19, although most of the quarry is within MU20. Limestone is removed from the quarry, which is utilised at the nearby cement works. The quarry is 250m landward of the existing shoreline. There are no landfill sites within MU19.

### ***Water Quality and Pollution***

SEPA (2000) classified the coastal waters in the western part of MU19 as Class B (Good). East of Brox Burn the coastal water is Class A (Excellent). There are no designated bathing beaches in the management unit and no water quality issues were reported during the consultation process.

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### **Archaeology and Built Heritage**

There are 31 sites of cultural heritage identified within MU19 (Table 9.90). Enclosures and a historic settlement at NT688783 are listed and protected as a scheduled ancient monument. This site is over 200m from the existing shoreline and thus is not under threat from erosion/flooding. Other archaeological sites are located around the house and gardens of Broxmouth Estate (NT667776) and are well setback from the shoreline. Sites of interest close to the shoreline include the old limestone quarry at Millstone Neuk (NT707780) and cists at Lawrie's Den (NT700782).

Only one of the 19 site of architectural site of importance within MU19 lies within 200m of the existing shoreline. This site is the historic stores and cottages known as "The Vaults", which are located on Dunbar East Links (NT702782) at Lawrie's Den, which is a B Listed building.

**Table 9.90: Cultural Heritage Within MU19**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 0      | RCAHMS            |
| Archaeological Sites (land)   | 11     | RCAHMS            |
| Scheduled Ancient Monuments   | 1      | Historic Scotland |
| Listed Buildings*             | 9      | ELC               |
| Architecture Sites*           | 10     | RCAHMS            |
| TOTAL                         | 31     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### **Natural Environment**

The foreshore of MU19 comprises large outcrops of limestone rock, with small pockets of sand and shingle, backed by a hinterland formed of raised beach deposits overlain by blown sand deposits. The eastern part of MU19 lies within the Barns Ness Coast section of the Firth of Forth SSSI, notified for the geological and botanical interests of its coastland habitat (Table 9.91). The site has also been notified as a Geological Conservation Review (GCR) Site as it encompasses a complete series of sedimentary rocks known as the Lower Limestone Formation, dating from the Dinantian time period of the Carboniferous.

The principal factors affecting management of the SSSI are to ensuring that the rock exposures are not obscured and that access is easily obtained to the site (SNH 2000c). The long-term management objectives for the SSSI are:

1. To ensure exposures remain un-obscured.
2. To maintain adequate access to the exposures.
3. To maintain the botanical and other natural heritage interests of the coastal habitats within the SSSI.
4. To encourage responsible access and educational use of the SSSI.

The mouth of the Brox Burn is a provisional SWT Wildlife site, although this has yet to be surveyed and designated.

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**Table 9.91 Summary of the geological and botanical interests of the Barns Ness Coast section of the Firth of Forth SSSI (source SNH 2000c)**

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geological interest</b> | <p>Barns Ness SSSI illustrates a sequence of sedimentary rocks, formed during the Carboniferous geological period (340 million years ago), when shallow, tropical seas extended across the Midland Valley (or lowland central belt area) of Scotland. Two major groups of sedimentary rocks are exposed on the coast: the limestone beds and a group consisting of sandstones, mudstones and occasional coal seams. These different sediment layers indicate the changing environment that existed during this period.</p> <p>One of the limestone units is covered by a series of basin shaped hollows, known as a 'karst' surface, which formed when the limestone was exposed to the atmosphere during Carboniferous times, and was then weathered prior to being covered by successive sequences of sediment, demonstrating the drastic change in sea level that occurred at that time. Marine fossils can be found in great abundance on the site, including solitary and colonial corals, seashells, sea lilies and trace fossils.</p> |
| <b>Botanical interest</b>  | <p>Habitats include shingle and sandy shores, sand dunes and a large area of mineral enriched dune grassland. The beachhead saltmarsh, rocky stacks and limestone grassland are of particular interest as examples of very unusual habitats in the Lothians. The grassland contains an exceptionally diverse range of wild flowers, with species such as Purple Milk-vetch, Restharrow and Red and White Campion. The site as a whole supports a number of locally rare plant species, including Sea Milkwort, Saltmarsh Rush, Crested Hair-grass, Yellow Horned Poppy, Sea Arrow-grass, Sea Meadow-grass and various sedges - Sand, Distant and Long-bracted Sedges. The site is also important for birds, butterflies, day flying moths and invertebrates.</p>                                                                                                                                                                                                                                                                             |

Habitats within 1km of the shoreline of MU19 were classified during the Phase 1 Habitat survey of East Lothian (Table 9.92). The largest habitat types include arable land, amenity grassland and semi-improved grassland. The golf course amenity grassland forms the immediate coastal hinterland and a small area (0.5ha) of continuous saltmarsh was identified in the inter-tidal area (NT703782).

**Table 9.92: Phase 1 Habitats within MU19 (source: Hutcheon et al 1998)**

| <b>Habitat code</b> | <b>Phase 1 habitat</b>       | <b>Area (ha)</b> |
|---------------------|------------------------------|------------------|
| A1.1.2              | Broad-leaved, plantation     | 6.1              |
| A1.2.2              | Coniferous plantation        | 0.7              |
| A1.3.2              | Mixed woodland, plantation   | 22.0             |
| A2.1                | Dense scrub                  | 0.2              |
| B4                  | Improved grassland           | 12.3             |
| B6                  | Poor semi-improved grassland | 38.4             |
| C3.1                | Tall ruderal                 | 0.1              |
| G1                  | Standing water               | 2.0              |
| H2.6                | Saltmarsh - continuous       | 0.5              |
| I2.1                | Quarry                       | 4.2              |
| J1.1                | Arable                       | 45.8             |
| J1.2                | Amenity grassland            | 39.9             |
| J3.6                | New Buildings                | 0.2              |
| Unclassified        | Urban and Roads              | 12.5             |
| <b>Total</b>        |                              | <b>184.9</b>     |



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#### **Relevant policies and plans**

There are no existing planning applications in MU19 that may have an impact on the shoreline management. The development of the coastal corridor path along the entire length of East Lothian may have a potential impact on MU19, as this will open up access to this relatively remote part of the coast, although golfers already use the shoreline.

#### **Key interests**

Dunbar Golf Club has key interests in MU19, primarily to protect their golf course from coastal erosion (Dunbar Golf Course, correspondence, 3<sup>rd</sup> October 2001). During the written consultation process, the Golf Club expressed their wish to hold their existing defence line and the areas of immediate concern extend from the 14<sup>th</sup> green to the 17<sup>th</sup> fairway. In order to protect these areas the Golf Club would like to:

1. Move large rocks already on the beach to an area along the high water line adjacent to the 14<sup>th</sup> green.
2. Erect a man-made barrier around the 15<sup>th</sup> tee and along the 15<sup>th</sup> fairway, which is gradually collapsing onto the beach.
3. Place boulders and probably wire cages from the Broxburn estuary along the edge of the 17<sup>th</sup> fairway to protect this area from extremely high tides.

Public concerns along the shoreline of MU19 related to coastal erosion; the large amount of dumped rubbish and rubble along the shoreline, which is aesthetically poor; and access problems and prohibition notices preventing access along the golf course shoreline (SPI 2001a).

#### **Valuation of Assets**

The assets within MU19 have an estimated monetary value of £23M (Table 9.93), an average of £123,000 per ha. However, the immediate coastal hinterland, which is potentially at risk from coast erosion or flooding, is classed as Open Area.

**Table 9.93 Valuation of Assets in MU19**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>  |
|---------------------------|---------------------------|-------------------|
| High Quality Agricultural | 32%                       | 291 420           |
| Open Area                 | 58%                       | 106 683           |
| Urban                     | 8%                        | 21 547 400        |
| Industrial                | 2%                        | 841 800           |
| <b>Total</b>              |                           | <b>22 787 303</b> |

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### **Option Evaluation**

Analysis of historical OS maps has indicated that most of the MU19 shoreline has experienced net accretion between 1907 and 1999 (Appendix C, View 19). Map analysis indicates that maximum rates of seaward migration of MHWS are 0.7m/yr in the vicinity of Brox Burn (Table 4.6) and highlights only a short section of shoreline that has experienced erosion at Mill Stone Neuk, at the eastern edge of the management unit (NT706781). Thus, the perceived threat of coastal erosion expressed by the Golf Club is not part of a long-term trend on this part of the shoreline. In areas where localised erosion appears to be a problem, it is likely to be a seasonal, short-term process that is not likely to result in loss of land in the long-term. East Lothian Council Countryside Rangers suggest 85% of this frontage is stable.

**Hold the Line** is the preferred option expressed by Dunbar Golf Course, who would set out to achieve this by providing coastal defences at the locations where coastal erosion is causing immediate concern (see above). However, they comment that the remainder of the coastline bordering the coast may need attention at a later date (Dunbar Golf Course, correspondence, 3<sup>rd</sup> October 2001). The monetary cost of Hold the Line has been estimated as £250,000, based on the construction of gabion defences along 400m of shoreline (15<sup>th</sup> and 17<sup>th</sup> fairways) and rock revetment at the 14<sup>th</sup> green in Year 1 of the Plan. These defences replace Defences No 56 and 57 described above and are based on the proposals expressed by Dunbar East Golf Club. It is assumed that the remaining defences in the management unit (Defence No 54 and 55) require general maintenance only.

This option is not economically feasible as the estimated cost of the Holding the Line is likely to exceed the benefits, as erosion rates, and thus the value of land lost under No Active Intervention, are negligible. It is recommended that the golf club accept short-term localised erosion along the shoreline and do not carry out “ad hoc” hard solutions to solve immediate concerns. The long-term trend of this stretch of shoreline is one of accretion.

There are no locations within MU19 where **Advance the Line** and **Retreat the Line** are feasible options.

**No Active Intervention** is the preferred strategic coastal defence option for MU19. As map analysis indicates a stable or accreting shoreline, potential land losses under this option are negligible. If localised erosion does cause loss of land in a particular locality, it is likely to be short-lived and compensated for by accretion elsewhere in the process unit.

**No Active Intervention** is the preferred option in terms of the aesthetic character and natural heritage interests of the management unit. Several of the existing defences are unsightly and unnatural (e.g. Defence No 56 and 57), with rock and rubble placed on the upper beach. The removal of these defences should be considered, as they are of limited effectiveness at reducing erosion and may be transferring the problem elsewhere to adjacent shorelines.

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### **9.12 PU12: MILL STONE NEUK TO TORNESS POINT**

The shoreline of Torness Power Station forms a distinct management unit (MU21), while the remainder of the process unit is contained within the Barns Ness management unit (MU20) (Figure 9.1).

This stretch of coast faces northeast and comprises a small embayment at White Sands between the headlands at Mill Stone Neuk and Barns Ness. There is a slight embayment from Barns Ness to the headland at Chapel Point. The coastline is rocky surrounding Skateraw Harbour, to the west of Torness Point. The coast is composed of the following morphological elements (SNH, 2000c):

- low-lying rock platforms;
- shingle and/or sandy foreshore;
- low active dunes and slightly older grass-covered dunes further inland at White Sands

Accretion is occurring in the following locations (Table 4.6):

- Mill Stone Neuk to White Sands;
- Barns Ness to Chapel Point;
- Skateraw Harbour.

Erosion is occurring at Catcraig (Table 4.7). Anthropogenic influences include a limestone outcrop at Barns Ness, affected by geological faulting, which has been mined in the past (SNH, 2000c), and Torness Power Station occupies reclaimed land with massive coastal defences fronted by rock ledges (East Lothian Council, 2001d).

The dominant wave directions for this stretch of coast are from the sector between north and east. Although sediment transport is believed to be from east to west for this section of coast (Barne et al., 1997), most of the beach systems are believed to be largely self-contained in terms of sediment movements (Ramsay and Brampton, 2000). Refer to Section 4.6 for further details of sediment transport processes.

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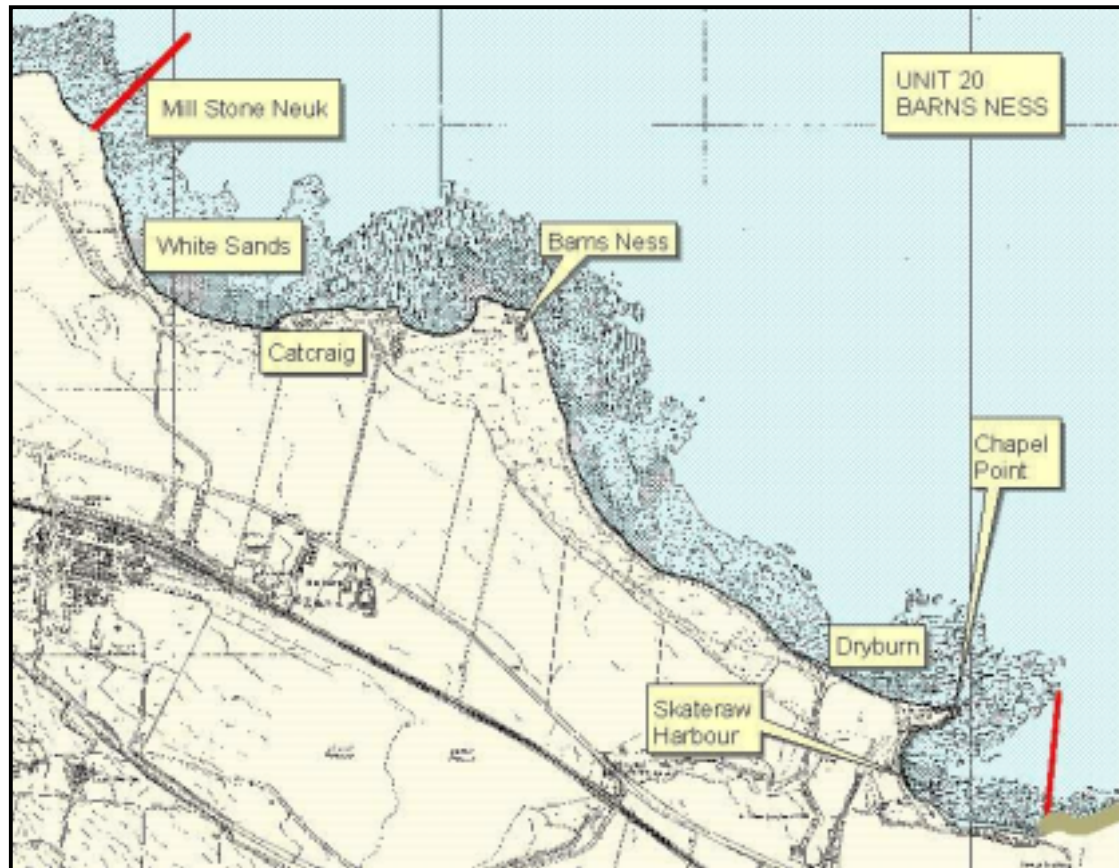
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## 9.12.1 Management Unit 20, Barns Ness

Management Unit 20 extends along approximately 5.5km of shoreline from Mill Stone Neuk in the west (NT707779) to Torness Power Station in the east (NT744753).



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**Table MU20.1 Summary of Attributes of Management Unit 20**

| Coastal Processes           |                                                                                                                                |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Shoreline Evolution         | Stable or accreting. Localised erosion at Catcraig.                                                                            |
| Geomorphology               | Low lying rock platforms, shingle and/or sandy foreshore, dunes                                                                |
| Sediment Drift              | Low or moderate net westerly drift.                                                                                            |
| Coastal Defences            |                                                                                                                                |
| Type                        | Natural: Rock outcrops, pocket beaches                                                                                         |
| Human and Built Environment |                                                                                                                                |
| Land use                    | Agriculture, golf course, quarries (mainly disused)                                                                            |
| Sea use                     | Limited fishing                                                                                                                |
| Infrastructure              | -                                                                                                                              |
| Recreation and Tourism      | Walking, golf, bathing, bird-watching, recreation beaches                                                                      |
| Historic Environment        | 3 scheduled ancient monuments, including the limekilns and quarry at Catcraig. 59 other sites of cultural heritage identified. |
| Natural Environment         |                                                                                                                                |
| Habitat Types               | Neutral grassland, tall ruderal, dune grassland, open dune, coastal grassland, rock exposure, and saltmarsh                    |
| Designated Sites            | Barns Ness Coast SSSI<br>GCR Site<br>Provisional SWT Wildlife site                                                             |
| Key Interests               |                                                                                                                                |
|                             | Extension to quarrying, public access to the shore.                                                                            |
| Valuation of Assets         |                                                                                                                                |
|                             | £71 M                                                                                                                          |

**Table MU20.2 Screening of Strategic Options with Management Objectives**

| Strategic Option               | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|--------------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention         | √                  | √           | √                         | √                         | •           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention           | √                  | √           | √                         | √                         | •           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line (or Selectively) | √                  | √           | X                         | X                         | √           | √                     | √         | X                      | X                   | X         | √             | NA       | NA       |
| Advance The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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## ***Coastal Defences***

No hard coastal defences were identified in MU20. However, East Lothian Council noted that bricks, rubble etc. had been dumped along the eastern flank of White Sands Bay by a private landowner to protect a private road (East Lothian Council 2001d). The rubble is exposed periodically depending on local conditions. During the site visit in July 2001, there was evidence of small-scale active erosion in places along dunes, particularly at the eastern end of the Bay and no rubble was exposed at this time. The bay is backed by older, well-vegetated sand dunes.

## ***Land-use***

Arable land is the principal land use within MU20 (Table 9.94), comprising over 60% of the management unit. The immediate coastal hinterland is classed as coarse grassland, although Dunbar East Golf Course makes up the western part of the management unit and the quarry at Skateraw forms the hinterland in the eastern part (Figure 9.3).

**Table 9.94: Land-use classification in MU20 (source: MLURI 1988)**

| <b>Land-use class</b> | <b>Domain</b>                            | <b>Area (ha)</b> |
|-----------------------|------------------------------------------|------------------|
| Arable                | Arable: no rock no farms no trees        | 332.5            |
| Quarries              | Quarries (area)                          | 91.0             |
| Coarse grassland      | Undif. Nardus/Molinia: no rock no trees  | 52.3             |
| Improved grassland    | Imp. pasture: no rock no farms no trees  | 21.4             |
| Factories & urban     | Factory                                  | 15.2             |
| Smooth grassland      | Undiff. smooth grass.: no rock no trees  | 11.3             |
| Recreational land     | Golf course                              | 10.1             |
| Factories & urban     | Built-up (area)                          | 3.7              |
| Smooth grassland      | Smooth grass/low scrub: no rock no trees | 2.1              |
| Improved grassland    | Imp. pasture: no rock no farms trees     | 0.2              |
|                       |                                          | 539.8            |

## ***Residential Development, Industry, Ports and Harbours***

There is no major residential development within MU20, although the small settlements of East Barns and Skateraw are within the management unit. Blue Circle Cement Works, located at the landward extent of the management unit, holds consents for the extraction of limestone, sand and gravel. There are no operational ports or harbours within MU19, although the Council has a long-term commitment to supporting a roll-on/roll-off ferry terminal in East Lothian, the preferred location of which is at Skateraw (NT738755) (Section 2.2). Skateraw has a disused limekilns and slipway.

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### ***Recreation and Tourism***

This area has a long history of recreational use with visitors attracted by the sites natural features and peaceful nature. It is popular with particular specialist interest groups including ornithologists, botanists and geologists, and is a good educational resource. In the last few years, East Lothian Council have been encouraging informal recreation (SNH 2000c). A new car park has been built, bylaw signs erected and picnic tables placed along the coastline. The outstanding geology of the site has led to the creation of a geological trail along the Catcraig to Barns Ness section of the shoreline and interpretative panels have been placed here. The geology of Barns Ness Coast is described in Lothian Geology An Excursion Guide, which may attract more tourists to this part of the shoreline.

The beaches at White Sands, Barns Ness and from Dry Burn to Torness are recognised as important recreational beaches and are included in East Lothian Council's summer beach cleaning schedule (Ash 1994). White Sands is also a designated bathing beach and many visitors visit White Sands, particularly during the summer months.

### ***Fishing Activity***

There is no commercial fishing activity within MU20, although local sea fishing may take place from Skateraw or the rocks.

### ***Agriculture and Forestry***

Mixed Agriculture, both arable and rough grazing, is the main land use within MU20. There is no forestry within the management unit.

### ***Quarrying and Landfill***

Quarrying has been an important economic activity in MU20 for many years. There are disused limekilns and associated abandoned quarry pits around Catcraig and Skateraw. Part of the old quarry site is now a popular wildlife area, which provides important shelter for migrating birds and is popular with local ornithologists.

Quarries cover 91ha of land within MU20, with a large limestone and sand and gravel quarry landward of White Sands Bays, close to Blue Circle Cement Works and a smaller quarry at Skateraw Harbour, immediately west of Torness. Much of this quarried area is redundant and the western part operates as Oxwell Mains Landfill Site (NT702774).

### ***Water Quality and Pollution***

The coastal waters of White Sands Bay are Designated Bathing Waters under the EEC Bathing Water Directive and achieved a Guideline Pass in 2000 and 2001. The water quality over the entire length of MU20 is classed as Class A (Excellent) (SEPA 2000).

SEPA currently carry out surveys to assess the impacts of leachate from Oxwell Mains Landfill site on the foreshore at White Sands Bay and adjacent areas. The surveys have found that there is some effect of leachate on the foreshore and these are being addressed by leachate management procedures (SEPA East, pers. comm. 2001). SEPA also noted that there is a very localised impact of the Consented North Quarry Outfall on the inter-tidal of White Sands Bay. The impact is within a 30m radius of the Outfall (NT708777) and is well within the limits set by the consent (SEPA East, pers. comm. 2001).



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### ***Archaeology and Built Heritage***

There are three Scheduled Ancient Monuments in MU20 including the limekilns and limestone quarry at Catcraig (NT714772), Ring ditches and cropmarks near Skateraw (NT727755) and an enclosure close to Dryburn Bridge (NT726752). The site at Catcraigs lies adjacent to the shoreline of White Sands Bay and is potentially at risk from flooding or erosion. The limekilns at Catcraig (NT715773) and Skateraw (NT738754) are also Listed Buildings. Barns Ness Lighthouse and the keeper's cottage and walls (NT723772) are also Listed structures. The remaining sites of architectural interest within MU20 are setback from the shoreline.

A further 36 sites of archaeological interest have been identified within MU20 (Table 9.95), a number of which lie within 200m of the existing shoreline including: a house (NT708775); enclosure and structures (NT722771); St Denis's Chapel, buildings and enclosures at Chapel Point (NT739758) and the old boathouse and slipway at Skateraw (NT737756). The remaining sites of interest are setback from the shoreline.

Five shipwrecks of archaeological importance lie within MU20. These include the wrecks of a 5<sup>th</sup> Rate minor warship and a schooner at Skateraw Harbour (NT738757, NT744755); a barque and an unidentified craft at Barns Ness (NT737770, NT721782) and a schooner at Mill Stone Neuk (NT710782).

**Table 9.95: Cultural Heritage Within MU20**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 5      | RCAHMS            |
| Archaeological Sites (land)   | 36     | RCAHMS            |
| Scheduled Ancient Monuments   | 3      | Historic Scotland |
| Listed Buildings*             | 9      | ELC               |
| Architecture Sites*           | 9      | RCAHMS            |
| TOTAL                         | 62     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

### ***Natural Environment***

The Barns Ness Coast section of the Firth of Forth SSSI covers the entire inter-tidal and part of the immediate hinterland of MU20 (Figure 7.1). The geological and botanical interest for which the site is notified is summarised in Table 9.91. The SSSI boundary extends inland to include the important grassland habitats along the coastal strip. SNH (2000c) have defined management objectives to ensure that the geological exposures are not obscured and the botanical interests are maintained (Section 9.11.2).

The Dry Burn (NT734759) has been identified as a provisional Wildlife Site, although this has yet to be surveyed and designated.

A diverse range of natural habitats was identified in MU20 during the Phase 1 Habitat survey of East Lothian (Table 9.96). The immediate coastal hinterland supports a mix of neutral grassland, tall ruderal, dune grassland, open dune, coastal grassland, rock exposure, and saltmarsh indicating the high botanical interest of MU20. Arable land covers the largest area of the management unit (294ha) and quarries covers 100ha of land.

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**Table 9.96: Phase 1 Habitats within MU20 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                  | Area (ha) |
|--------------|----------------------------------|-----------|
| A1.1.2       | Broad-leaved, plantation         | 0.3       |
| A1.2.2       | Coniferous plantation            | 0.3       |
| A1.3.2       | Mixed woodland, plantation       | 0.7       |
| B2.1         | Neutral grassland, unimproved    | 12.9      |
| B2.2         | Neutral grassland, semi-improved | 14.3      |
| B4           | Improved grassland               | 15.6      |
| B6           | Poor semi-improved grassland     | 3.4       |
| C3.1         | Tall ruderal                     | 1.2       |
| F2.2         | Inundation vegetation            | 0.2       |
| H2.6         | Saltmarsh – continuous           | 0.8       |
| H6.5         | Dune grassland                   | 26.7      |
| H6.8         | Open dune                        | 3.7       |
| H8.4         | Coastal Grassland                | 22.9      |
| I1.4.2       | Rock exposure, acid/neutral      | 0.5       |
| I2.1         | Quarry                           | 100.1     |
| J1.1         | Arable                           | 294.1     |
| J1.2         | Amenity grassland                | 11.1      |
| J1.3         | Ephemeral/short perennial        | 0.4       |
| J3.6         | New Buildings                    | 0.8       |
| J4           | Bare ground                      | 0.6       |
| Unclassified | Urban and Roads                  | 29.2      |
| Total        |                                  | 539.8     |

### ***Relevant policies and plans***

Planning consents exist to extend the current Blue Circle quarry east to the Dry Burn. There is an estimated 60 years of quarryable resource available. This has the potential to impact on the nature conservation and recreational importance of the area. The reinstatement of the north quarry is the subject of a current planning application. A large water body suitable for recreation and nature conservation purposes is proposed. This has the potential to increase the number of visitors to the coast and thus, will affect the subsequent management of the area.

There is currently a planning application to extract and process sand, gravel and clay from a site close to Skateraw Farm (NT735755). The boundary shown in the planning application is approximately 100m from the coast at Skateraw harbour and may potentially have an impact on shoreline planning. A further planning application seeks to provide shallow ponds to attract birds and provide refuge for them. This proposed area lies immediately adjacent to the coast, which may have potential impacts on the shoreline.

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The proposal to develop a sustainable coastal path extends along the shoreline of MU20 (Halcrow Fox 1998), which may increase the amount of recreational users of the shoreline. In addition, there is a planning application to construct a new vehicular access road to White Sands from the west, which is intended to be for local access and recreation purposes (SNH 2000c). There are also proposals to upgrade the coastal footpath track from White Sands to Barns Ness to a vehicular highway, which would significantly impact upon the recreational value of the area and construction work could have a detrimental impact on the geological and biological interest of the SSSI (SNH 2000c). SNH recommend that the coastal track be maintained as a coastal footpath/cycle path with minimal vehicular access.

#### **Key interests**

SEPA expressed concern about the water quality in White Sands Bay (discussed above). No other key interests in MU20 were highlighted during the written consultation phase. Public concerns related to the aesthetic impact of the Blue Circle cement works and quarrying. Several comments suggested that Skateraw would make an excellent harbour (SPI 2001a).

#### **Valuation of Assets**

Assets within MU20 have an estimated monetary value of £71M (Table 9.97). For the purposes of economic assessment the coastal strip is classified as either High Quality Agricultural (based on its SSSI status) or Open Area. 67% of land within MU20 is classed as High Quality Agricultural.

**Table 9.97 Valuation of Assets in MU20**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>  |
|---------------------------|---------------------------|-------------------|
| High Quality Agricultural | 67%                       | 1 819 590         |
| Open Area                 | 8%                        | 41 197            |
| Urban                     | 6%                        | 48 924 400        |
| Industrial                | 19%                       | 20 146 000        |
| <b>Total</b>              |                           | <b>70 931 187</b> |

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### ***Option Evaluation***

Historical map analysis indicates that most of the shoreline of MU20 has shown either negligible change or accretion between 1907 and 1999 (Appendix C, Views 20 and 21). Erosion has occurred at Catcraig on the eastern side of White Sands Bay (View 20) and it is likely that this is the location where rubble and rocks were placed to prevent erosion of the private road (East Lothian Council 2001d). Assets potentially at risk from erosion here include the scheduled site of the disused limekilns and quarry, which lie immediately landward of the shoreline. The scheduled site covers a relatively large area (7ha) and erosion is not likely to be a significant threat to the site.

**Hold the Line** would be detrimental to the natural environment in MU20 and would interrupt the operation of natural coastal processes, potentially having an impact on adjacent shorelines. The diverse coastal habitats have developed due to the dynamic coastal processes, which operate naturally along the shoreline and any attempt to stabilise these processes will impact the scientific interest of the site. No assets have been identified that are at risk to flooding / coastal erosion and thus there is no economic justification for the Hold the Line option.

**Advance the Line** and **Retreat the Line** are not feasible options in MU20, given that the existing shoreline is natural along the entire management unit.

**No Active Intervention** is the preferred management option for MU20, as there is no significant risk to assets from coastal processes. Most of the shoreline of MU20 has undergone accretion, although localised erosion should be accepted as a natural and short-lived process along the shoreline. For example the salt marsh at the Barns Ness Lighthouse is periodically eroded during winter storms but re-establishes itself in the spring (SNH 2000c), highlighting the dynamism of natural processes along this coastline.

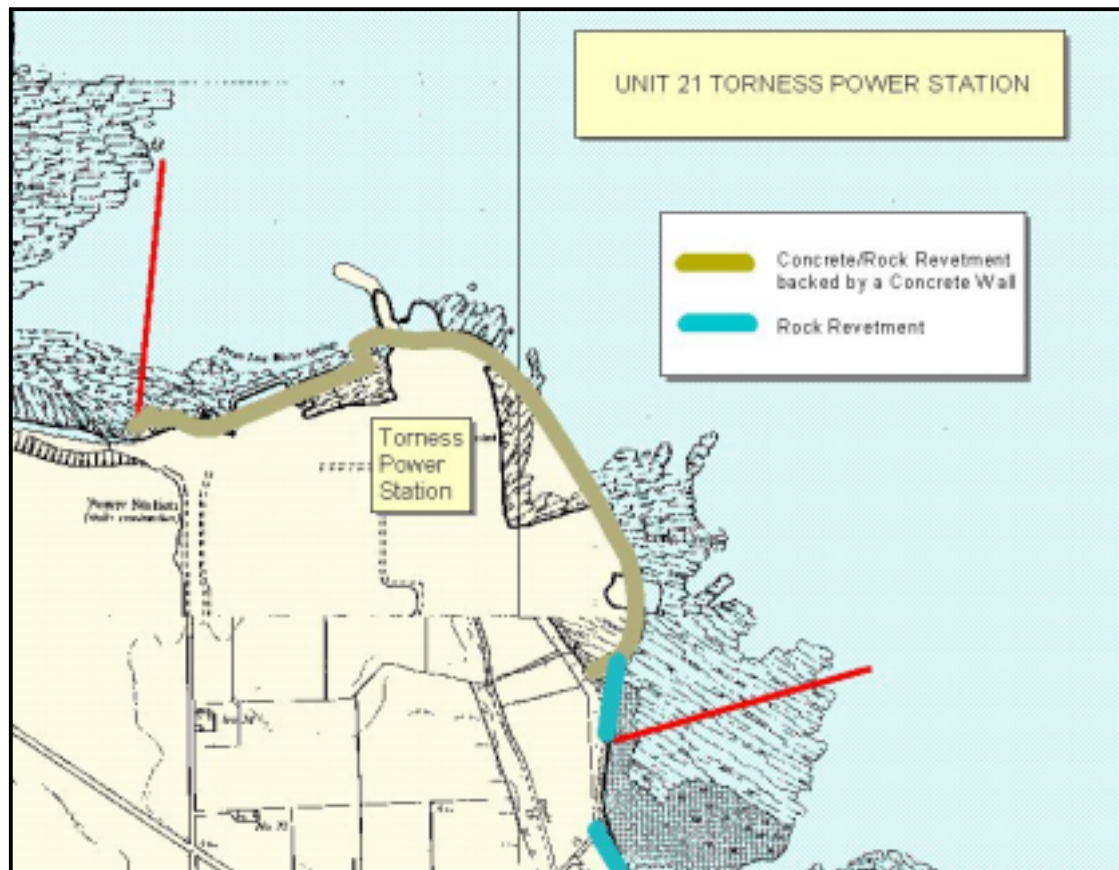
The monetary cost of the No Active Intervention option is negligible as there is limited loss of land and any erosion is likely to be compensated by accretion, which is occurring along the shoreline. No Active Intervention will have negligible impact on adjacent shorelines, as natural processes will not be interrupted.

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### 9.12.2 Management Unit 21, Torness Power Station

Management unit 21 covers the approximately 1.5km reclaimed shoreline of Torness Nuclear Power Station, which will require specific management strategies.



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**Table MU21.1 Summary of Attributes of Management Unit 21**

| Coastal Processes           |                                                                   |
|-----------------------------|-------------------------------------------------------------------|
| Shoreline Evolution         | Landclaim. Present shoreline lies 300m seaward of 1907 shoreline. |
| Geomorphology               | Rock outcrops                                                     |
| Sediment Drift              | Low or moderate net westerly drift.                               |
| Coastal Defences            |                                                                   |
| Type                        | Man-made: Concrete revetment/wall with rock armouring             |
| Human and Built Environment |                                                                   |
| Land use                    | Torness Nuclear Power Station                                     |
| Sea use                     | Limited fishing                                                   |
| Infrastructure              | Outfalls                                                          |
| Recreation and Tourism      | -                                                                 |
| Historic Environment        | Limited. 13 sites of interest identified, including 4 shipwrecks  |
| Natural Environment         |                                                                   |
| Habitat Types               | Rocky shores                                                      |
| Designated Sites            | -                                                                 |
| Key Interests               |                                                                   |
|                             | Protection of Scottish Nuclear assets                             |
| Valuation of Assets         |                                                                   |
|                             | £16 M                                                             |

**Table MU21.2 Screening of Strategic Options with Management Objectives**

| Strategic Option       | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention | √                  | X           | X                         | √                         | √           | X                     | X         | X                      | X                   | X         | X             | X        | NA       |
| Limited Intervention   | √                  | X           | X                         | √                         | √           | X                     | X         | X                      | X                   | X         | X             | X        | NA       |
| Hold The Line          | √                  | √           | √                         | X                         | √           | √                     | √         | √                      | √                   | √         | √             | √        | NA       |
| Advance The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line       | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- X Option meets objective
- Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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### ***Coastal Defences***

Torness Nuclear Power Station is constructed on reclaimed land and is set back from the shoreline by about 300m. The site is protected along the whole frontage by a concrete revetment, backed by a concrete vertical embankment with an overspill return channel behind it (Defence No 58). The Torness defences have been designed to a standard of 1:10 000 years and are in very good condition. The toe of the revetment is protected either by a wide expanse of rock armouring (Plate 9.42) or by concrete tetrapods (Plate 9.43). The Torness defences are in private ownership.

The dunes to the south of the Torness site have rock armour toe protection (Defence No 59). This is a continuation of the rock armour protection laid along the toe of the revetment that protects the Torness site and extends along the base of the dunes for a distance of approximately 100m before petering out to the east. This defence consists of scattered rock armour at the toe of the dunes.

### ***Land-use***

The nuclear power station is the principal land-use within MU21, covering 58.8ha (Table 9.98). Arable land covers the landward part of the management unit.

**Table 9.98: Land-use classification in MU21 (source: MLURI 1988)**

| Land-use class    | Domain                            | Area (ha) |
|-------------------|-----------------------------------|-----------|
| Factories & urban | Factory                           | 58.8      |
| Arable            | Arable: no rock no farms no trees | 23.1      |
| Total             |                                   | 81.9      |

### ***Residential Development, Industry, Ports and Harbours***

There is no residential development within the management unit and industry is dominated by the power station. There are no ports or harbours within MU21, although the power station has a jetty, which may be used for industrial purposes.

### ***Recreation and Tourism***

Recreation and tourism within MU21 is limited due to the presence of the nuclear power station. However, a raised walkway with interpretative panels allows walkers to pass along the coastal protection around the perimeter of the power station.

### ***Fishing Activity***

There is no commercial fishing activity within MU21, although sea fishing regularly takes place adjacent to the power station outflow.

### ***Agriculture and Forestry***

Agriculture is limited to the landward part of the management unit and there is no forestry.

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU21.

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#### **Water Quality and Pollution**

The water quality along this stretch of shoreline is classed as Class A (Excellent) by SEPA (2000). No water quality or pollution issues have been raised along this shoreline.

#### **Archaeology and Built Heritage**

There are 4 shipwrecks off the coast of MU21, presumably due to the exposed nature of this part of the coast and the rocky crags around Torness Point. Three wrecks are located at Long Craigs, Torness Point (NT755752), while the other is further offshore at NT750770.

There are no scheduled ancient monuments or listed buildings within MU21 (Table 9.99), although 7 archaeological and 2 architectural sites of importance are recorded in the RCAHMS database. The only site of interest within 100m of the shoreline is a farm croft at NT745753, although the power station itself is identified of architectural interest.

**Table 9.99: Cultural Heritage Within MU21**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 4      | RCAHMS            |
| Archaeological Sites (land)   | 7      | RCAHMS            |
| Scheduled Ancient Monuments   | 0      | Historic Scotland |
| Listed Buildings*             | 0      | ELC               |
| Architecture Sites*           | 2      | RCAHMS            |
| TOTAL                         | 13     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

#### **Natural Environment**

The natural environment of MU21 has been heavily modified as it has been reclaimed, defended along its entire length and heavily used for industry. No natural heritage designations have been conferred to the shoreline of MU21, although the Barns Ness Coast section of the Firth of Forth SSSI lies to the west of the management unit.

**Table 9.100: Phase 1 Habitats within MU21 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat     | Area (ha) |
|--------------|---------------------|-----------|
| H1.3         | Coastal-Inter-tidal | 2.9       |
| H6.4         | Dune slack          | 0.2       |
| H6.5         | Dune grassland      | 0.6       |
| J1.1         | Arable              | 18.5      |
| J3.6         | New Buildings       | 57.6      |
| Unclassified | Urban and Roads     | 2.1       |
| Total        |                     | 81.9      |

The Phase 1 Habitat survey of East Lothian classified most of MU21 as New Buildings, which relate to the Power Station buildings. Only 3.7ha of natural habitat (coastal inter-tidal, dune slack and dune grassland) was identified in MU21 (Table 9.100).



