THE MORAY FIRTH

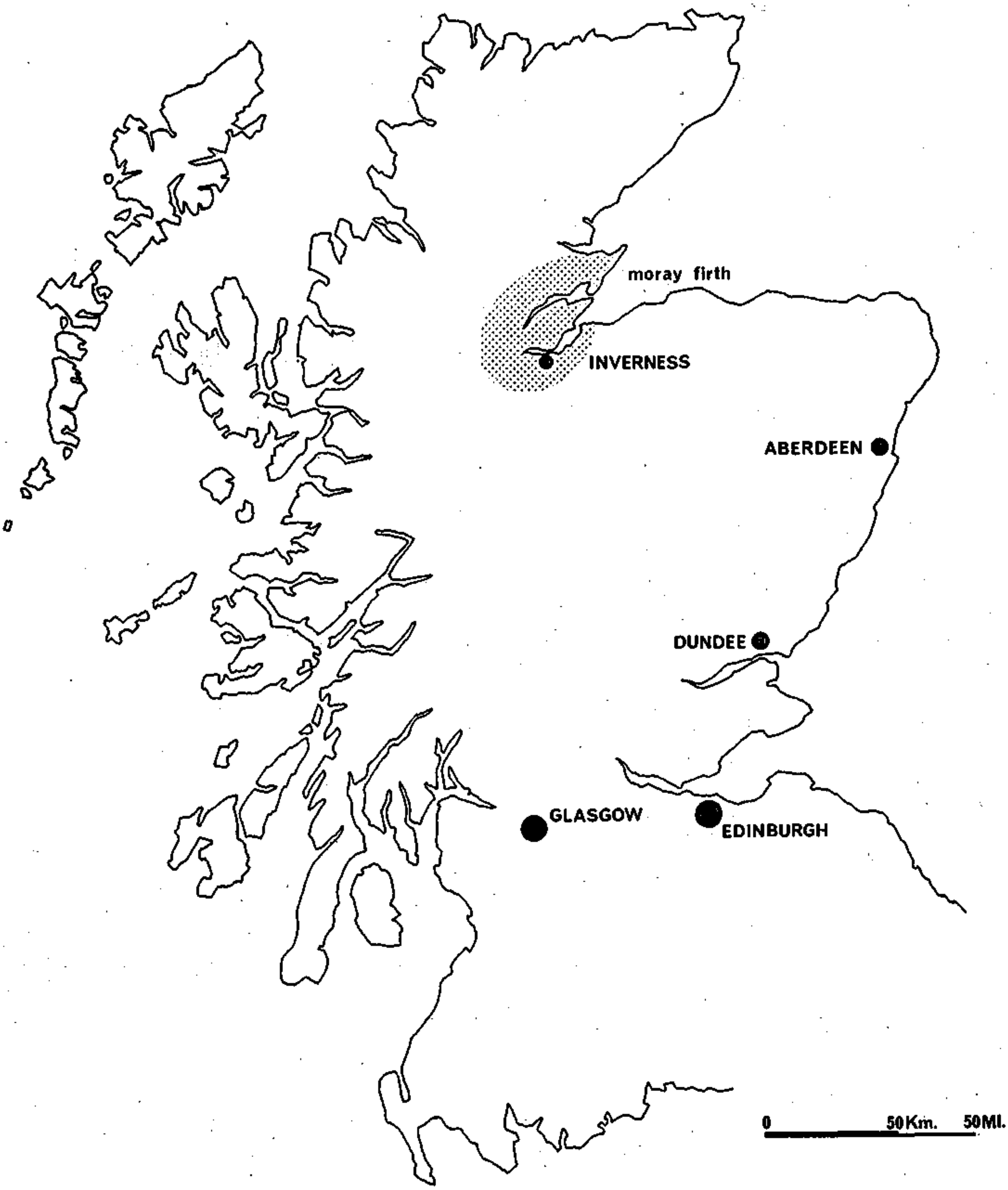
a plan for growth
in a sub-region of the Scottish Highlands

REPORT

to the Highlands and Islands Development Board

the Jack Holmes Planning Group

march 1968



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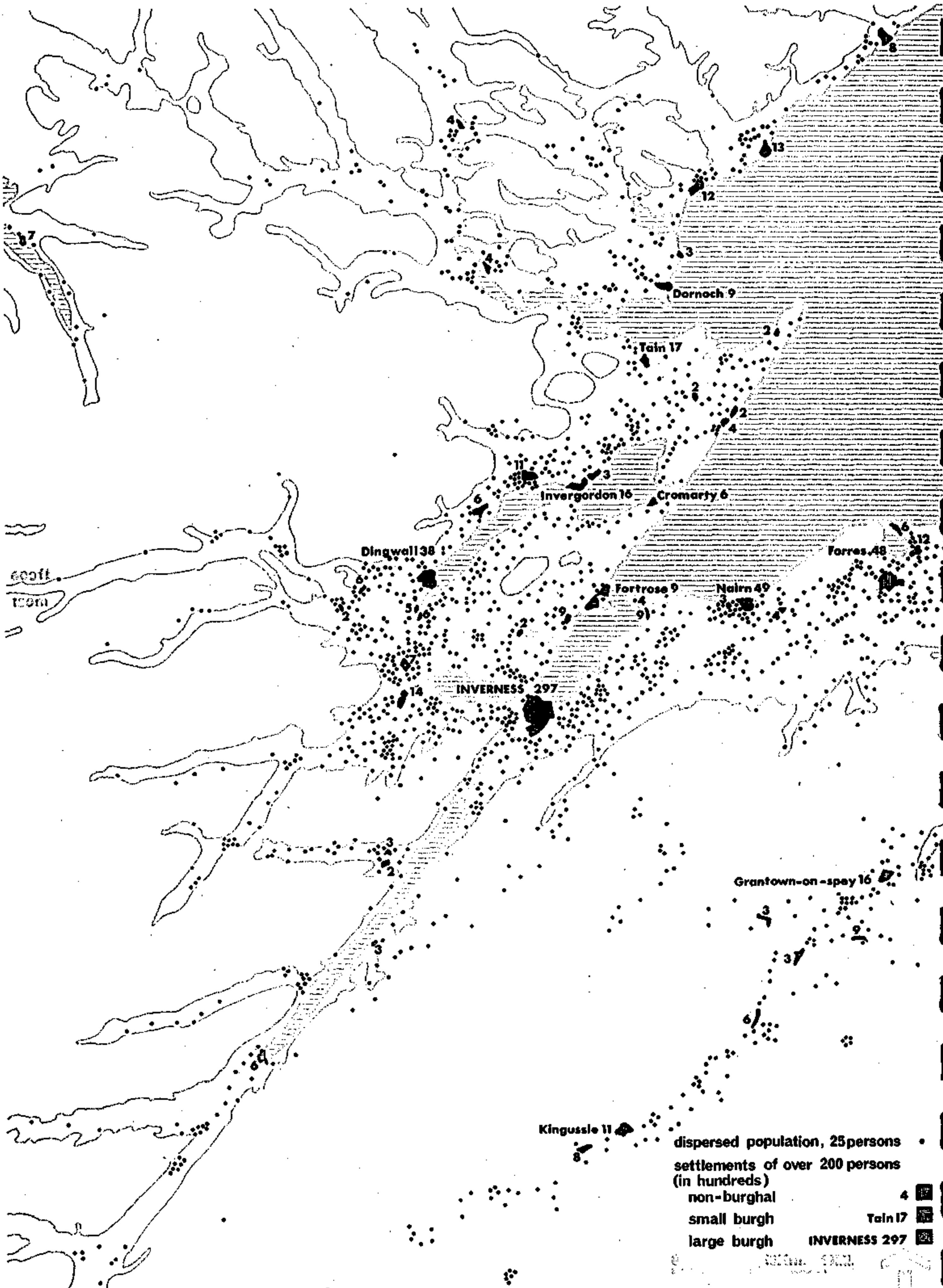
CONTENTS OF THE REPORT

PART ONE

INTRODUCTION, OUTLINE OF REPORT AND SUMMARY OF MAIN CONCLUSIONS

CONTENTS



DISTRIBUTION OF POPULATION 1961

compiled from Scotland Population Distribution 1961 published by Wm. Collins on behalf of the University of Glasgow 1965

INTRODUCTION

The Highlands and Islands Development Board was established in 1965 to assist the people of the Scottish Highlands and Islands to improve their social and economic conditions and to enable the area to play a more effective part in the growth of the nation. Paragraphs 88 to 97 of the Board's first Report relate to the importance of the Moray Firth Development in their overall policy for achieving its objectives.

Our appointment to assess the capacity of the Moray Firth area for development was confirmed in January, 1967, and had been preceded by an Industrial Credibility Study. Our task was "to prepare a plan for urban land use, and an infrastructure arising from industrial expansion at Invergordon". It has not been part of our brief to argue the case for industrial development at Invergordon from the local, regional or national points of view, but to examine and report on the consequences of such development. The brief issued to us by the Highlands and Islands Development Board is fully set out in Appendix One.