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#### ***Relevant policies and plans***

All planning applications received within a 4km radius of Torness Power Station must be referred to Scottish Nuclear for their observations and comment (Policy NRG2, East Lothian Council 1998). The sustainable coastal path follows the coastal walkway around the perimeter of Torness Power Station.

#### ***Key interests***

Scottish Nuclear has key interests in MU21, although they did not respond to the written consultation. Given the importance of the nuclear power station to the local economy, in terms of employment, and the business operations of Scottish Nuclear, it is likely that they would advocate a Hold the Line strategy to coastal defence.

#### ***Valuation of Assets***

For the purposes of economic assessment, the assets within MU21 have been valued at £16M (Table 9.101). This is likely to be an underestimate of the actual asset value, as the Nuclear power station has been given the standard unit value for industry (Section 8.5).

**Table 9.101 Valuation of Assets in MU21**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>  |
|---------------------------|---------------------------|-------------------|
| High Quality Agricultural | 23%                       | 96 725            |
| Open Area                 | 2%                        | 1 474             |
| Urban                     | 3%                        | 3 554 600         |
| Industry                  | 72%                       | 11 896 800        |
| <b>Total</b>              |                           | <b>15 549 599</b> |

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## Option Evaluation

The entire shoreline of MU21 has been reclaimed and the present shoreline lies up to 310m seaward of the 1907 shoreline (Table 4.6 and View 22, Appendix C). In order to maintain this artificial shoreline position, robust coastal defences will be required.

For the economic assessment, it is assumed that if **No Active Intervention** is adopted the existing defences will be undermined and the shoreline will erode back to its 1907 position, resulting in the loss of 19.8 of industrial land. It is assumed that this loss will occur gradually over the next 50 years. The monetary value of this loss is estimated at £3.3M (discounted to 2001 values). However, this value has been estimated base on the value of land lost only and does not account for the environmental disaster that would occur if the nuclear power station were eroded. The monetary value of this is impossible to quantify and not within the scope of this study. Nevertheless, the economic case for **Holding the Line** in MU21 is strong with a benefit-cost ratio of 124 (Table 9.102).

**Table 9.102 Results of Cost-Benefit Analysis for MU21 (values are discounted to 2001 values)**

| Option                 | Losses    | Benefit   | Cost   | Ratio |
|------------------------|-----------|-----------|--------|-------|
| No Active Intervention | 3,308,099 | -         | -      |       |
| Hold The Line          | 0         | 3,308,099 | 26,732 | 124   |

Neither **Advance the Line** nor **Retreat the Line** are feasible options for MU21 and are not considered further.

**Hold the Line** is the preferred strategic management option for MU21, as this will protect Torness Nuclear Power Station and prevent the environmental damage that would follow if the sea were to encroach on this asset. The defences extend for approximately 1.6 km and are in good condition (Appendix D). No new construction is required and the cost of Hold the Line has been estimated by assuming maintenance costs of £1 per metre for every year of the Plan.

The monetary benefit of Hold the Line is assumed to be the value of the loss of land that is saved if No Active Intervention were adopted (Table 9.102). Natural coastal processes will have been affected during the period of land claim and subsequent protection of the reclaimed land, however given that no new defences have been recommended, a policy of Hold the Line is unlikely to have any additional impacts on adjacent shorelines.

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## 9.13 PU13: TORNESS POINT TO COCKBURNSPATH

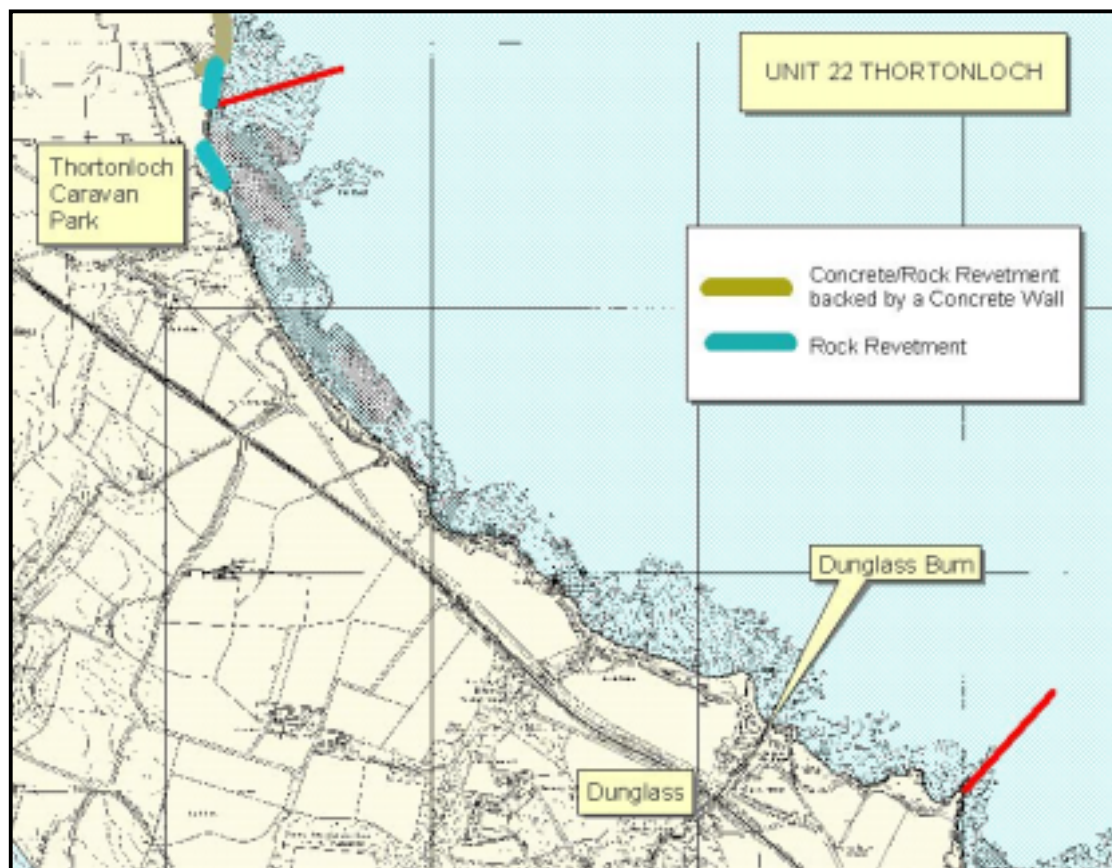
PU13 forms a distinct management unit, MU22, which is the last management unit in East Lothian. Borders Council manages the coast to the southeast. The overall form of the coast faces northeast. The coast changes from being a shallow embayment at Thorntonloch, to the east of Torness Point, to an essentially linear form for the remaining length to Cockburnspath.

The coastline is predominantly rocky, with a sandy foreshore at Thorntonloch backed by sand dunes. East of Torness, the rock type changes from mostly limestone to Old Red Sandstone, which forms cliffs. Variations in geological strength produce ridges and gullies on the rock platform, forming the foreshore (Brazier et al., 1998). Accretion is occurring from Dunglass to Reed Point (Table 4.6). Coastal defences have been installed in the last 5 years at Thorntonloch as a result of storm damage (East Lothian Council, 2001d).

The dominant wave directions for this stretch of coast are from the sector between north and east. Although sediment transport is believed to be from east to west for this section of coast (Barne et al., 1997), many of the beach systems are believed to be largely self-contained in terms of sediment movements (Ramsay and Brampton, 2000). Refer to Section 4.6 for further details of sediment transport processes.

### 9.13.1 Management Unit 22, Thorntonloch

Management unit 22 covers approximately 4.5km of coast and is predominantly rural in nature, although a caravan park lies behind the low dunes at the western end of the unit.



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**Table MU22.1 Summary of Attributes of Management Unit 22**

| Coastal Processes           |                                                                                |
|-----------------------------|--------------------------------------------------------------------------------|
| Shoreline Evolution         | Stable or accreting, localised erosion at Thortonloch Caravan Park             |
| Geomorphology               | Rock foreshore, sand beach backed by sand dunes                                |
| Sediment Drift              | Low or moderate net westerly drift.                                            |
| Coastal Defences            |                                                                                |
| Type                        | Man-made: Rock revetment (tank-traps) and dune planting<br>Natural: Sand beach |
| Human and Built Environment |                                                                                |
| Land use                    | Agriculture, Caravan Park                                                      |
| Sea use                     | Limited fishing                                                                |
| Infrastructure              | A road, East coast railway                                                     |
| Recreation and Tourism      | Recreational use of Thortonloch beach and dunes                                |
| Historic Environment        | 71 sites of cultural heritage identified                                       |
| Natural Environment         |                                                                                |
| Habitat Types               | Rocky shores, beach and dune habitats                                          |
| Designated Sites            | Provisional SWT Wildlife Site                                                  |
| <b>Key Interests</b>        | Coastal erosion and management at Thortonloch Caravan Park                     |
| <b>Valuation of Assets</b>  | £58 M                                                                          |

**Table MU22.2 Screening of Strategic Options with Management Objectives**

| Strategic Option               | Technically Viable | Sustainable | Adjacent Management Units | Natural Coastal Processes | Archaeology | Land use and Planning | Fisheries | Recreation and Tourism | Nature Conservation | Landscape | Water Quality | Industry | Harbours |
|--------------------------------|--------------------|-------------|---------------------------|---------------------------|-------------|-----------------------|-----------|------------------------|---------------------|-----------|---------------|----------|----------|
| No Active Intervention         | √                  | √           | √                         | √                         | √           | X                     | √         | X                      | √                   | √         | √             | NA       | NA       |
| Limited Intervention           | √                  | √           | √                         | √                         | √           | √                     | √         | √                      | √                   | √         | √             | NA       | NA       |
| Hold The Line (or Selectively) | √                  | √           | X                         | X                         | √           | √                     | √         | √                      | X                   | √         | √             | NA       | NA       |
| Advance The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |
| Retreat The Line               | X                  | -           | -                         | -                         | -           | -                     | -         | -                      | -                   | -         | -             | -        | -        |

Key:

- √ Shading indicates the Preferred Option
- √ Option meets objective
- X Option does not meet objective
- Option meets objective over part of the unit
- NA Not applicable
- Not considered if option is not technically viable

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## ***Coastal Defences***

Hard coastal defences (Defence No 60) protect 150m of the shoreline of MU22, in the vicinity of Thortonloch Caravan Park. The defences were constructed about 5 years ago, via a combination of local volunteer labour and contractors (East Lothian Council 2001d), and have been adapted and maintained since.

In general the beach at Thortonloch is wide and sandy and backed by dunes, which decrease in height from west to east. West of the Caravan Park to Torness the dunes are natural and have no protection, although during the site visit there was some evidence of toe erosion of the dunes. In front of the caravan park the dunes are lower and have been protected at their toe (Defence No 60). This defence is mainly old tank traps, which have been laid in a double layer at the base of the eroding dune face (Plate 9.44), although a 50m section is protected with smaller blocks of rock armour. The defence is vertical and shows evidence of failure in places, although generally the defence appears to be in a reasonable condition and is fronted by a wide sand beach, with an upper shingle beach becoming more prominent at the eastern end. Sea-lyme grass planted to encourage dune stabilisation has been relatively successful (East Lothian Council 2001d).

## ***Land-use***

The main land-use in MU22 is Arable land, which covers 340ha of the management unit (Table 9.103). A narrow strip of smooth grassland with rock outcrops runs adjacent to the shoreline for most of the management unit.

**Table 9.103: Land-use classification in MU22 (source: MLURI 1988)**

| Land-use class        | Domain                                   | Area (ha) |
|-----------------------|------------------------------------------|-----------|
| Arable                | Arable: no rock no farms no trees        | 339.7     |
| Mixed woodland        | Undiff. mixed woodland (area)            | 27.3      |
| Improved grassland    | Imp. pasture: no rock no farms trees     | 23.0      |
| Coniferous plantation | Coniferous (plantation - area)           | 15.8      |
| Smooth grassland      | Undiff. smooth grass.: rock no trees     | 11.2      |
| Smooth grassland      | Smooth grass/low scrub: no rock no trees | 5.0       |
| Factories & urban     | Factory                                  | 3.9       |
| Broadleaved woodland  | Undiff. broadleaf (area)                 | 3.7       |
| Factories & urban     | Built-up (area)                          | 2.9       |
| Smooth grassland      | Undiff. smooth grass.: no rock no trees  | 2.0       |
| Total                 |                                          | 434.5     |

## ***Residential Development, Industry, Ports and Harbours***

Residential development is limited in MU22, with scattered farm buildings and part of the small settlement of Cove covering 2.9ha of land. There is no industrial development within the management unit, although Torness Power Station is adjacent to the western boundary. There are no ports or harbours within MU22. The main A1 road and the main east coast railway line run through MU22.

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### ***Recreation and Tourism***

Thortonloch beach is a popular tourist beach, with recreational users using the shoreline of MU22 for passive recreation. The Caravan Park at Thortonloch provides accommodation for visitors to the coast and visitor pressure is likely to be high around the dunes on the access routes between the Park and the beach, which may cause localised erosion. Thortonloch is also a designated Bathing Beach under the EEC Directive. The coastline at Dunglass Ravine and beach is an outstanding natural landscape (SPI 2001a) and is a provisional SWT Wildlife site.

### ***Fishing Activity***

There is no commercial fishing activity within MU22, although some small scale fishing may take place.

### ***Agriculture and Forestry***

Agriculture is the main economic activity in MU22, with over 75% of the management unit classified as arable land. There is a small area (15.8ha) of commercial forestry in the vicinity of Dunglass Burn (NT769719).

### ***Quarrying and Landfill***

There are no coastal quarries or landfill sites within MU22.

### ***Water Quality and Pollution***

The coastal waters of MU22 are classed as Class A (Excellent) by SEPA (2000). This is an improvement on the 1999 classification, when only a Class B (Good) was achieved (SEPA 2001). The coastal waters of Thortonloch are Designated Bathing Waters under the EEC Bathing Water Directive and achieved a Guideline Pass in 2000 and 2001.

### ***Archaeology and Built Heritage***

There are 71 sites of cultural heritage in MU22 (Table 9.104). Two of these are the scheduled ancient monuments of Dunglass Collegiate Church (NT766718) and enclosures close to Thornton Mill (NT744739). Both of the ancient monuments lie over 800m from the existing shoreline.

A further 23 sites of archaeological importance have been identified within MU22, several of which lie within 100m of the shoreline including enclosures (NT752742); military camp (NT753740); historic buildings (NT757736, NT759732); pit alignment and crop marks (NT757734); a fort, cists and roman glass (NT766726); Butcher's Hole, an old natural harbour (NT7773725), fort and cists (NT773724); settlement (NT773723) and possible platforms (NT779721). The shipwrecks of two schooners (NT761745, NT771749), a steamship (NT761745), a brig (NT761744) and an unknown craft (NT771749) are located in the coastal waters of MU22.

Most of the sites of architectural interest, including listed buildings, are set back from the shoreline and are located in the small settlement of Dunglass. Those close to the shoreline include two adjoining cottages in Thortonloch (NT752744) and Dunglass Mill (NT772724).

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**Table 9.104: Cultural Heritage Within MU22**

| Category                      | Number | Source            |
|-------------------------------|--------|-------------------|
| Maritime Archaeological Sites | 5      | RCAHMS            |
| Archaeological Sites (land)   | 23     | RCAHMS            |
| Scheduled Ancient Monuments   | 2      | Historic Scotland |
| Listed Buildings*             | 20     | ELC               |
| Architecture Sites*           | 21     | RCAHMS            |
| TOTAL                         | 71     |                   |

\* Note: some architecture sites are also designated as Listed Buildings

## ***Natural Environment***

The Phase 1 Habitat survey only extends to the East Lothian border at Dunglass Burn, thus part of the area of MU22 is not classified. Arable land forms the largest habitat type in MU22 (Table 9.105). 41.7ha of the inter-tidal area of MU22 has been classified as coastal – inter-tidal habitat. The coastal edge comprises a range of grasslands, dune habitats, tall ruderal, dense scrub, amenity grassland and arable land.

**Table 9.105: Phase 1 Habitats within MU22 (source: Hutcheon et al 1998)**

| Habitat code | Phase 1 habitat                     | Area (ha) |
|--------------|-------------------------------------|-----------|
| A1.1.1       | Woodland, broadleaved, semi-natural | 1.5       |
| A1.1.2       | Broad-leaved, plantation            | 9.5       |
| A1.2.2       | Coniferous plantation               | 8.9       |
| A1.3.2       | Mixed woodland, plantation          | 7.8       |
| A2.1         | Dense scrub                         | 2.8       |
| B2.1         | Neutral grassland, unimproved       | 0.5       |
| B2.2         | Neutral grassland, semi-improved    | 6.3       |
| B4           | Improved grassland                  | 30.0      |
| C3.1         | Tall ruderal                        | 4.4       |
| G1           | Standing water                      | 0.2       |
| H1.3         | Coastal-Inter-tidal                 | 41.7      |
| H6.4         | Dune slack                          | 0.3       |
| H6.5         | Dune grassland                      | 0.8       |
| H8.4         | Coastal Grassland                   | 3.3       |
| J1.1         | Arable                              | 223.7     |
| J1.2         | Amenity grassland                   | 7.9       |
| J3.6         | New Buildings                       | 0.7       |
| Unclassified |                                     | 84.2      |
| Total        |                                     | 434.5     |

No natural heritage designations have been conferred on the shoreline of MU22, although the Dunglass Burn is a provisional SWT Wildlife Site.

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## ***Relevant policies and plans***

There are no existing planning applications close to the shoreline of MU22. Policy NRG2 applies to the western part of MU22, as it lies within a 4km radius of Torness Power Station, where all planning applications must be referred to Scottish Nuclear for their observations and comment (East Lothian Council 1998).

The Council plan to convert the A1 to dual carriageway, south of Dunbar (Table 2.7). However, it is likely that the new route will swing away from the coast (J. Squires, pers. comm. 2001).

The sustainable coastal path is proposed to follow the cliff top and shoreline along MU22 (Halcrow Fox 1998). At present, there is no path along this part of the coast and construction of any path would have to be to a high specification to ensure longevity and safety (Halcrow Fox 1998). If construction of a path goes ahead, the Council should ensure that it is setback from the existing shoreline to avoid future coastal defence costs to protect the footpath.

## ***Key interests***

No key interests were highlighted in MU22 during the written consultation process. Public concern was related to coastal erosion and management at Thortonloch Caravan Park, where it is reported that the defences require repairs and maintenance nearly every year (SPI 2001a). Another member of the public noted that there is periodic loss and replacement of sand on Thortonloch beach (SPI 2001a).

## ***Valuation of Assets***

The assets in MU22 have an estimated monetary value of £58M (Table 9.106). Most of the land use is agricultural, although a narrow strip of land classed as open land, forms the immediate coastal hinterland. Urban land, which includes roads, railways and residential areas, makes up 9% of the management unit. The A1 road runs through MU22 and is approximately 150m from the coast in places. The main east coast railway line runs landward and parallel to the road.

**Table 9.106 Valuation of Assets in MU22**

| <b>Asset Type</b>         | <b>% Land in Category</b> | <b>Value (£)</b>  |
|---------------------------|---------------------------|-------------------|
| High Quality Agricultural | 73%                       | 1 580 940         |
| Open Area                 | 18%                       | 77 728            |
| Urban                     | 9%                        | 56 924 000        |
| Industrial                | 0%                        | 142 800           |
| <b>Total</b>              |                           | <b>58 725 468</b> |



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### **Option Evaluation**

Map analysis showed negligible change in the shoreline position in MU22 over the last 100 years (Appendix C, View 22 and 23) with the exception of a short section of accretion, south of Dunglass Burn (Table 4.6). However, the public highlighted an increase in erosion along the frontage of Thortonloch Caravan Park in the last decade, although this is not substantiated by map analysis. Localised erosion may have been exacerbated by human pressure on the dunes. Defences have been constructed to halt the erosion and have an estimated residual life of 10-25 years (Appendix D). As no rates of erosion are available for MU22, the estimated monetary cost of **No Active Intervention** is negligible.

**No Active Intervention** would result in the eventual demise of the defences fronting Thortonloch. The rate of land lost is negligible, however this may increase in the future as it is predicted that there will be a general tendency for landward movement of beaches on the open coast coupled with a reorientation of bays in planshape (Section 4.10). In addition, this stretch of shoreline may have suffered an increase in erosion, due to the defences and reclaimed shoreline at Torness Point, which may have reduced the supply of sediment to this part of the coast. For the purposes of cost-benefit assessment, we have assumed a worst case erosion rate of 0.25m/year along this part of the coast, resulting in 12.5m of shoreline lost in the 50 year Plan Period.

**Hold the Line** along the entire frontage is not economically feasible, given the cost of constructing new defences along the coast. In addition, as neither erosion nor flooding is a threat to the assets in MU22 such a policy is not required. **Selectively Hold the Line** may be more appropriate for MU22, whereby the defences fronting Thortonloch Caravan Park are maintained only, as it appears erosion here is threatening the seaward edge of the Park (SPI 2001a). However, results from the cost-benefit analysis (Table 9.107) indicate that this is not an economically viable option in the 50-year term of Plan. The cost of Selectively Hold the Line is estimated based on maintenance costs of £1 per metre per year and complete replacement of the toe protection in Year 25 of the Plan. The benefit-cost ratio is low (0.004), as a negligible area of land is saved from erosion.

**Table 9.107 Results of Cost-Benefit Analysis for MU22 (values are discounted to 2001 values)**

| Option                    | Losses | Benefit | Cost   | Ratio |
|---------------------------|--------|---------|--------|-------|
| No Active Intervention    | 63     | -       | -      |       |
| Selectively Hold The Line | 0      | 63      | 17,290 | 0.004 |

Neither **Advance the Line** nor **Retreat the Line** are feasible options for MU22.

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The preferred option for MU22 is **Limited Intervention**, as the economic case for Selectively Hold the Line is weak. In addition, artificially stabilising a short section of shoreline may result in enhanced erosion elsewhere in the process unit, either at the flanks of the defence unit or downdrift, due to a reduction in sediment supply.

In the long-term a slow rate of coastal erosion may result in some loss of the frontage at the Caravan Park, however evidence suggests that the rate of loss is likely to be fairly low.

Management techniques such as:

- the relocation of caravans back from the shoreline,
- discouraging access to the beach from the caravan park over the dunes and
- dune planting and fencing solutions

comprise a more sustainable approach to coastal management in this management unit. A monitoring programme such as surveys from fixed markers should be instigated to assess future changes.

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### **10** Summary

Strategic coastal defence or management options have been recommended for each management unit on the East Lothian shoreline, taking into account coastal processes, coastal defences, land-use, the human and built environment and the natural environment (Chapter 9). This chapter summarises the findings and sets out the preferred option and recommendations for each management unit. Priorities for shoreline management in East Lothian are also identified.

#### **10.1** Preferred Management Options

The preferred management option for each management unit are summarised in Table 10.1. An estimated cost of the recommended capital works is also given, along with an estimate of the annual maintenance cost (at 2001 values). The Net Present Value of the preferred coastal defence option over the 50 years of the Plan period is also given.

#### **10.2** Additional Recommendations for Shoreline Management

Preferred options for coastal defence for each management unit (Table 10.2) were selected following the appraisal of various strategic coastal defence options with the needs and objectives of each unit. Additional recommendations for shoreline management were made in the "Options Evaluation" section of each management unit (Chapter 9). These recommendations, other key issues and monitoring requirements relating to specific management units are summarised in Table 10.2.

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**Table 10.1 Summary of Preferred Strategic Coastal Defence Option for Management Units on the East Lothian Coastline**

| MU | Name                               | Preferred Option                                           | Capital Works                                                                                                                                                                                                                          | Estimated Cost of Capital Works | Annual Inspection/ Maintenance | NPV over 50 Years |
|----|------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------|-------------------|
| 1  | Eastfield to River Esk             | Selectively Hold the Line                                  | Repairs to River Esk defences within 10 Years. Raising of Fisherrow Promenade and mouth of Fisherrow Harbour. - Cost estimate not made, as more detailed study required                                                                | ?                               | 2,800                          | 46,781            |
| 2  | Ash Lagoons                        | Hold the Line                                              | Defences have estimated Residual Life of > 50 years                                                                                                                                                                                    | -                               | 2,700                          | 45,110            |
| 3  | The Cast                           | Hold the Line<br>(Retreat the Line should be investigated) | Existing gabion and rock armour defences are in poor condition. Estimated replacement within 5 years if Hold the Line is pursued. However, it is also recommended that the Council investigate the possibility of Retreating the Line. | 584,590                         | 845                            | 523,959           |
| 4  | Prestonpans                        | Selectively Hold the Line                                  | Existing property walls observed to be in poor condition. ELC have estimated repair costs.                                                                                                                                             | 395,000                         | 1,245                          | 414,556           |
| 5  | Humlocks & Cockenzie Power Station | Hold the Line                                              | Defences at Power Station in good condition. Rock Armour at Sailing Club and Humlocks has residual life < 5years                                                                                                                       | 413,400                         | 1,063                          | 325,516           |
| 6  | Cockenzie and Port Seton           | Hold the Line                                              | Replacement of the rock armour east of Port Seton Promenade will be necessary in the next 15 years                                                                                                                                     | 170,130                         | 2,000                          | 103,570           |
| 7  | Gosford Bay                        | Selectively Hold the Line                                  | Rock Revetment required to protect coast road at Gosford House. Placement of toe protection at section of sloping masonry, which protects the coast road for a section of approximately 100m in Longniddry within 3 years              | 838,460                         | 641                            | 616,298           |
| 8  | Aberlady Bay                       | No Active Intervention                                     |                                                                                                                                                                                                                                        | 0                               | 0                              | 0                 |
| 9  | Gullane Bay                        | Limited Intervention                                       | Visitor management and management of sea buckthorn should be continued                                                                                                                                                                 | 0                               | 0                              | 0                 |
| 10 | Archerfield and Yellowcraig        | No Active Intervention                                     |                                                                                                                                                                                                                                        | 0                               | 0                              | 0                 |
| 11 | Broad Sands and West Links         | Limited Intervention                                       | Visitor management, such as dune fencing and signs to keep visitors off the eroding dunes, and relocation of trees/greens away from the eroding shore.                                                                                 | 0                               | 0                              | 0                 |

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| MU | Name                    | Preferred Option          | Capital Works                                                                                     | Estimated Cost of Capital Works | Annual Inspection/ Maintenance | NPV over 50 Years |
|----|-------------------------|---------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------|-------------------|
| 12 | North Berwick           | Selectively Hold the Line | Maintain existing defences.                                                                       |                                 | 2,500                          | 41,769            |
| 13 | Tantallon               | No Active Intervention    |                                                                                                   | 0                               | 0                              | 0                 |
| 14 | Ravensheugh             | Limited Intervention      | Visitor management (e.g. dune fencing and signs)                                                  | 0                               | 0                              | 0                 |
| 15 | Belhaven Bay            | No Active Intervention    |                                                                                                   | 0                               | 0                              | 0                 |
| 16 | Winterfield Golf Course | Selectively Hold the Line | Protect the clubhouse with the provision of rock armour along toe of slope.                       | 106,000                         | 100                            | 101,571           |
| 17 | Dunbar Cliffs           | Selectively Hold the Line | Gabion toe protection at Bayeswell Hotel should be maintained                                     |                                 |                                |                   |
| 18 | Dunbar                  | Hold the Line             | Repairs to walls and Lamer Street Access Steps and Provision of Flood gate at cobbled access ramp | 65,000                          | 1000                           | 75,124            |
| 19 | Dunbar Golf Course      | No Active Intervention    |                                                                                                   | 0                               | 0                              | 0                 |
| 20 | Barns Ness              | No Active Intervention    |                                                                                                   | 0                               | 0                              | 0                 |
| 21 | Torness Power Station   | Hold the Line             | Maintenance of defences at Nuclear Power Station will be required for the foreseeable future      | N/A                             |                                |                   |
| 22 | Thorntonloch            | Limited Intervention      | Dune management and monitoring. Relocation of caravans may be appropriate in the future.          | 0                               | 0                              | 0                 |

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**Table 10.2 Additional Recommendations for Shoreline Management for Management Units on the East Lothian Coastline**

| MU | Name                               | Additional Recommendations and Key Issues                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Eastfield to River Esk             | Part of the shoreline of MU1 is natural, with a low dune system separating the sand beach from the road and Fisherrow Links. This part of the shoreline is presently stable or accreting, although it is likely the dunes will undergo some temporary phases of erosion during winter storms. This is a natural coastal process and short-lived phases of erosion should not be considered a problem. The preferred strategic option for coastal defence in MU1 is to Selectively Hold the Line. This involves maintenance of the existing defences only. No new construction of coastal defences is recommended, although capital works may be required at the mouth of the River Esk, Fisherrow Harbour and Fisherrow promenade.                                                                                                                                                                                                                                                                                                                                                                  |
| 2  | Ash Lagoons                        | The shoreline of MU2 is an area of land-claim and natural coastal processes have been affected due to reclamation. However, erosion of the reclaimed land (and thus the release of PVA to the environment) will have major environmental effects on the adjacent shoreline, water quality, recreation and wildlife of the surrounding area and would be unacceptable to SEPA, SNH and other environmental bodies. A policy of Hold the Line is thus the preferred option.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3  | The Cast                           | The preferred option for MU3 is Hold the Line, although this is not necessary viable in an economic sense (benefit to cost ratio 0.08). It is recommended that the Council investigate the feasibility of Retreating the Line as this may reduce the need for expensive coastal defences and may also allow historic sites of archaeological heritage, such as Morrison's Haven to be re-opened.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 4  | Prestonpans                        | Selectively Hold the Line is the preferred option for MU4. The existing defence line should be maintained for the urban shoreline, which is currently protected by coastal defences and property walls. In the east, a wide shingle beach fronts the management unit and although there are some signs of limited erosion there is no immediate risk to property. Natural processes should be allowed to continue in this part of the management unit, although monitoring should be carried out to assess future risk.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 5  | Humlocks & Cockenzie Power Station | The preferred option for MU5 is Hold the Line. MU5 is an area of land claim on which Cockenzie Power Station is situated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 6  | Cockenzie and Port Seton           | Hold the Line is the preferred strategic coastal defence option for MU6. The costs associated with this option relate to general maintenance and monitoring costs of existing defences and replacement costs of Defence No. 22, at the eastern limit of MU6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 7  | Gosford Bay                        | Selectively Hold the Line is the preferred option for MU7. In order to prevent further erosion and eventual failure of the coast road in the vicinity of Gosford House, it is recommended that the existing defence be replaced with a more robust structure, such as an engineered rock revetment at the back of the beach. Further Strategy Studies will be required prior to any works being undertaken. In addition, toe protection to the masonry works, which support the coast road is required within the Plan period. As the shoreline in MU7 is mainly natural, it is likely to undergo short-lived phases of erosion, within a long-term trend of accretion along much of the management unit. This should be accepted and allowed to continue for most of the shoreline of MU7. The defence at Greencraigs Hotel is unsightly and in very poor condition. It is recommended that these are not maintained as they appear to be having limited effect. Removal of the remaining scattered rubble along this stretch should be considered, allowing natural coastal processes to operate. |

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| MU | Name                        | Additional Recommendations and Key Issues                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8  | Aberlady Bay                | No Active Intervention is the preferred option for MU8. Erosion is not causing a significant threat to assets anywhere in the management unit. This strategy of management allows natural changes in the dune system to continue. As the long-term trend in the dunes at Aberlady is one of accretion, the No Active Intervention approach is unlikely to create significant problems in the long-term and will have no impact on adjacent shorelines. However, adoption of this option should be consonant with a policy of monitoring the natural changes by either repeat fixed photography, aerial photography or beach surveys. The first two monitoring strategies are preferred, as these will be less disruptive to sensitive dune habitats. However, adoption of the No Active Intervention option would result in the eventual deterioration of the coastal defences at Kilspindie Golf Course. The defences here are already in poor condition and have an estimated residual life of 5 years. However, the potential loss of land is likely to be negligible given the low rates of erosion recorded on this stretch of coast. |
| 9  | Gullane Bay                 | Limited Intervention is the preferred option in MU9, where visitor management and management of sea buckthorn is continued. Limited Intervention will permit the operation of natural processes, but will result in a continuation of natural erosion of the dune system, particularly at Gullane Bents. Visitor management will attempt to slow down the rate of natural erosion. It is not economically viable to prevent further erosion in the long term and it is recommended that Gullane Bents be managed with this in mind. However, natural rates of dune erosion may be reduced if visitors are kept off the eroding foredune, and East Lothian Council should continue to encourage this. Fixed photographs or surveys should be established to monitor the changes in the dune system, however this should be carried out to ensure minimal disturbance to the dunes. Management of the spread of the Sea Buckthorn in the backdune area should be continued, and the correct levels of the species for optimum dune habitats should be defined and maintained, if possible.                                                   |
| 10 | Archerfield and Yellowcraig | The preferred option for MU10 is No Active Intervention. If the new development at Archerfield goes ahead, it should be set well back from the existing shoreline, by at least 50m. This will avoid tying future generations into the need for inflexible and expensive coastal defences, which will certainly be detrimental to the natural environment. This should be taken into consideration during the planning and construction phase of the Archerfield development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 11 | Broad Sands and West Links  | Limited Intervention is the preferred option for MU11. Dune erosion of Links courses in Scotland is a common problem and the current thinking is that this erosion should be managed as an acceptable natural processes and coastal defence is not a long-term sustainable option and will merely transfer the problem downdrift to another part of the shoreline. Consideration to the relocation of tees / greens away from the shoreline should be considered, together with establishing a monitoring programme to assess future changes. In terms of user management of Yellowcraig and the dunes at Broad Sands, the Council should consider methods such as dune fencing and planting to keep visitors off the eroding dunes, with an aim to reduce the amount of human induced erosion.                                                                                                                                                                                                                                                                                                                                            |

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| MU | Name                    | Additional Recommendations and Key Issues                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 | North Berwick           | Selectively Hold the Line is the preferred option for MU12. Some of the existing defences should be maintained, but no new defences are recommended. A series of fixed monitoring stations should be established to monitor the erosion/accretion trends in Milsey Bay. Short-term solutions to localised erosion are not practicable and often do not solve the problem (e.g. failure of Defence No 38). Dune erosion that is not causing a threat to roads or property should be allowed to continue, as this is a natural process, which may be short-lived. However, if beach monitoring indicates that coastal erosion is threatening the integrity of the road, soft coastal defences should be considered to help stabilise the dunes and encourage vegetation. The geotextile matting at Tantallon Terrace appears to have been successful in encouraging vegetation of the dune face and this type of defence should be given priority over hard defences such as rock armour. Consideration should also be given to the recycling of sand removed from the road in the western part of Milsey Bay back to the eroding sections of beach in the eastern part of the Bay, instead of removing sediment from the system. In addition, it is recommended that the remainder of Defence No 38 be removed from the toe of the dunes. |
| 13 | Tantallon               | No Active Intervention is the preferred option for MU13. No Active Intervention is compatible with the nature conservation objectives of the management unit, as this will cause minimal disturbance to the rare botanical interests and breeding bird population of the shoreline and will have negligible impacts on adjacent shorelines. It is recommended that fixed monitoring stations be set up at sensitive locations (e.g. Glen Golf course and potentially threatened sites of archaeological interest) in order to establish the rates and trends of coastal erosion. This will enable future decisions to be made with a much better understanding of the problem.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 14 | Ravensheugh             | Limited Intervention is the preferred option for MU14. This would allow continuation of the natural processes and would not detract from the natural heritage interests of the site. Future “ad-hoc” coastal protection, such as that put in place by the Scottish Scripture Union Summer Camp, should be discouraged in future. It is been suggested that localised dune erosion is caused by human pressure, thus management practices aimed to encourage visitors to stay off the dunes in sensitive areas should be considered (such as dune fencing, signs etc.). It is also recommended that a series of fixed monitoring stations be established to monitor rates of cliff erosion at Seacliff to determine the nature of the problem and to assess the need for future coastal defence, such as toe protection at the base of the cliff.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 15 | Belhaven Bay            | No Active Intervention is the preferred option in MU15, as there is no evidence that erosion is causing any significant threat to amenity anywhere in the management unit. Retreat the Line is feasible in part of the management unit, via the removal of Buist’s embankment although further investigation is required if this option is to be adopted. A system of monitoring natural changes on this dynamic shoreline should be instigated, either by establishing a record of aerial surveys/ fixed photographs or by setting up a series of fixed monitoring stations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 16 | Winterfield Golf Course | The preferred option for MU16 is to Selectively Hold the Line. It is recommended that a properly engineered coastal defence to protect the toe of the slope at the clubhouse be constructed to replace the dilapidated seawall. It is also recommended that the “ad hoc” coastal defences preventing localised erosion of the raised beach deposits of Winterfield Golf Course be removed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



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| MU | Name                  | Additional Recommendations and Key Issues                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17 | Dunbar Cliffs         | Selectively Hold the Line is the preferred option for MU17. No additional construction is required but the gabion defences should be inspected regularly. As coastal erosion is likely to continue in MU17, it is recommended that the coastal walkway be moved back from the cliff edge and relocated. This will reduce the need for increasingly robust coastal protection in the future and will minimise potential public safety issues. The path at NT676792 should be set back from the shoreline, thus reducing the need to continue to maintain the old concrete retaining wall, which is sagging and in very poor condition. It is also recommended that a series of fixed monitoring stations be established along the shoreline of MU17. Monitoring, such as measuring the distance from the cliff top to the fixed marker and/or taking photographs from fixed locations should be carried out on a monthly basis to establish erosion rates. The base of the cliffs should also be inspected regularly to establish rates of undercutting and identify areas potentially at risk of landslips. |
| 18 | Dunbar                | Hold the Line is the preferred option for coastal defence in MU18. The survey of existing structures identified several areas where attention is required in the short term.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 19 | Dunbar Golf Course    | No Active Intervention is the preferred option for MU19. As map analysis indicates a stable or accreting shoreline, potential land losses under the No Active Intervention option are negligible. If localised erosion does cause loss of land in a particular locality, it is likely to be short-lived and compensated for by accretion elsewhere in the process unit. It is recommended that the golf club accept short-term localised erosion along the shoreline and do not carry out "ad hoc" hard solutions to solve immediate concerns. The long-term trend of this stretch of shoreline is one of accretion. Several of the existing defences are unsightly and unnatural (e.g. Defence No 56 and 57), with rock and rubble placed on the upper beach. The removal of these defences should be considered, as they are of limited effectiveness at reducing erosion and may be transferring the problem elsewhere to adjacent shorelines.                                                                                                                                                           |
| 20 | Barns Ness            | No Active Intervention is the preferred option for MU20, as there is no significant risk to assets from coastal processes. Most of the shoreline of MU20 has undergone accretion, although localised erosion should be accepted as a natural and short-lived process along the shoreline.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 21 | Torness Power Station | Hold the Line is the preferred option for MU21, as this will protect the asset of Torness Nuclear Power Station and would prevent the environmental damage if this were to be eroded.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 22 | Thorntonloch          | The preferred option for MU22 is Limited Intervention. In the long-term, the Caravan Park should accept that a slow rate of coastal erosion may result in some loss of their frontage, however evidence suggests that the rate of loss is likely to be fairly low. Management techniques, such as relocating caravans back from the shoreline, discouraging users to access the beach over the dunes and dune planting and fencing solutions is a more sustainable approach to coastal defence in this management unit. A monitoring programme such as surveys from fixed markers should be instigated to assess future changes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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#### **10.3 Further Investigations**

The SMP has identified areas where further studies are required. These include:

1. Investigation into the feasibility of managed realignment at The Cast (MU3);
2. Strategy Study to determine and design the coastal engineering works required to protect the coast road at Gosford Bay (MU7);
3. Investigation into the feasibility of sand recycling at Milsey Bay, North Berwick (MU12);
4. Investigation into the feasibility of managed realignment at Buist's embankment (Belhaven Bay) (MU15); and
5. Establishing monitoring programmes to assess rates of natural coastal change at several locations along the East Lothian coast (e.g. MU4, MU8, MU9, MU11, MU12, MU13, MU14, MU15, MU17 and MU22). This will enable future management decisions to be based on a better understanding of coastal processes.

A local desk study has already been carried out to investigate possible causes of sand loss and other management issues at Dunbar East Beach. This study tentatively identified a possible mechanism for the sand loss. It also recommends, in outline, the type of further studies that will be necessary to confirm these findings and formulate sustainable coastal defence or management proposals for Dunbar East Beach.

#### **10.4 Priorities for Shoreline Management in East Lothian**

The SMP sets out a number of recommendations for future coastal defence works and further studies. We consider the priorities for shoreline management in East Lothian to be:

1. Gosford Bay. The existing defences have failed and engineering works are urgently required in order to protect the coast road from subsidence and erosion. Alternatively, the Council may have to consider relocation of the road away from the eroding shoreline.
2. Erosion and failure of the existing defences at The Cast is creating a public safety issue and visual amenity impacts. The Council should consider replacing the gabions along this stretch of coast if Hold the Line is pursued. However, it is also recommended that the Council investigate the feasibility of Retreat the Line in MU3.
3. The existing wall at Dunbar East Beach (MU18) is in very poor condition and urgently requires repairs.
4. The river training works at the mouth of the River Esk (MU1) are in very poor condition and capital works will be required within the next 10 years.

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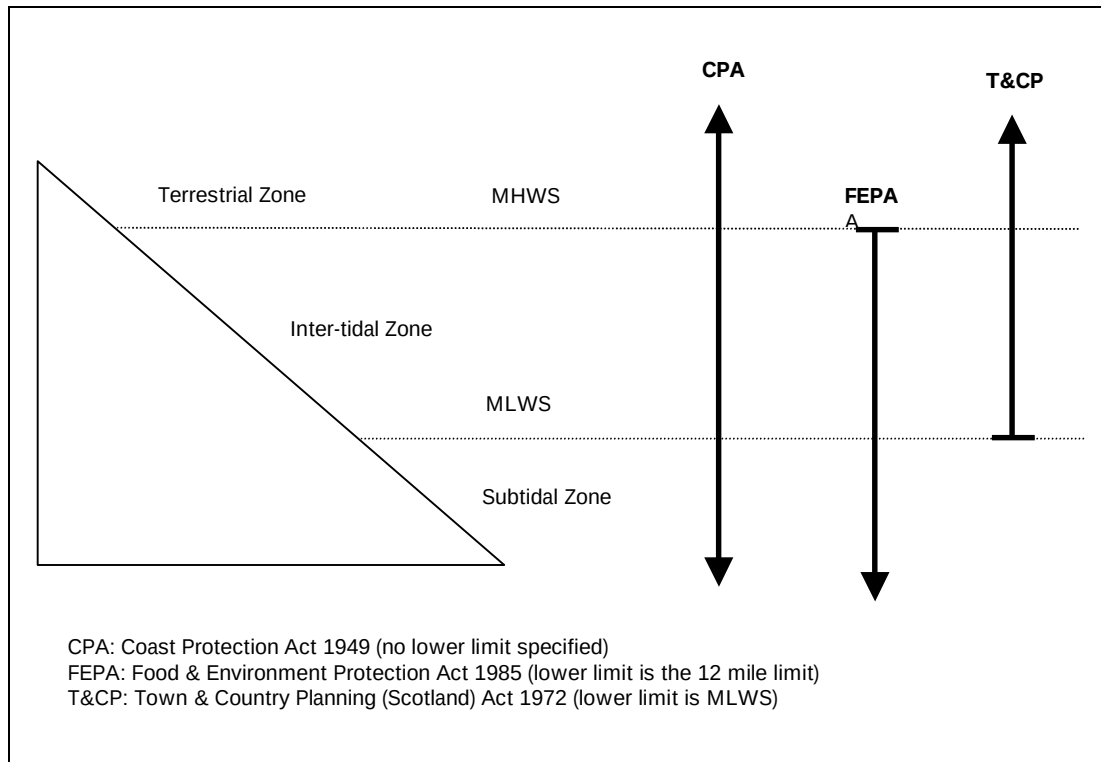
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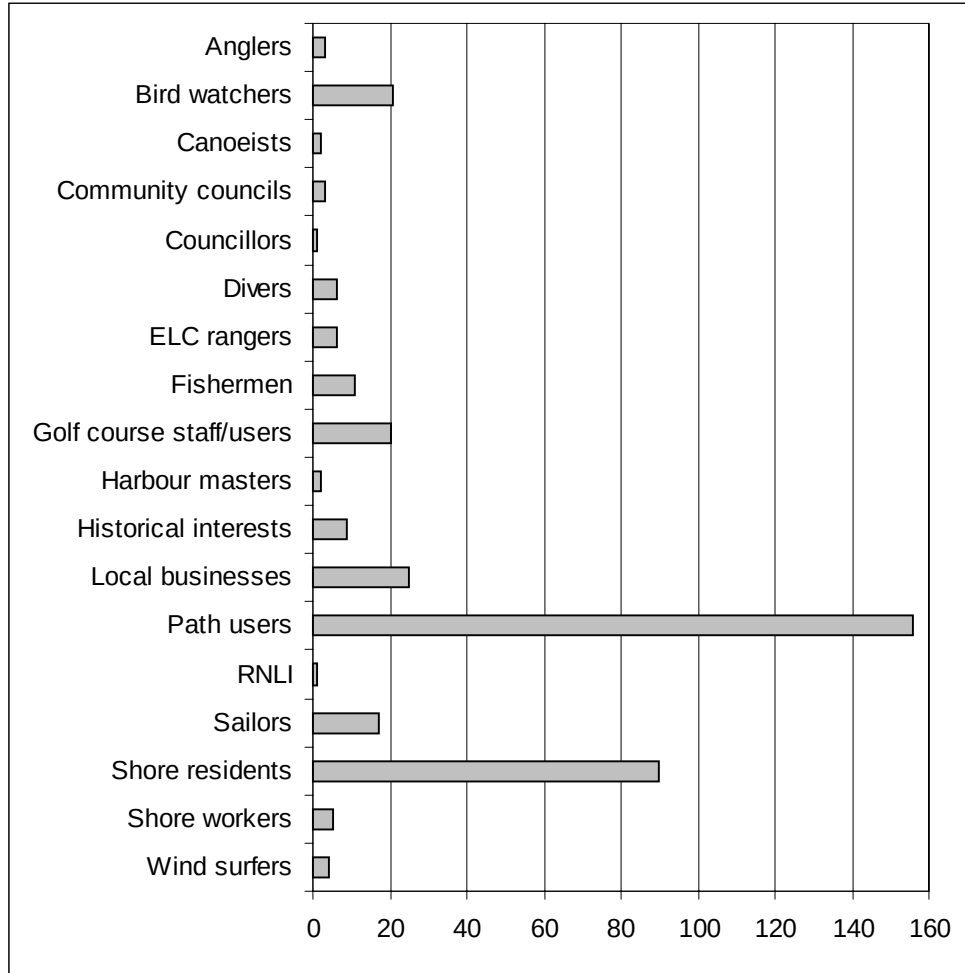
Figure 1.1 – Map of the East Lothian region (Bartholomew, 2001).

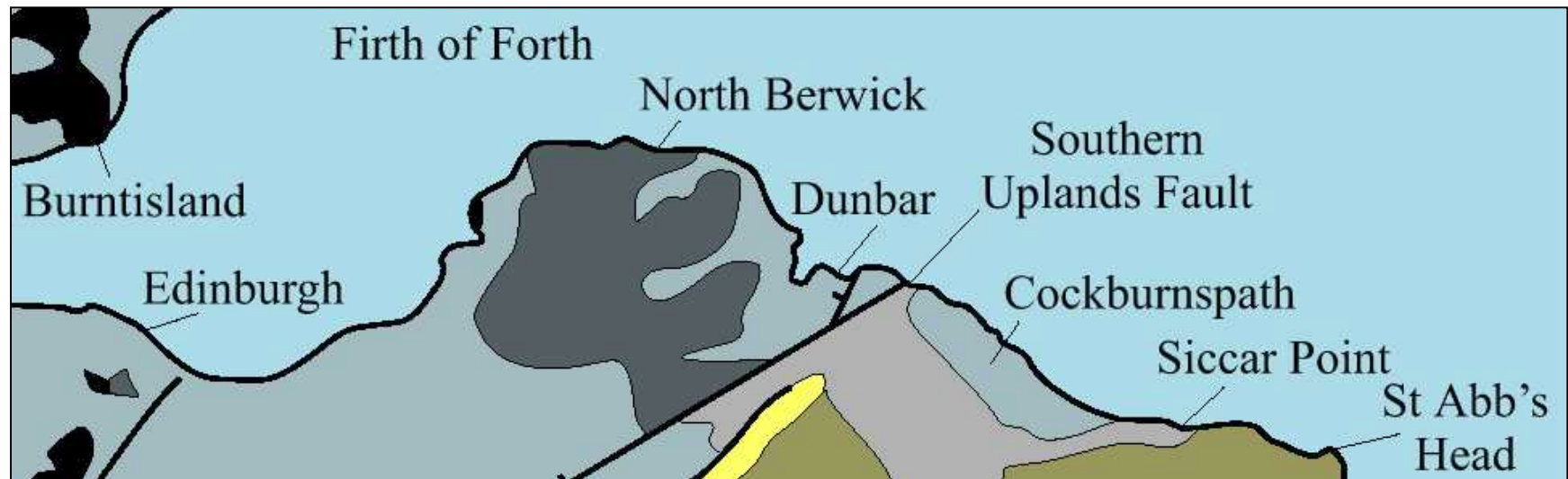
**Figure 2.1 Overlapping areas of responsibility for principal legislation controlling development of Coast Protection Works (source SNH 1996a)**





**Figure 3.1 Range of people who participated in the SPI consultation exercise**





| Stratigraphy                                                                        |               | Rock types                                   | Structures                                                                                                        |
|-------------------------------------------------------------------------------------|---------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
|    | Carboniferous | Mudstone, sandstone, coals                   |  Fault, tick on downthrow side |
|    | Devonian      | Sandstone, conglomerate, mudstone, siltstone |                                                                                                                   |
|   | Silurian      | Greywacke, siltstone, shales                 |                                                                                                                   |
|  | Ordovician    | Mudstone                                     |                                                                                                                   |
|  | Dalradian     | Schist, quartzite                            |                                                                                                                   |
| Igneous rocks                                                                       |               | Rock types                                   |                                                                                                                   |
|  | Extrusive     | Lavas, olivine-basalt, andesites, tuffs      |                                                                                                                   |
|  | Intrusive     |                                              |                                                                                                                   |
|  | Dyke          |                                              |                                                                                                                   |

Figure 4.1 – Simplified solid geology of the East Lothian region (Barne *et al.*,

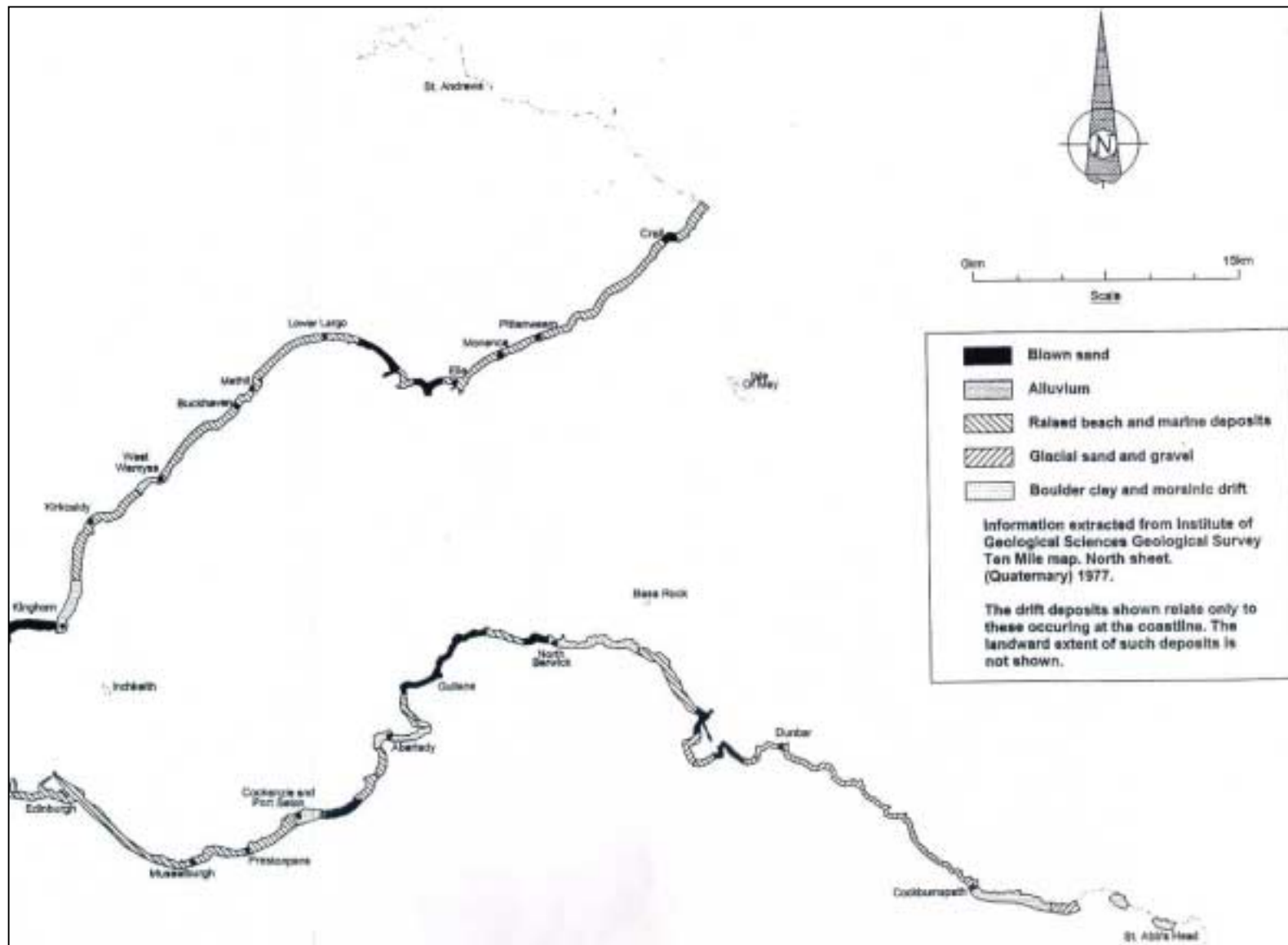
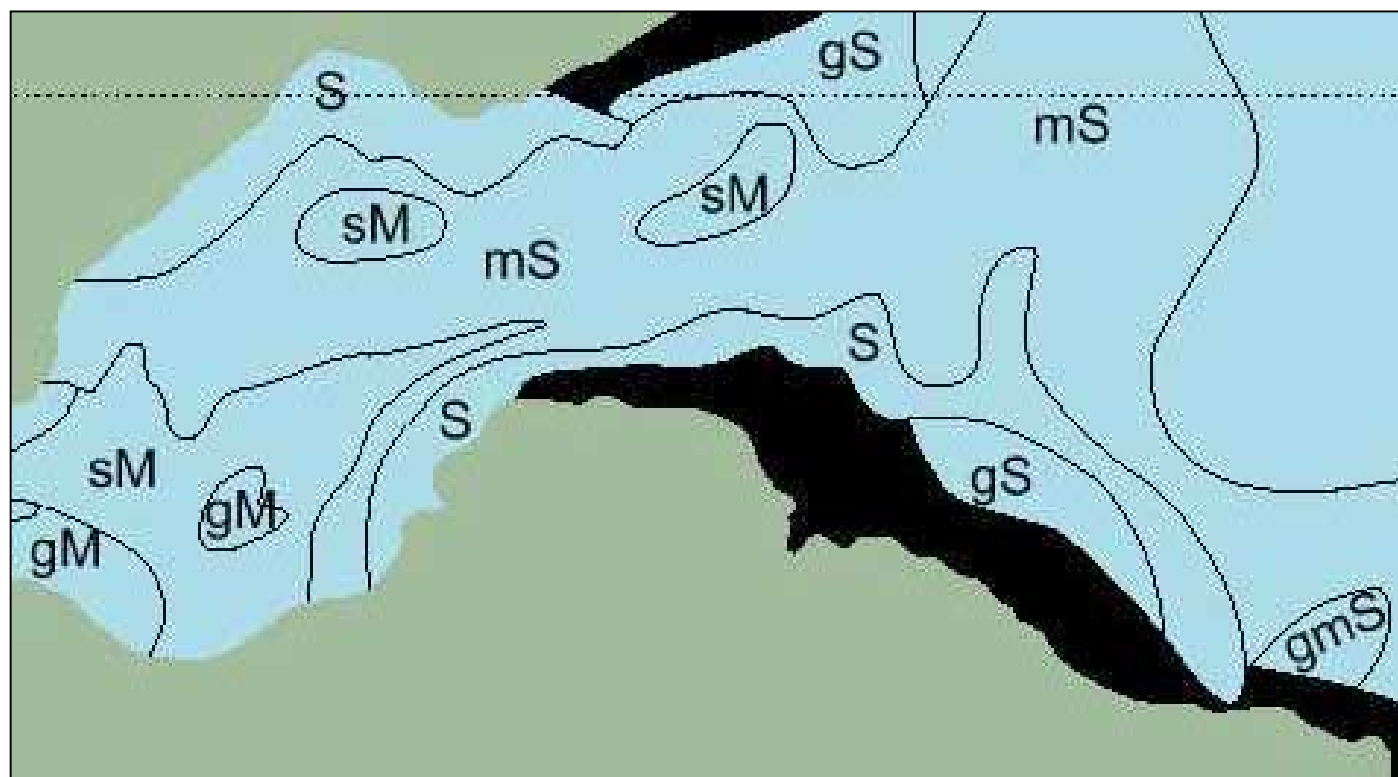


Figure 4.2 – Simplified drift geology of the East Lothian region (Ramsay and Brampton, 2000).



| Key to seabed sediment symbols                                 |              |                                                                                                                                                      |
|----------------------------------------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <span style="border: 1px solid black; padding: 2px;">sM</span> | Sandy mud    | <span style="border: 1px solid black; padding: 2px;">gmS</span> Gravelly muddy sand                                                                  |
| <span style="border: 1px solid black; padding: 2px;">gM</span> | Gravelly mud | <span style="border: 1px solid black; padding: 2px;">gS</span> Gravelly sand                                                                         |
| <span style="border: 1px solid black; padding: 2px;">S</span>  | Sand         | <span style="border: 1px solid black; padding: 2px;">G</span> Gravel                                                                                 |
| <span style="border: 1px solid black; padding: 2px;">mS</span> | Muddy sand   | <span style="border: 1px solid black; padding: 2px;">sG</span> Sandy gravel                                                                          |
|                                                                |              | <span style="display: inline-block; width: 15px; height: 15px; background-color: black; margin-right: 5px;"></span> Outcrop of bedrock on the seabed |

Figure 4.3 – Simplified sedimentology of the East Lothian region (Barne *et al.*, 1997).

| AGE          | PERIOD     | EPOCH         | IMPORTANT EVENTS                                                                                                                                                                                                                                                                                                                                                                                |
|--------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Present      | Quaternary | Holocene      | <b>Dune reworking</b> e.g. Gullane<br>20 <sup>th</sup> Cent. – land reclamation, recreation<br>19 <sup>th</sup> Cent. – golf courses and railway opening<br>18 <sup>th</sup> Cent. – vegetation destruction by rabbits and pulling for thatch<br>17 <sup>th</sup> Cent. – village inundation by sand<br>6000 – 0 years BP - end of rapid SLR and relative sea level fall. <b>Dune Formation</b> |
| 6 000 yrs BP |            |               | <b>Raised beach formation</b><br>8 000 – 6 000 years BP – Rapid SLR of Main Postglacial Transgression<br>10 000 to 8 500 years BP – relative sea level fall                                                                                                                                                                                                                                     |
| 0.01 Mya     |            | Pleistocene   | <b>Deposition of glacial and glacio-fluvial deposits</b><br>Late Devensian – 25 000 to 10 300 years BP including maximum ice advance 18 000 years BP<br>Final glacial stage (Devensian) – 70 000 to 10 300 years BP                                                                                                                                                                             |
| 1.6 Mya      |            |               |                                                                                                                                                                                                                                                                                                                                                                                                 |
| 280 Mya      |            | Carboniferous | Deposition of predominant Carboniferous sediments including sandstones, limestones and Coal Measures, and igneous rock formation                                                                                                                                                                                                                                                                |
| 360 Mya      |            | Devonian      | Tectonic activity leading to formation of Depression of Scotland's Midland Valley and igneous rock formation                                                                                                                                                                                                                                                                                    |
| 408 Mya      |            |               |                                                                                                                                                                                                                                                                                                                                                                                                 |

Figure 4.4 – Abridged geological time-scale chart to illustrate significant events for the East Lothian Region

(Key: Mya – Millions of years ago BP – Before Present SLR – Sea level rise)

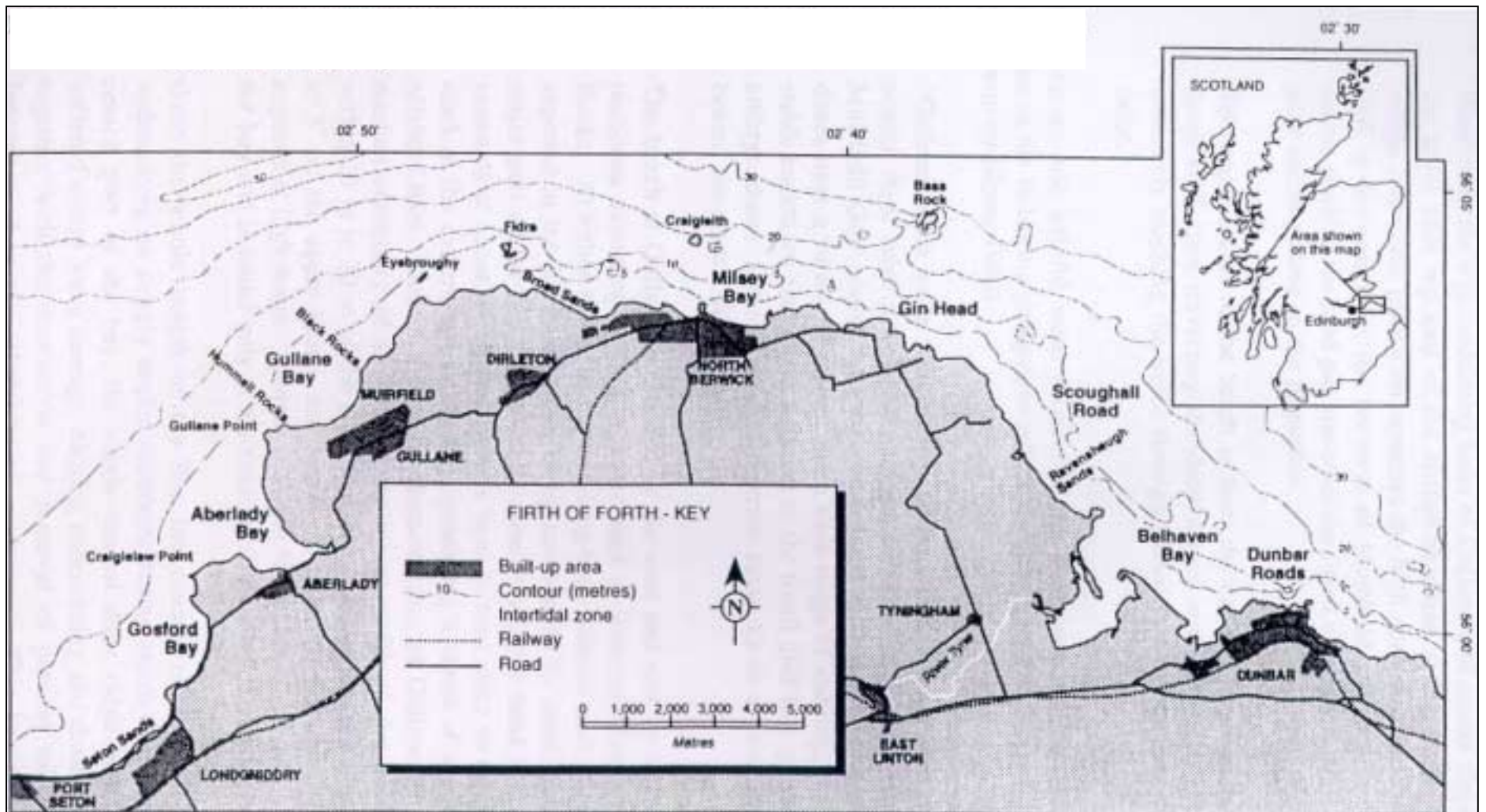


Figure 4.5 – Nearshore and offshore bathymetry between Port Seton and Dunbar in the East Lothian region (IOE, 1995).

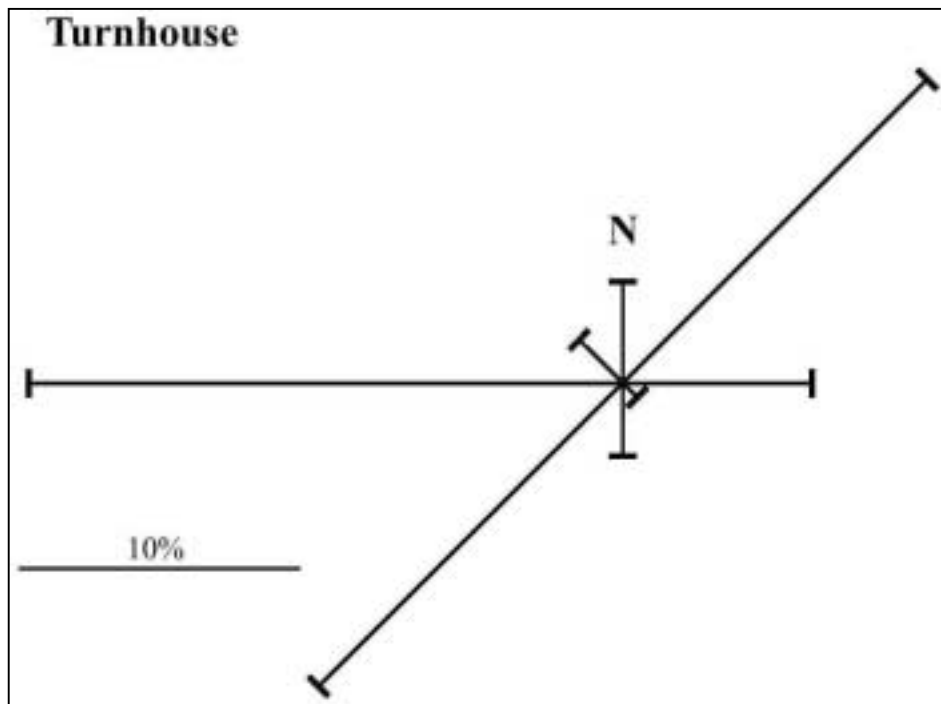


Figure 4.6a – Wind directions at Turnhouse, Edinburgh at 1500 hrs, 1971 – 1980. Average of winter and summer frequencies. (Barne *et al.*, 1997 using data from Harrison, 1987).



Figure 4.6b – Diagram to illustrate the 'funnelling effect' of the Firth of Forth on winds. The hourly mean windspeed (m/s) exceeded for 75 % of the time from 1965-1973 is shown. (Barne *et al.*, 1997 using data from Caton, 1976).



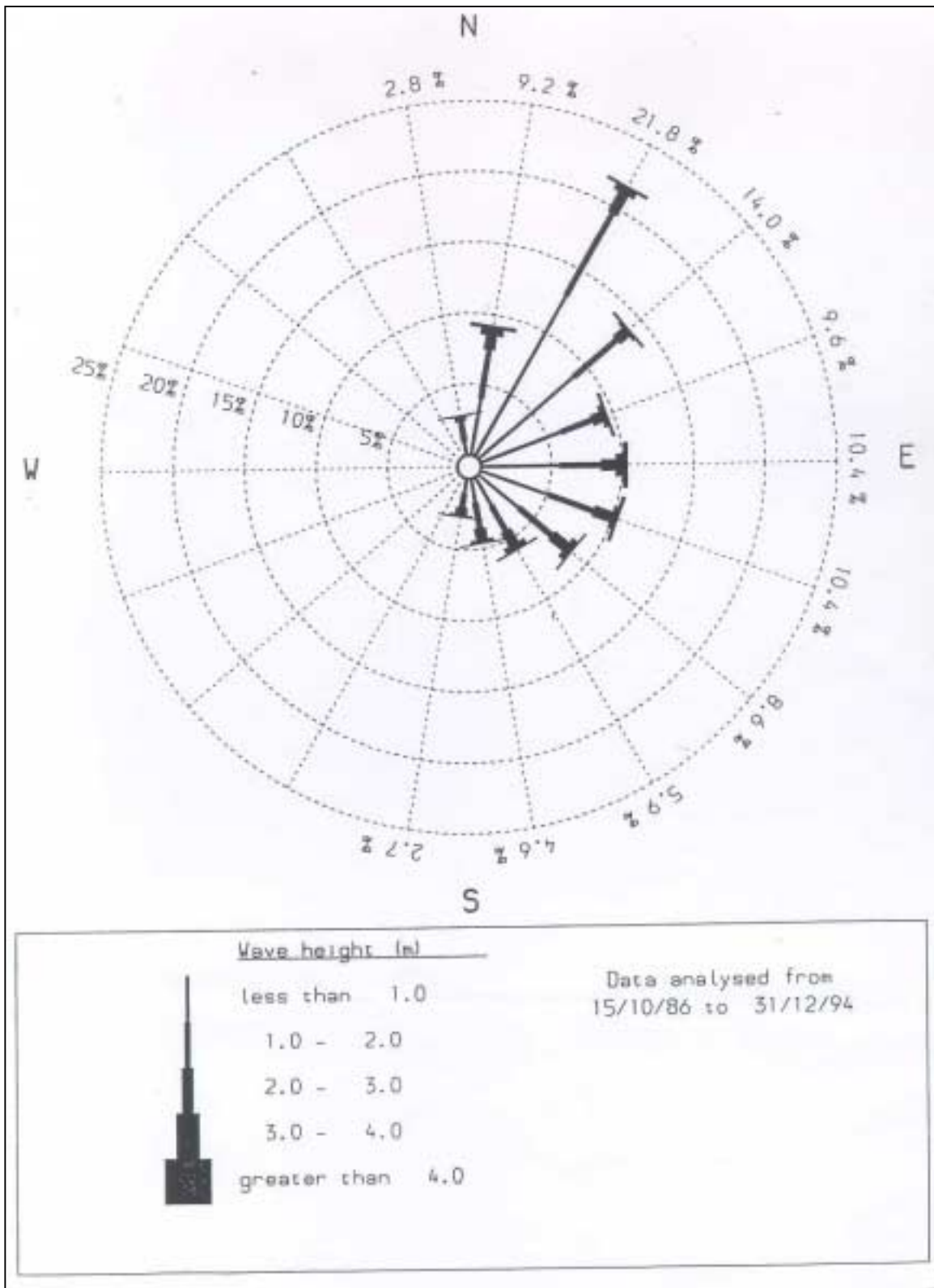


Figure 4.7 – Offshore total wave climate east of the Firth of Forth (Ramsay and Brampton, 2000).



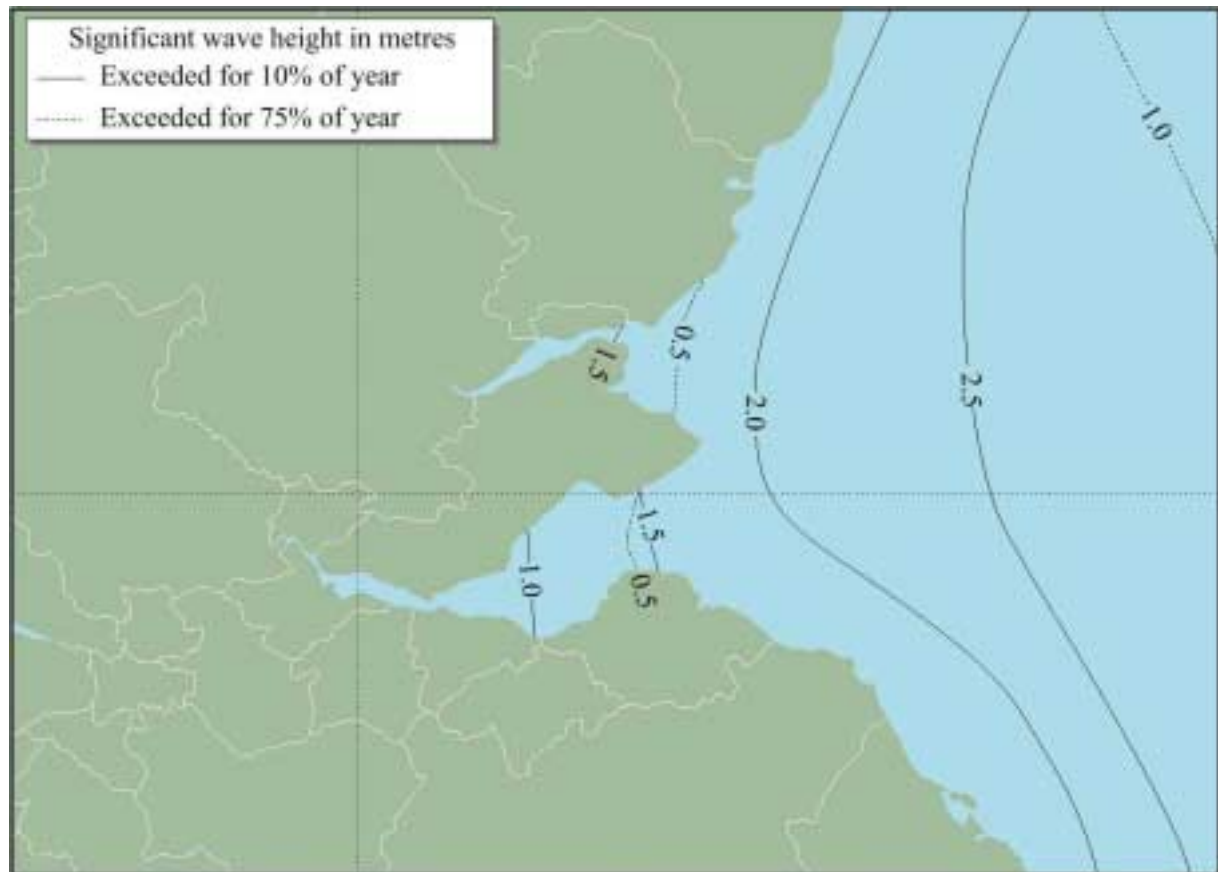


Figure 4.8 – Map showing significant wave height (m) exceeded for 10 % and 75 % of the year in the East Lothian region and surrounding area (Barne *et al.*, 1997 using data from Draper, 1991).