This investigation of the capacity for development in the Moray Firth area has had to be carried out in the absence of the sort of information normally available to urban expansion studies. The amount and type of industrial development expected, the rate of industrial growth and consequently the rate and character of population expansion have remained largely unknown during the period of the study. This situation has made us very conscious of the need for a plan with real flexibility, and has also deterred us from attempting speculative quantitative forecasts, except in a few special circumstances. It is an important conclusion from our analysis that further work will be required as soon as reliable data become available as to the type, scale, timing and location of industrial development.

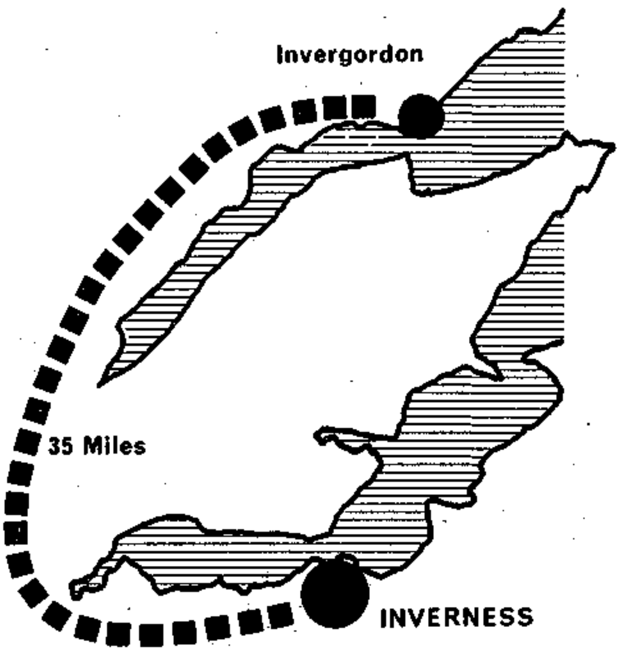
Clearly the most important single fact known to us was the probability of large-scale, capital-intensive, industrial development in the vicinity of Invergordon. Indeed this possibility is the immediate cause of the whole study, which could in fact be described as an account of how we answered the question, if major industrial development occurs at Invergordon where should the people live? This question raises many more, and some of them are specified in our brief. The answers to such questions as far as we have been able to ascertain them make up the strategy for development, which we foresee could result in a future population of between 250,000 and 300,000 persons living in the Moray Firth area, compared with its present population of approximately 70,000. The possibilities which we have identified on our Strategy map cannot be taken as more than an indication of reasonable areas for development if the need arises and if the principles underlying the strategy are adopted. We have throughout the study been extremely conscious that any development will cause changes in the local agricultural economy and will affect the rural character of the sub-region. In devising a feasible and flexible strategy we have attempted to limit to the necessary minimum any disruptive effects of development, while obtaining the maximum benefit from any inevitable changes.

In our analysis of the capacity of the Study Area, it was clear from the beginning that some of the possibilities for development were much more likely than others. Indeed during the fourteen months of our study this has become even more evident despite the fact that at this date, there is still no irreversible decision to develop industry at Invergordon. However, the Highlands and Islands Development board have always regarded the imminent possibility of industry at Invergordon as one of the facts that any strategy for development must fully recognise. It has therefore been necessary to concentrate attention on the immediate implications of such a development but this does not mean that the additional studies referred to are any less important than those included in the report itself.

The portions of this study which are clearly a plan for early action (largely Parts 4 and 5) and which provide a guide as to how and where to make a start on the building and civil engineering projects required also serve a wider purpose. We have used them as the means of testing in some detail the sub-regional strategy derived by working at a much smaller scale. The techniques of analysis, and the principles underlying the subsequent structure of settlement patterns are common to all levels in our study. The long term strategy designed at a scale of 1:25,000, the Alness plan designed at 1:2500 and the locality layout designed at 1:500, form a coherent and integrated whole. For example, 2.10 at the regional scale, and map 4.2 at the settlement scale and the sketch 5.7 are all examples of the "window" concept (see Part Two) and the cover of the Report is itself a further example. Throughout the study we attempted in this way to marry together urgent short term plans and a possible long term strategy by consistent methods of working, and continual cross-checking between the different scales of study.

The selection of the study area stems from a national policy decision to promote development in the Scottish Highlands, and Invergordon is accepted as the catalyst of regional development because of its inherent physical suitability for industry. However, more than mere physical suitability for industry is required before regional development can take effect, and important among the supporting roles is the vital function of Inverness as the sub-regional capital, containing the skills, institutions and transportation facilities that will articulate the development process. It is because we regard this functional link as being fundamentally important that our strategy emphasises development between Invergordon and Inverness. There is in fact capacity for further development north of Tain and east of Ardisier which we have not examined. In essence, therefore, our capacity study can be said to be based on industrial growth at Invergordon leading to further regional development which will occur in Inverness itself or between these two potential growth points.

Much of our enquiry has therefore been devoted to establishing that the residential capacity of the study area can be expanded to match such an increase in industrial growth. This capacity has been established and as the Report demonstrates, it is expected that development in this area can be accompanied by an extremely high quality of environment. The natural beauty of the area, its wonderful views, the accessibility of outdoor recreational opportunities, the low rainfall and high sunshine record, combine to offer a setting which can hardly be rivalled in the country. It has been our challenge to provide the framework for a built environment comparable in quality to these natural assets.



OUTLINE OF REPORT.

The report is arranged broadly according to the way in which we tackled our remit, that is by working first at the sub-regional scale and defining possible areas of development. Subsequently, some of these possibilities were used as areas of search within which more detailed proposals for development were drawn up, as in the case of Alness, and in a single example an actual housing layout has been tested.

Part Two begins by outlining the objectives on which the strategy is based, that is the need for the maximum possible flexibility that can be combined with the social, economic and environmental characteristics that make such a strategy feasible. The second portion of Part Two is an analysis at the sub-regional scale of the major elements that create limitations on, and opportunities for, development. Here we consider not only the physical restraints of topography, climate, and existing development, but also such elements as agricultural potential, transportation possibilities, social needs, and alternative ways of phasing the development.

Part Three is, therefore, an account of the strategy evolved from the analyses described in Part Two. It discusses the major alternatives considered, and the major options or choices it has proved possible to retain within the strategy.

Part Four contains the results of a study to draw up a master plan for the settlement which is expected to develop first, as a consequence of industrial development at Invergordon. The Alness study thus contains proposals for the development of a settlement for about 16,000 persons.

Part Five is a housing layout sample study within Alness, and demonstrates how the general planning approach in Parts Two, Three and Four can be realised in an actual residential development including the primary school and local shops.

Part Six. As explained previously, only selected samples of the possible developments shown in the sub-regional strategy have been fully examined in more detail and at a larger scale. However, particular issues did emerge from Part Two which required further examination as part of the necessary testing of the sub-regional strategy. It is these that constitute the supporting studies contained in Part Six.

The Appendices are mainly of a technical nature and a general summary of our main conclusions can be found on page 8.

SUMMARY OF MAIN CONCLUSIONS

		PART
1.	The Report demonstrates that the Moray Firth area could house a population of 250,000 to 300,000 in comfort and in pleasant surroundings.	THREE
2.	The splendid natural setting presents an opportunity to create higher environmental quality than perhaps anywhere in the British Isles.	TWO
3.	The strategy is based on the hypothesis that major capital intensive industries will be established at Invergordon. It is also assumed that the combination of assets offered by the site at Invergordon - deep water harbour, flat land, ample fresh water and rail head - will be reserved for those industries which need them.	TWO
4.	Major sites for other industries at Evanton, Muir of Ord, Kirkhill, Inverness, Dalcross and, if required, at Tore, satisfy a wide range of locational requirements.	TWO
5.	The settlement pattern of the strategy gives a diversity of physical environments in which to accommodate a variety of social patterns.	TWO
6.	The strategy can accommodate all of the wide variations of scale, timing and speed of development that seem to us even remotely possible. The report contains both a long term strategy, and plans for infrastructure to meet the implications of immediate industrial development at Invergordon.	TWO and THREE
7.	The strategy achieves feasibility and flexibility through a combination of landscape opportunities, land restraints, transportation possibilities, settlement thresholds and phasing opportunities.	TWO
8.	The units of development known as Localities have within themselves the basic social requirements for a settled way of life from the start.	FOUR
9.	Housing sites have been chosen from the best available, but with due regard to conservation of the best agricultural land.	FOUR

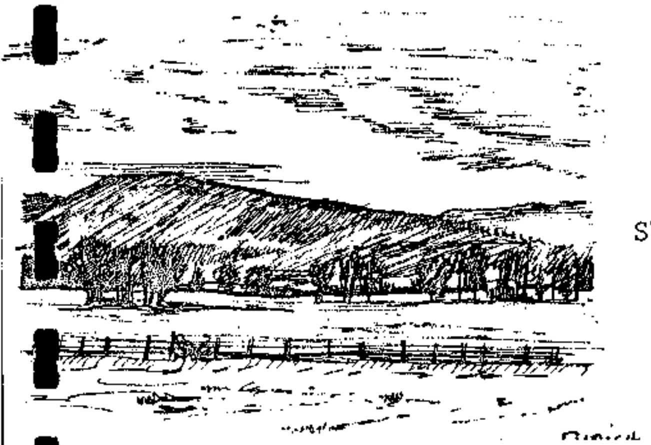
		PART
10.	The survey criteria used in selecting housing sites were shelter, protection, views and aspect. Each community has a 'window' to the view.	TWO and FIVE
11.	The design criteria used in further selection were:- convenience and choice of journey to work, relationship to existing communities, transportation pattern and settlement hierarchy.	TWO
12.	Inverness as the Highland capital and Invergordon as the primary industrial generator are joined by a fast transportation spine to which other settlements are easily attached.	THREE and SIX
13.	Other towns in the area are proposed for expansion to between 16,000 and 22,000 population. They are Alness, Evanton and Muir of Ord. Three new towns of similar size are included at Fearn, Brahan and Balloch.	THREE
14.	Several existing towns and villages are expanded to between 3,000 and 7,000 population. They are Dingwall, Maryburgh/Conon Bridge, Tain, Beauly, Kirkhill, Aultfearn and Belladrum.	THREE
15.	In special circumstances development on the north shore of the Beauly Firth is allowed for in the Tore Option.	THREE
16.	The transportation pattern is a Fast Road from Inverness to Invergordon with Primary Distributor loop roads serving each of the communities. This 'Aaron's Rod' pattern is a very economical and efficient system for a linear development.	TWO and SIX
17.	The full length of the Fast Road will be necessary from the start. Increases in width of various stretches will synchronise with the development of townships. Distributors will only be required as localities and townships are built up.	THREE
18.	We have not found any special condition or circumstance which would lead us to expect that building and civil engineering cost would be higher in this area than anywhere else in the United Kingdom provided that the indigenous resources of heavy building materials are fully and sensibly used in preference to the imported article.	SIX
19.	The programme of implementation could only be carried through by an executive authority set up for this specific purpose.	SIX

		PART
20.	Early sites for housing will be available at Alness which is close to Invergordon, and at Maryburgh/ Conon Bridge and Dingwall as alternatives within easier reach of Inverness.	THREE
21.	The Alness Study serves both as a model to test the principles used in the Strategy and as a plan of action for the first infrastructure development	FOUR and FIVE
22.	To reach capacity by the end of the century development must be implemented by means of rolling programmes and forms of serial contracting.	SIX
23.	Our investigations have revealed the need for further study of particular problems and localities.	SIX

PART TWO

SUB-REGIONAL STUDY

CONTENTS



Cnoc Fyrish and fields Alness

ILLUSTRATIONS

OBJECTIVES.

The examination of the capacity of the Study Area for development was subjected from the very beginning of our work to certain important conditions. These a priori conditions are in the nature of general objectives and can be discussed under two headings - feasibility and flexibility.

Feasibility. Important though the economic implications of feasibility are, the term has a wider meaning in this context. It is being increasingly realised that the wise planner frames his social aims in terms of providing for the maximum choice of physical environments in which a variety of social patterns may exist, rather than in terms of encouraging particular social patterns. Potential incomers will have heard something either of jobs or housing prospects before they decide to move and when considering this important step, the range of choice that will be available to them may be the deciding factor. It may be the choice of work, or the chance for a second member of the family to take a job, the safe walking distance to primary school or the chance to bring a grandparent to live nearby; or it may simply be the quality of environment in which a growing family can stretch itself, that will tip the scales. All of these are valid reasons, and the range of tastes and personal preferences which each incoming family will bring makes it essential to provide as wide a choice of living conditions and of jobs as possible within a coherent pattern of communities.

The first newcomers would be likely to be attracted by jobs in Invergordon, so that in the early stages most people would want to live at a reasonable travelling distance from there, hence the selection of Alness for early development. But from the first, there would be some who prefer to live elsewhere, perhaps nearer to Inverness the regional centre, where other members of the family might want to work. There would also be a few who would choose to live in one of the smaller, older communities and who would be prepared to face up to a longer journey to work. When this range of preference is combined with the likely range of family sizes and earning power which might be included in any group of families, the need for variety of environments is readily appreciated as a pre-condition to a feasible strategy, as well as cost-effectiveness.

In the context of a development in which a large proportion of the population is expected to be incomers, feasibility must also include the need for an extremely high quality of environment. It is important to achieve a standard that could, because of its attractive qualities ensure the success of any development that may occur. It is a formidable task to plan new development in such a lovely natural setting. It must please the incomers who may be accustomed to quite different surroundings; but the present quality must not be destroyed for the people who live there now, for the returning exile, or for those who come as visitors from time to time.

Thus we began by deciding that our strategy must be feasible in economic, social and environmental terms.

Flexibility. As in the case of feasibility this term also has a wider than usual meaning. For the reasons given in the Introduction, the time scale involved is unknown, and at the time of writing this applies as much to the first industrial development as to all the subsequent stages. Important as it is in all plans to be flexible, in the strategy for the Moray Firth area it is crucial that very wide variations in the timing, and scale and rate of development should not impair its feasibility. Two particular aspects of this problem have been kept constantly in mind. First has been the difficulty of achieving this flexibility in a particular part of Britain which has many unique and special circumstances. The pattern of land and sea, the distribution of high and low ground, and the location of existing settlements all have significant consequences for flexibility and we have judged it important to recognise this. We have attempted to ensure that the urban form emerging from the strategy of development is appropriate to the Moray Firth at all stages of its possible growth.

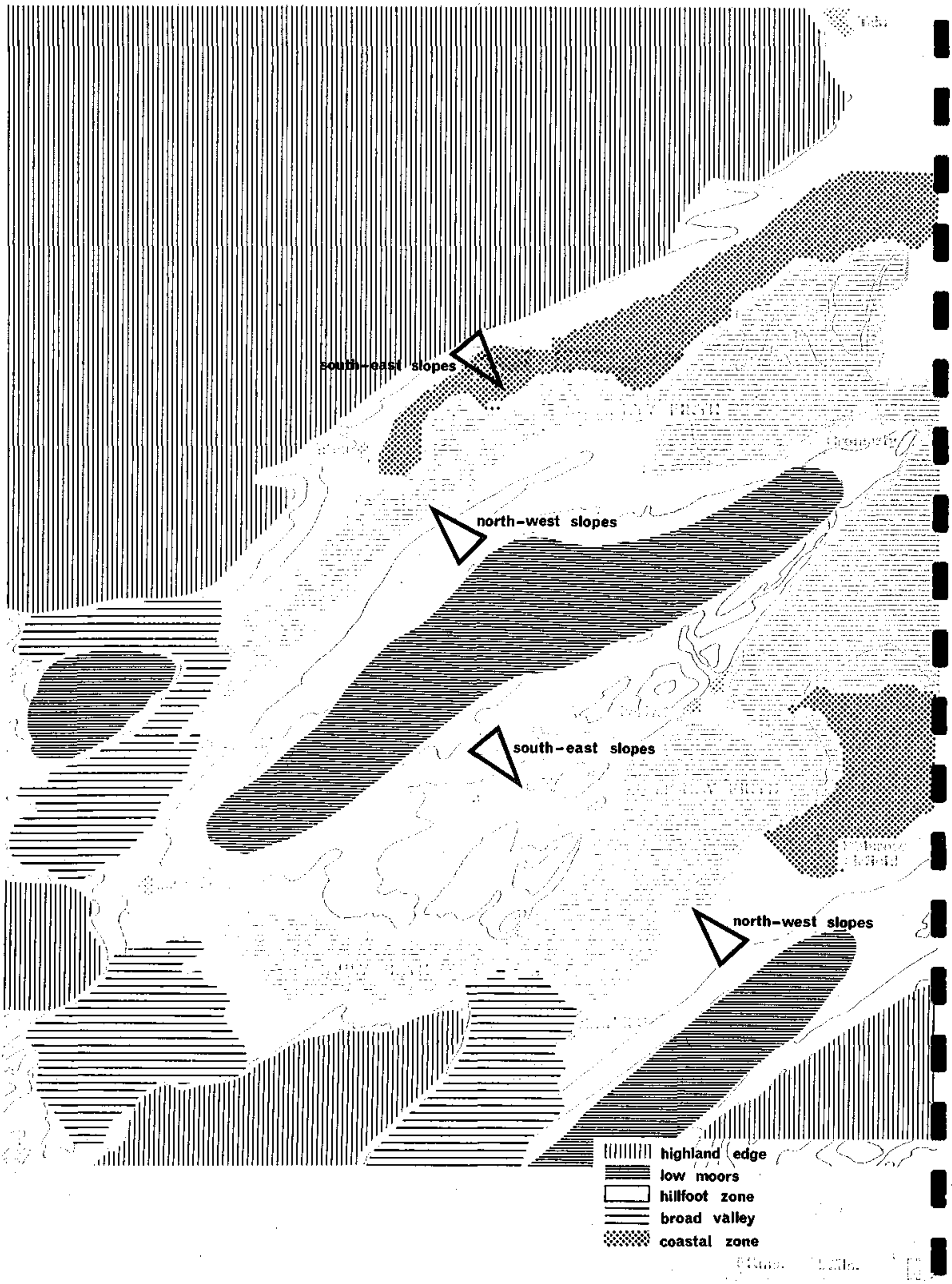
Secondly, however, is the significance of social change and its impact on flexibility. Social change, which appears to be increasingly rapid, is not a problem confined to the Moray Firth but will inevitably have its impact on this area too. Social scientists are not agreed on the extent to which it is possible to forecast social change and clearly in the absence of any known time period for development this becomes an insoluble problem. Throughout the Study we have tried to bear in mind the certainty that social change will continue to occur, and to recognise that radically different levels of income, hours of work, desires for educational and cultural opportunities will exist in the future. It is our expectation that although clear national trends will be foreseen, it is also possible and likely that the dispersion about the average will increase as more people find themselves able to choose their activities more freely. It is this belief which has made us extremely conscious of the need for variety in the characteristics of towns and villages to accommodate the increasing exercise of choice by all members of society. It may also be true that by providing the opportunities for maximum choice we also reduce the likelihood of building in a form which will rapidly become outmoded.