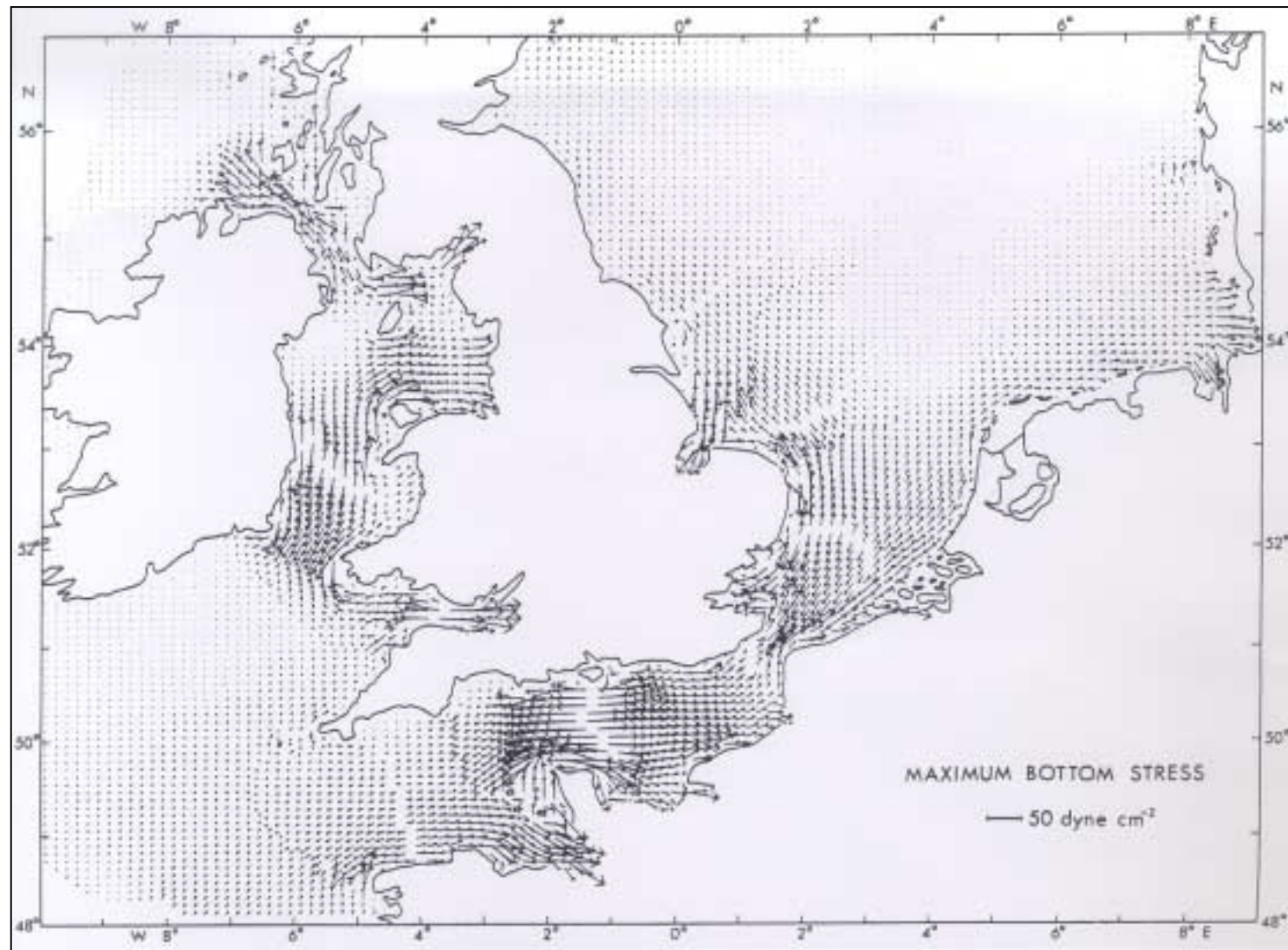


Figure 4.9 - Maximum bottom stress vectors due to  $M_2$  and  $M_4$  tidal interactions (Pingree and Griffiths, 1979).

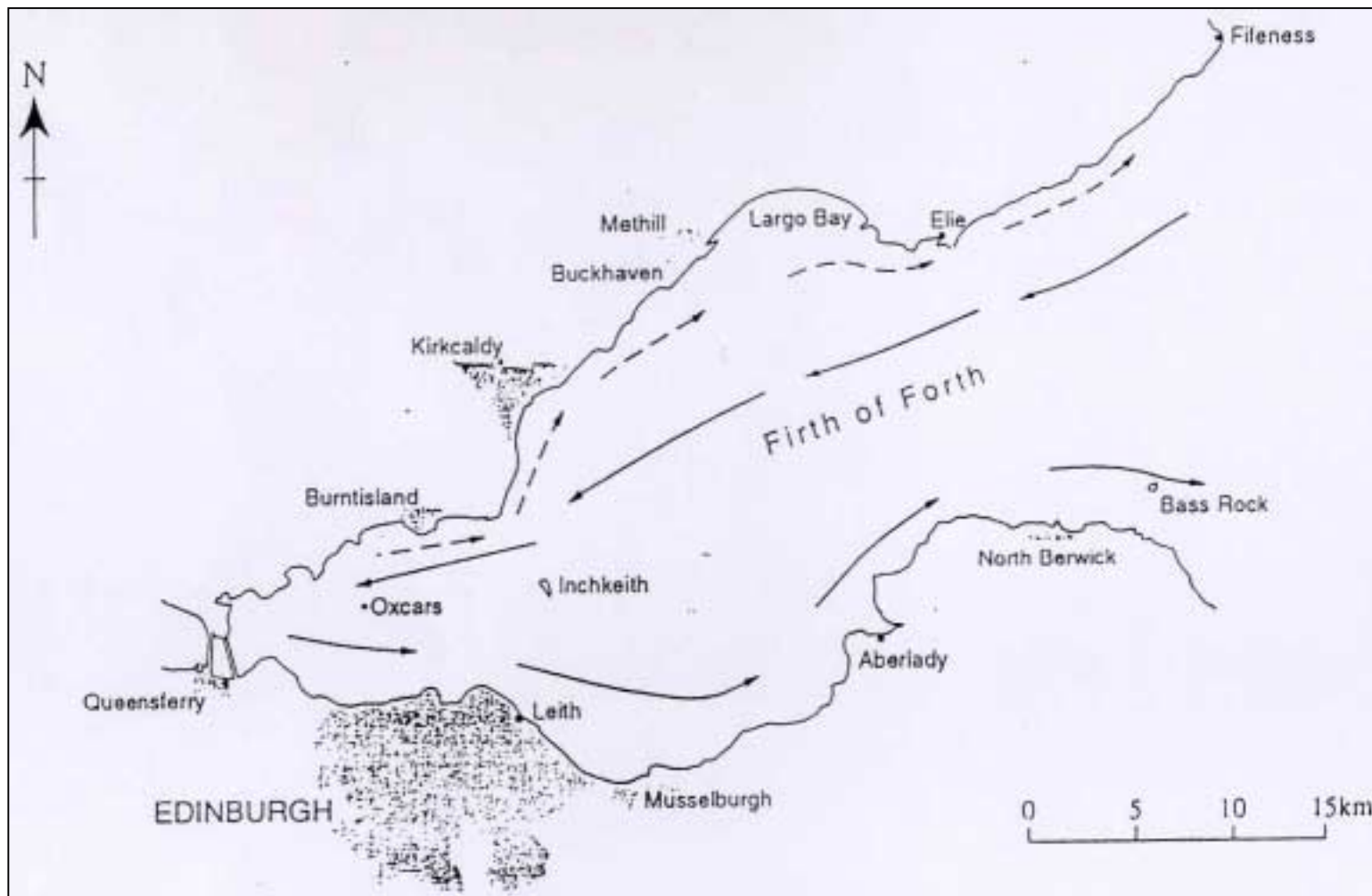


Figure 4.10a – Summary of tidal current direction in the Firth of Forth (GUARD, 1996).

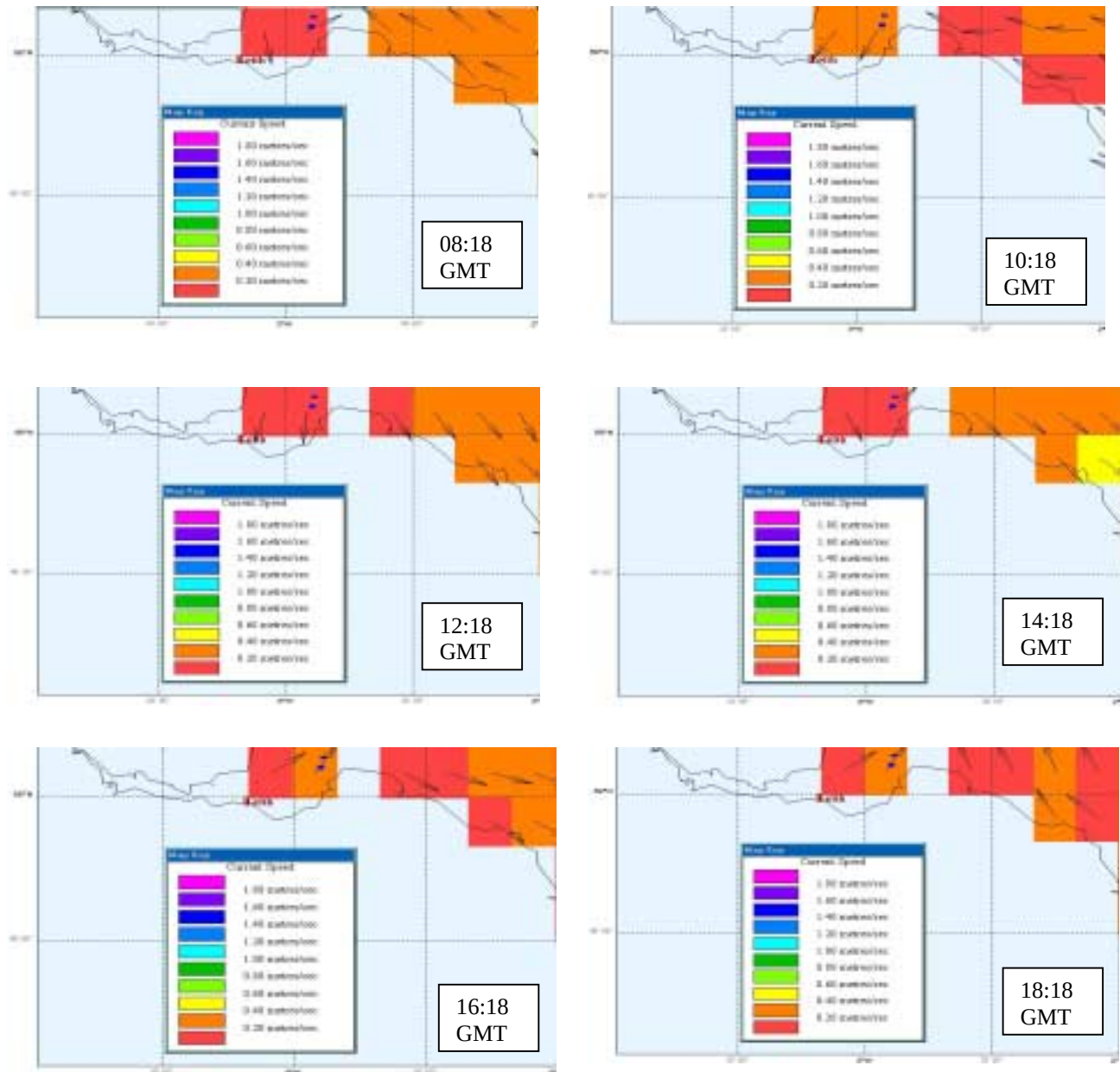


Figure 4.10b – Time sequence of tidal currents (21/06/01) obtained from a Continental Shelf model showing magnitude and direction for spring tide in the East Lothian region (Proudman Oceanographic Laboratory, 2001).



Figure 4.11 – Landforms of the East Lothian region and surrounding area (Barne *et al.*, 1997).





Figure 4.12a - Generalised sand transport pathways on the continental shelf around the UK and France (Stride, 1973).

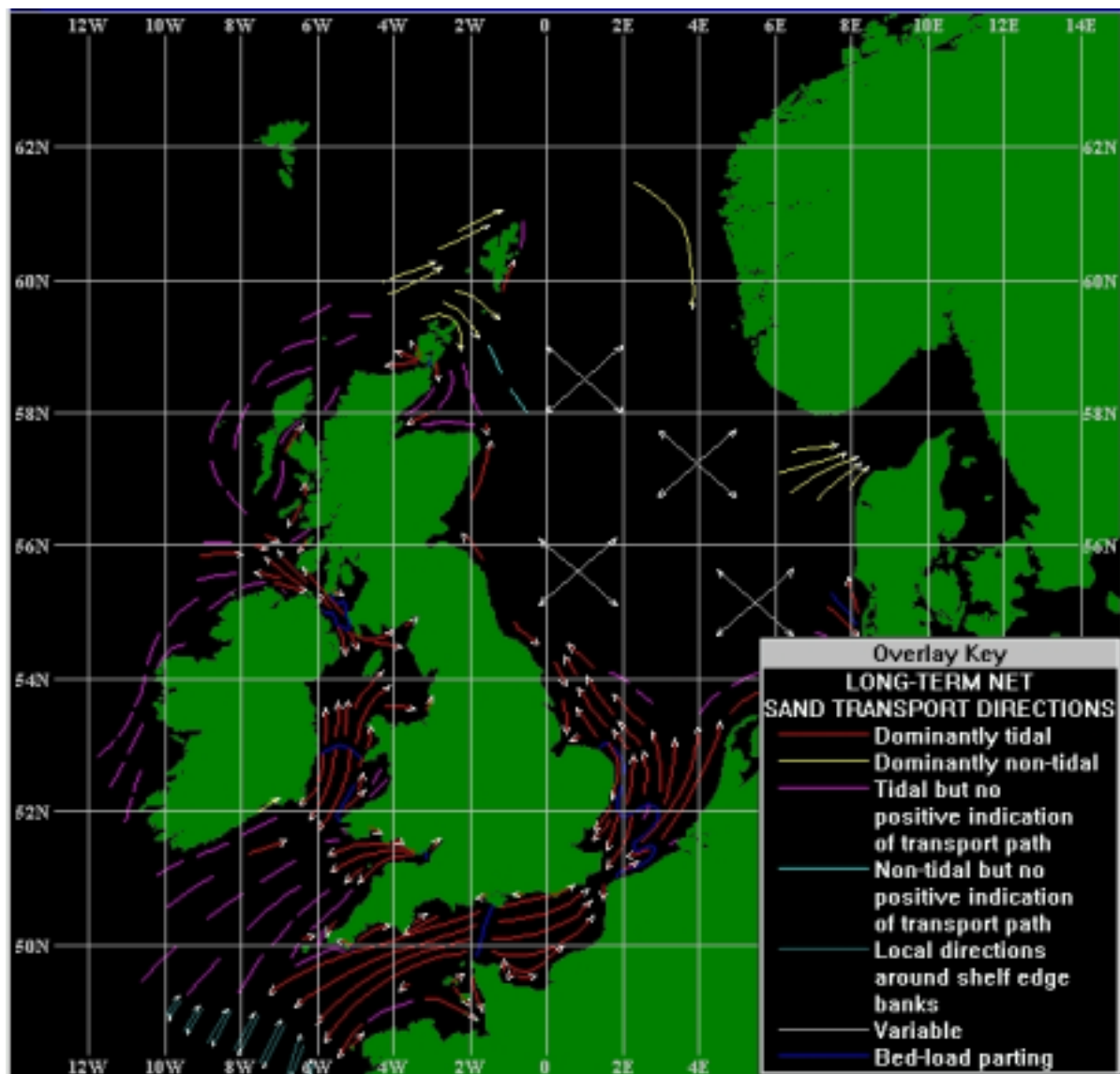


Figure 4.12b – Long-term sand transport directions (UKDMAP, 1998).

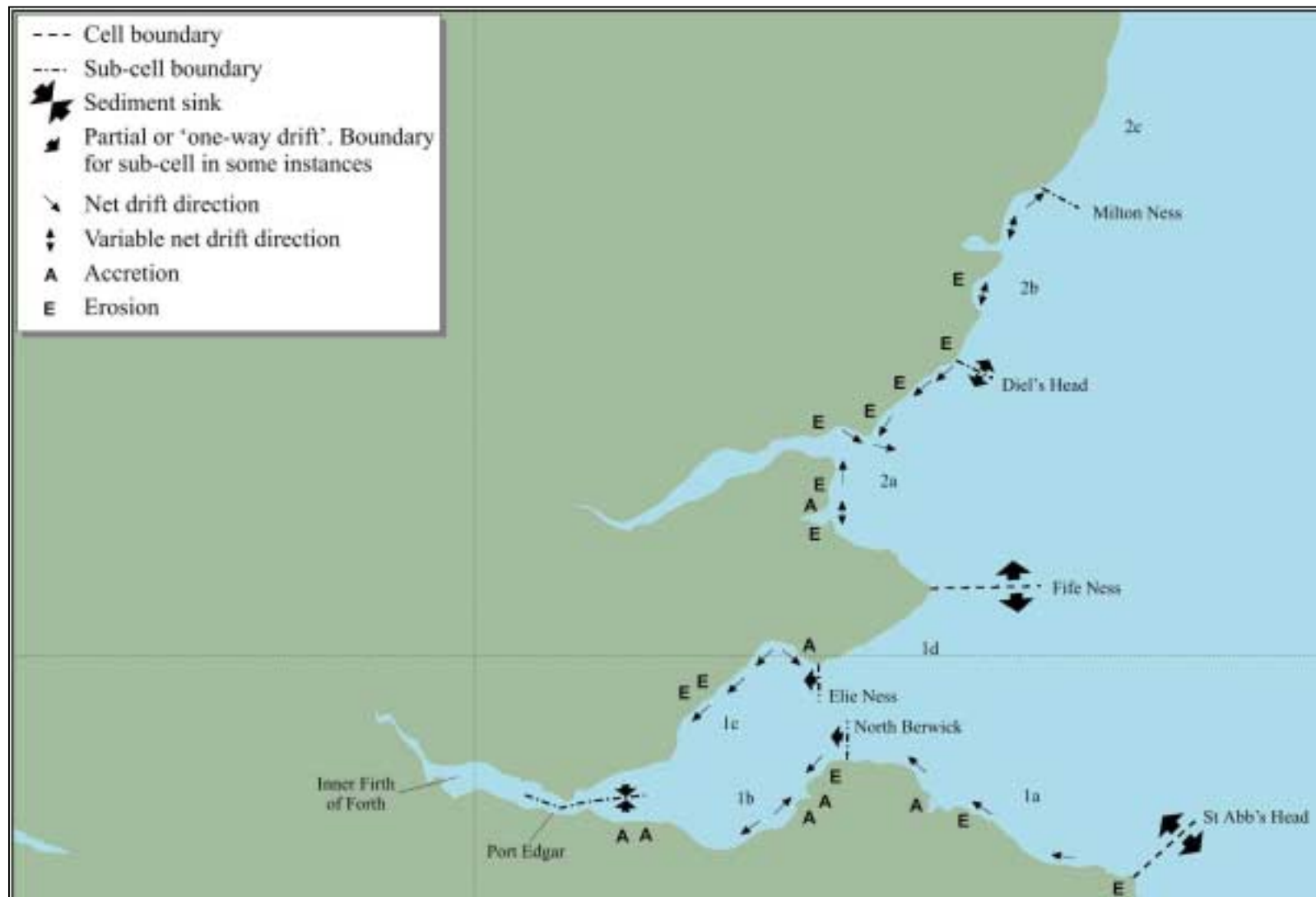


Figure 4.13a – Sediment transport adopting 'coastal cells' concept for the East Lothian area and adjacent coastline (Barne *et al.*, 1997 using data from HR Wallingford, 1995).



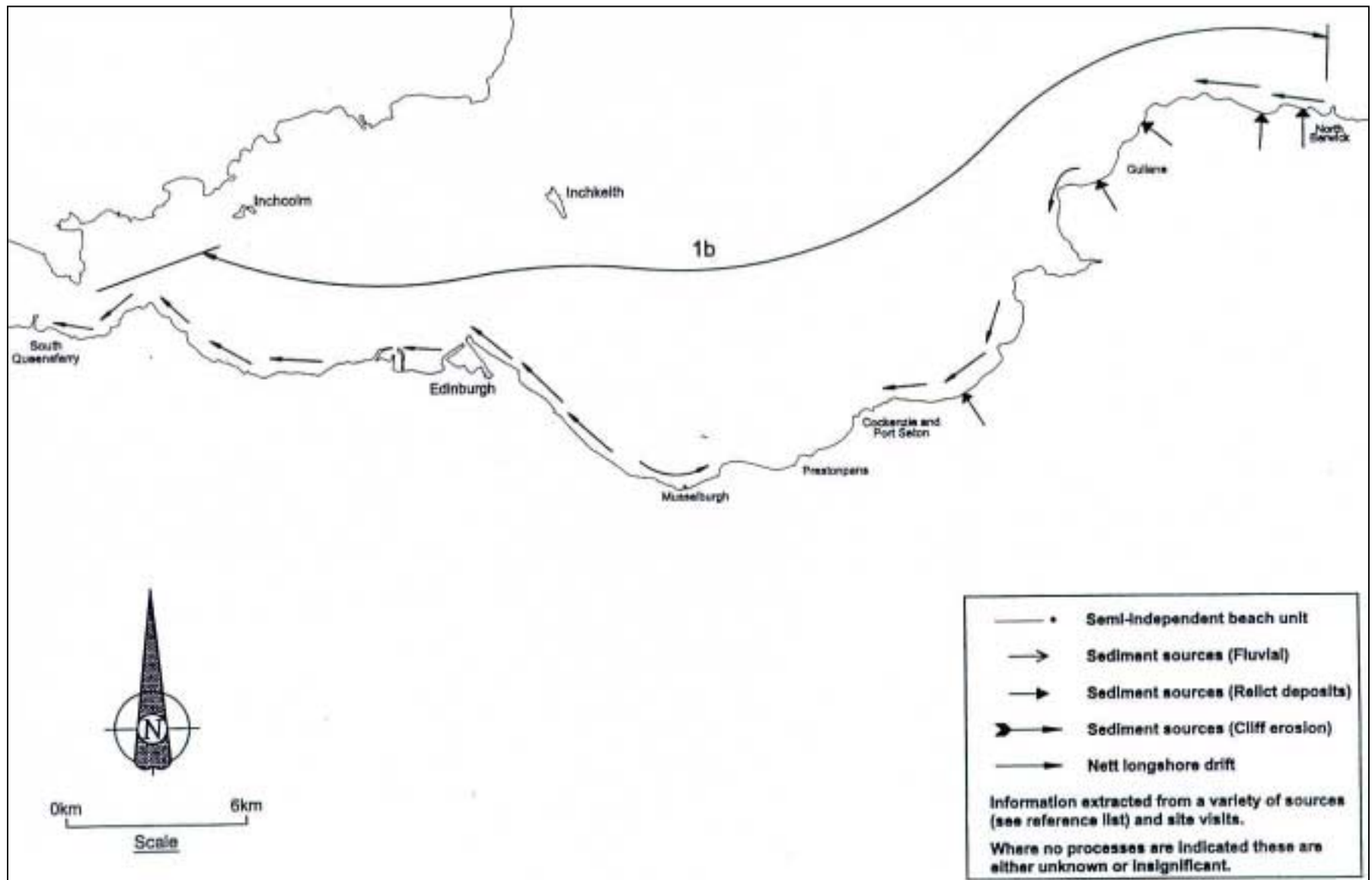


Figure 4.13b – Dominant littoral processes between Musselburgh and North Berwick and adjacent coastline of the East Lothian region (Ramsay and Brampton, 2000). NB. 1b indicates a sub-cell according to 'coastal cells' concept.

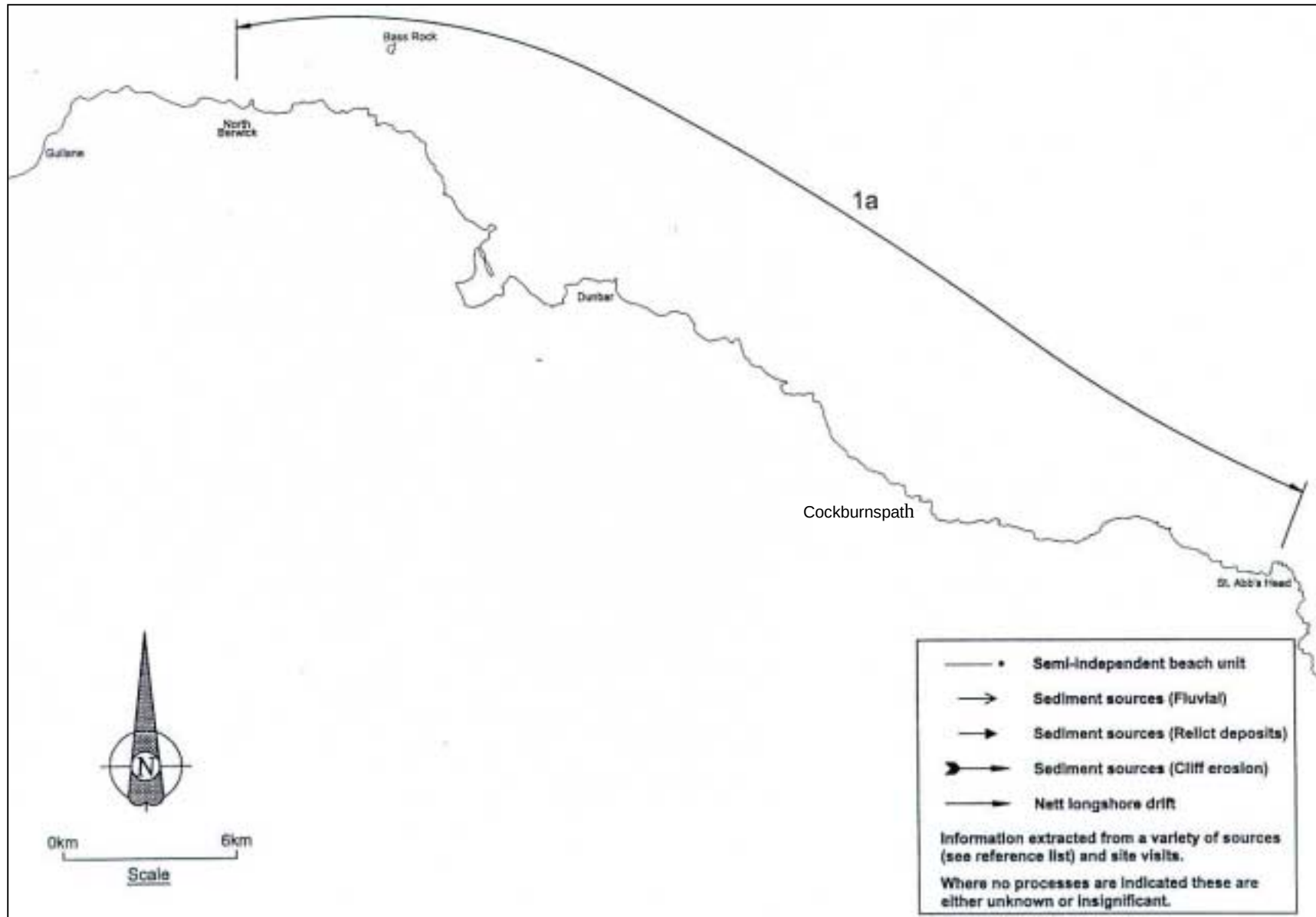


Figure 4.13c – Dominant littoral processes between North Berwick and Cockburnspath and adjacent coastline of the East Lothian region (Ramsay and Brampton, 2000). NB. 1a indicates a sub-cell according to 'coastal cells' concept.

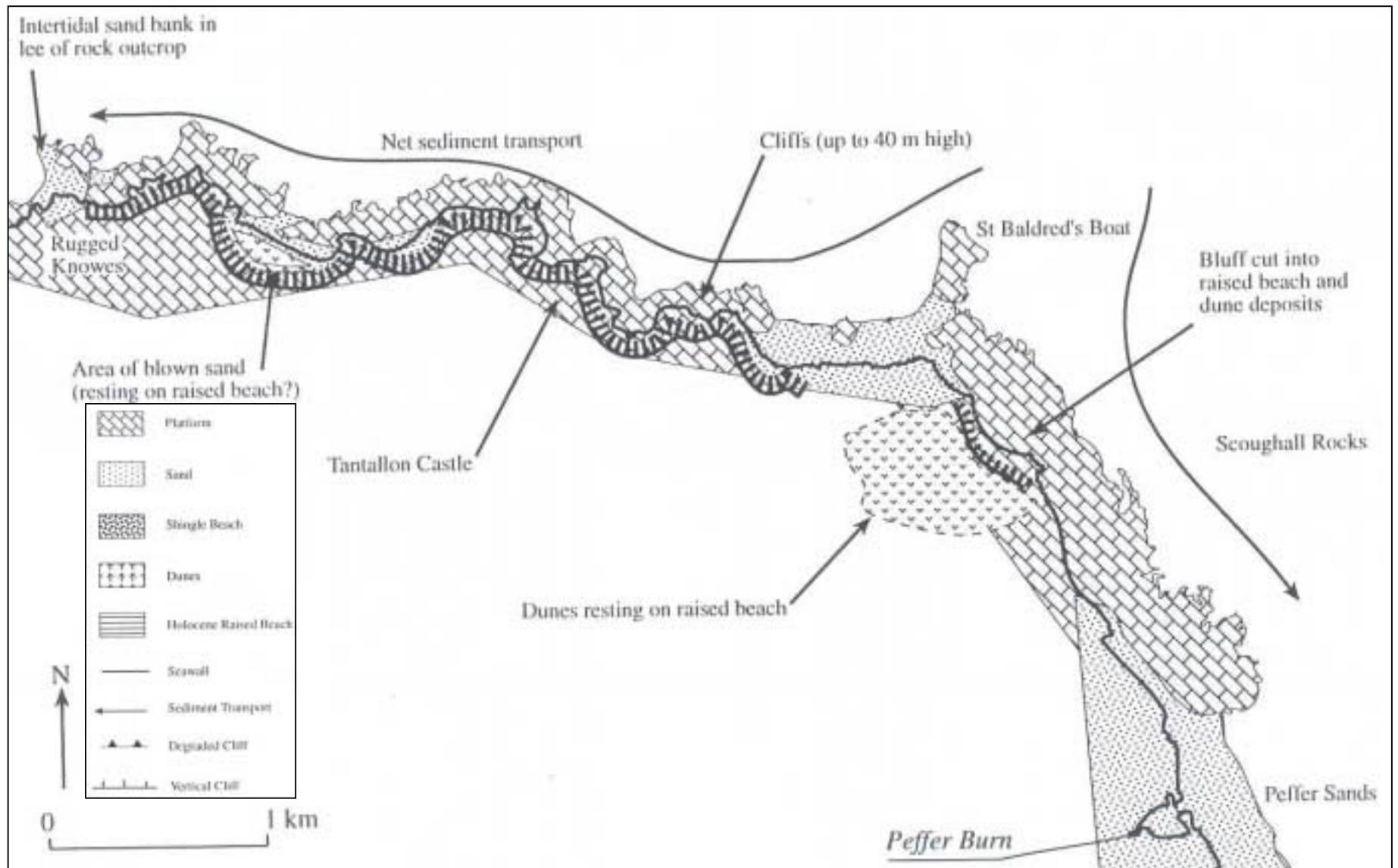


Figure 4.13d – Landforms and proposed sediment transport divergence at St. Baldred's Boat in the East Lothian region (Firth *et al.*, 1995).

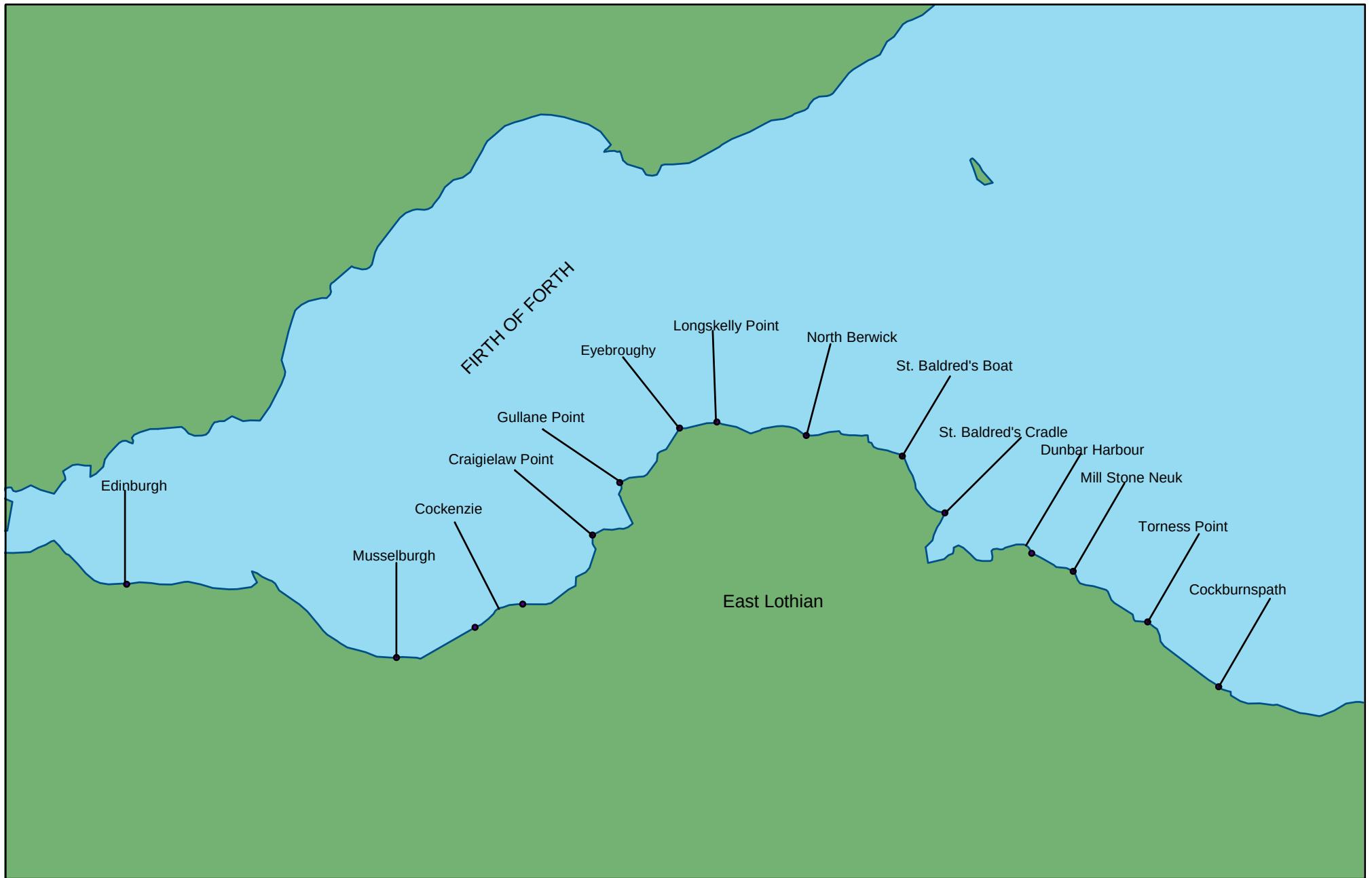


Figure 4.14 Simplified map of the East Lothian region showing coastal process unit boundaries