Our notion of the good plan is one in which the concepts of feasibility and flexibility outlined above are achieved. It is for this reason that we refer to our 'strategy' rather than to a master plan. The need is for a concept which can cope with change; which allows for the greatest possible freedom to adapt to changing economic circumstances, and to changing notions about society; and which manages to work reasonably well whatever the stage of growth and whatever the future expectations.

CONSTRAINTS AND OPPORTUNITIES

The purpose of this section of the Report is to establish at the sub-regional scale the capacity of the Study Area for development in the light of the objectives outlined in the preceding section. Our studies of the many and varied elements which can act as a limitation on development, or can create an opportunity for development, may be grouped into three categories - those associated with the land itself, those closely dependent upon the nature of the transportation system adopted and those which arise from social needs. These various studies were carried out simultaneously, with continuous cross reference, since we believe that in a very real sense, the true cost of each piece of development is the value of the alternatives foregone. Further, it is important to remember that the various constraints and opportunities have been examined in the context of our brief, and therefore this Report does not contain proposals for agricultural and tourist development except in the context of increased urban development. This point is expanded in the list of further studies in Part Six.

In general terms the limits of the Study Area itself, as well as the strategy for development, have been determined by a combination of opportunities and constraints. Inverness and Invergordon, for very different reasons, form the bases from which any development will arise and consequently, using a social restraint such as a public transport journey to work of not more than twenty minutes, gives us a Study Area extending from Tain in the north to



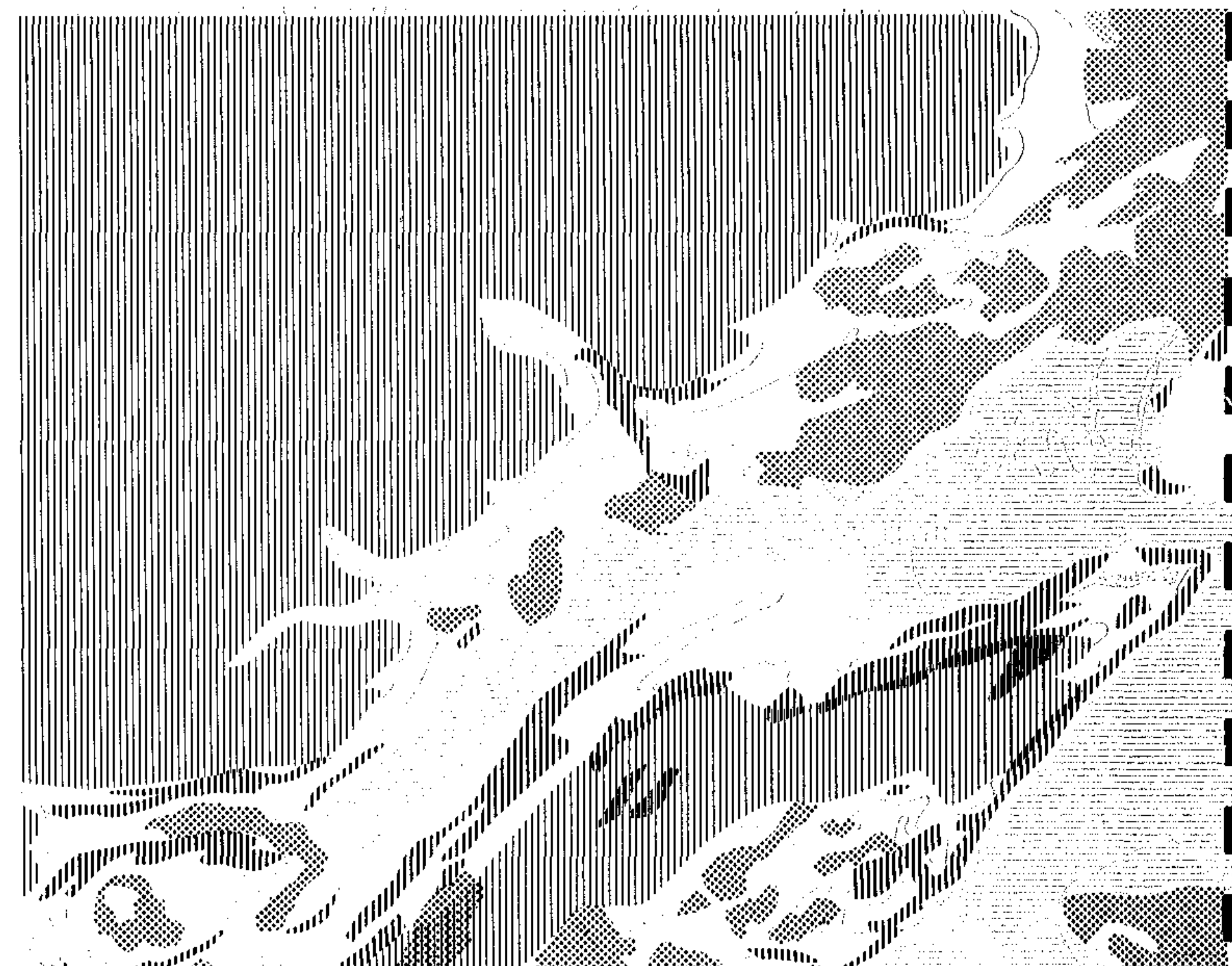
AREAS OF LANDSCAPE CHARACTER 2.0

Ardersier in the east, and including the northern end of Loch Ness in the south. The physical restraints provided by the coast-lines of the Cromarty, Beauly and Moray Firths together with the surrounding mountain masses further define a narrow 'U'-shaped coastal corridor which is the focus of the following studies.

Landscape Opportunities.

The Study Area has incomparable assets in its climate and scenery. Splendid hills lie on one side, the coast with all its interest and variety on the other, and all the many distant views are enhanced by the unusual qualities of the atmosphere. It is probably true that nowhere else in the United Kingdom enjoys scenery of this character as well as a dry and sunny climate. The outstanding feature contributing to this distinctive scenic character is the constant and close association of mountain and sea. The strip of humanised landscape which follows the curve between Tain and Inverness is constantly dominated by this association so that its own considerable scenic qualities are always presented as foreground or middle-ground to a panoramic backdrop. The scenery of the Black Isle and the area east of Inverness is less dramatic, since the views are generally more open and the high land more distant.

A very complex series of deposition and erosion processes associated with glacial, marine and fluvial activity has resulted in a topography which ranges from rounded foothills through undulating lowland to large, flat



exposed high ground

land steeper than 1:5

north facing slopes steeper than 1:12

land flatter than 1:30

TOPOGRAPHY

2.

view down Cromarty Firth towards Dingwall

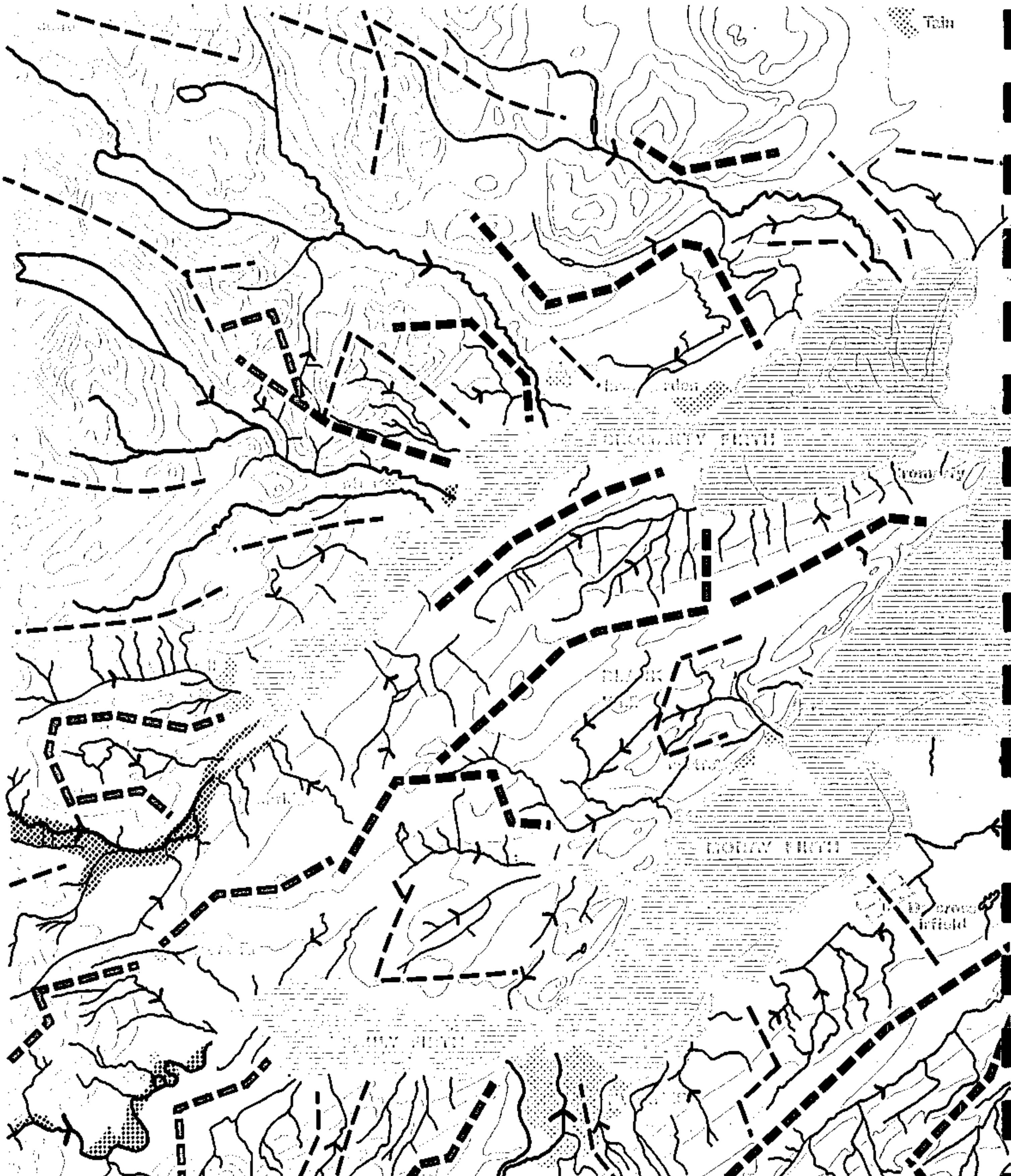
coastal areas generally within a space of some 3-4 miles (6 kms.).

We have identified the broad areas of landscape character which arise out of variations of topography, soil, climate and vegetation and which are influenced by their relationship to latitude, elevation and human activity. There are five basic types found in the Study Area: the highland edge, the low moors, the hill-foot zone, the broad valleys and the coastal zone. Map 2.0 shows their distribution and emphasises the north-east/south-west grain which gives the study area its characteristic sequence of north-west or south-east facing slopes separated by ridges of high ground or strips of tidal water.

Closer study of the areas of landscape character reveals features which constitute physical and visual barriers. Such features define or contain areas within which the local terrain and micro-climate are distinctive. They form a strong natural framework for possible land use and environment in terms of identity and shelter. We have called these areas "Containment Areas" and examples of their application can be seen in Part Four.

shoreline between Alness & Invergordon

The processes which created the land forms have also brought about marked changes in the nature and properties of the surface materials over very short distances. Such changes take many forms, but generally relate to soil type and drainage, and have had a marked influence on the evolution of the present-day land-use and settlement pattern. To-day as in the past, the network of large and small streams constitutes



watersheds

areas liable to flood

WATERSHEDS

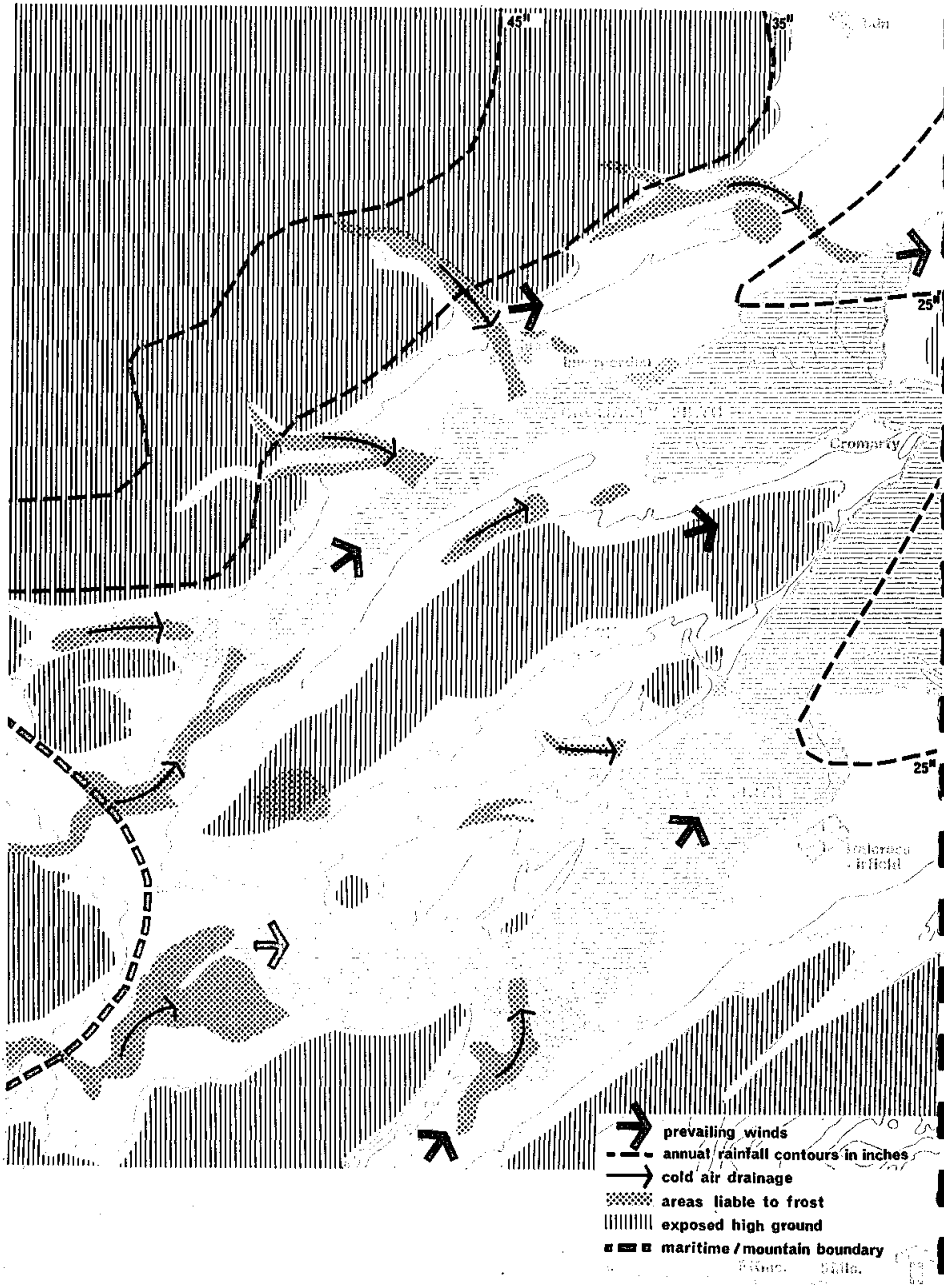
2.

an attraction for development because of their inherent visual and recreational opportunities.

The general climate of the area is mild and oceanic, enjoying very favourable regimes of temperature, rainfall and sunshine which are commonly associated with lower latitudes of the British Isles, the duration of sunshine for example being the equivalent to that of Coventry and the temperatures to those of Durham (See Appendix 3). The mild conditions and relatively low rainfall are attributable to the effect of the mountain massif to the west and south, which moderates the influence of the prevailing westerly and south-westerly winds. Climate changes rapidly with altitude, however, and the favourable conditions relate almost entirely to the lowlands where they improve slightly from west to east. Extreme conditions of temperature, wind and precipitation are rarely encountered and the occurrence of other weather hazards such as fog and lightning is also infrequent. The latitude of the area - the same as southern Norway - brings about longer day-lengths in summer and shorter day-lengths in winter with appropriate variations in the influence of solar radiation. In these latitudes the air has a transparency which gives rise to rapid and enchanting changes in the quality of light unknown further south.