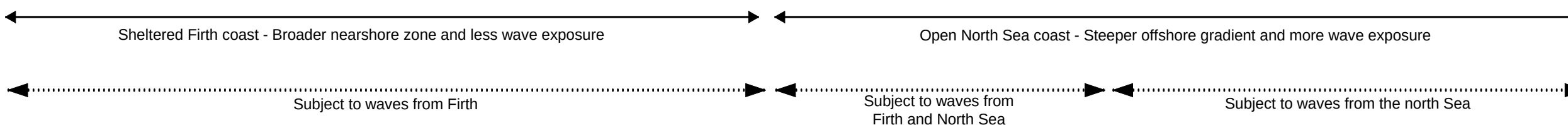
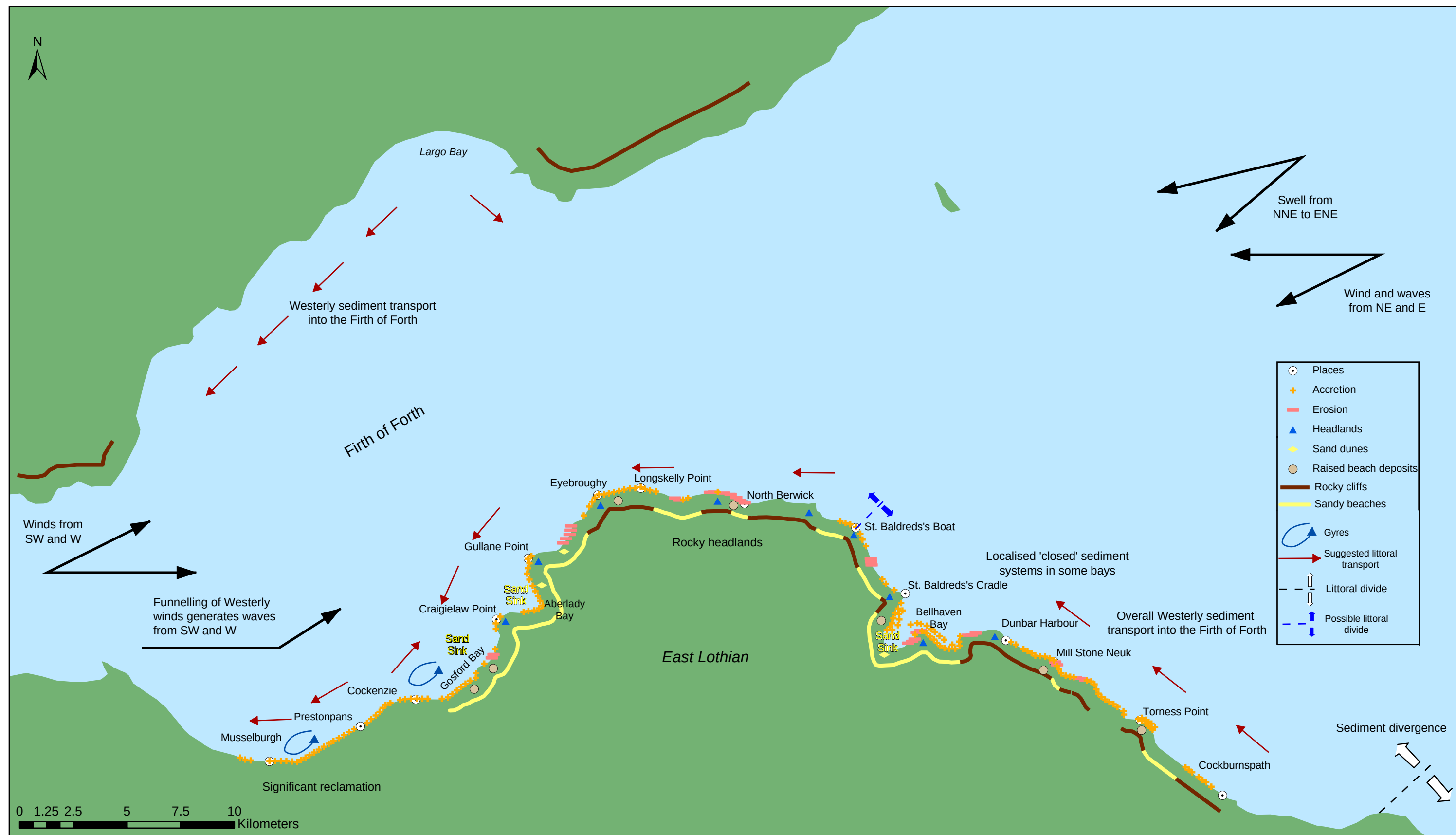
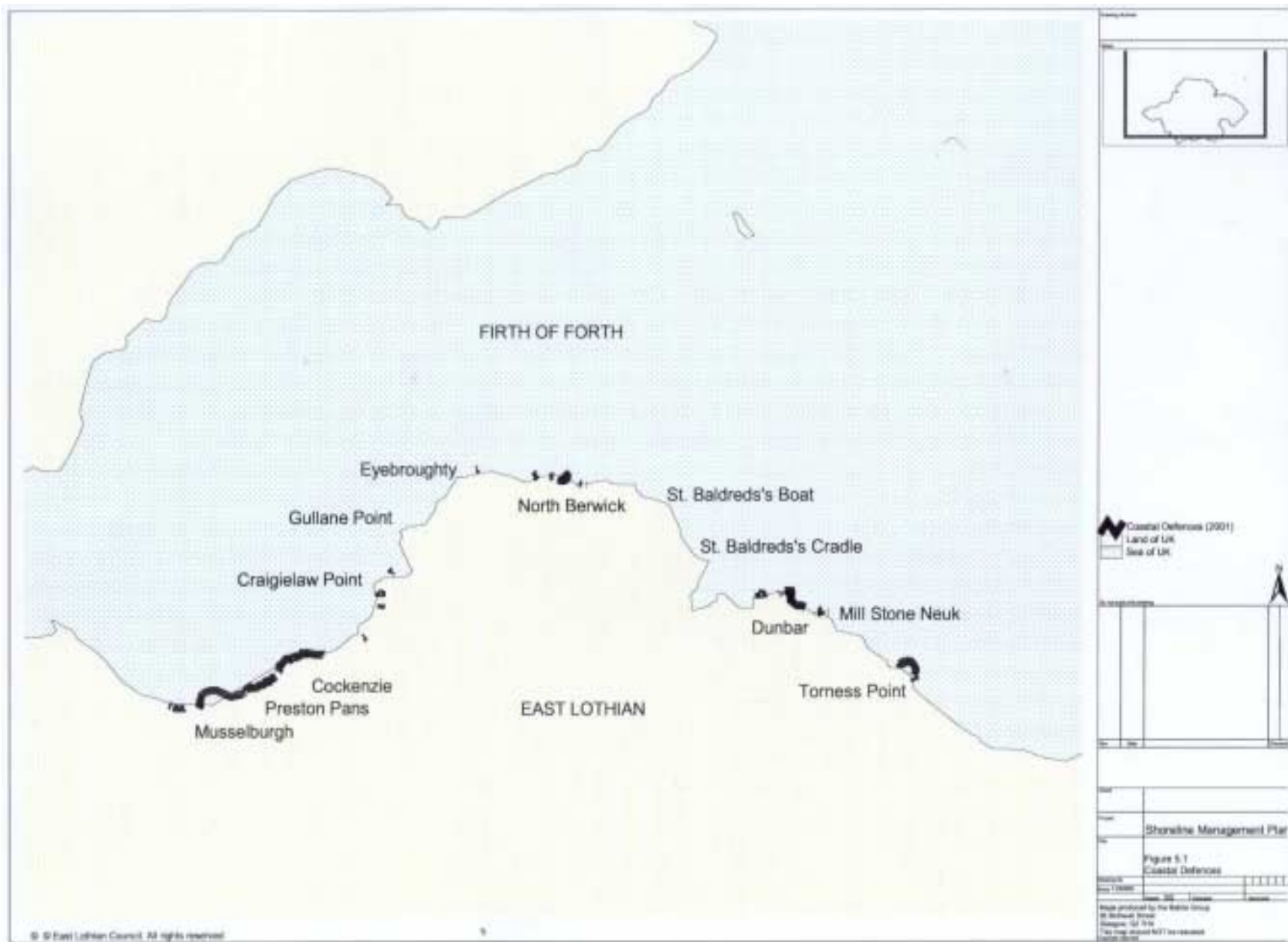
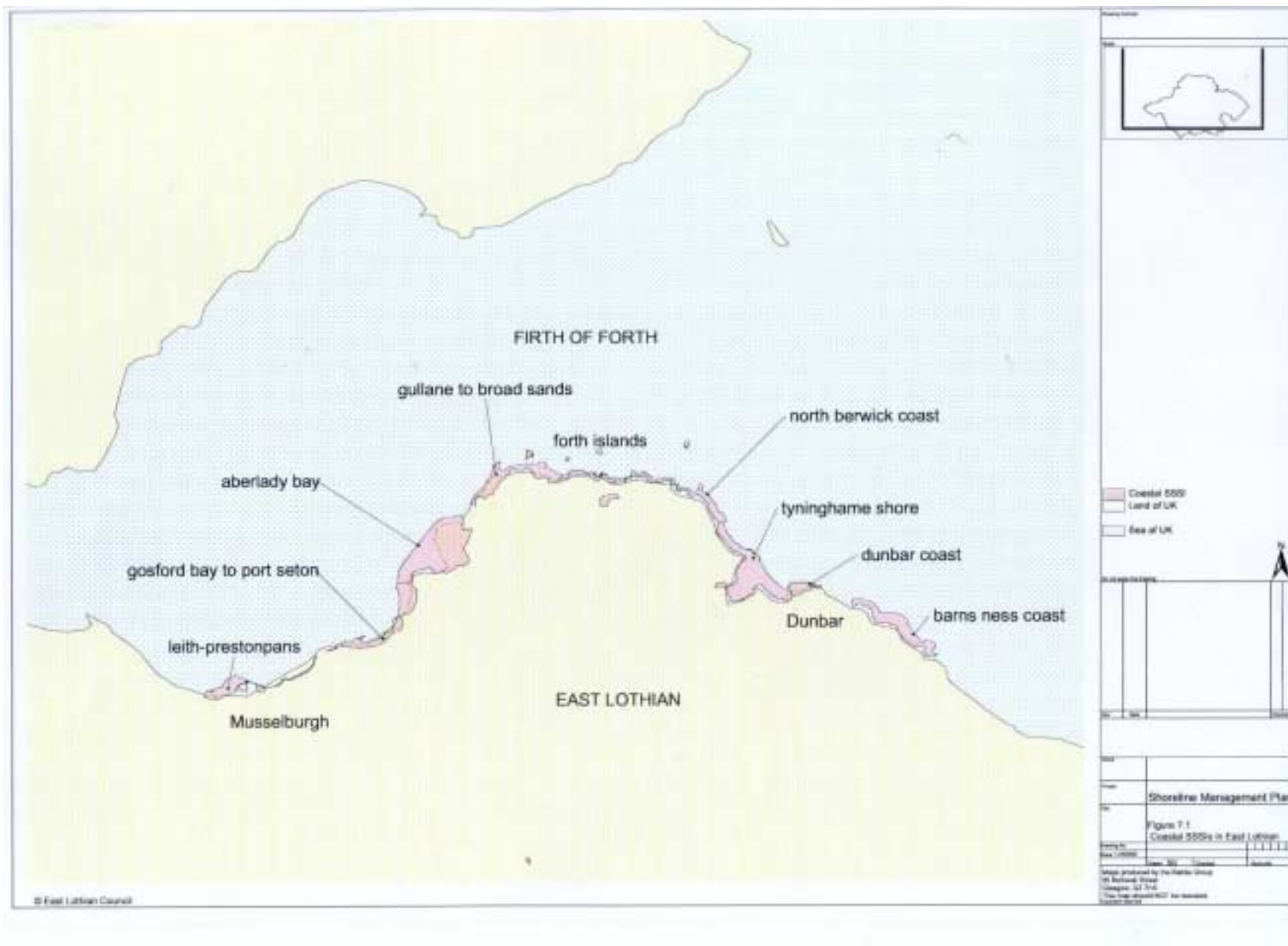
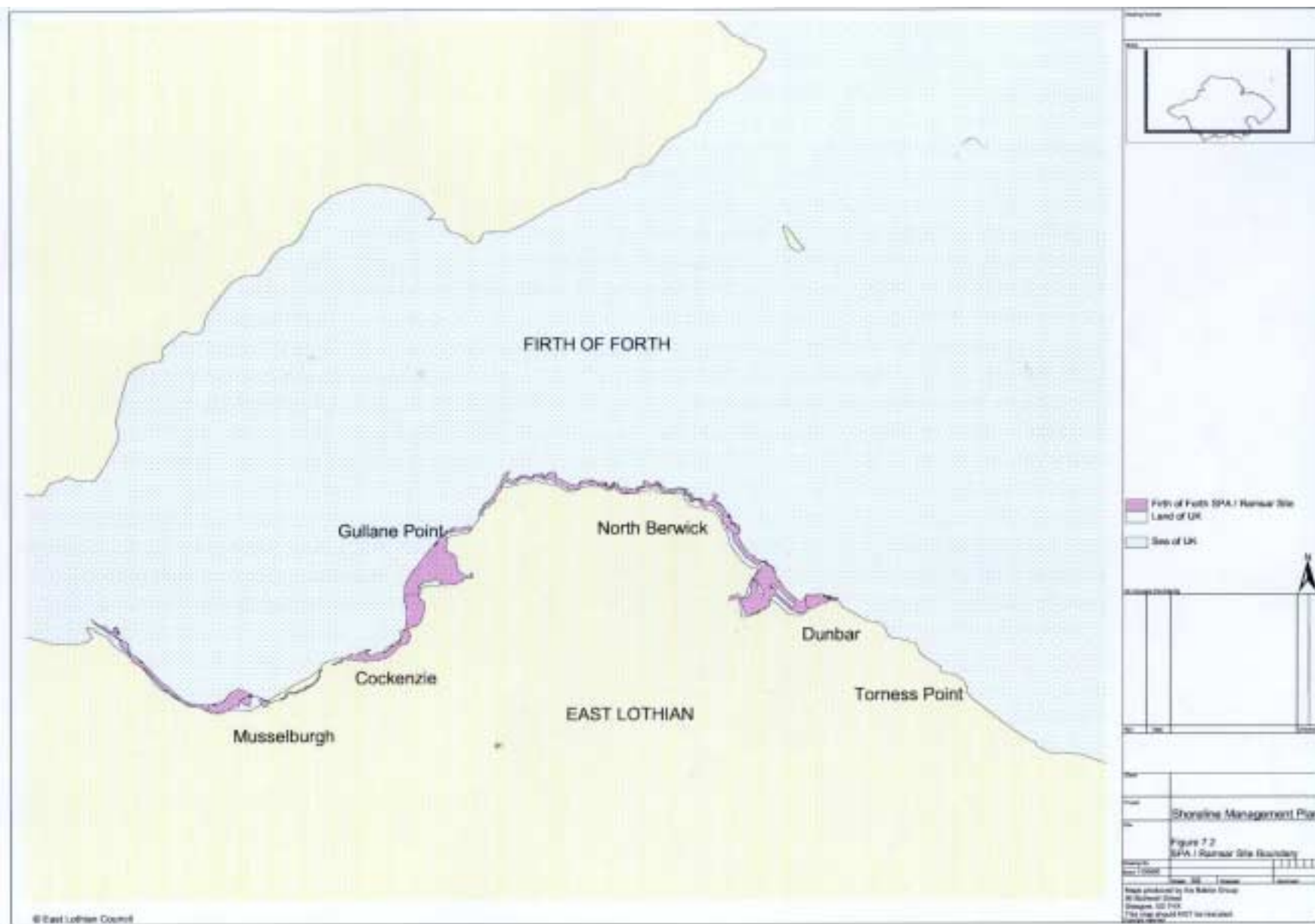


Figure 4.15 Conceptual model of the East Lothian study area to illustrate major features and processes

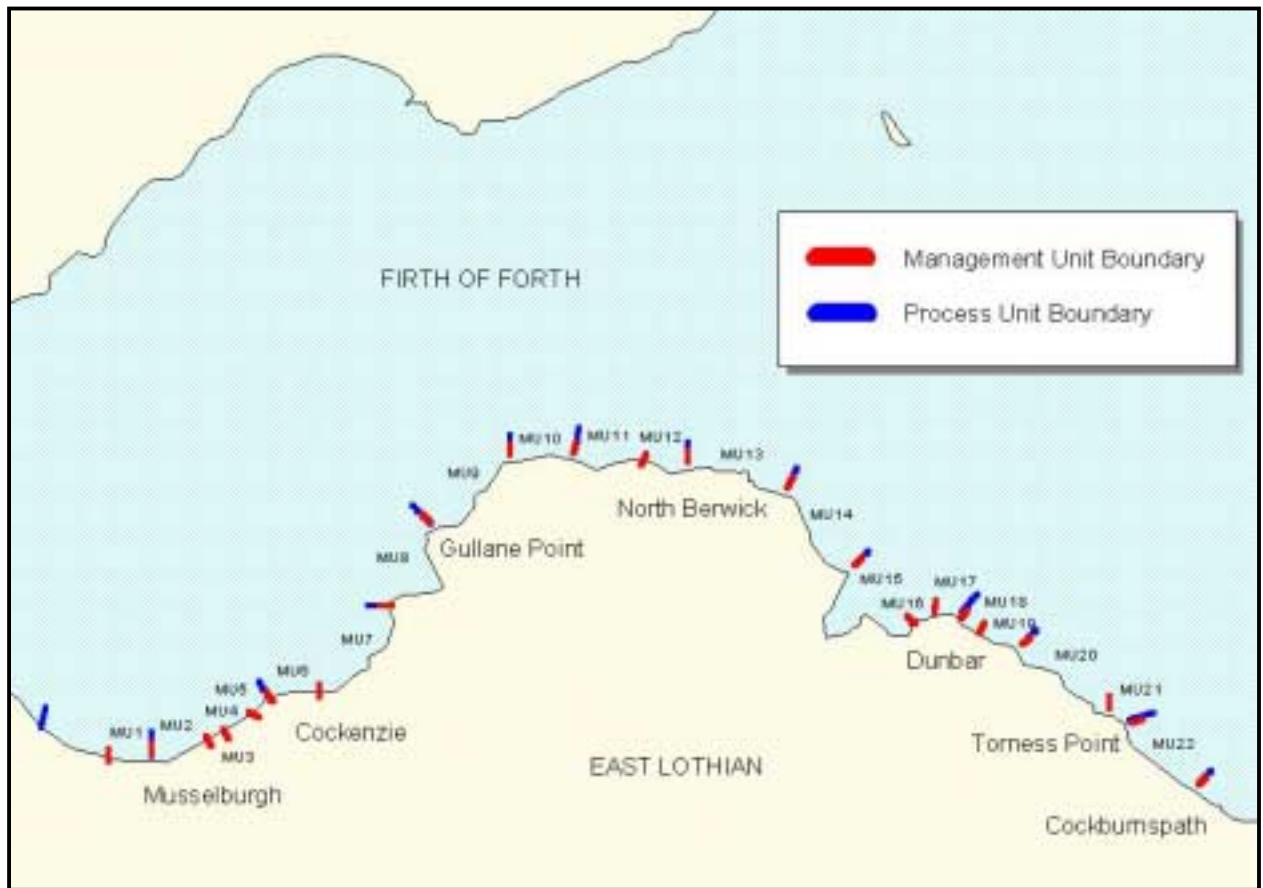












**Figure 9.1 Management Units on the East Lothian Shoreline**

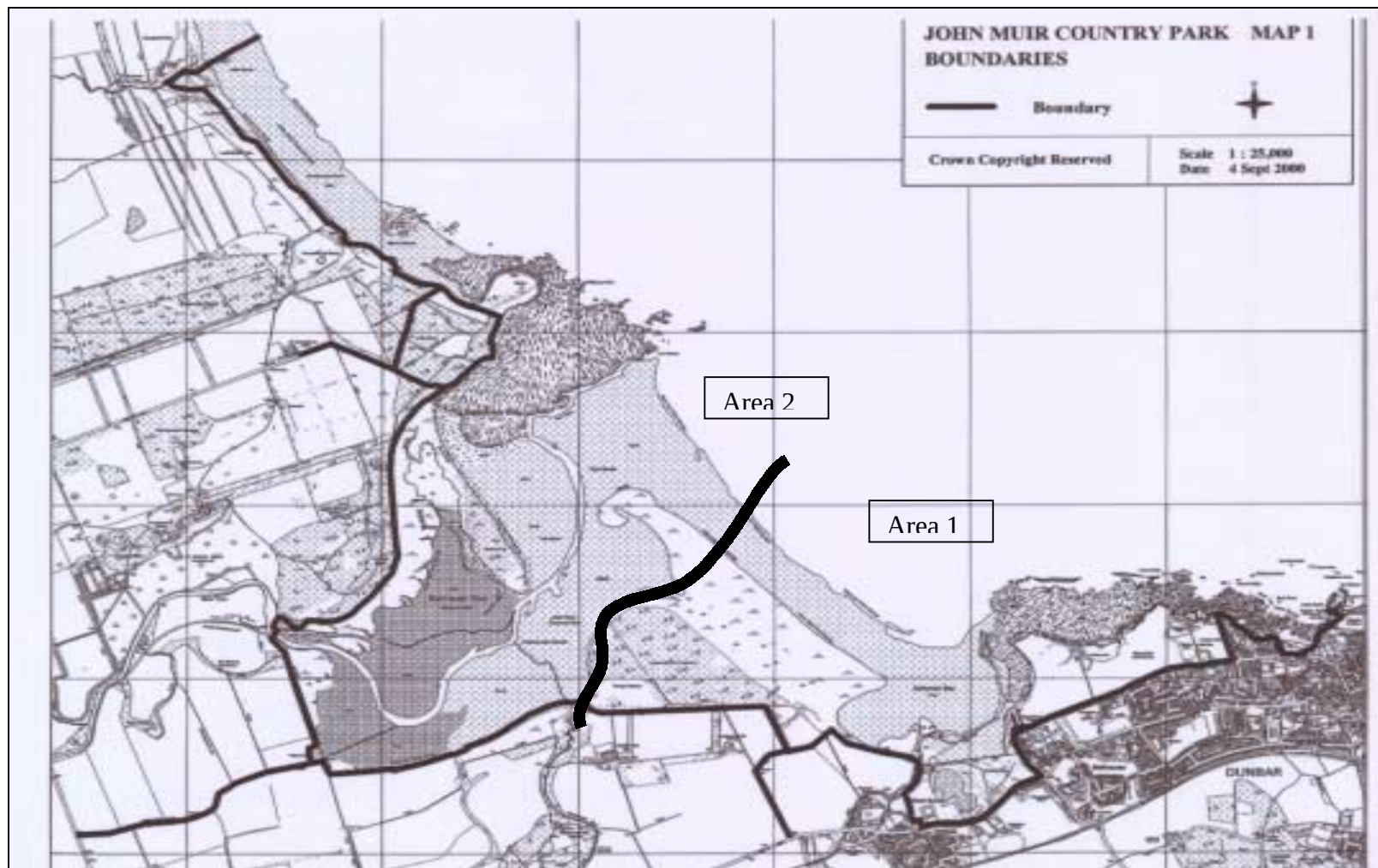


Figure 9.5 – John Muir Country Park Boundaries (source: East Lothian Council 2000)

## **Plates**

**East Lothian Council**  
**Shoreline Management Plan**

Final Report

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Plate 9.1 Defence No. 1 Rock Armour east of Burnstane Burn



Plate 9.2 Defence No. 2 Concrete Seawall at Fisherrow Sands





Plate 9.3 Defence No 6  
Fisherrow Promenade Wall



Plate 9.4 Defence No 7 Mouth of River Esk River Defences



Plate 9.5 Defence No 8 Ash Lagoons



Plate 9.6 Defence No 10 Gabions at the Cast (Good Condition)





Plate 9.7 Defence No 10 Eroded Gabions at the Cast (Poor Condition)



Plate 9.8 Defence No 11  
Prestonpans Walkway and  
Coastal Defence





Plate 9.9 Defence No 18  
Cockenzie Shoreline  
(NT400758)



Plate 9.10 Defence No 18 Cockenzie Shoreline (NT402758)



Plate 9.11 Defence No 19 Port Seton Harbour (head of harbour)



Plate 9.12 Defence No 19  
Port Seton Harbour  
(concreting)



Plate 9.13 Defence No 20  
Port Seton Shoreline (new  
housing development)



Plate 9.14 Defence No 21 Port Seton Promenade





Plate 9.15 Defence No 22 Easterly extent of Port Seton



Plate 9.16 Defence No 23 Aberlady to Longniddry Coast Road (Longniddry)



Plate 9.17 Defence No 24 Aberlady to Longniddry Coast Road (Gosford House)



Plate 9.18 Shingle Beach, composed of basaltic gravels at Marine Villa, Archerfield





Plate 9.19 Defence No 28 North Berwick West Links Golf Course (High Embankment)



Plate 9.20 Defence No 29 North Berwick West Links Golf Course (Timber Revetment)



Plate 9.21 North Berwick West Links Golf Course (Erosion and rubble)



Plate 9.22 Defence No 30 North Berwick Bay, Timber Wall



Plate 9.23 Defence No 32 North Berwick Bay, Low masonry wall



Plate 9.24 Defence No 33 North Berwick Harbour





Plate 9.25 Defence No 33  
North Berwick Harbour  
(Repairs to outer wall)



Plate 9.26 Defence No 38 North Berwick East Links (Dune Erosion)



Plate 9.27 Defence No 39 Winterfield Golf Course, Gabions



Plate 9.28 Defence No 40 Winterfield Golf Course, Anti-tank defences



Plate 9.29 Defence No 41 Winterfield Golf Course, Old Masonry seawall



Plate 9.30 Defence No 43  
Dunbar Cliff-top trail,  
Gabions





Plate 9.31 Defence No 46 Dunbar, Victoria Harbour



Plate 9.32 Defence No 46  
Dunbar, Victoria Harbour,  
undercutting of path



Plate 9.33 Defence No 46 Dunbar, Old Harbour



Plate 9.34 Slip way from Dunbar East Beach to the Old Harbour



Plate 9.35 Defence No 47 Dunbar East Beach, Lamer Street Steps



Plate 9.36 Defence No 47 Dunbar East Beach, Scoured hole at base of wall



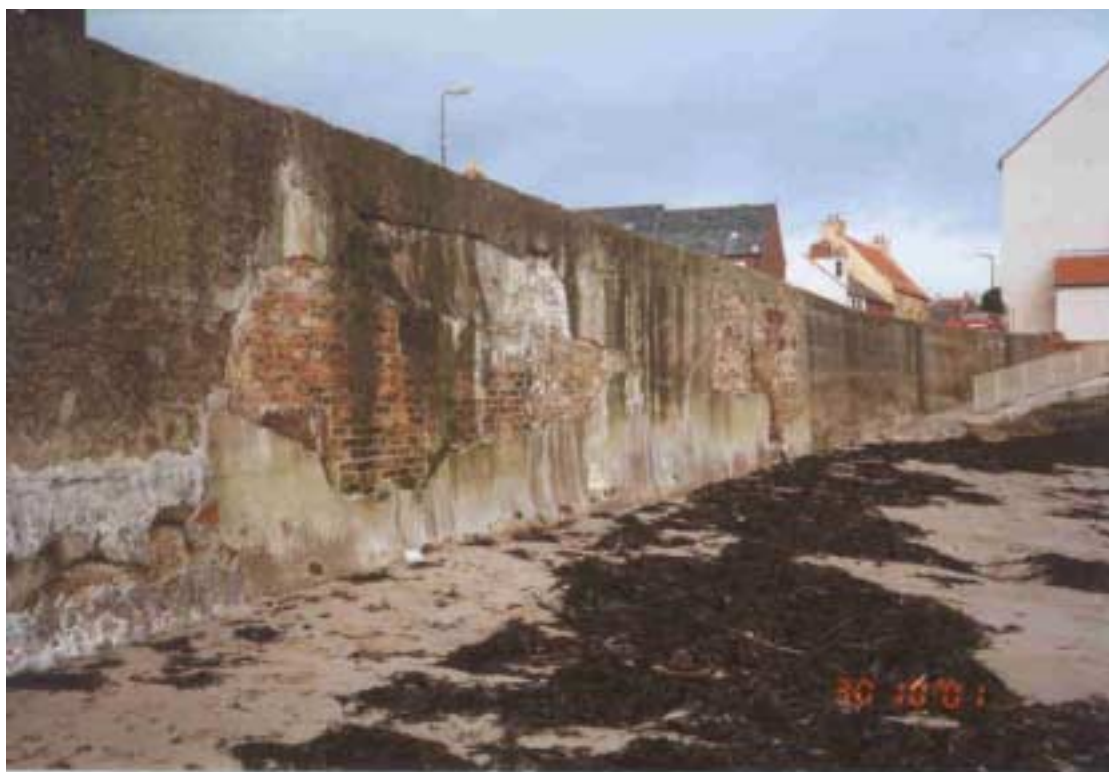


Plate 9.37 Defence No 47 Dunbar East Beach, Lamer Street Wall



Plate 9.38 Defence No 48 Dilapidated Groyne (Dunbar East Beach)



Plate 9.39 Defence No 51 Dunbar East Beach, Garden walls in need of repair



Plate 9.40 Defence No 51 Dunbar East Beach, Masonry wall at new flat development





Plate 9.41 Defence No 56 Dunbar Golf Club East Links Rock Armour



Plate 9.42 Defence No 58 Torness Power Station (Concrete Embankment protected by rock revetment)



Plate 9.43 Defence No 58 Torness Power Station (Concrete Embankment protected by tetrapods)



Plate 9.44 Defence No 60 Thorntonloch Caravan Park

## Appendix A: Written Consultation

**East Lothian Council**  
**Shoreline Management Plan**

Final Report

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**East Lothian Shoreline Management Plan:  
Consultation Letter to Local Organisations**

4 April 2001

Dear Sirs

**East Lothian Council  
Shoreline Management Plan**

In recent years coastal erosion has become a significant issue in some parts of Scotland. However, the effects of coastal defence measures or protection in one stretch of coastline can have significant implications elsewhere (e.g. increased coastline erosion, inland flooding, property damage, loss of natural habitats). East Lothian Council has recently commissioned the Babbie Group to develop a Shoreline Management Plan (SMP) for the East Lothian Coast. The SMP shall help conserve the coastline and contribute towards the future development of coastal management strategy.

As a first step in this study we are inviting a wide range of local organisations with known or potential interests in the coastline to a series of meetings to be held in April and May. The appendix sheet attached gives further information regarding the SMP process.

Accordingly, we invite you and your members to attend one of these meetings. A list of times, dates and venues is attached. Please feel free to invite others who you feel may have an interest in the study and do not hesitate to get in touch if you would like further information.

We thank you in anticipation of your assistance and look forward to your contribution to this important study.

Yours faithfully

Dr Yusuf Kaya  
Technical Director

Enc  
JBC

## **East Lothian Shoreline Management Plan: Consultation Letter to National Organisations**

4 April 2001

Dear Sirs

### **East Lothian Council Shoreline Management Plan**

In recent years coastal erosion has become a significant issue in some parts of Scotland. Shoreline management plans (SMP) provide an overview of what action is required to protect the coast. East Lothian Council has recently commissioned the Babbie Group to develop a Shoreline Management Plan for the East Lothian coast to:

- help conserve the coastline and contribute towards the future development of coastal management strategy;
- co-ordinate and facilitate coastal defence action in East Lothian;
- improve understanding of the coastal processes;
- identify the need for site specific research and investigations;
- facilitate consultation between those bodies with an interest in the coastline;
- identify important activities and uses associated with the coast and its environs;
- highlight opportunities for maintaining and enhancing the natural environment of the coast;
- consider the importance of alternative means of dealing with coastal erosion.

It is important that the SMP takes full account of natural processes and human and other environmental influences and needs.

There are a number of required stages involved in the preparation of an agreed strategy for shoreline management. The first stage is to collect and collate all relevant data that exists with regard to the shoreline, encompassing engineering, scientific, environmental and planning aspects. As part of this stage, all relevant groups and organisations with an interest in the coastline have been identified and will be contacted so that their views, ideas and requirements may be taken into account.

In the second stage, the SMP itself will be formulated. This involves additional research to obtain existing data, and additional consultations to discuss and, eventually, approve a draft SMP document. In preparing the plan, four key issues will be addressed as follows:

- (i) **Coastal Processes**, including consideration of the historical evolution of the coastline, collection of relevant coastal information for waves, tides and sediment transport. A prediction of the future evolution of the coastline will also be undertaken as well as an assessment of local geology/geomorphology and its influence on the coastal regime.
- (ii) **Coastal Defences**, the current defences along the coast, their effectiveness, current condition and life expectancy will be evaluated.
- (iii) **Land Use and the Human and Built Environment**; including planning policy guidance for the coastal zone, users of the coastline and conflicts arising from such uses.
- (iv) **Natural Environment**, including designated areas of importance under National and EC legislation and identification of the impacts of coastal defences upon habitats and species.

As a first step in this study, we would appreciate your written response providing us with details of any areas of interest you may have, identifying any key issues relevant to the study area and the SMP. For your information we enclose a plan of our study area which can be marked up and returned with any details you consider relevant.

We thank you in anticipation of your assistance and look forward to your contribution to this important study.

Yours faithfully

Dr Yusuf Kaya  
Technical Director

Enc

JBC

**East Lothian Shoreline Management Plan:  
Consultation Letter to Public Organisations**

4 April 2001

Dear Sirs

**East Lothian Council  
Shoreline Management Plan**

**Do you have an interest in what happens to the East Lothian Coastline?**

In recent years coastal erosion has become a significant issue in some parts of Scotland. However, the effects of coastal defence measures or protection in one stretch of coastline can have significant implications elsewhere (e.g. increased coastline erosion, inland flooding). Therefore, we need you the public to help contribute opinions and local knowledge on this issue. After all, its your shoreline and we all need it to be managed well, so come and have your say!

Accordingly, we invite you to attend one of the open public meetings listed in the attached invite sheet. Please feel free to invite others who you feel may have an interest in the study (e.g. family, friends or associates) and do not hesitate to get in touch if you would like further information. With your help, East Lothian Council, in association with the Babbie Group, aim to develop a Shoreline Management Plan (SMP) that shall help conserve the coastline and contribute towards the future development of coastal management strategy.

We thank you in anticipation of your assistance and look forward to your contribution to this important study.

Yours faithfully

Dr Yusuf Kaya  
Technical Director

Enc

JBC



## The SMP Process

The aim of the East Lothian Shoreline Management Plan (SMP) is to:

- help conserve the coastline and contribute towards the future development of coastal management strategy;
- co-ordinate and facilitate coastal defence action in East Lothian;
- improve understanding of the coastal processes;
- identify the need for site specific research and investigations;
- facilitate consultation between those bodies with an interest in the coastline;
- identify important activities and uses associated with the coast and its environs;
- highlight opportunities for maintaining and enhancing the natural environment of the coast;
- consider the importance of alternative means of dealing with coastal erosion.

It is important that the SMP takes full account of natural processes and human and other environmental influences and needs.

There are a number of required stages in order that this document fulfills its role as an agreed strategy for shoreline management. The first stage is to collect and collate all relevant data that exists with regard to the shoreline, encompassing engineering, scientific, environmental and planning aspects. As part of this stage, all relevant groups and organisations with an interest in the coastline are identified and contacted in order that their views, ideas and requirements may be taken into account.

In the second stage, the SMP itself will be formulated and this involves additional research to obtain existing data, and additional consultations to discuss and, eventually, approve a draft SMP document. In preparing the plan, four key issues will be addressed as follows:

- (i) Coastal Processes, including consideration of the historical evolution of the coastline, collection of relevant coastal information for waves, tides and sediment transport. A prediction of the future evolution of the coastline will also be undertaken as well as an assessment of local geology/geomorphology and its influence on the coastal regime.
- (ii) Coastal Defences, the current defences along the coast, their effectiveness, current condition and life expectancy will be evaluated.
- (iii) Land Use and the Human and Built Environment, including planning policy guidance for the coastal zone, users of the coastline and conflicts arising from such uses.
- (iv) Natural Environment, including designated areas of importance under National and EC legislation and identification of the impacts of coastal defences upon habitats and species.

Once all essential data has been collected, the coastline will be divided into 'Management Units'. These management Units (MUs) are defined according to landuse and geomorphology. The coastal defence options for each of the MUs will then be considered following consultation on the preferred strategic coastal defence options. Consultation will aim to identify all of the potential implications and consequences of the defence options for the MUs.

The strategic coastal defence options will include the following:

- Do nothing;
- Hold the existing defence line by maintaining or changing the standard/type of protection;
- Advance the existing defence line; and
- Retreat the existing defence line.

Once completed, the SMP will detail the preferred coastal defence option for each management unit within the coastal sub-cell (sediment sub-cell).

## **East Lothian Shoreline Management Plan Mussleburgh to Dunbar**

### **Invitation to Open Meeting**

You are invited to attend one of the meetings to be held as part of the consultation process for the East Lothian Shoreline Management Plan. Meetings will be held on the dates indicated at the six venues listed below. Afternoon meetings start at 1:30pm and finish at 3:30pm, and evening meetings start at 7:00pm and finish at 9:00pm.

Please note: you are requested to attend only one of the meetings.

| <b>Date</b> | <b>Venue</b>                                      |
|-------------|---------------------------------------------------|
| April 18    | The Ship Inn, 184 North High Street, Musselburgh. |
| April 19    | The Old Ship Inn Hotel, 40 Links Road, Port Seton |
| May 2       | Longniddry Inn, Main Street, Longniddry           |
| May 3       | The Golf Inn, Main Street, Gullane                |
| May 9       | Auld House, 19 Forth Street, North Berwick        |
| May 10      | Craig-en-Gelt Hotel, Marine Road, Dunbar          |

Yours faithfully

Dr Yusuf Kaya  
Technical Director

## Appendix B: Public Consultation

## Appendix B: Public Consultation

### Appendix B: Summary Analysis of SPI Public Consultations

| Page |                                       |                    |
|------|---------------------------------------|--------------------|
| 3    | Musselburgh                           | Concerns           |
| 4    | Musselburgh                           | Positives          |
| 5    | Musselburgh                           | Improvements       |
| 6    | Musselburgh                           | Trends and Changes |
| 7    | Prestonpans, Cockenzie and Port Seton | Concerns           |
| 8    | Prestonpans, Cockenzie and Port Seton | Positives          |
| 9    | Prestonpans, Cockenzie and Port Seton | Improvements       |
| 10   | Prestonpans, Cockenzie and Port Seton | Trends and Changes |
| 11   | Longniddry                            | Concerns           |
| 12   | Longniddry                            | Positives          |
| 13   | Longniddry                            | Improvements       |
| 14   | Longniddry                            | Trends and Changes |
| 15   | Gullane                               | Concerns           |
| 16   | Gullane                               | Positives          |
| 17   | Gullane                               | Improvements       |
| 18   | Gullane                               | Trends and Changes |
| 19   | North Berwick                         | Concerns           |
| 20   | North Berwick                         | Positives          |
| 21   | North Berwick                         | Improvements       |
| 22   | North Berwick                         | Trends and Changes |
| 23   | Dunbar                                | Concerns           |
| 24   | Dunbar                                | Positives          |
| 25   | Dunbar                                | Improvements       |
| 26   | Dunbar                                | Trends and Changes |
| 27   | East of Dunbar                        | Concerns           |
|      |                                       | Positives          |
|      |                                       | Improvements       |
|      |                                       | Trends and Changes |

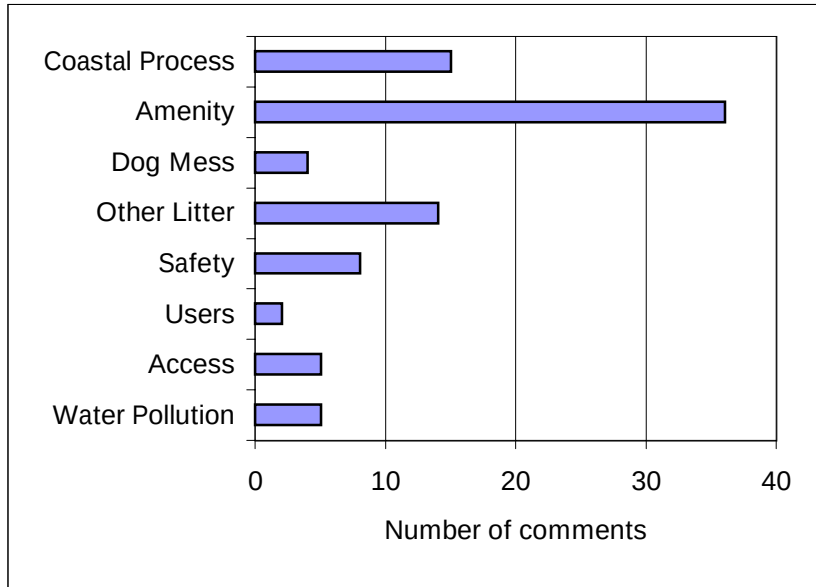
## **Appendix B: Public Consultation**

Appendix B: Summary Analysis of SPI Public Consultations

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## Appendix B: Public Consultation

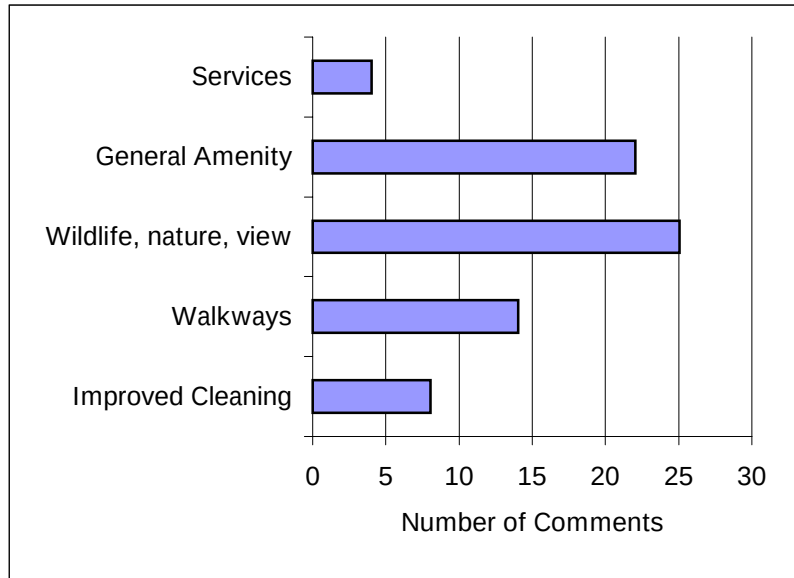
### Musselburgh Concerns



|                   | Coastal Process | Amenity   | Dog Mess | Other Litter | Safety   | Users    | Access   | Water Pollution | Total     |
|-------------------|-----------------|-----------|----------|--------------|----------|----------|----------|-----------------|-----------|
| Cockenzie Harbour | 0               | 0         | 0        | 1            | 0        | 0        | 0        | 0               | 1         |
| Cuthill Rock      | 1               | 1         | 0        | 0            | 0        | 1        | 0        | 1               | 4         |
| Fisherrow         | 4               | 18        | 4        | 8            | 3        | 0        | 0        | 2               | 39        |
| Fisherrow Sands   | 3               | 1         | 0        | 1            | 0        | 0        | 0        | 1               | 6         |
| General           | 0               | 5         | 0        | 1            | 0        | 0        | 0        | 0               | 6         |
| Harbour           | 3               | 5         | 0        | 0            | 2        | 0        | 0        | 1               | 11        |
| Lagoons           | 1               | 3         | 0        | 2            | 2        | 1        | 5        | 0               | 14        |
| Preston Grange    | 1               | 2         | 0        | 0            | 0        | 0        | 0        | 0               | 3         |
| River             | 2               | 1         | 0        | 1            | 1        | 0        | 0        | 0               | 5         |
| <b>TOTAL</b>      | <b>15</b>       | <b>36</b> | <b>4</b> | <b>14</b>    | <b>8</b> | <b>2</b> | <b>5</b> | <b>5</b>        | <b>89</b> |

## Appendix B: Public Consultation

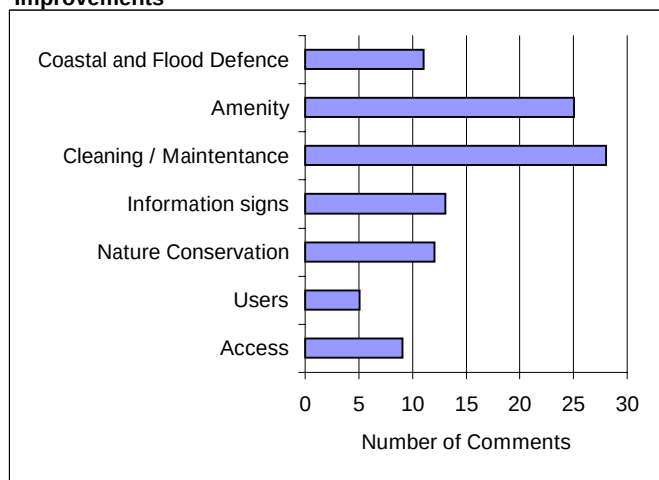
### Musselburgh Positives



|                 | Services | General Amenity | Wildlife, nature, view | Walkways  | Improved Cleaning | Total     |
|-----------------|----------|-----------------|------------------------|-----------|-------------------|-----------|
| Cuthill Rock    | 0        | 0               | 0                      | 1         | 2                 | 3         |
| Fisherrow       | 2        | 10              | 8                      | 3         | 2                 | 25        |
| Fisherrow Sands | 0        | 0               | 2                      | 0         | 0                 | 2         |
| General         | 0        | 2               | 3                      | 1         | 1                 | 7         |
| Harbour         | 1        | 4               | 2                      | 0         | 1                 | 8         |
| Lagoons         | 0        | 2               | 7                      | 5         | 1                 | 15        |
| Leverhall       | 0        | 0               | 1                      | 0         | 0                 | 1         |
| Preston Grange  | 0        | 1               | 0                      | 0         | 0                 | 1         |
| River           | 1        | 3               | 2                      | 4         | 1                 | 11        |
| <b>TOTAL</b>    | <b>4</b> | <b>22</b>       | <b>25</b>              | <b>14</b> | <b>8</b>          | <b>73</b> |

## Appendix B: Public Consultation

### Musselburgh Improvements

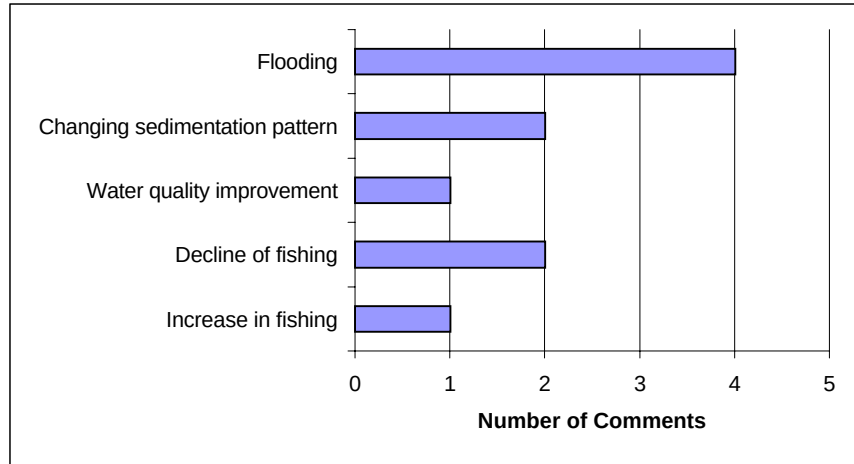


|                 | Coastal and Flood Defence | Amenity   | Cleaning / Maintenance | Information signs | Nature Conservation | Users    | Access   | Total      |
|-----------------|---------------------------|-----------|------------------------|-------------------|---------------------|----------|----------|------------|
| Fisherrow       | 5                         | 7         | 7                      | 0                 | 0                   | 1        | 4        | 24         |
| Fisherrow Sands | 2                         | 2         | 12                     | 0                 | 0                   | 0        | 1        | 17         |
| General         | 1                         | 8         | 8                      | 7                 | 9                   | 2        | 2        | 37         |
| Harbour         | 2                         | 4         | 0                      | 2                 | 0                   | 0        | 0        | 8          |
| Joppa           | 0                         | 0         | 1                      | 0                 | 0                   | 0        | 0        | 1          |
| Lagoons         | 0                         | 2         | 0                      | 1                 | 2                   | 1        | 1        | 7          |
| Leverhall       | 0                         | 0         | 0                      | 2                 | 0                   | 0        | 0        | 2          |
| Leverhall Links | 0                         | 1         | 0                      | 0                 | 1                   | 1        | 1        | 4          |
| River           | 1                         | 1         | 0                      | 1                 | 0                   | 0        | 0        | 3          |
| <b>TOTAL</b>    | <b>11</b>                 | <b>25</b> | <b>28</b>              | <b>13</b>         | <b>12</b>           | <b>5</b> | <b>9</b> | <b>103</b> |



## Appendix B: Public Consultation

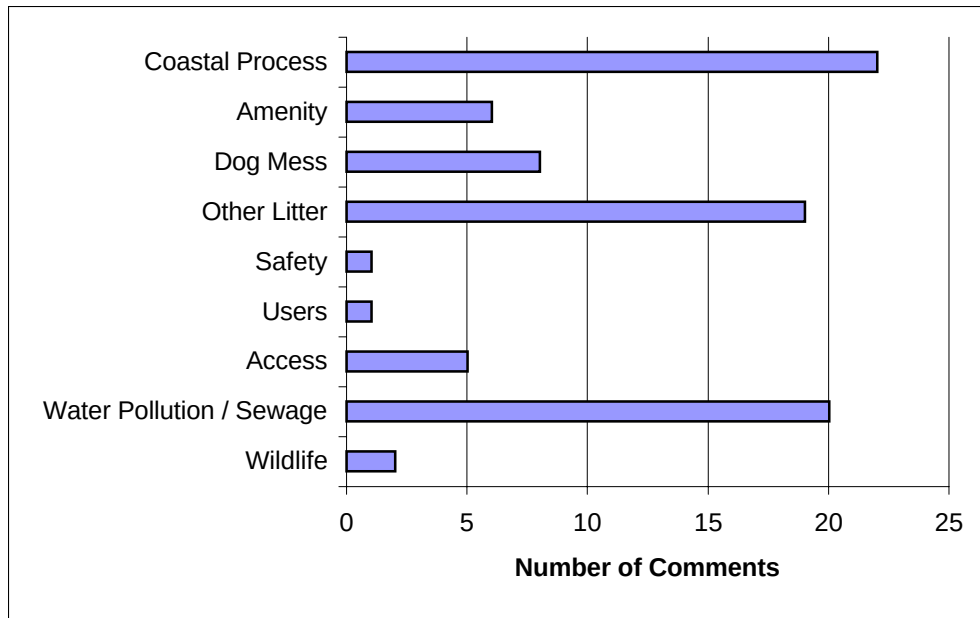
### Musselburgh Trends and Changes



|                 | Flooding | Changing sedimentation pattern | Water quality improvement | Decline of fishing | Increase in fishing | Total     |
|-----------------|----------|--------------------------------|---------------------------|--------------------|---------------------|-----------|
| Fisherrow       | 1        | 0                              | 0                         | 0                  | 0                   | 1         |
| Fisherrow Sands | 0        | 1                              | 0                         | 0                  | 0                   | 1         |
| General         | 2        | 0                              | 1                         | 1                  | 1                   | 5         |
| Harbour         | 0        | 1                              | 0                         | 1                  | 0                   | 2         |
| River           | 1        | 0                              | 0                         | 0                  | 0                   | 1         |
| <b>TOTAL</b>    | <b>4</b> | <b>2</b>                       | <b>1</b>                  | <b>2</b>           | <b>1</b>            | <b>10</b> |

## Appendix B: Public Consultation

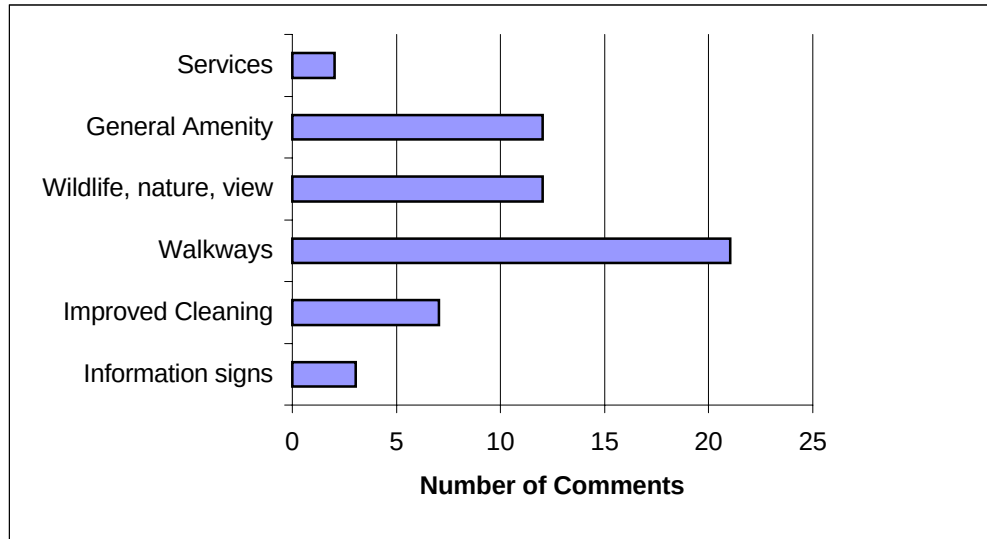
### Prestonpans, Cockenzie and Port Seton Concerns



|                       | Coastal Process | Amenity  | Dog Mess | Other Litter | Safety   | Users    | Access   | Water Pollution / Sewage | Wildlife | Total     |
|-----------------------|-----------------|----------|----------|--------------|----------|----------|----------|--------------------------|----------|-----------|
| Cockenzie& Port Seton | 5               | 1        | 0        | 5            | 0        | 0        | 2        | 7                        | 1        | 21        |
| General               | 0               | 2        | 2        | 2            | 0        | 1        | 1        | 2                        | 0        | 10        |
| Lagoons               | 1               | 1        | 0        | 0            | 0        | 0        | 0        | 3                        | 0        | 5         |
| Leverhall             | 0               | 1        | 0        | 1            | 0        | 0        | 1        | 0                        | 0        | 3         |
| Ox Rock               | 1               | 0        | 0        | 1            | 0        | 0        | 0        | 0                        | 0        | 2         |
| Power Station         | 1               | 1        | 0        | 0            | 0        | 0        | 0        | 0                        | 0        | 2         |
| Preston Grange        | 5               | 0        | 0        | 4            | 1        | 0        | 0        | 1                        | 0        | 11        |
| Prestonpans           | 4               | 0        | 4        | 1            | 0        | 0        | 1        | 2                        | 0        | 12        |
| Seton Sands           | 5               | 0        | 2        | 5            | 0        | 0        | 0        | 5                        | 1        | 18        |
| <b>Total</b>          | <b>22</b>       | <b>6</b> | <b>8</b> | <b>19</b>    | <b>1</b> | <b>1</b> | <b>5</b> | <b>20</b>                | <b>2</b> | <b>84</b> |

## Appendix B: Public Consultation

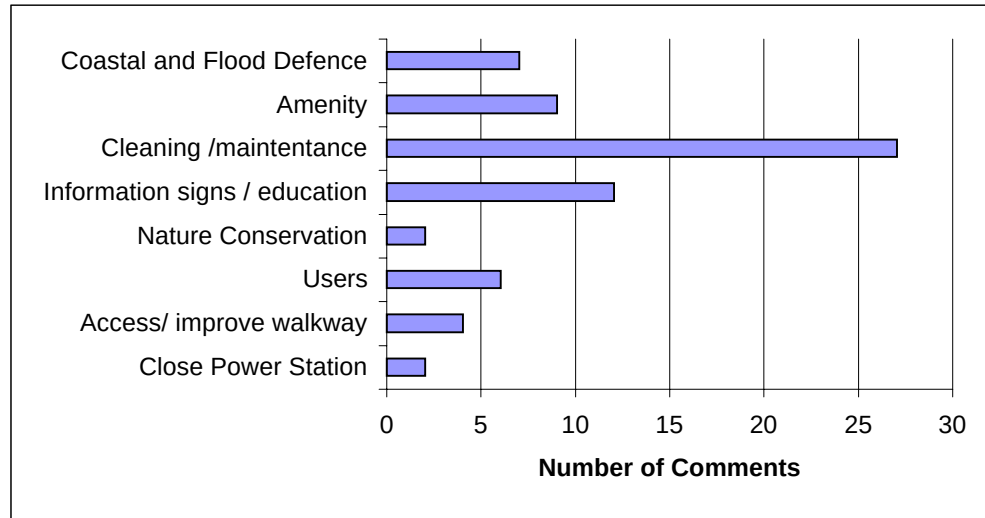
### Prestonpans, Cockenzie and Port Seton Positives



|                      | Services | General Amenity | Wildlife, nature, view | Walkways | Improved Cleaning | Information signs | Total |
|----------------------|----------|-----------------|------------------------|----------|-------------------|-------------------|-------|
| Cockenzie&Port Seton | 0        | 6               | 1                      | 4        | 1                 | 0                 | 12    |
| General              | 1        | 3               | 4                      | 4        | 3                 | 1                 | 16    |
| Lagoons              | 0        | 3               | 1                      | 5        | 0                 | 0                 | 9     |
| Power Station        | 0        | 0               | 0                      | 3        | 0                 | 0                 | 3     |
| Prestonpans          | 0        | 0               | 4                      | 5        | 0                 | 0                 | 9     |
| Seton Sands          | 0        | 0               | 1                      | 0        | 3                 | 1                 | 5     |
| Preston Grange       | 1        | 0               | 1                      | 0        | 0                 | 1                 | 3     |
| TOTAL                | 2        | 12              | 12                     | 21       | 7                 | 3                 | 57    |

## Appendix B: Public Consultation

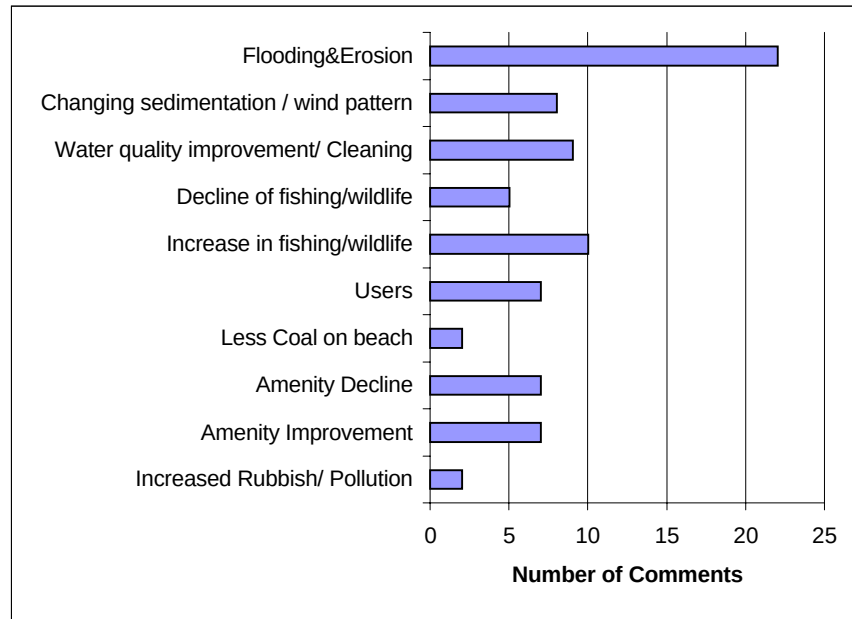
### Prestonpans, Cockenzie and Port Seton Improvements



|                       | Coastal and Flood Defence | Amenity  | Cleaning /maintenance | Information signs / education | Nature Conservation | Users    | Access/ improve walkway | Close Power Station | Total     |
|-----------------------|---------------------------|----------|-----------------------|-------------------------------|---------------------|----------|-------------------------|---------------------|-----------|
| Cockenzie& Port Seton | 2                         | 5        | 8                     | 3                             | 0                   | 2        | 2                       | 0                   | 22        |
| General               | 1                         | 0        | 6                     | 5                             | 1                   | 1        | 0                       | 0                   | 14        |
| Lagoons               | 0                         | 0        | 2                     | 1                             | 0                   | 0        | 0                       | 0                   | 3         |
| Ox Rocks              | 1                         | 0        | 1                     | 0                             | 0                   | 0        | 1                       | 0                   | 3         |
| Power Station         | 0                         | 3        | 1                     | 1                             | 0                   | 0        | 0                       | 2                   | 7         |
| Prestonpans           | 2                         | 1        | 5                     | 1                             | 0                   | 1        | 1                       | 0                   | 11        |
| Seton Sands           | 0                         | 0        | 3                     | 1                             | 1                   | 1        | 0                       | 0                   | 6         |
| Preston Grange        | 1                         | 0        | 1                     | 0                             | 0                   | 1        | 0                       | 0                   | 3         |
| <b>TOTAL</b>          | <b>7</b>                  | <b>9</b> | <b>27</b>             | <b>12</b>                     | <b>2</b>            | <b>6</b> | <b>4</b>                | <b>2</b>            | <b>69</b> |

## Appendix B: Public Consultation

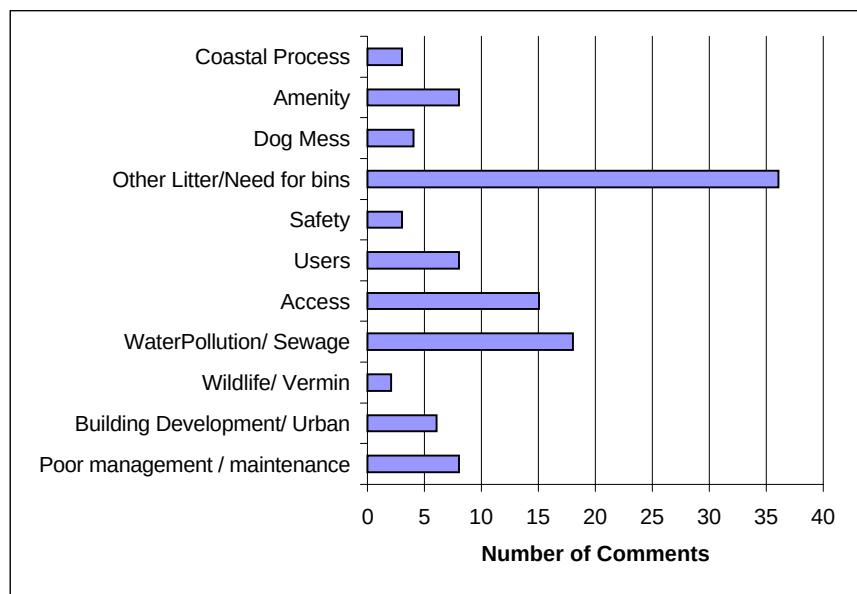
### Prestonpans, Cockenzie and Port Seton Trends and Changes



|                       | Flooding&<br>Erosion | Changing<br>sedimentation /<br>wind pattern | Water quality<br>improvement/<br>Cleaning | Decline of<br>fishing/wildlife | Increase in<br>fishing/wildlife | Users | Less Coal on<br>beach | Amenity<br>Decline | Amenity<br>Improvement | Increased<br>Rubbish/<br>Pollution |
|-----------------------|----------------------|---------------------------------------------|-------------------------------------------|--------------------------------|---------------------------------|-------|-----------------------|--------------------|------------------------|------------------------------------|
| Cockenzie& Port Seton | 2                    | 2                                           | 0                                         | 1                              | 0                               | 1     | 0                     | 5                  | 3                      | 0                                  |
| General               | 4                    | 4                                           | 6                                         | 1                              | 3                               | 3     | 0                     | 0                  | 2                      | 2                                  |
| Lagoons               | 1                    | 0                                           | 0                                         | 0                              | 0                               | 0     | 0                     | 0                  | 1                      | 0                                  |
| Ox Rocks              | 1                    | 0                                           | 0                                         | 1                              | 1                               | 1     | 0                     | 0                  | 0                      | 0                                  |
| Power Station         | 0                    | 0                                           | 0                                         | 0                              | 0                               | 1     | 0                     | 1                  | 0                      | 0                                  |
| Preston Grange        | 5                    | 1                                           | 0                                         | 1                              | 3                               | 1     | 0                     | 1                  | 0                      | 0                                  |
| Prestonpans           | 6                    | 1                                           | 2                                         | 1                              | 3                               | 0     | 1                     | 0                  | 0                      | 0                                  |
| Seton Sands           | 3                    | 0                                           | 1                                         | 0                              | 0                               | 0     | 1                     | 0                  | 1                      | 0                                  |
| TOTAL                 | 22                   | 8                                           | 9                                         | 5                              | 10                              | 7     | 2                     | 7                  | 7                      | 2                                  |

## Appendix B: Public Consultation

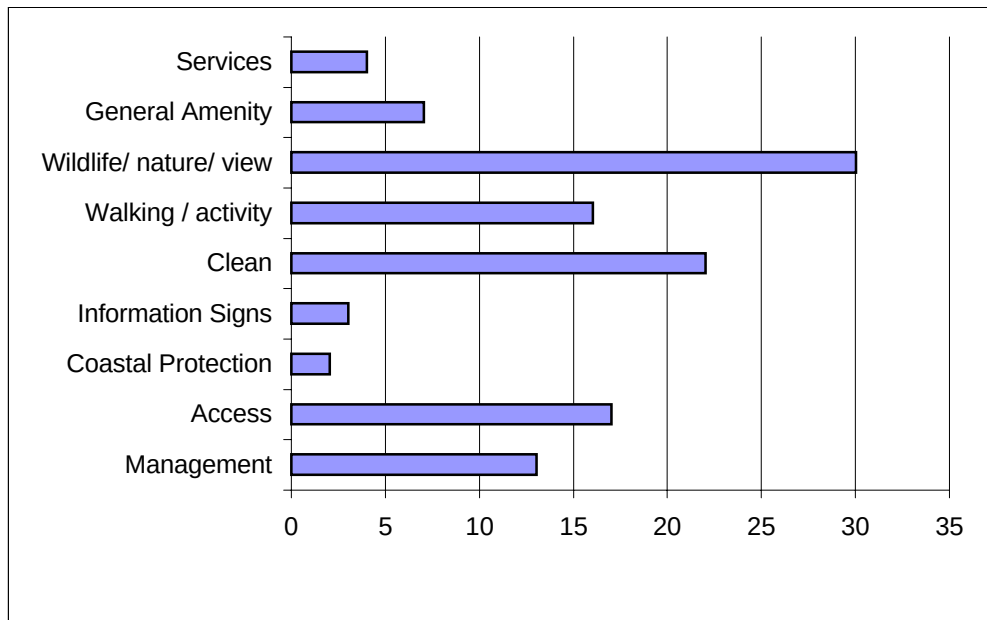
### Longniddry Concerns



|                  | Coastal Process | Amenity  | Dog Mess | Other Litter/Need for bins | Safety   | Users    | Access    | WaterPollution/ Sewage | Wildlife/ Vermin | Building Development/ Urban | Poor management / maintenance | Total      |
|------------------|-----------------|----------|----------|----------------------------|----------|----------|-----------|------------------------|------------------|-----------------------------|-------------------------------|------------|
| Aberlady Point   | 0               | 0        | 0        | 1                          | 0        | 0        | 0         | 0                      | 0                | 0                           | 0                             | 1          |
| Car Park No 1    | 0               | 1        | 0        | 3                          | 0        | 0        | 0         | 0                      | 0                | 0                           | 0                             | 4          |
| Car Park No 2    | 0               | 1        | 1        | 6                          | 1        | 3        | 1         | 0                      | 0                | 0                           | 0                             | 13         |
| Cockenzie        | 0               | 0        | 0        | 0                          | 0        | 0        | 0         | 0                      | 0                | 2                           | 0                             | 2          |
| Craigielaw       | 0               | 0        | 0        | 0                          | 0        | 0        | 0         | 0                      | 0                | 2                           | 0                             | 2          |
| Craigielaw Point | 0               | 1        | 0        | 0                          | 0        | 0        | 4         | 0                      | 0                | 0                           | 0                             | 5          |
| Ferny Ness       | 0               | 0        | 1        | 3                          | 1        | 3        | 4         | 1                      | 1                | 0                           | 1                             | 15         |
| General          | 0               | 3        | 1        | 4                          | 0        | 2        | 0         | 6                      | 1                | 1                           | 3                             | 21         |
| Gosford          | 0               | 0        | 0        | 4                          | 0        | 0        | 2         | 1                      | 0                | 0                           | 3                             | 10         |
| Gosford Sands    | 0               | 0        | 0        | 4                          | 1        | 0        | 0         | 1                      | 0                | 0                           | 0                             | 6          |
| Longniddry       | 0               | 0        | 1        | 2                          | 0        | 0        | 2         | 1                      | 0                | 0                           | 0                             | 6          |
| Seton Mains      | 0               | 0        | 0        | 0                          | 0        | 0        | 0         | 3                      | 0                | 0                           | 0                             | 3          |
| Seton Sands      | 3               | 2        | 0        | 9                          | 0        | 0        | 2         | 5                      | 0                | 1                           | 1                             | 23         |
| <b>Total</b>     | <b>3</b>        | <b>8</b> | <b>4</b> | <b>36</b>                  | <b>3</b> | <b>8</b> | <b>15</b> | <b>18</b>              | <b>2</b>         | <b>6</b>                    | <b>8</b>                      | <b>111</b> |

## Appendix B: Public Consultation

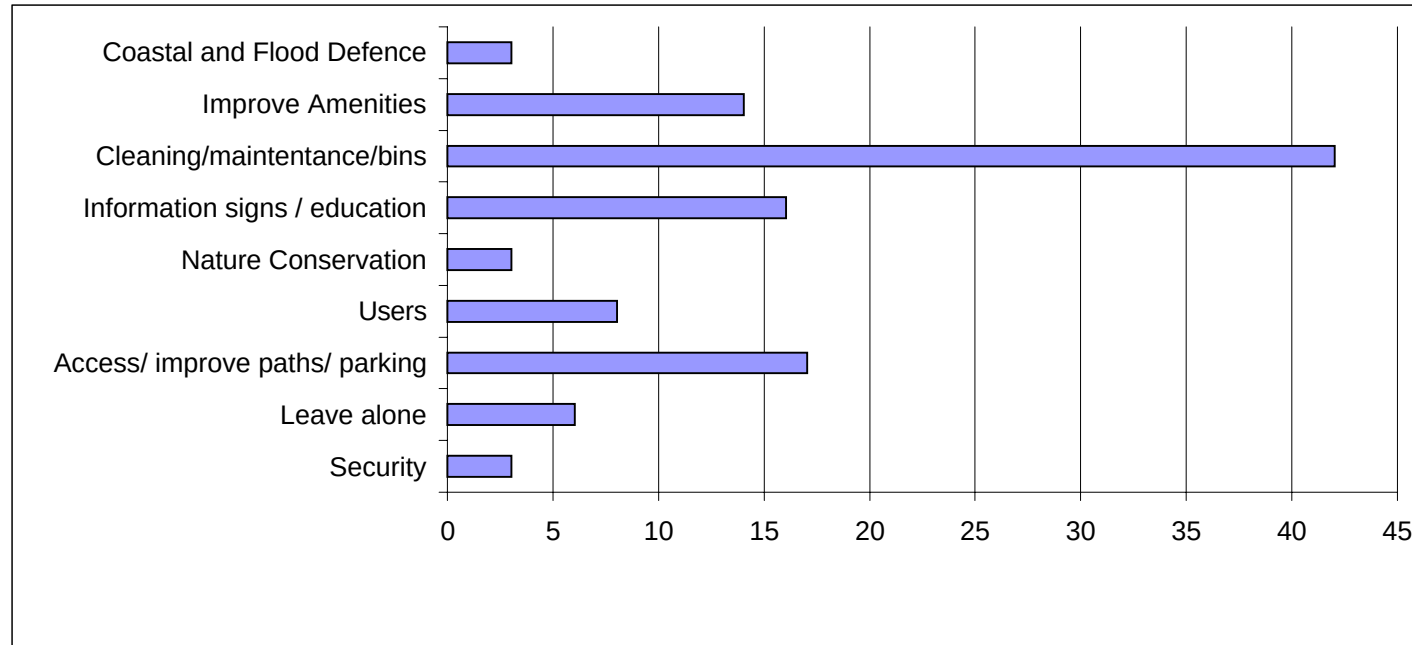
### Longniddry Positives



|                  | Services | General Amenity | Wildlife/ nature/ view | Walking / activity | Clean     | Information Signs | Coastal Protection | Access    | Management | Total      |
|------------------|----------|-----------------|------------------------|--------------------|-----------|-------------------|--------------------|-----------|------------|------------|
| Aberlady Bay     | 0        | 1               | 4                      | 1                  | 0         | 0                 | 0                  | 1         | 1          | 8          |
| Craigielaw Point | 0        | 0               | 0                      | 0                  | 0         | 0                 | 0                  | 1         | 0          | 1          |
| Ferny Ness       | 1        | 2               | 1                      | 2                  | 2         | 1                 | 0                  | 3         | 1          | 13         |
| General          | 2        | 2               | 12                     | 6                  | 8         | 1                 | 0                  | 7         | 5          | 43         |
| Gosford Bay      | 1        | 0               | 6                      | 2                  | 1         | 0                 | 0                  | 0         | 1          | 11         |
| Gullane          | 0        | 0               | 0                      | 0                  | 1         | 0                 | 0                  | 0         | 1          | 2          |
| Kilspindie       | 0        | 0               | 0                      | 1                  | 0         | 0                 | 0                  | 0         | 0          | 1          |
| Seton Sands      | 0        | 2               | 7                      | 4                  | 10        | 1                 | 2                  | 5         | 4          | 35         |
| <b>Total</b>     | <b>4</b> | <b>7</b>        | <b>30</b>              | <b>16</b>          | <b>22</b> | <b>3</b>          | <b>2</b>           | <b>17</b> | <b>13</b>  | <b>114</b> |

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### Longniddry Improvements

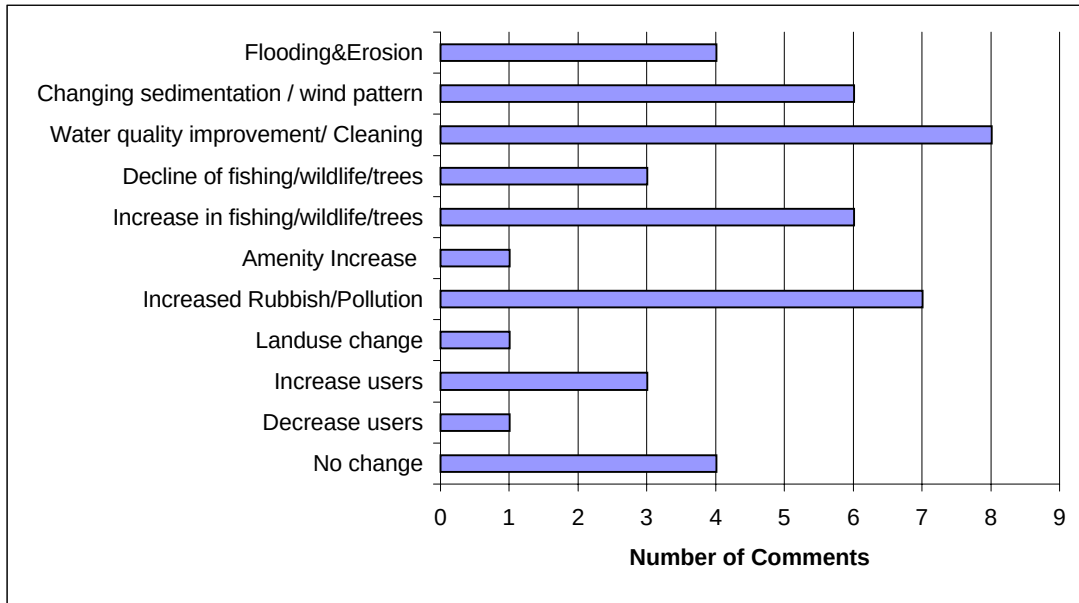


| Location      | Coastal and Flood Defence | Improve Amenities | Cleaning/maintenance/bins | Information signs / education | Nature Conservation | Users    | Access/ improve paths/ parking | Leave alone | Security | Total      |
|---------------|---------------------------|-------------------|---------------------------|-------------------------------|---------------------|----------|--------------------------------|-------------|----------|------------|
| Aberlady Bay  | 0                         | 0                 | 1                         | 2                             | 1                   | 0        | 1                              | 0           | 0        | 5          |
| Car Park No 1 | 0                         | 2                 | 2                         | 3                             | 0                   | 0        | 0                              | 0           | 0        | 7          |
| Car Park No 2 | 0                         | 5                 | 4                         | 2                             | 0                   | 0        | 2                              | 0           | 0        | 13         |
| Car Park No 3 | 0                         | 2                 | 3                         | 2                             | 0                   | 0        | 2                              | 0           | 0        | 9          |
| Ferny Ness    | 1                         | 1                 | 1                         | 1                             | 1                   | 4        | 3                              | 0           | 1        | 13         |
| General       | 0                         | 0                 | 18                        | 4                             | 1                   | 3        | 7                              | 3           | 2        | 38         |
| Gosford Bay   | 0                         | 0                 | 1                         | 0                             | 0                   | 0        | 0                              | 2           | 0        | 3          |
| Gosford Sands | 0                         | 0                 | 1                         | 2                             | 0                   | 1        | 1                              | 0           | 0        | 5          |
| Longniddry    | 0                         | 0                 | 2                         | 0                             | 0                   | 0        | 0                              | 1           | 0        | 3          |
| Seton Sands   | 2                         | 4                 | 9                         | 0                             | 0                   | 0        | 1                              | 0           | 0        | 16         |
| <b>Total</b>  | <b>3</b>                  | <b>14</b>         | <b>42</b>                 | <b>16</b>                     | <b>3</b>            | <b>8</b> | <b>17</b>                      | <b>6</b>    | <b>3</b> | <b>112</b> |



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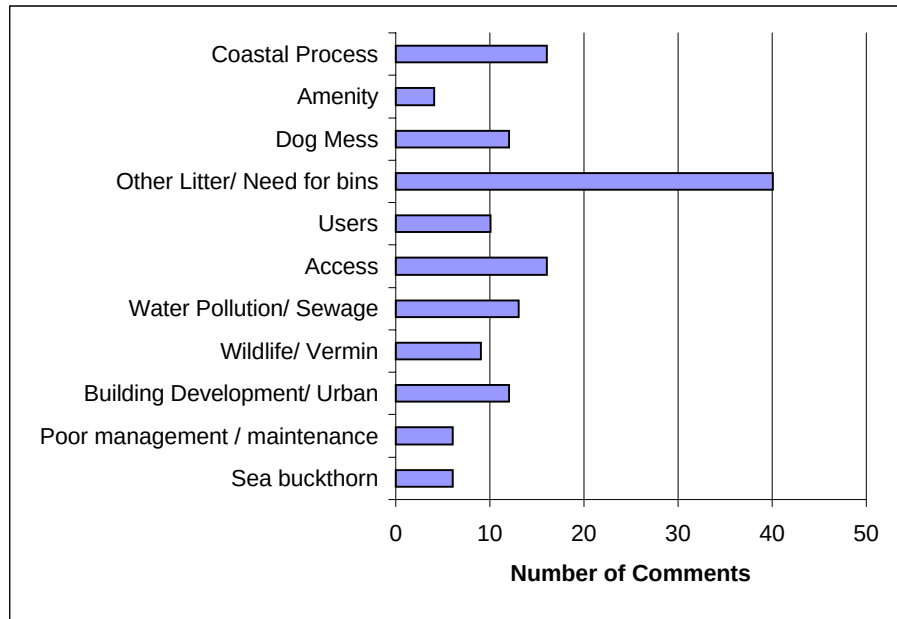
### Longniddry Trends and Changes



|                  | Flooding& Erosion | Changing sedimentation / wind pattern | Water quality improvement/ Cleaning | Decline of fishing/wildlife/trees | Increase in fishing/wildlife/trees | Amenity Increase | Increased Rubbish/Pollution | Landuse change | Increase users | Decrease users | No change | Total     |
|------------------|-------------------|---------------------------------------|-------------------------------------|-----------------------------------|------------------------------------|------------------|-----------------------------|----------------|----------------|----------------|-----------|-----------|
| Aberlady Bay     | 0                 | 1                                     | 0                                   | 0                                 | 0                                  | 0                | 0                           | 1              | 0              | 0              | 0         | 2         |
| Craigielaw Point | 0                 | 0                                     | 0                                   | 0                                 | 0                                  | 0                | 1                           | 0              | 0              | 0              | 0         | 1         |
| Ferry Ness       | 0                 | 0                                     | 0                                   | 1                                 | 0                                  | 0                | 0                           | 0              | 1              | 0              | 0         | 2         |
| General          | 1                 | 2                                     | 7                                   | 1                                 | 5                                  | 1                | 3                           | 0              | 2              | 1              | 4         | 27        |
| Gosford Bay      | 1                 | 0                                     | 0                                   | 0                                 | 0                                  | 0                | 0                           | 0              | 0              | 0              | 0         | 1         |
| Gosford Sands    | 1                 | 0                                     | 0                                   | 0                                 | 0                                  | 0                | 0                           | 0              | 0              | 0              | 0         | 1         |
| Longniddry       | 0                 | 0                                     | 0                                   | 0                                 | 0                                  | 0                | 1                           | 0              | 0              | 0              | 0         | 1         |
| Seton Sands      | 1                 | 3                                     | 1                                   | 1                                 | 1                                  | 0                | 2                           | 0              | 0              | 0              | 0         | 9         |
| <b>Total</b>     | <b>4</b>          | <b>6</b>                              | <b>8</b>                            | <b>3</b>                          | <b>6</b>                           | <b>1</b>         | <b>7</b>                    | <b>1</b>       | <b>3</b>       | <b>1</b>       | <b>4</b>  | <b>44</b> |