Bienn a' Bha'ach Ard from Kirkhill

Apart from the natural growth of Birch on poor and uncultivated ground, the greater part of the woody vegetative growth in the area has originated from deliberate planting to develop woodland, provide shelter and also for its decorative value. As a result, this part of Easter Ross is now one of the most densely afforested



45"
35"
25"
25"
Cromarty
prevailing winds
annual rainfall contours in inches
cold air drainage
areas liable to frost
exposed high ground
maritime / mountain boundary

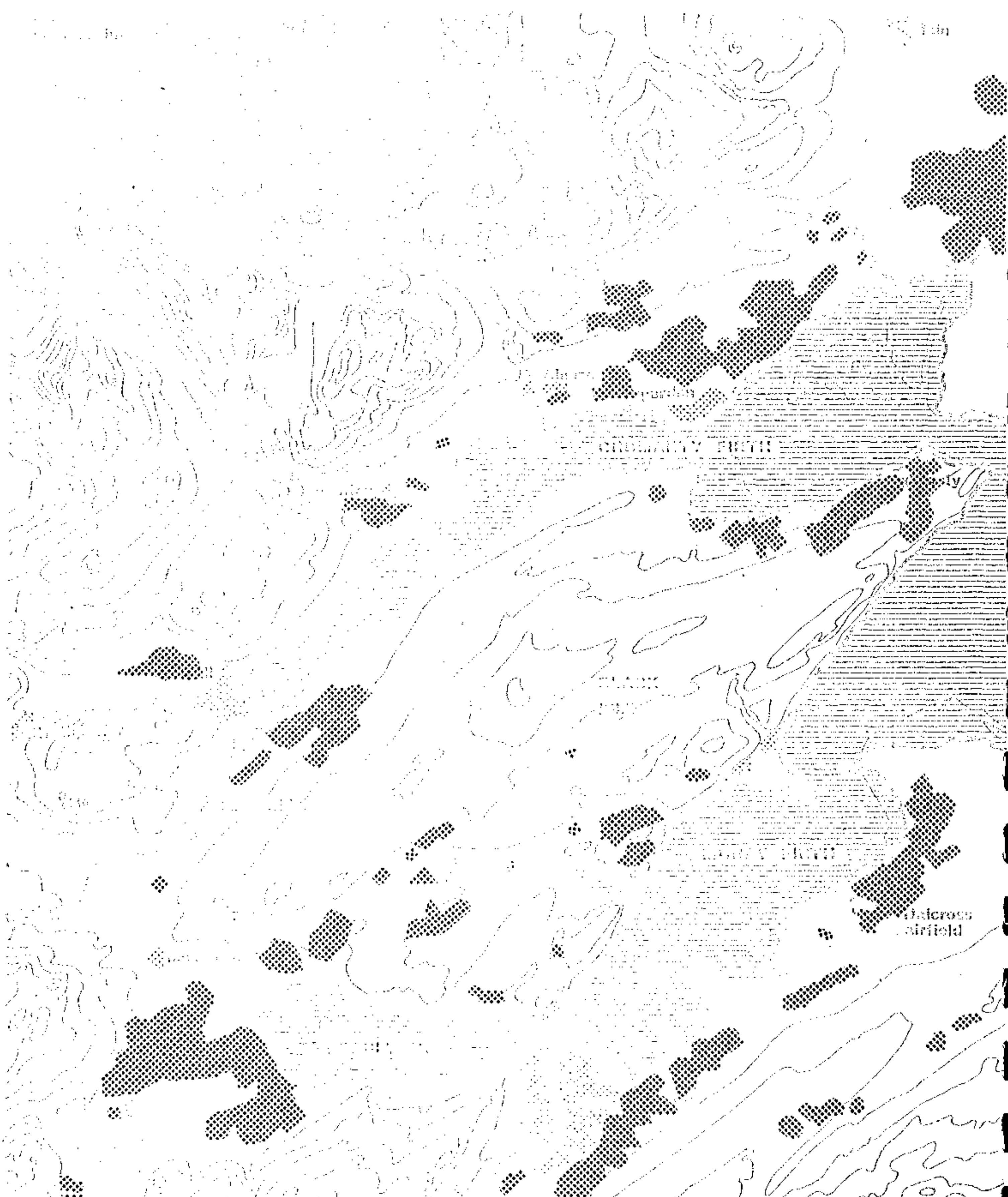
CLIMATE

areas in Scotland, and provides a striking contrast to the typically treeless landscape of the Scottish Highlands.

Hardwood trees grow well, below the 450 feet (150 m.) contour, while the soft-woods flourish up to elevations of 1000-1200 feet (350-400m.) above sea level. The number of species found is limited with Beech, Sycamore, Elm, Oak and Ash the more usual hardwood types and Scots Pine, Larch and Spruce representing the bulk of softwoods. The range of native and naturalised shrubs is even more limited being mainly Gorse, Broom, Briar and Elderberry. During the spring and early summer when the Gorse and Broom are in flower, the splashes of brilliant yellow over the landscape are spectacular, and have become associated with the area in the memory of all who have seen them. These shrubs succeed up to altitudes of about 500'-600' (150-200 m.) above sea level above which heather and ling associations occur. Ling also appears with Blaeberry (vaccinium) under birch scrub, as low as 100 feet (30 m.) above sea level.

Field hedges are generally of thorn while those found in gardens are usually either Beech or Privet. The cultivated trees and shrubs to be found in gardens are generally rather limited in variety, but this is to be expected in a predominantly rural area of great natural beauty.

Given a variety of ecological conditions and influences it is to be expected that the area should support a mixed wild life population and range of botanical species. A detailed study is not yet available but as shown in Appendix 4 the wild fowl concentrations, which



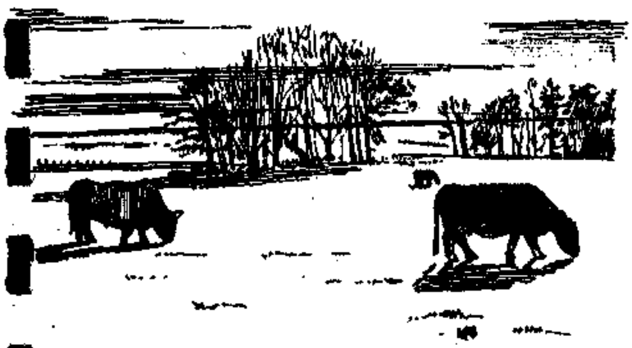
class A & B + land (Dept. of Ag.)

AGRICULTURE

depend to a large extent on the presence of feeding grounds on the mud-flats, are one of the most important wild life resources in the area (Map 2.6). The pattern and incidence of breeding and migrant birds is also of considerable interest, and all the major rivers are used for salmon fishing.

The valleys of the rivers and streams are of particular importance for wild life and as botanical habitats, and many contain valuable areas of natural or semi-natural woodland with associated plant communities. Rare and interesting species are to be found; for instance, the slopes of Craigton Light near Kessock is the only known habitat in the north of the Maiden Pink (Dianthus deltoides). Many of these areas of scientific interest are, by their very nature, areas of great natural beauty, and they are of considerable value for both education and recreation.

At present it is the agricultural scene which dominates the man-made features of the landscape in the Moray Firth. Centuries of agricultural effort have been put into improving and reclaiming the lowlands (below 100', 30 m.) with their kinder climate and better fertility, once the natural drainage is improved. Consequently there are to-day substantial areas of fertile agricultural land (Map 2.4) which are being efficiently farmed. In the lowland zones are concentrated the larger arable farm units, practising an intense and highly mechanised farming, whereas further inland, in the hill foot zone (up to 400 feet, 120 m.) the farm size is markedly less and a feature of the scenery is the small field. This area, once



Pasture below Alness

class 1 & 2 land
(Macaulay Inst.)

characterised by crofting, is now largely given over to stock rearing and there is less evidence of arable cultivation.

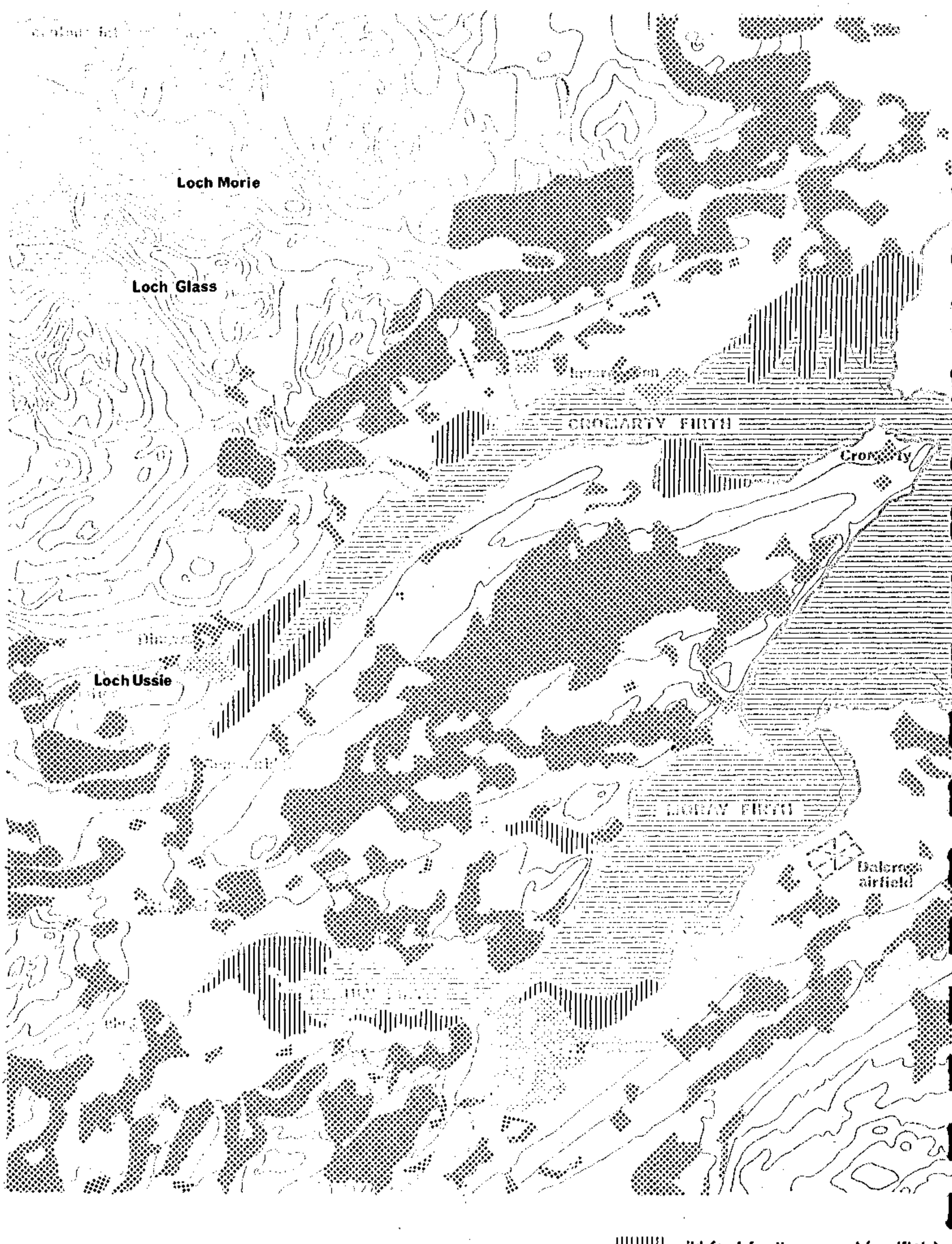
The location of existing towns and villages has been strongly influenced by the local soil, drainage and coastal conditions. Inland they are to be found either on the gravel beds of the marine levels or at the lower edge of the clays of the hill-foot zone where better conditions exist for building or where the land is more sheltered. Private estates, on the other hand, are more often found within the hill-foot zone where their forestry, gaming and agricultural activities could be combined. The growth of Inverness has, of course, arisen out of its geographical position in relation to natural lines of communication which have been readily exploited as for example in the construction of the Caledonian Canal.

We are confronted, therefore, with a rural landscape in which particularly fine and distinctive natural scenery has blended gracefully over the years with human activity. It will provide a magnificent setting for development only if it can be achieved without destroying the very qualities and characteristics of the sub-region which make it so attractive to development.

Black Isle from Coul Hill

Land Restraints.

There are some physical conditions which in relation to present day levels of technology can only be overcome by incurring heavy additional costs - such as the coastline, steep slopes, exposed sites and land liable to regular flooding. However, in addition to such physical



WOODLAND & MUDFLATS 2.6

restraints this section also examines the impact on the Area's capacity for development that arises from the distribution of existing settlements, good agricultural land and major woodland areas. The resulting area which is generally suitable for development (Map 2.9) is then examined in subsequent sections in relation to transportation possibilities and social needs.

Topography. The most significant features affecting development are shown on Map 2.1. This makes clear the extent of high ground which in such a northerly latitude precludes development because of the exposure to harsh climatological conditions. Elsewhere in the study area ground steeper than 1 in 5 is regarded as unsuitable for normal development because of construction limitations. Ground steeper than 1:12 on north facing slopes is regarded as unsuitable for normal residential development owing to the consequent restriction of sun-lighting. The map also reveals clearly the wide extent of land in the coastal fringe which has a gradient of less than 1 in 30 and which can therefore be regarded as potentially suitable for industrial development.

Water. Because of the topography, movement within the Study Area has been largely along the coastal strip, where the main barriers have been the many rivers flowing into the Firths (Map 2.2). Rising in the nearby mountains, these rivers and their associated valleys change rapidly in character along their courses. The effect of this in the past has been the growth of villages associated with crossing points in the hillfoot and coastal zones. These natural

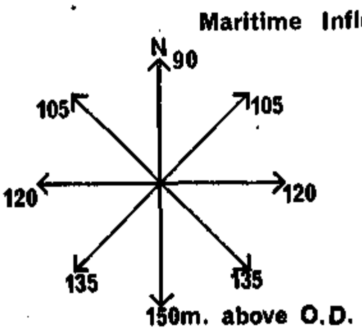
AREAS OF EXCEPTIONAL HOUSING POTENTIAL 2.7

drainage patterns facilitate the provision of water supply and sewerage systems. The recent experience of flooding has drawn attention to the problems arising from the interplay of natural run-off, high tides and the artificial extension of natural catchments for hydro-electric power. The consequences of increased run off will have to be carefully watched as development proceeds, but on the other hand, the extensive, mountainous hinterland provides an enormous natural catchment area which can be further harnessed for domestic and industrial needs if required.

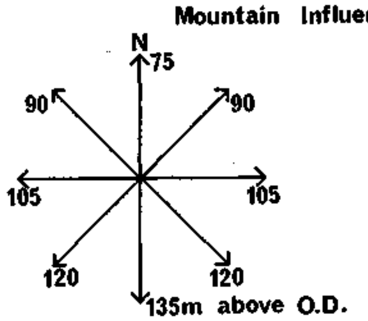
The coastline is, of course, a restraint on development, although the extensive areas of mud flat exposed at low tide, as at Nigg Bay and at the head of the Beauly Firth, may offer opportunities for future reclamation under changing technological and economic conditions.

The narrowness of the arms of the sea (such as Cromarty Firth) and the recreation potential of the rivers make the effective treatment of industrial and domestic effluents a point of particular importance.

Maritime Influenced



Mountain Influenced



ASPECT DIAGRAMS

<u>Climate</u>. There are local variations in climate. Poor land drainage, aspect and topography all contribute to a pattern of cold air drainage and temperature variations which can be important at the local scale. Map 2.3 shows the areas which have a greater liability to frost arising from cold air drainage. The aspect diagrams indicate the acceptable upper limit on development which varies with aspect and the proportions of maritime and mountain influence. The 500 foot

(150 m.) contour represents the upper limit on south facing slopes under predominantly maritime influence. The contour level of the acceptable limit is reduced for east, west and north aspects and for land under predominantly mountain influence.

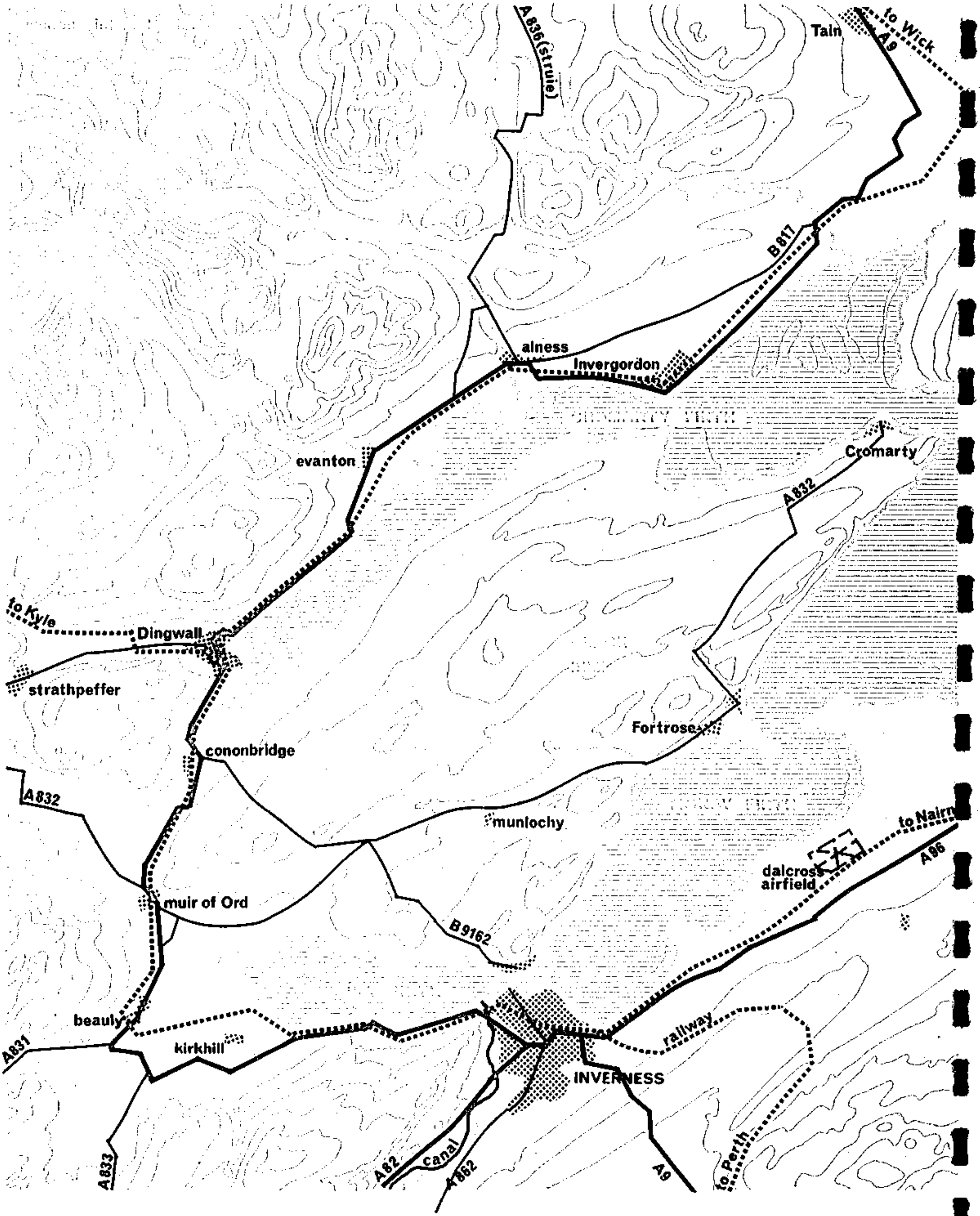
Woodland. In recent years the increasing afforestation of the poorer ground in the hill foot zone, together with that on the heathlands of the highland edge (over 400 feet, 120 m.) has enhanced the scenic quality of the landscape, particularly by softening the views inland towards the mountains. It is important to recognise the favourable aspects of shelter and visual attraction that such plantations create. At the same time because of their extensive distribution major woodland areas must be regarded as a physical restraint limiting the development potential (Map 2.6).