## Appendix B: Public Consultation

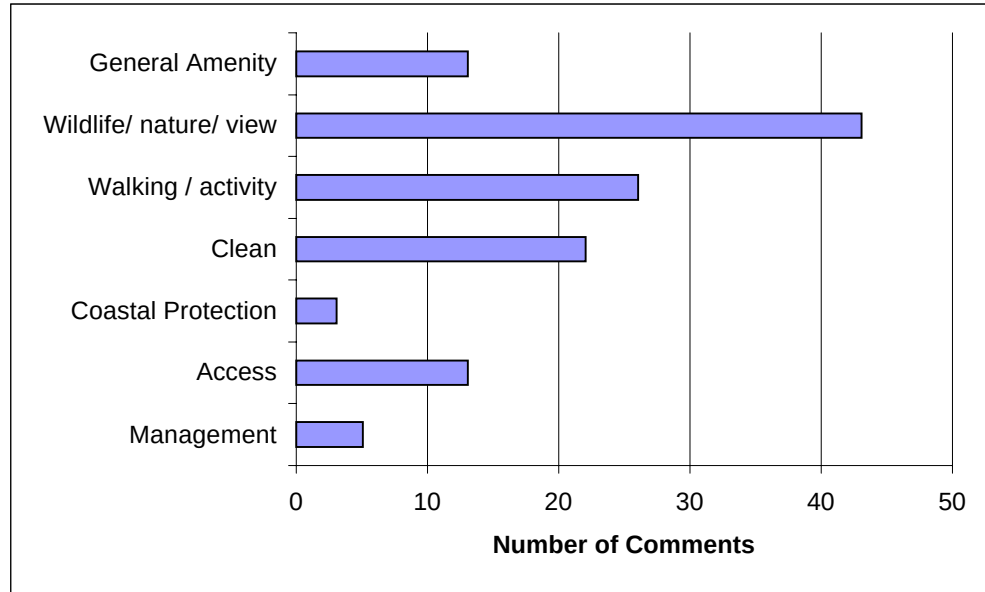
### Gullane Concerns



|                  | Coastal Process | Amenity | Dog Mess | Other Litter/ Need for bins | Users | Access | Water Pollution/ Sewage | Wildlife/ Vermin | Building Development/ Urban | Poor management / maintenance | Sea buckthorn | Total |
|------------------|-----------------|---------|----------|-----------------------------|-------|--------|-------------------------|------------------|-----------------------------|-------------------------------|---------------|-------|
| Aberlady         | 1               | 0       | 0        | 2                           | 2     | 1      | 4                       | 0                | 0                           | 0                             | 0             | 10    |
| Black Rocks      | 2               | 0       | 1        | 5                           | 0     | 1      | 1                       | 1                | 0                           | 0                             | 1             | 12    |
| Eldbotle Woods   | 0               | 0       | 0        | 0                           | 0     | 0      | 0                       | 1                | 0                           | 0                             | 0             | 1     |
| Eyebroughty      | 0               | 0       | 0        | 2                           | 0     | 0      | 2                       | 1                | 0                           | 0                             | 0             | 5     |
| General          | 2               | 0       | 0        | 9                           | 2     | 2      | 0                       | 1                | 5                           | 3                             | 1             | 25    |
| Gullane          | 3               | 2       | 2        | 6                           | 3     | 4      | 0                       | 1                | 0                           | 2                             | 2             | 25    |
| Gullane Bents    | 4               | 0       | 7        | 8                           | 1     | 3      | 5                       | 1                | 1                           | 1                             | 1             | 32    |
| Gullane Point    | 1               | 0       | 1        | 3                           | 2     | 2      | 1                       | 1                | 1                           | 0                             | 0             | 12    |
| Longskelly Rocks | 1               | 0       | 1        | 4                           | 0     | 1      | 0                       | 1                | 0                           | 0                             | 1             | 9     |
| West Links       | 2               | 0       | 0        | 1                           | 0     | 1      | 0                       | 1                | 4                           | 0                             | 0             | 9     |
| Yellowcraig      | 0               | 2       | 0        | 0                           | 0     | 1      | 0                       | 0                | 1                           | 0                             | 0             | 4     |
| Total            | 16              | 4       | 12       | 40                          | 10    | 16     | 13                      | 9                | 12                          | 6                             | 6             | 144   |

## Appendix B: Public Consultation

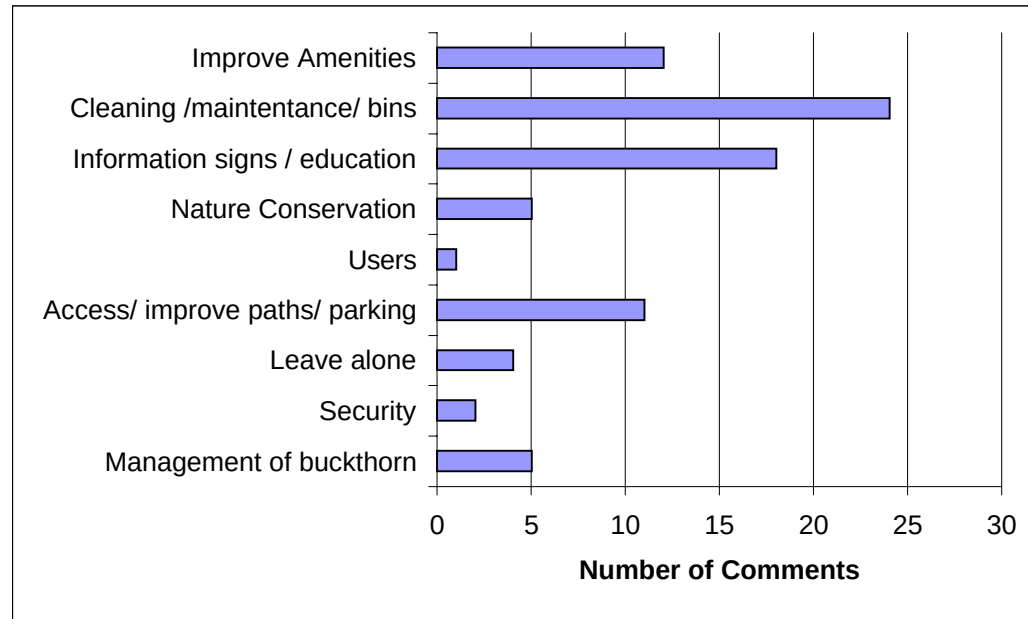
### Gullane Positives



|                  | General<br>Amenity | Wildlife/<br>nature/<br>view | Walking /<br>activity | Clean | Coastal<br>Protection | Access | Management | Total |
|------------------|--------------------|------------------------------|-----------------------|-------|-----------------------|--------|------------|-------|
| Aberlady         | 0                  | 3                            | 1                     | 0     | 0                     | 1      | 1          | 6     |
| Black Rocks      | 0                  | 1                            | 0                     | 0     | 0                     | 0      | 0          | 1     |
| Eyebroughty      | 0                  | 4                            | 1                     | 1     | 0                     | 0      | 0          | 6     |
| General          | 9                  | 23                           | 12                    | 10    | 0                     | 5      | 3          | 62    |
| Gullane          | 0                  | 1                            | 2                     | 2     | 0                     | 0      | 0          | 5     |
| Gullane Bents    | 2                  | 4                            | 7                     | 6     | 3                     | 5      | 1          | 28    |
| Longskelly Rocks | 0                  | 1                            | 0                     | 0     | 0                     | 0      | 0          | 1     |
| West Links       | 0                  | 1                            | 1                     | 1     | 0                     | 0      | 0          | 3     |
| Yellowcraigs     | 2                  | 5                            | 2                     | 2     | 0                     | 2      | 0          | 13    |
| Total            | 13                 | 43                           | 26                    | 22    | 3                     | 13     | 5          | 125   |

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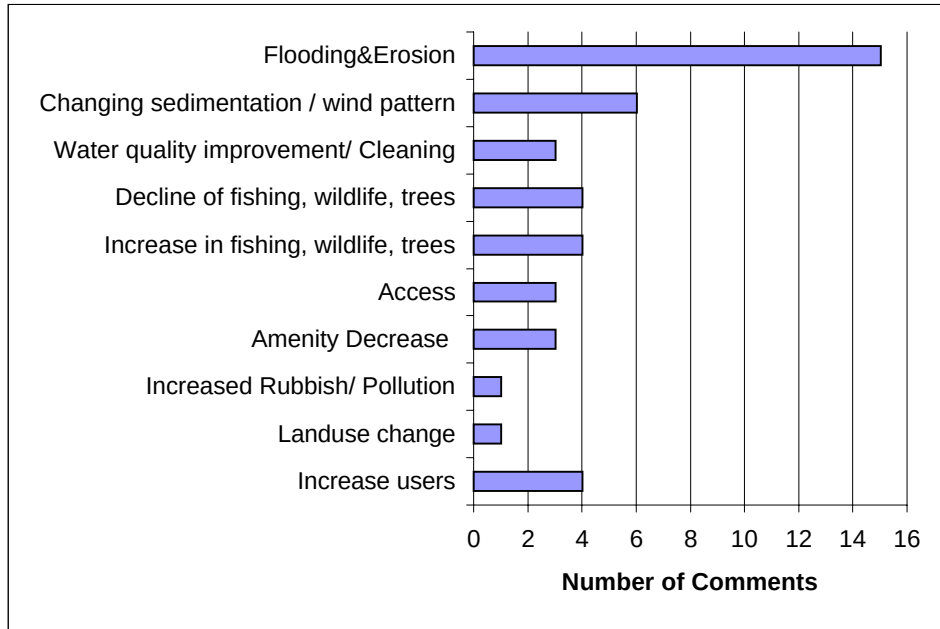
### Gullane Improvements



|                | Improve Amenities | Cleaning /maintenance/ bins | Information signs / education | Nature Conservation | Users | Access/ improve paths/ parking | Leave alone | Security | Management of buckthorn | Total |
|----------------|-------------------|-----------------------------|-------------------------------|---------------------|-------|--------------------------------|-------------|----------|-------------------------|-------|
| Aberlady       | 0                 | 2                           | 0                             | 2                   | 0     | 0                              | 0           | 0        | 0                       | 4     |
| Black Rocks    | 0                 | 0                           | 2                             | 0                   | 0     | 0                              | 0           | 0        | 0                       | 2     |
| Eldbotle Woods | 0                 | 0                           | 0                             | 0                   | 0     | 1                              | 1           | 0        | 0                       | 2     |
| Eyebroughty    | 0                 | 1                           | 0                             | 0                   | 0     | 0                              | 0           | 0        | 0                       | 1     |
| General        | 0                 | 0                           | 1                             | 1                   | 0     | 0                              | 0           | 0        | 0                       | 2     |
| Gullane        | 0                 | 2                           | 0                             | 0                   | 0     | 1                              | 0           | 1        | 0                       | 4     |
| Gullane Bents  | 8                 | 17                          | 9                             | 2                   | 0     | 5                              | 1           | 1        | 2                       | 45    |
| Gullane Links  | 0                 | 2                           | 4                             | 0                   | 0     | 1                              | 0           | 0        | 1                       | 8     |
| Muirfield      | 0                 | 0                           | 0                             | 0                   | 0     | 1                              | 0           | 0        | 1                       | 2     |
| West Links     | 0                 | 0                           | 0                             | 0                   | 1     | 0                              | 1           | 0        | 0                       | 2     |
| Yellowcraigs   | 4                 | 0                           | 2                             | 0                   | 0     | 2                              | 1           | 0        | 1                       | 10    |
| Total          | 12                | 24                          | 18                            | 5                   | 1     | 11                             | 4           | 2        | 5                       | 82    |

## Appendix B: Public Consultation

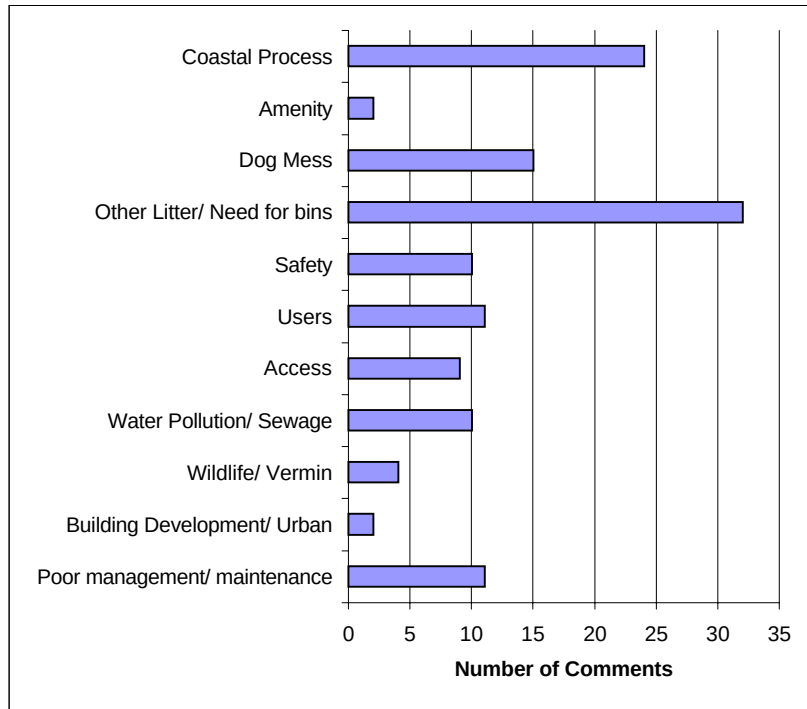
### Gullane Trends and Changes



|               | Flooding&<br>Erosion | Changing<br>sedimentation<br>/ wind pattern | Water quality<br>improvement/<br>Cleaning | Decline of<br>fishing,<br>wildlife, trees | Increase in<br>fishing,<br>wildlife, trees | Access | Amenity<br>Decrease | Increased<br>Rubbish/<br>Pollution | Landuse<br>change | Increase<br>users | Total |
|---------------|----------------------|---------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------|---------------------|------------------------------------|-------------------|-------------------|-------|
| Fidra         | 0                    | 0                                           | 0                                         | 0                                         | 0                                          | 1      | 0                   | 0                                  | 0                 | 0                 | 1     |
| General       | 11                   | 4                                           | 3                                         | 3                                         | 2                                          | 2      | 2                   | 1                                  | 1                 | 4                 | 33    |
| Gullane       | 0                    | 0                                           | 0                                         | 0                                         | 1                                          | 0      | 0                   | 0                                  | 0                 | 0                 | 1     |
| Gullane Bents | 4                    | 1                                           | 0                                         | 1                                         | 1                                          | 0      | 1                   | 0                                  | 0                 | 0                 | 8     |
| Kilspindie    | 0                    | 1                                           | 0                                         | 0                                         | 0                                          | 0      | 0                   | 0                                  | 0                 | 0                 | 1     |
| Total         | 15                   | 6                                           | 3                                         | 4                                         | 4                                          | 3      | 3                   | 1                                  | 1                 | 4                 | 44    |

## Appendix B: Public Consultation

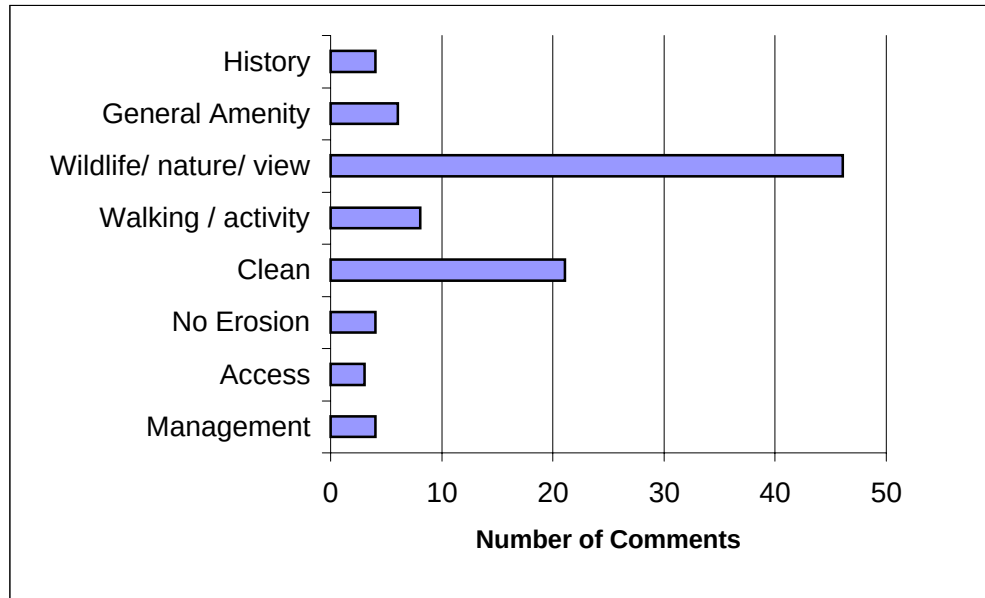
### North Berwick Concerns



|                           | Coastal Process | Amenity | Dog Mess | Other Litter/ Need for bins | Safety | Users | Access | Water Pollution/ Sewage | Wildlife/ Vermin | Building Development / Urban | Poor management/ maintenance | Total |
|---------------------------|-----------------|---------|----------|-----------------------------|--------|-------|--------|-------------------------|------------------|------------------------------|------------------------------|-------|
| Broadsands                | 4               | 0       | 0        | 1                           | 0      | 0     | 0      | 0                       | 0                | 0                            | 0                            | 5     |
| Canty Bay                 | 3               | 0       | 0        | 0                           | 0      | 0     | 0      | 1                       | 0                | 0                            | 0                            | 4     |
| Car Rocks                 | 1               | 0       | 0        | 0                           | 0      | 0     | 0      | 0                       | 0                | 0                            | 0                            | 1     |
| General                   | 5               | 1       | 3        | 8                           | 1      | 5     | 1      | 3                       | 3                | 2                            | 0                            | 32    |
| North Berwick             | 1               | 1       | 1        | 4                           | 3      | 0     | 4      | 2                       | 0                | 0                            | 2                            | 18    |
| North Berwick East Beach  | 5               | 0       | 5        | 7                           | 1      | 1     | 0      | 2                       | 0                | 0                            | 5                            | 26    |
| North Berwick Golf Course | 1               | 0       | 0        | 1                           | 0      | 2     | 1      | 0                       | 0                | 0                            | 0                            | 5     |
| North Berwick West Beach  | 3               | 0       | 6        | 6                           | 4      | 2     | 1      | 2                       | 0                | 0                            | 4                            | 28    |
| Seacliff                  | 1               | 0       | 0        | 3                           | 0      | 0     | 0      | 0                       | 1                | 0                            | 0                            | 5     |
| Yellowcraigs              | 0               | 0       | 0        | 2                           | 1      | 1     | 2      | 0                       | 0                | 0                            | 0                            | 6     |
| Total                     | 24              | 2       | 15       | 32                          | 10     | 11    | 9      | 10                      | 4                | 2                            | 11                           | 130   |

## Appendix B: Public Consultation

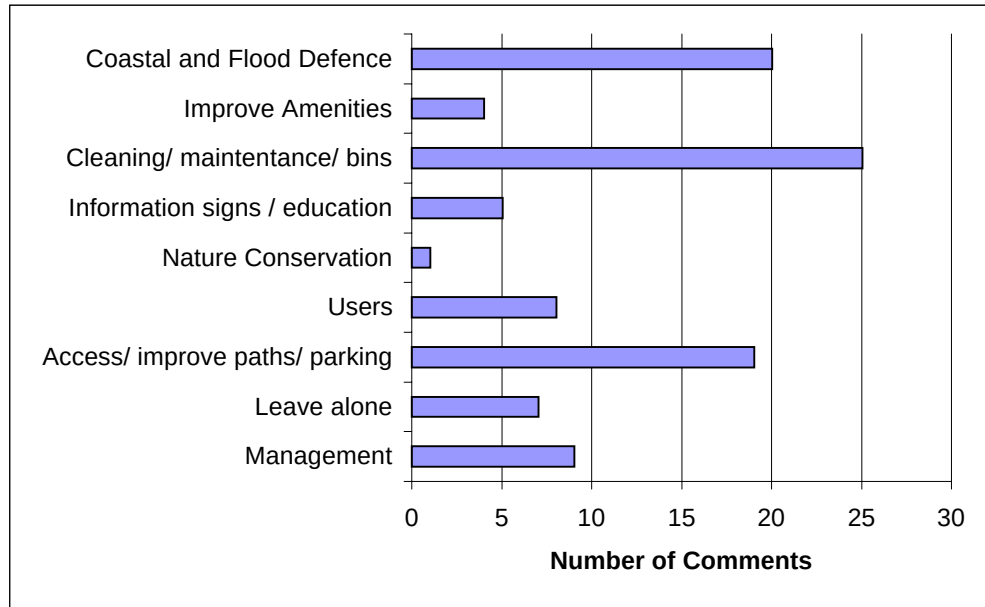
### North Berwick Positives



|                          | History | General Amenity | Wildlife/<br>nature/<br>view | Walking /<br>activity | Clean | No Erosion | Access | Management | Total |
|--------------------------|---------|-----------------|------------------------------|-----------------------|-------|------------|--------|------------|-------|
| Canty Bay                | 0       | 0               | 0                            | 0                     | 0     | 0          | 1      | 0          | 1     |
| Car Rocks                | 1       | 0               | 1                            | 0                     | 0     | 0          | 0      | 0          | 2     |
| East of North Berwick    | 0       | 0               | 0                            | 0                     | 0     | 2          | 0      | 0          | 2     |
| General                  | 2       | 1               | 29                           | 6                     | 13    | 1          | 1      | 3          | 56    |
| North Berwick            | 0       | 2               | 7                            | 1                     | 3     | 0          | 0      | 0          | 13    |
| North Berwick East Beach | 0       | 2               | 1                            | 0                     | 3     | 0          | 0      | 0          | 6     |
| North Berwick West Beach | 0       | 0               | 3                            | 1                     | 1     | 0          | 1      | 0          | 6     |
| Seacliff                 | 1       | 1               | 2                            | 0                     | 1     | 1          | 0      | 1          | 7     |
| Yellowcraigs             | 0       | 0               | 3                            | 0                     | 0     | 0          | 0      | 0          | 3     |
| Total                    | 4       | 6               | 46                           | 8                     | 21    | 4          | 3      | 4          | 96    |

## Appendix B: Public Consultation

### North Berwick Improvements

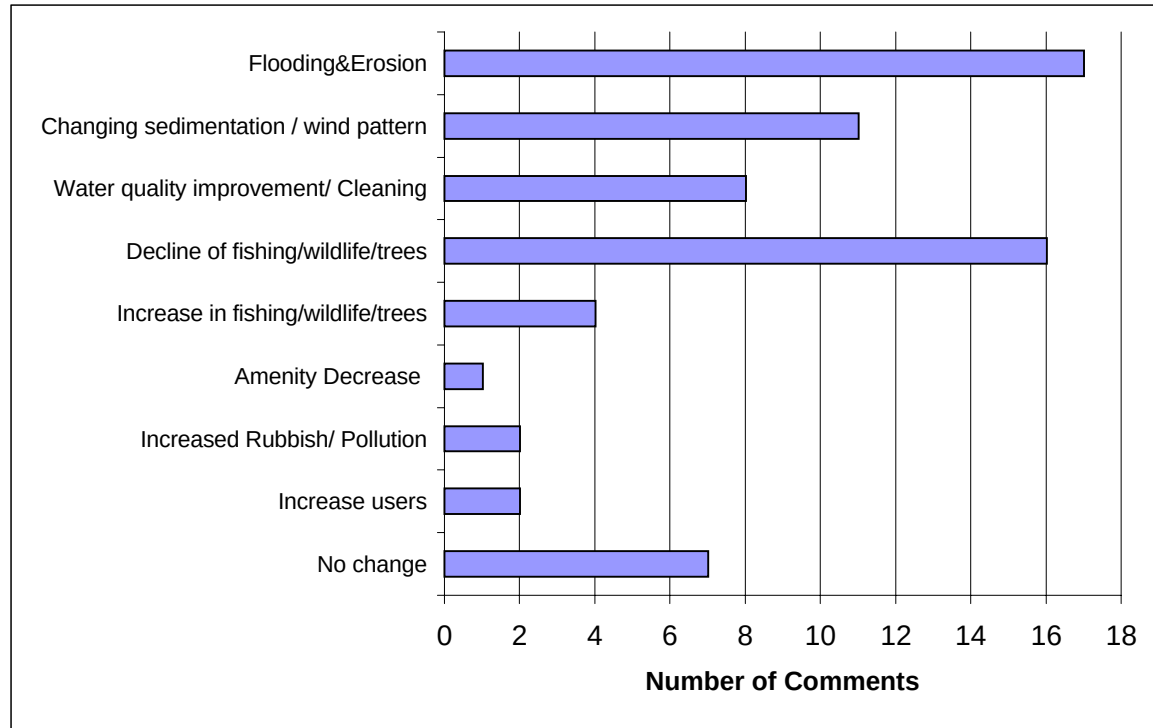


|                          | Coastal and Flood Defence | Improve Amenities | Cleaning/ maintenance/ bins | Information signs / education | Nature Conservation | Users | Access/ improve paths/ parking | Leave alone | Management | Total |
|--------------------------|---------------------------|-------------------|-----------------------------|-------------------------------|---------------------|-------|--------------------------------|-------------|------------|-------|
| Broadsands               | 4                         | 0                 | 3                           | 0                             | 0                   | 0     | 1                              | 0           | 0          | 8     |
| Car Rocks                | 1                         | 0                 | 0                           | 0                             | 0                   | 0     | 0                              | 0           | 0          | 1     |
| East Links               | 1                         | 2                 | 0                           | 2                             | 0                   | 0     | 4                              | 0           | 0          | 9     |
| General                  | 3                         | 0                 | 5                           | 2                             | 1                   | 4     | 6                              | 6           | 5          | 32    |
| North Berwick            | 1                         | 1                 | 0                           | 1                             | 0                   | 2     | 6                              | 0           | 3          | 14    |
| North Berwick East Beach | 2                         | 0                 | 8                           | 0                             | 0                   | 1     | 1                              | 1           | 1          | 14    |
| North Berwick West Beach | 3                         | 0                 | 9                           | 0                             | 0                   | 1     | 1                              | 0           | 0          | 14    |
| West Links               | 5                         | 0                 | 0                           | 0                             | 0                   | 0     | 0                              | 0           | 0          | 5     |
| Yellowcraig              | 0                         | 1                 | 0                           | 0                             | 0                   | 0     | 0                              | 0           | 0          | 1     |
| Total                    | 20                        | 4                 | 25                          | 5                             | 1                   | 8     | 19                             | 7           | 9          | 98    |



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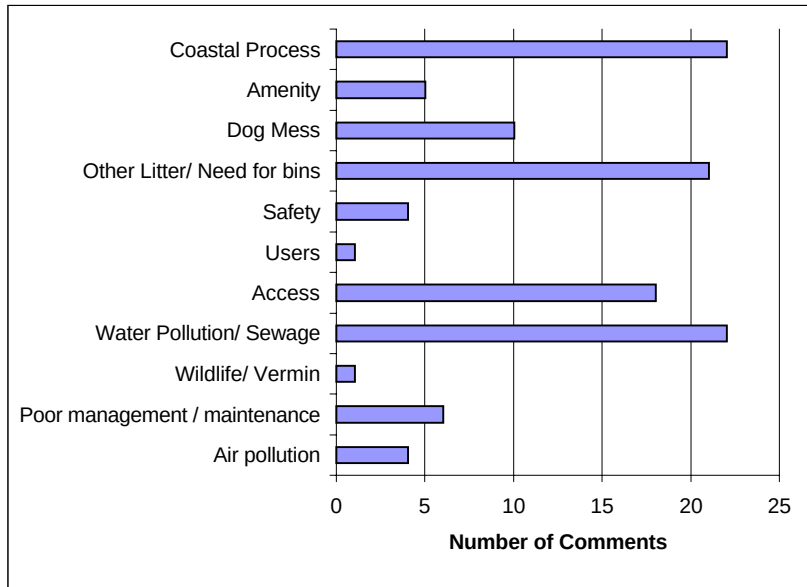
### North Berwick Trends and Changes



|                          | Flooding&<br>Erosion | Changing<br>sedimentation /<br>wind pattern | Water quality<br>improvement/<br>Cleaning | Decline of<br>fishing/wildlife/<br>rees | Increase in<br>fishing/wildlife/<br>rees | Amenity<br>Decrease | Increased<br>Rubbish/<br>Pollution | Increase<br>users | No change | Total |
|--------------------------|----------------------|---------------------------------------------|-------------------------------------------|-----------------------------------------|------------------------------------------|---------------------|------------------------------------|-------------------|-----------|-------|
| General                  | 8                    | 4                                           | 3                                         | 13                                      | 4                                        | 1                   | 2                                  | 0                 | 1         | 36    |
| Leithies                 | 1                    | 0                                           | 0                                         | 0                                       | 0                                        | 0                   | 0                                  | 0                 | 0         | 1     |
| North Berwick            | 3                    | 0                                           | 1                                         | 2                                       | 0                                        | 0                   | 0                                  | 0                 | 0         | 6     |
| North Berwick East Beach | 2                    | 3                                           | 2                                         | 0                                       | 0                                        | 0                   | 0                                  | 1                 | 3         | 11    |
| North Berwick West Beach | 2                    | 4                                           | 2                                         | 1                                       | 0                                        | 0                   | 0                                  | 1                 | 2         | 12    |
| Tantallon                | 1                    | 0                                           | 0                                         | 0                                       | 0                                        | 0                   | 0                                  | 0                 | 0         | 1     |
| Yellowcraigs             | 0                    | 0                                           | 0                                         | 0                                       | 0                                        | 0                   | 0                                  | 0                 | 1         | 1     |
| Total                    | 17                   | 11                                          | 8                                         | 16                                      | 4                                        | 1                   | 2                                  | 2                 | 7         | 68    |

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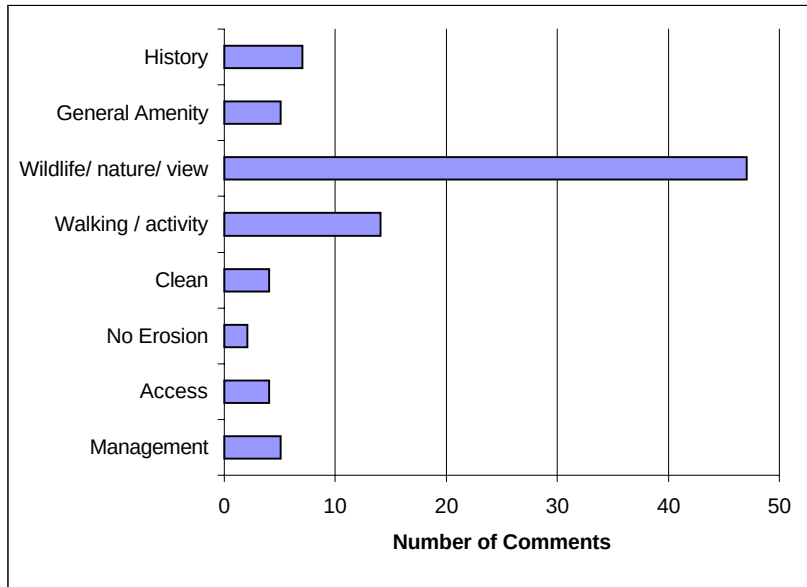
### Dunbar Concerns



|                         | Coastal Process | Amenity  | Dog Mess  | Other Litter/ Need for bins | Safety   | Users    | Access    | Water Pollution/ Sewage | Wildlife/ Vermin | Poor management / maintenance | Air pollution | Total      |
|-------------------------|-----------------|----------|-----------|-----------------------------|----------|----------|-----------|-------------------------|------------------|-------------------------------|---------------|------------|
| Belhaven Bay            | 2               | 0        | 1         | 3                           | 1        | 0        | 3         | 7                       | 0                | 0                             | 0             | 17         |
| Broxmouth               | 0               | 0        | 0         | 0                           | 0        | 0        | 1         | 0                       | 0                | 0                             | 4             | 5          |
| Dunbar Castle           | 1               | 0        | 0         | 0                           | 0        | 0        | 1         | 0                       | 0                | 2                             | 0             | 4          |
| Dunbar Golf Course      | 4               | 0        | 0         | 2                           | 0        | 0        | 2         | 0                       | 0                | 0                             | 0             | 8          |
| Dunbar Harbour          | 2               | 0        | 1         | 1                           | 0        | 0        | 0         | 0                       | 0                | 1                             | 0             | 5          |
| East Barns              | 1               | 0        | 0         | 1                           | 0        | 0        | 0         | 0                       | 0                | 0                             | 0             | 2          |
| East Beach              | 4               | 4        | 4         | 8                           | 1        | 0        | 2         | 7                       | 0                | 0                             | 0             | 30         |
| General                 | 1               | 1        | 1         | 4                           | 0        | 0        | 1         | 1                       | 0                | 2                             | 0             | 11         |
| John Muir Country Park  | 0               | 0        | 2         | 1                           | 0        | 1        | 0         | 2                       | 0                | 0                             | 0             | 6          |
| Long Craigs             | 1               | 0        | 1         | 0                           | 1        | 0        | 2         | 0                       | 0                | 0                             | 0             | 5          |
| Torness                 | 0               | 0        | 0         | 0                           | 1        | 0        | 0         | 0                       | 0                | 0                             | 0             | 1          |
| Tynninghame             | 1               | 0        | 0         | 0                           | 0        | 0        | 1         | 1                       | 0                | 0                             | 0             | 3          |
| White Sands             | 1               | 0        | 0         | 1                           | 0        | 0        | 3         | 4                       | 0                | 1                             | 0             | 10         |
| Winterfield Golf Course | 4               | 0        | 0         | 0                           | 0        | 0        | 2         | 0                       | 1                | 0                             | 0             | 7          |
| <b>Total</b>            | <b>22</b>       | <b>5</b> | <b>10</b> | <b>21</b>                   | <b>4</b> | <b>1</b> | <b>18</b> | <b>22</b>               | <b>1</b>         | <b>6</b>                      | <b>4</b>      | <b>114</b> |

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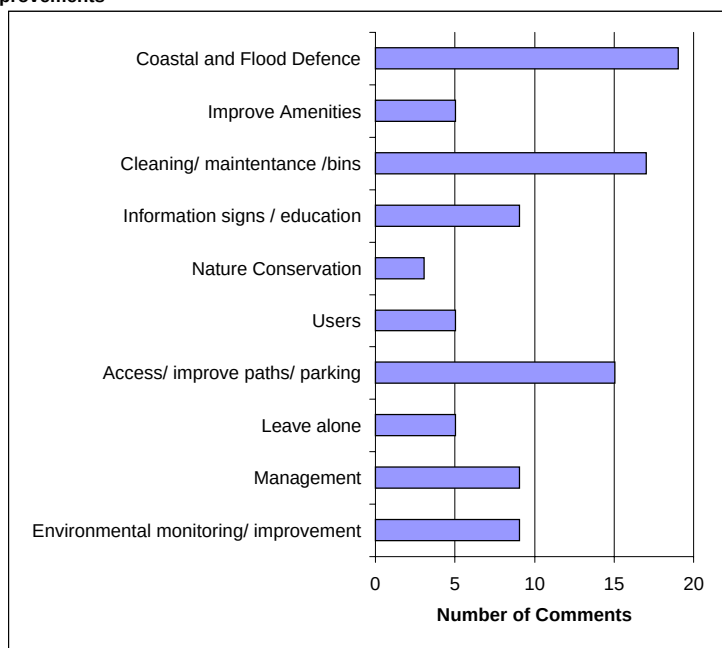
### Dunbar Positives



|                         | History  | General Amenity | Wildlife/ nature/ view | Walking / activity | Clean    | No Erosion | Access   | Management | Total     |
|-------------------------|----------|-----------------|------------------------|--------------------|----------|------------|----------|------------|-----------|
| Barnes Ness             | 0        | 0               | 1                      | 0                  | 0        | 0          | 0        | 0          | 1         |
| Belhaven Bay            | 0        | 1               | 3                      | 0                  | 0        | 0          | 0        | 0          | 4         |
| Dunbar Castle           | 3        | 0               | 4                      | 0                  | 0        | 0          | 0        | 0          | 7         |
| Dunbar Golf Course      | 0        | 0               | 0                      | 2                  | 0        | 0          | 0        | 0          | 2         |
| Dunbar Harbour          | 1        | 0               | 1                      | 0                  | 0        | 0          | 0        | 0          | 2         |
| East Beach              | 1        | 1               | 1                      | 1                  | 0        | 0          | 0        | 0          | 4         |
| General                 | 1        | 3               | 26                     | 4                  | 2        | 0          | 3        | 2          | 41        |
| John Muir Country Park  | 0        | 0               | 4                      | 1                  | 0        | 0          | 0        | 3          | 8         |
| Long Craigs             | 0        | 0               | 2                      | 4                  | 1        | 1          | 0        | 0          | 8         |
| Tynninghame             | 1        | 0               | 3                      | 1                  | 0        | 0          | 0        | 0          | 5         |
| White Sands             | 0        | 0               | 2                      | 0                  | 1        | 0          | 1        | 0          | 4         |
| Winterfield Golf Course | 0        | 0               | 0                      | 1                  | 0        | 1          | 0        | 0          | 2         |
| <b>Total</b>            | <b>7</b> | <b>5</b>        | <b>47</b>              | <b>14</b>          | <b>4</b> | <b>2</b>   | <b>4</b> | <b>5</b>   | <b>88</b> |

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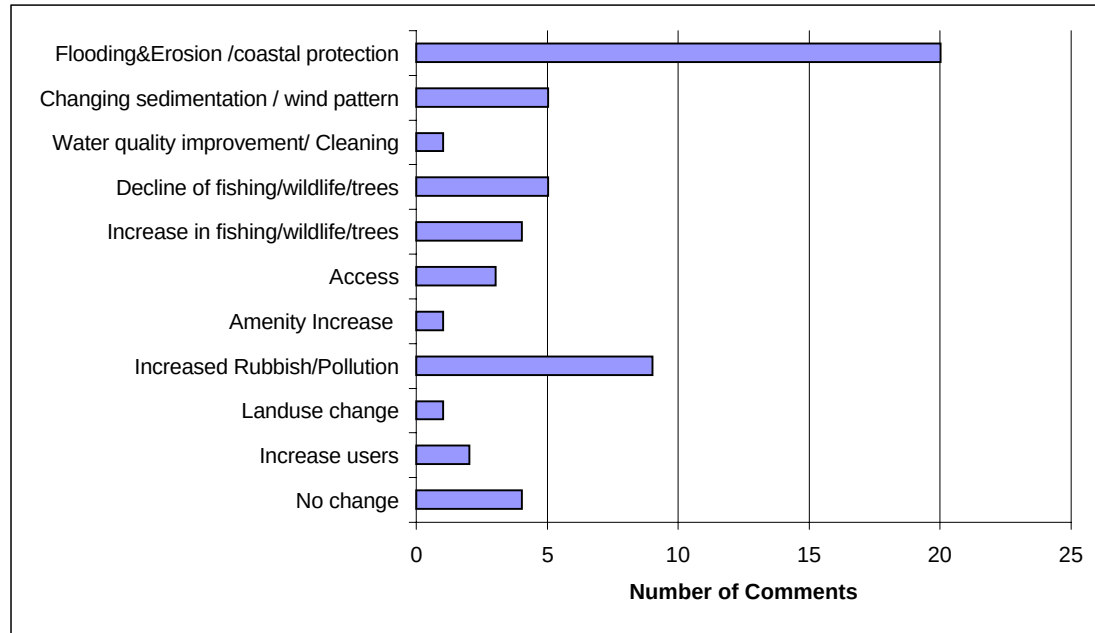
### Dunbar Improvements



|                         | Coastal and Flood Defence | Improve Amenities | Cleaning/ maintenance /bins | Information signs / education | Nature Conservation | Users    | Access/ improve paths/ parking | Leave alone | Management | Environmental monitoring/ improvement | Total     |
|-------------------------|---------------------------|-------------------|-----------------------------|-------------------------------|---------------------|----------|--------------------------------|-------------|------------|---------------------------------------|-----------|
| Belhaven Bay            | 0                         | 0                 | 4                           | 0                             | 0                   | 0        | 1                              | 0           | 0          | 1                                     | 6         |
| Broxmouth               | 0                         | 0                 | 0                           | 0                             | 0                   | 0        | 1                              | 0           | 0          | 1                                     | 2         |
| Dunbar Castle           | 0                         | 0                 | 0                           | 2                             | 0                   | 0        | 0                              | 0           | 0          | 0                                     | 2         |
| Dunbar Cliffs           | 1                         | 0                 | 0                           | 0                             | 0                   | 0        | 2                              | 0           | 1          | 0                                     | 4         |
| Dunbar Golf Course      | 1                         | 0                 | 0                           | 0                             | 1                   | 0        | 2                              | 0           | 0          | 0                                     | 4         |
| Dunbar Harbour          | 2                         | 1                 | 2                           | 0                             | 0                   | 0        | 0                              | 0           | 0          | 0                                     | 5         |
| East Beach              | 6                         | 1                 | 5                           | 0                             | 0                   | 0        | 0                              | 0           | 0          | 1                                     | 13        |
| General                 | 6                         | 1                 | 4                           | 6                             | 1                   | 3        | 5                              | 5           | 8          | 3                                     | 42        |
| John Muir Country Park  | 0                         | 1                 | 0                           | 0                             | 0                   | 2        | 0                              | 0           | 0          | 0                                     | 3         |
| Seafeld Pond            | 0                         | 1                 | 0                           | 0                             | 0                   | 0        | 0                              | 0           | 0          | 2                                     | 3         |
| Tynninghame             | 1                         | 0                 | 1                           | 1                             | 0                   | 0        | 0                              | 0           | 0          | 0                                     | 3         |
| West Barnes             | 0                         | 0                 | 0                           | 0                             | 0                   | 0        | 1                              | 0           | 0          | 0                                     | 1         |
| White Sands             | 0                         | 0                 | 1                           | 0                             | 0                   | 0        | 2                              | 0           | 0          | 1                                     | 4         |
| Winterfield Golf Course | 2                         | 0                 | 0                           | 0                             | 1                   | 0        | 1                              | 0           | 0          | 0                                     | 4         |
| <b>Total</b>            | <b>19</b>                 | <b>5</b>          | <b>17</b>                   | <b>9</b>                      | <b>3</b>            | <b>5</b> | <b>15</b>                      | <b>5</b>    | <b>9</b>   | <b>9</b>                              | <b>96</b> |

## Appendix B: Public Consultation

### Dunbar Trends and Changes



|                    | Flooding&<br>Erosion<br>/coastal<br>protection | Changing<br>sedimentation /<br>wind pattern | Water quality<br>improvement/<br>Cleaning | Decline of<br>fishing/wildlife/tr<br>ees | Increase in<br>fishing/wildlife/tr<br>ees | Access   | Amenity<br>Increase | Increased<br>Rubbish/P<br>ollution | Landuse<br>change | Increase<br>users | No change | Total     |
|--------------------|------------------------------------------------|---------------------------------------------|-------------------------------------------|------------------------------------------|-------------------------------------------|----------|---------------------|------------------------------------|-------------------|-------------------|-----------|-----------|
| Belhaven Bay       | 0                                              | 0                                           | 0                                         | 0                                        | 0                                         | 0        | 0                   | 1                                  | 0                 | 0                 | 0         | 1         |
| Biel Burn          | 3                                              | 0                                           | 0                                         | 0                                        | 0                                         | 0        | 0                   | 0                                  | 0                 | 0                 | 0         | 3         |
| Dunbar Castle      | 0                                              | 0                                           | 0                                         | 0                                        | 1                                         | 0        | 0                   | 0                                  | 0                 | 0                 | 0         | 1         |
| Dunbar Cliffs      | 6                                              | 0                                           | 0                                         | 0                                        | 0                                         | 0        | 0                   | 0                                  | 0                 | 0                 | 0         | 6         |
| Dunbar Golf Course | 1                                              | 1                                           | 0                                         | 0                                        | 0                                         | 0        | 0                   | 0                                  | 0                 | 0                 | 0         | 2         |
| Dunbar Harbour     | 1                                              | 0                                           | 0                                         | 0                                        | 1                                         | 0        | 0                   | 0                                  | 0                 | 1                 | 0         | 3         |
| East Beach         | 2                                              | 0                                           | 1                                         | 0                                        | 0                                         | 0        | 0                   | 0                                  | 0                 | 1                 | 0         | 4         |
| General            | 7                                              | 4                                           | 0                                         | 5                                        | 2                                         | 3        | 1                   | 8                                  | 1                 | 0                 | 2         | 33        |
| Tynninghame        | 0                                              | 0                                           | 0                                         | 0                                        | 0                                         | 0        | 0                   | 0                                  | 0                 | 0                 | 1         | 1         |
| White Sands        | 0                                              | 0                                           | 0                                         | 0                                        | 0                                         | 0        | 0                   | 0                                  | 0                 | 0                 | 1         | 1         |
| <b>Total</b>       | <b>20</b>                                      | <b>5</b>                                    | <b>1</b>                                  | <b>5</b>                                 | <b>4</b>                                  | <b>3</b> | <b>1</b>            | <b>9</b>                           | <b>1</b>          | <b>2</b>          | <b>4</b>  | <b>55</b> |

## Appendix B: Public Consultation

### East of Dunbar Concerns

|              | Coastal Process | Industry | Total    |
|--------------|-----------------|----------|----------|
| Blue Circle  | 0               | 1        | 1        |
| Cove         | 1               | 0        | 1        |
| Thortonloch  | 2               | 0        | 2        |
| Torness      | 0               | 1        | 1        |
| <b>Total</b> | <b>3</b>        | <b>2</b> | <b>5</b> |

### Positive Aspects

|              | Wildlife/nature/view |
|--------------|----------------------|
| Fast Castle  | 1                    |
| Thortonloch  | 1                    |
| Siccar Point | 1                    |
| <b>Total</b> | <b>3</b>             |

### Suggested Improvements

|              | Develop harbour | Improve Amenities | Nature Conservation |
|--------------|-----------------|-------------------|---------------------|
| Barnes Ness  | 0               | 0                 | 1                   |
| General      | 0               | 1                 | 0                   |
| Skateraw     | 2               | 0                 | 0                   |
| Thortonloch  | 0               | 1                 | 0                   |
| <b>Total</b> | <b>2</b>        | <b>2</b>          | <b>1</b>            |

### Trends & Changes

|             | Flooding&Erosion/<br>coastal protection | Changing<br>sedimentation /<br>wind pattern | Management |
|-------------|-----------------------------------------|---------------------------------------------|------------|
| Thortonloch | 6                                       | 2                                           | 1          |

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## Appendix C: Historical Coastal Change

### **GIS Outputs for the East Lothian Region (23 figures from west to east).**

(Note: The base map used for displaying historical coastal change is the OS 1:10000 raster map. The 1999 MHWS and MLWS were extracted from the OS Landline digital data at 1:2500. The 1907 MHWS and MLWS were digitised on screen from the OS historic raster maps at 1:2500. The base map may have errors, due to the scale of mapping).



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## Appendix D: Coastal Defences

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# **East Lothian Council Shoreline Management Plan**

## **Appendix D: Coastal Defences**

### **Note to accompany the Coastal Defence Survey**

The assessment of structure condition is based on a general visual inspection and refers only to the apparent coherence of the visible portions of the structure and its material constituents. This assessment is qualitative and as such the adequacy of the original 'design' or material selection in performing the task of coast protection at any site is out with the scope of this general assessment. Notwithstanding this, it is noted that many of the protection works visited have failed in some manner or other, and that many do not appear to have been specifically designed to resist the rigours of their exposure.

Residual life is dependent on function, condition and environment. In some cases, the structures visited perform the dual function of retaining wall and wave wall for example. This implies pressures on the wall that are not solely those emanating from its coastal function. It may be argued that, for example, the physical presence of a wall may continue to offer adequate protection to the coast behind, from a coast protection point of view, even though its structural performance may have been otherwise impaired. However, for the purpose of the assessment made here such considerations have been ignored and the appraisals presented are instead based on apparent general structure integrity considerations alone. It should also be noted that the ability of a structure to sustain its performance over time is dependent upon the level of service it experiences and will be affected by any variations in this that occurs. For example, increased severity or direction of storms may have a direct effect, as may changes in bathymetry etc that may occur as a result of storms. Further, it is noted that many of the structures visited have been subject to maintenance, repair and augmentation, probably on an ongoing (if sometimes ad-hoc) basis. The assessment of residual life should therefore not be construed as a suggested period without maintenance. In this regard, periodic inspection is recommended, with particular review taking place following significant storms.

# **East Lothian Council Shoreline Management Plan**

## **Note Outlining The Specification of the Coastal Defence Survey**

This will be a land-based inspection. Ordnance Survey base maps (output from the GIS) will be used as a base to record the survey of existing coastal defences. It is envisaged that some of the coastal defences (e.g. sea wall, flood embankments) will be marked on the OS base maps. These will be verified in the field and notes made on their existing condition, their role and effectiveness in coastal defence and their anticipated residual life. The type and extent of any other coastal defences not indicated on the OS maps will be recorded on the base maps, with annotations. A standard table will be used for each type of defence (embankment, revetment etc.), average dimensions, length of coast affected, condition etc. This information and the location of all existing coastal defences will be added to the GIS database.

Spot height and bench mark levels from the GIS OS maps will be used as a visual reference as to the level of the coastal defences. Details are recorded in standard table, which is broadly based on the MAFF Coast Protection Survey. The headings in the table are described below:

### **Asset Type**

One or more of the following descriptions are used to identify the main components of the defence:

- Concrete/masonry wall - a shoreline structure whose primary purpose is either to protect against erosion or alleviate flooding, or a combination of both, and in which wave action is the dominant design consideration. Quay walls and other vertical walls, which have limited exposure would also be included within this category.
- Stone/masonry faced revetment - indicates that the defence consists of or incorporates a facing treatment including stone, masonry, pitching or other forms of revetment treatment.
- Rock revetment - indicates that the defence consists of a facing treatment including rock armour
- Gabions
- Sheet pile walls
- Groynes

### **Condition**

A representative statement on the condition of the defence element is to be provided. The four condition classifications are:

- Class 1: condition as built
- Class 2: some signs of wear, needs to be kept under observation; returnable to condition as built with simple maintenance
- Class 3: moderate works required; probably limited to a maintenance operation to return to satisfactory condition
- Class 4: significant works needed; capital works probably required within 5 years

### **Degree of Exposure**

## **East Lothian Council Shoreline Management Plan**

Indicates the degree of openness of the defence to the prevailing storm conditions. Selection is made from:

- High Exposure
- Medium Exposure
- Low Exposure

### **Foreshore Type**

Describes the principal sediment type on the foreshore fronting the defences:

- Mud
- Sand
- Gravel
- Scree/Cobble
- Bedrock

### **Eroding/ Stable/ Accreting**

This is a visual assessment of the condition of the foreshore fronting the defence. Is it eroding, stable or accreting?

### **Principle Land-use Type**

Principle type is to be categorised to reflect the principle land-use, within the 1km hinterland boundary. A judgement of the principle land-use type is made initially from OS maps, aerial photograph and the land-use mapping and verified in the field. The following categories are used:

- A** Areas of dense conurbation where erosion could lead to serious infrastructure failure and endanger life. Major trunk roads, motorways and railways may be included in this category.
- B** Predominately urban areas, including housing, industry and commerce. The zone at risk will include "A" and "B" class roads. Little agricultural land is likely to be present.
- C** High grade agricultural land suitable for cereal and cash crops. Residential and industrial property, as well as roads, amenity and/or navigation interests may also be predominant.
- D** Typical land use incorporating average grass margin crops and permanent pasture. Little residential or industrial property will be present. Conservation and water ecology interests may be significant.
- E** This covers areas that are generally of low grade land use. Residential or industrial property is unlikely to be present. Agricultural use is likely to be limited to horse paddocks, forestry and scrub grazing land. Land within this category may have a high conservation value.

### **Reference Port**

The Admiralty Tide Tables (Volume 1, Part 2) identifies the reference port most applicable for tide level prediction from the range of secondary ports listed. The reference port entered against the defence is the secondary port nearest to that defence.

## **East Lothian Council Shoreline Management Plan**

### **HAT Level**

This is the level of the Highest Astronomical Tide (HAT).

### **LAT Level**

This is the level of the Lowest Astronomical Tide (LAT) and is often referred to as Chart Datum.

### **Residual Life**

An assessment of the residual life in years of the defence is made.

### **Approx. Crest Level (m OD)**

This is a visual assessment of the approximate level of the crest of the coastal defence. The level is assessed visually via knowledge of the level of nearby bench marks or spot levels from the Ordnance Survey digital maps.

### **Report**

In addition to the above points, a short paragraph should accompany each coastal defence describing the main attributes and characteristics together with any other relevant information.

### **Note**

The following 3 pages are the list of coastal defences noted during this project.

East Lothian Council Shoreline Management Plan

Appendix D: Coastal Defence Survey

| Id  | Location    | MU  | Description          | OS Grid Ref |          | Asset Type | Condition | Degree of Exposure | Principle Landuse Type | Risk             | Reference Port | Hat mOD | Lat mOD | Residual Life | Length (m) | Foreshore Type  | Eroding/ Stable/ Accreting | Approx. Crest Level (m OD) | Property at Risk    |
|-----|-------------|-----|----------------------|-------------|----------|------------|-----------|--------------------|------------------------|------------------|----------------|---------|---------|---------------|------------|-----------------|----------------------------|----------------------------|---------------------|
|     |             |     |                      | Start       | Finish   |            |           |                    |                        |                  |                |         |         |               |            |                 |                            |                            |                     |
| 1   | Musselburgh | MU1 | Fisherrow sands      | NT328732    | NT329731 | R Rev      | 2         | Medium             | B                      | Erosion          | Leith          | 3.2     | -2.9    | 10-25         | 124        | Sand            | Stable                     | approx 5m                  | Domestic            |
| 2   | Musselburgh | MU1 | Fisherrow sands      | NT330730    | NT332730 | C/M wall   | 2         | Medium             | B                      | Flooding         | Leith          | 3.2     | -2.9    | 25-50         | 155        | Sand            | Accreting                  | approx 5m                  | A Road              |
| 4   | Musselburgh | MU1 | Fisherrow sands      | NT333730    | NT334730 | C/M wall   | 1         | Medium             | B                      | Flooding         | Leith          | 3.2     | -2.9    | 25-50         | 131        | Sand            | Stable                     | approx 4.5m                | Commercial/Domestic |
| 3   | Musselburgh | MU1 | Fisherrow sands      | NT332730    | NT333730 | C/M wall   | 2         | Medium             | B                      | Flooding         | Leith          | 3.2     | -2.9    | 25-50         | 105        | Sand            | Stable                     | varies                     | Commercial          |
| 5   | Musselburgh | MU1 | Fisherrow harbour    | NT334730    | NT335730 | Harbour    | 2         | High               | B                      | Flooding         | Leith          | 3.2     | -2.9    | >50           | 133        | Sand/mud        | Stable                     | varies                     | Commercial/Domestic |
| 6   | Musselburgh | MU1 | Fisherrow promenade  | NT335730    | NT337730 | C/M wall   | 2         | Medium             | B                      | Flooding         | Leith          | 3.2     | -2.9    | 10-25         | 131        | Sand            | Stable                     | approx 4.3m                | Road/Domestic       |
| 7   | Musselburgh | MU1 | Mouth of Esk         | NT345735    | NT346736 | C/M wall   | 4         | Low                | B                      | Flooding         | Leith          | 3.2     | -2.9    | <10           | 1040       | Mud             | Stable                     | approx 4.5m                | Domestic            |
| 8   | Musselburgh | MU2 | Ash Lagoons          | NT346736    | NT370738 | C/M wall   | 1         | High               | D                      | Flooding         | Leith          | 3.2     | -2.9    | >50           | 2726       | Sand            | Stable                     | approx 4.9m                | Reclaimed land      |
| 9   | Musselburgh | MU3 | The Cast             | NT370738    | NT372739 | R Rev      | 3         | Medium             | D                      | Erosion          | Leith          | 3.2     | -2.9    | <5            | 129        | Sand/shingle    | Eroding                    | approx 4.9m                | Reclaimed land      |
| 10  | Musselburgh | MU3 | The Cast             | NT372739    | NT378741 | Gabions    | 4         | High               | D                      | Erosion          | Leith          | 3.2     | -2.9    | <1            | 716        | Sand/shingle    | Eroding                    | varies                     | Reclaimed land      |
| 11  | Prestonpans | MU4 | Prestonpans          | NT378741    | NT380743 | C/M wall   | 3         | High               | B                      | Erosion/Flooding | Leith          | 3.2     | -2.9    | <10           | 311        | Bedrock/shingle | Eroding                    | varies                     | Domestic            |
| 12  | Prestonpans | MU4 | Prestonpans          | NT380743    | NT381743 | C/M wall   | 2         | Medium             | B                      | Erosion/Flooding | Leith          | 3.2     | -2.9    | 25-50         | 91         | Sand/shingle    | Stable                     | varies                     | Domestic            |
| 13  | Prestonpans | MU4 | Prestonpans          | NT381743    | NT389747 | C/M wall   | 3         | High               | B                      | Erosion/Flooding | Leith          | 3.2     | -2.9    | <10           | 843        | Bedrock/shingle | Eroding                    | varies                     | Domestic            |
| 14  | Prestonpans | MU5 | Preston Links        | NT390750    | NT390753 | R Rev      | 3         | Medium             | D                      | Erosion          | Leith          | 3.2     | -2.9    | <10           | 260        | Shingle/cobble  | Eroding                    | varies                     | Reclaimed land      |
| 15  | Cockenzie   | MU5 | Preston Links        | NT390753    | NT392754 | R Rev      | 1         | High               | D                      | Erosion          | Leith          | 3.2     | -2.9    | >50           | 236        | Shingle/cobble  | Stable                     | varies                     | Reclaimed land      |
| 16  | Cockenzie   | MU5 | Cockenzie Power Stat | NT392754    | NT397756 | C/M wall   | 1         | High               | B                      | Erosion          | Leith          | 3.2     | -2.9    | >50           | 567        | Mud             | Stable                     |                            | Industrial          |
| 17  | Cockenzie   | MU6 | Cockenzie Harbour    | NT397756    | NT398757 | Harbour    | 2         | Medium             | B                      | Flooding         | Leith          | 3.2     | -2.9    | >50           | 235        | Bedrock         | Stable                     | varies                     | Commercial/Domestic |
| 18  | Cockenzie   | MU6 | Cockenzie Shoreline  | NT399757    | NT404759 | C/M wall   | 2         | Low                | B                      | Erosion/Flooding | Leith          | 3.2     | -2.9    | 25-50         | 474        | Bedrock         | Stable                     | varies                     | Domestic            |
| 19  | Port Seton  | MU6 | Port Seton Harbour   | NT404759    | NT406760 | Harbour    | 2         | High               | B                      | Flooding         | Leith          | 3.2     | -2.9    | >50           | 368        | Bedrock         | Stable                     | approx 8m                  | Commercial/Domestic |
| 20  | Port Seton  | MU6 | Port Seton Dev.      | NT406760    | NT409760 | C/M wall   | 2         | Medium             | B                      | Erosion/Flooding | Leith          | 3.2     | -2.9    | >50           | 242        | Bedrock         | Stable                     |                            | Domestic            |
| 21  | Port Seton  | MU6 | Port Seton Promenade | NT409760    | NT414759 | C/M wall   | 2         | Medium             | B                      | Flooding         | Leith          | 3.2     | -2.9    | 25-50         | 575        | Sand            | Stable                     | approx 4.8m                | Road/Domestic       |
| 22  | Port Seton  | MU6 | Port Seton Housing   | NT414759    | NT415759 | C/M wall   | 3         | High               | B                      | Flooding         | Leith          | 3.2     | -2.9    | 10-25         | 107        | Sand            | Erosion                    | varies                     | Domestic            |
| 23A | Longniddry  | MU7 | Coast Road           | NT439769    | NT440769 | C/M wall   | 3         | Medium             | B                      | Erosion          | Leith          | 3.2     | -2.9    | <5            | 113        | Sand/shingle    | Erosion                    | 5.5m                       | Road                |
| 23B | Gosford Bay | MU7 | Coast Road           | NT444778    | NT445779 | C/M wall   | 2         | Medium             | B                      | Erosion          | Dunbar         | 3       | -2.9    | 10-25         | 228        | Shingle         | Erosion                    | approx 6.5m OD             | Coast Road          |



East Lothian Council Shoreline Management Plan

Appendix D: Coastal Defence Survey

| Id  | Location      | MU   | Description           | OS Grid Ref |          | Asset Type  | Condition | Degree of Exposure | Principle Landuse Type | Risk     | Reference Port | Hat mOD | Lat mOD | Residual Life | Length (m) | Foreshore Type  | Eroding/Stable/ Accreting | Approx. Crest Level (m OD) | Property at Risk        |
|-----|---------------|------|-----------------------|-------------|----------|-------------|-----------|--------------------|------------------------|----------|----------------|---------|---------|---------------|------------|-----------------|---------------------------|----------------------------|-------------------------|
|     |               |      |                       | Start       | Finish   |             |           |                    |                        |          |                |         |         |               |            |                 |                           |                            |                         |
| 24  | Gosford Sands | MU7  | Coast Road            | NT448784    | NT449787 | R Rev       | 4         | High               | B                      | Erosion  | Dunbar         | 3       | -2.9    | <5            | 235        | Shingle         | Erosion                   | approx 6.1m                | Road                    |
| 25  | Gosford Sands | MU7  | Greencraigs           | NT447793    | NT449790 | R Rev       | 3         | Medium             | D                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 193        | Sand/shingle    | Erosion                   | approx 5m OD               | Forestry/Greencraigs    |
| 26  | Kilspindie    | MU8  | Kilspindie Golf Cour. | NT454804    | NT455804 | C/M wall    | 3         | High               | C                      | Erosion  | Dunbar         | 3       | -2.9    | <5            | 228        | Bedrock/shingle | Erosion                   | approx 5.5mOD              | Golf Course             |
| 27  | Archerfield   | MU10 | Marine Villa          | NT502860    | NT503860 | Beach       | 2         | High               | C                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 73         | Shingle         | Erosion                   | beach level                | Housing                 |
| 28  | North Berwick | MU11 | West Links Golf Cour  | NT534855    | NT537857 | Gabions     | 3         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 232        | Sand/Bedrock    | Erosion                   |                            | Golf Course             |
| 29  | North Berwick | MU11 | West Links Golf Cour  | NT544856    | NT546856 | Timber wall | 2         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 175        | Sand/Bedrock    | Erosion                   |                            | Golf Course             |
| 30  | North Berwick | MU12 | North Berwick Bay     | NT549854    | NT551854 | Timber wall | 2         | Low                | B                      | Erosion  | Dunbar         | 3       | -2.9    | 25-50         | 232        | Sand/shingle    | Stable                    | approx 5.5m                | Recreation area         |
| 31  | North Berwick | MU12 | North Berwick Bay     | NT551854    | NT554855 | C/M wall    | 2         | Low                | B                      | Flooding | Dunbar         | 3       | -2.9    | 25-50         | 332        | Sand            | Stable                    | varies                     | Property                |
| 32  | North Berwick | MU12 | North Berwick Bay     | NT554855    | NT553856 | C/M wall    | 2         | Low                | B                      | Flooding | Dunbar         | 3       | -2.9    | 25-50         | 83         | Sand            | Stable                    | approx 3m                  | Property                |
| 33  | North Berwick | MU12 | N Berwick Harbour     | NT553856    | NT554857 | Harbour     | 3         | Medium             | B                      | Flooding | Dunbar         | 3       | -2.9    | >50           | 200        | Bedrock         | Stable                    | varies                     | Property                |
| 34  | North Berwick | MU12 | Seabird Centre        | NT554857    | NT554855 | C/M wall    | 1         | Medium             | B                      | Flooding | Dunbar         | 3       | -2.9    | >50           | 237        | Bedrock         | Stable                    | varies                     | Commercial              |
| 35  | North Berwick | MU12 | East Links            | NT554855    | NT555854 | C/M wall    | 1         | Low                | B                      | Flooding | Dunbar         | 3       | -2.9    | 25-50         | 155        | Sand            | Stable                    | approx 5.5m                | Domestic/Road           |
| 36  | North Berwick | MU12 | East Links            | NT560852    | NT560852 | Timber wall | 2         | Medium             | B                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 26         | Sand            | Stable                    |                            | Car Park                |
| 37  | North Berwick | MU12 | East Links            | NT561852    | NT851562 | Geotextile  | 2         | Medium             | B                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 115        | Sand            | Stable                    |                            | Road                    |
| 38  | North Berwick | MU12 | East Links            | NT565852    | NT565852 | R Rev       | 4         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | <10           | 38         | Sand            | Eroding                   | beach level                | Road/Golf Course        |
| 38A | Belhaven Bay  | MU15 | Seafeld Pond          | NT657785    | NT662786 | C/M wall    | 2         | Low                | C                      | Stable   | Dunbar         | 3       | -2.9    |               | 500        | Sand            | Stable                    |                            | Pond                    |
| 39  | Dunbar        | MU16 | Winterfield           | NT663789    | NT663791 | Gabions     | 3         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 129        | Sand/Bedrock    | Eroding                   |                            | Golf Course             |
| 40  | Dunbar        | MU16 | Winterfield           | NT663793    | NT664792 | R Rev       | 3         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 143        | Sand/shingle    | Eroding                   |                            | Golf Course             |
| 41  | Dunbar        | MU16 | Winterfield           | NT665791    | NT666791 | C/M wall    | 4         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | <10           | 47         | Sand/shingle    | Eroding                   |                            | Golf Course/ Club house |
| 42  | Dunbar        | MU16 | Winterfield           | NT666791    | NT667792 | C/M wall    | 4         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | <10           | 147        | Sand/shingle    | Eroding                   |                            | Golf Course             |
| 43  | Dunbar        | MU17 | Cliff-top path        | NT675792    | NT675792 | Gabions     | 2         | Medium             | B                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 25         | Shingle         | Eroding                   |                            | Domestic/Path           |
| 44  | Dunbar        | MU17 | Cliff-top path        | NT675792    | NT675792 | R Rev       | 2         | Medium             | B                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 21         | Shingle         | Eroding                   |                            | Domestic/Path           |
| 45  | Dunbar        | MU17 | Cliff-top path        | NT676792    | NT676792 | C/M wall    | 4         | Medium             | B                      | Erosion  | Dunbar         | 3       | -2.9    | <10           | 41         | Shingle/bedrock | Eroding                   |                            | Path                    |
| 46  | Dunbar        | MU17 | Dunbar Harbour        | NT678794    | NT681791 | Harbour     | 2         | High               | B                      | Flooding | Dunbar         | 3       | -2.9    | >50           | 684        | Bedrock         | Stable                    | approx 9.4m                | Domestic                |

East Lothian Council Shoreline Management Plan

Appendix D: Coastal Defence Survey

| Id | Location     | MU   | Description          | OS Grid Ref |           | Asset Type       | Condition | Degree of Exposure | Principle Landuse Type | Risk     | Reference Port | Hat mOD | Lat mOD | Residual Life | Length (m) | Foreshore Type  | Eroding/Stable/Accreting | Approx. Crest Level (m OD) | Property at Risk      |
|----|--------------|------|----------------------|-------------|-----------|------------------|-----------|--------------------|------------------------|----------|----------------|---------|---------|---------------|------------|-----------------|--------------------------|----------------------------|-----------------------|
|    |              |      |                      | Start       | Finish    |                  |           |                    |                        |          |                |         |         |               |            |                 |                          |                            |                       |
| 47 | Dunbar       | MU18 | East Beach           | NT681791    | NT682788  | C/M wall         | 4         | Medium             | B                      | Erosion  | Dunbar         | 3       | -2.9    | <10           | 312        | Sand/Bedrock    | Eroding                  | approx 6.4m                | Domestic/Road         |
| 48 | Dunbar       | MU18 | East Beach Groyne    | NT682788    | NT6827899 | Groyne           | 4         | Medium             | B                      |          | Dunbar         | 3       | -2.9    | 10-25         | 49         | Bedrock         | Eroding                  |                            |                       |
| 49 | Dunbar       | MU18 | East Beach           | NT682788    | NT682788  | C/M wall         | 2         | Medium             | B                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 31         | Bedrock         | Eroding/Stable           |                            | Domestic              |
| 50 | Dunbar       | MU18 | East Beach           | NT682788    | NT683787  | C/M wall         | 3         | Medium             | B                      | Flooding | Dunbar         | 3       | -2.9    | <10           | 89         | Sand/Bedrock    | Eroding                  |                            | Domestic              |
| 51 | Dunbar       | MU18 | East Beach           | NT683787    | NT683786  | C/M wall         | 3         | Medium             | B                      | Flooding | Dunbar         | 3       | -2.9    | <10           | 119        | Sand/Bedrock    | Eroding                  |                            | Domestic              |
| 52 | Dunbar       | MU18 | East Beach           | NT683786    | NT685785  | C/M wall         | 2         | Low                | B                      | Flooding | Dunbar         | 3       | -2.9    | 25-50         | 227        | Sand            | Accreting                |                            | Domestic              |
| 53 | Dunbar       | MU18 | Promenade East Beach | NT685785    | NT689785  | C/M wall         | 2         | Medium             | C                      | Flooding | Dunbar         | 3       | -2.9    | 25-50         | 336        | Bedrock/shingle | Stable                   | approx 4.4m                | Domestic/Golf Course  |
| 54 | Dunbar       | MU19 | Dunbar Golf Course   | NT689785    | NT689785  | C/M wall         | 2         | Medium             | C                      | Flooding | Dunbar         | 3       | -2.9    | 25-50         | 93         | Bedrock/shingle | Stable                   | approx. 5.5m               | Domestic/Golf Course  |
| 55 | Dunbar       | MU19 | Brox Burn            | NT696782    | NT696782  | Gabions          | 1         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 45         | Shingle         | Eroding                  |                            | Golf Course           |
| 56 | Dunbar       | MU19 | Dunbar Golf Course   | NT696782    | NT699783  | R Rev            | 4         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | <10           | 297        | Shingle         | Eroding                  |                            | Golf Course           |
| 57 | Dunbar       | MU19 | Dunbar Golf Course   | NT702782    | NT702782  | R Rev            | 4         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | <10           | 28         | Shingle         | Eroding                  |                            | Golf Course           |
| 58 | Torress      | MU21 | Torress Power Statio | NT743754    | NT751749  | C/R Rev C/M Wall | 1         | High               | C                      | Erosion  | Dunbar         | 3       | -2.9    | >50           | 1493       | Bedrock         | Stable                   |                            | Torress Power Station |
| 59 | Torress      | MU21 | Torress Power Statio | NT751749    | NT752748  | R Rev            | 2         | Medium             | D                      | Erosion  | Dunbar         | 3       | -2.9    | 25-50         | 135        | Sand            | Stable                   |                            | Torress Power Station |
| 60 | Thorntonloch | MU22 | Thorntonloch         | NT751746    | NT752745  | R Rev            | 2         | Medium             | C                      | Erosion  | Dunbar         | 3       | -2.9    | 10-25         | 145        | Sand/shingle    | Eroding                  |                            | Caravan Park          |

## Appendix E: Property Maintenance Survey (ELC)

**East Lothian Council**  
**Shoreline Management Plan**

Final Report

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## SHORELINE MANAGEMENT PLAN

### APPENDIX E: EAST LoTHIAN COUNCIL PROPERTY MAINTENANCE AUDIT

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ESTIMATED COSTS 2001 |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>LOCATION:</b> | <b>MUSSELBURGH</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                      |
|                  | 1 Harbour area ; (Murray Hutchison)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | By Others            |
|                  | 2 Sandy Promenade ; (Murray Hutchison)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | By Others            |
|                  | 3 Goose Green to Prestongrange ; Concrete retaining wall, owned by Scottish Power                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | By Others            |
| <b>LOCATION:</b> | <b>PRESTOPANS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |
|                  | 1 Wall at rear of Inchview; badly corroded and high tides are undermining at lower level.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 20 000               |
|                  | 2 Wall at Cuthill to redburn Junction: this area is in good condition and needs no attention.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0 00                 |
|                  | 3 Redburn Junction to Ormiston Place; Stepped access at Redburn Road area are not adequate and require extending.<br>Redburn Road area sea wall is experiencing undermining from high tides.<br>Wall to rear of Antonellis has water ingress and joints failing.<br>Flats between Redburn and Masonic Hall has holes and bulged areas in retaining wall.<br>Wall directly to the rear of the Masonic Hall has undermining and various repairs upon repairs.<br>Retaining wall to private house at Ormiston place is bulging and in bad state of repair.<br>John Muir walkway at Masonic Hall requires concrete repair.<br>Tanking blocks to Ormiston Place car park are badly corroded and being undermined by high tides.<br>Retaining wall for flats at Ormiston Place being undermined by high seas. | 300 000              |
|                  | 4 Ormiston Place to war Memorial ; Stepped access at West Seaside is uneven and has a large drop at lower level.<br>Retaining wall at West Seaside has large open crack and also experiencing undermining.<br>Repairs upon repairs to Aldhammer House retaining wall.<br>Aldhammer House concrete retaining wall is failing.<br>Stone wall to rear of War Memorial is failing and in bad state of repair.                                                                                                                                                                                                                                                                                                                                                                                               | 25 000               |
|                  | 5 Burns Monument to Power Station; Walls failing at low level below monument.<br>Stepped access at monument not adequate due to large drop at lower level.<br>Wall at Safeway area failing due to corrosion.<br>Spillway at Sailing Centre collapsed due to spring tides.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 50 000               |
| <b>LOCATION:</b> | <b>COCKENZIE/PORT SETON</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |
|                  | 1 Power Station ; Concrete retaining wall around Station land and Cockenzie Harbour. (Murray Hutchison)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | By Others            |
|                  | 2 Shoreline from Cockenzie to Port Seton Harbour has natural rock sea defences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | By Others            |
|                  | 3 Port Seton Harbour, (Murray Hutchison)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | By Others            |
|                  | 4 Promenade; three stepped areas require refacing due to corrosion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5 000                |

|                  |                                                                                                                            |           |
|------------------|----------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>LOCATION:</b> | <b>SETON SANDS TO NORTH BERWICK</b>                                                                                        |           |
|                  | Murray Hutchison                                                                                                           | By Others |
| <b>LOCATION:</b> | <b>NORTH BERWICK</b>                                                                                                       |           |
|                  | 1 West Links; Sleepered areas has various rotting timbers. (Murray Hutchison)                                              | By Others |
|                  | 2 Beach Road ; Sleepered areas has various rotting timbers                                                                 | 10 000    |
|                  | 3 Harbour and East Beach; (Murray Hutchison)                                                                               | By Others |
| <b>LOCATION:</b> | <b>NORTH BERWICK TO BELHAVEN BAY</b>                                                                                       |           |
|                  | Murray Hutchison                                                                                                           | By Others |
| <b>LOCATION:</b> | <b>DUNBAR</b>                                                                                                              |           |
|                  | 1 Belhaven Bay ; The bridge covering Biel Water does not cover span of water substantially enough                          | 5 000     |
|                  | 2 Tanking blocks to perimeter of Winterfield are not substantial enough. (Murray Hutchison).                               | By Others |
|                  | 3 Clifftop Trail ; The whole trail is either subsiding due to erosion or cracked and falling away due to the same problem. | By Others |
|                  | 4 Dunbar Harbours ; (Murray Hutchison).                                                                                    | By Others |
|                  | 5 East Beach ; Retaining walls are in bad state of repair in respect to undermining and holing of concrete walls.          | 50 000    |
|                  | 6 Remaining areas or any areas not mention ; (Murray Hutchison).                                                           | By Others |
| <b>GENERAL</b>   | Contingencies for areas not covered in above locations.                                                                    | 35 000    |
|                  | <b>Total.</b>                                                                                                              | 500 000   |

#### FOOTNOTE

1. Visual inspections only.
2. Based on one off repair costs undertaken within the financial year 2002/2003.
3. Assumed structural/site surveys on above reveal no untoward or exceptional site conditions.

## Appendix F: Natural Heritage Designations