Agriculture. The wide extent of good agricultural land is shown on two maps and as is explained more fully in Appendix 6, Map 2.4 is based largely on the existing use of farmland while map 2.5 is based on a more sophisticated technique which attempts to show land of great agricultural potential, whether or not it is being fully realised at the present time. The differences between these two assessments shows a number of areas which, although not at present highly productive have a latent potential for sustained cultivation, and we have regarded these as a restraint equal to existing areas of high quality farmland.

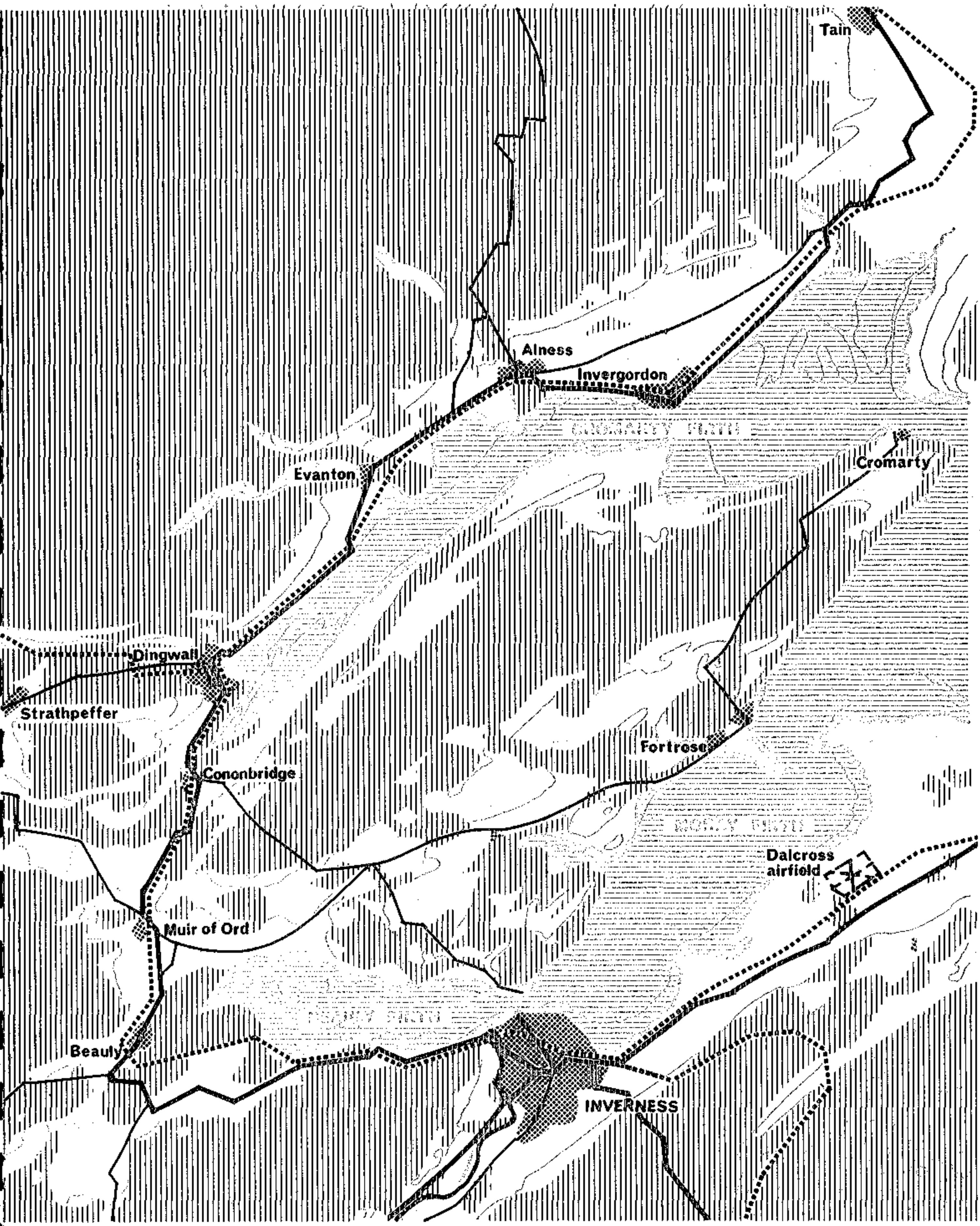
<u>Existing Development</u>. Map 2.8 showing the pattern of existing settlements and communications, demonstrates the influence of the physical landscape on the pattern of human activity. The importance of the pattern of existing settlements is that they constitute nuclei for possible expansion while the major roads, in conjunction with topography, can become a limitation on development. The railway, which serves the existing communities forms a barrier when on embankment or in cutting. At Kirkhill the presence of a number of overhead power lines forms a significant restraint.

<u>Combined Restraints</u>. The combined effect of the physical restraints is shown on Map 2.9 by the shaded areas. The white area remaining is generally physically capable of normal development since it is not too exposed, or too steep, or too subject to frost or flood and is not already developed as woodland or an existing settlement. The amount of such land is considerable including large areas in the Beauly Valley, between Evanton and Tain, in the vicinity of Muir of Ord, in the south eastern part of the Black Isle, and east of Inverness. With the notable exception of Dingwall there is considerable room for expansion immediately adjacent to each of the existing communities.

When these areas were examined in more detail not all were found to be equally suitable environmentally for housing development. Only some possessed the combination of high quality views, aspect, shelter, and soils so important in the creation of a high standard of environment. The



EXISTING DEVELOPMENT 2.8



existing development
climate, topography, woodland

COMBINED RESTRAINTS 2.9

main areas of 'special' quality were found near Tain Station, Alness, Evanton, Brahan, Muir of Ord, the Beauly Valley, and immediately east of Inverness near Balloch. All of these have been included in our strategy for development and are shown on the coloured map entitled Moray Firth Strategy.

Finally, it is perhaps wise to repeat that the basic land and environmental requirements of good quality agricultural and urban development are similar. Where there proved to be a choice, land of least agricultural value has been selected for urban development. However, the effect of social, economic and transportation restraints sometimes requires that urban development take place on high quality agricultural land. It should be appreciated that only a very small proportion of such land is required to fulfil our strategy (probably not more than 2-3 per cent of the agricultural land in the Study Area) and that in the light of recent trends, the remaining agricultural land will more than replace any production losses by increased productivity. Indeed, it should not be forgotten that development will itself make possible increased opportunities for local agricultural producers.

Transportation Possibilities.

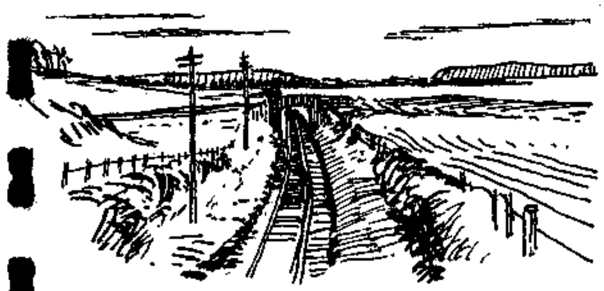
Before making proposals for the form of the transportation system, it is important to distinguish between the various means of movement for people and goods; that is, between feet, 'buses, private cars, lorries, rapid transit system or British rail.

We know from surveys in other areas that walking is acceptable up to one mile but that more than half of walking journeys are under a third of a mile. We also know that walking trips of over a third of a mile decrease rapidly with any increase in car ownership. It is natural to expect therefore that for distances over one third of a mile the majority of travellers will be seeking wheeled transport whether public or private, and since even when ownership of private cars reaches saturation point, some 60% of the population will still not have private transport available to them at all times, it is desirable that some form of public transport should be within one third of a mile of the majority of homes. This means a public transport service with stops at one-third to one-half mile intervals. Obviously the service which is subjected to this discipline cannot serve satisfactorily for longer journeys, such as say twenty miles, and so a hierarchy of public transport operation is required; for instance one category is recommended for journeys of up to about five miles, another for journeys between five miles and fifty miles, and another for journeys over fifty miles.

In the Moray Firth the short distance, multistop service will be provided by 'buses, as no other form of public transport has the independence and performance required for this type of service.

The next level of public transport, for journeys from five to fifty miles, with stops at not less than half mile intervals, could conceivably be some form of rapid transit system running on or over a reserved track. This system is best suited to a pattern of settlements in a narrow corridor, which gives a fixed line with stopping points at those centres of the activities that generate and attract travellers.

There are a number of factors, however, which make the concept of separate rapid transit improbable in the foreseeable future; first, the capital investment involved could not be justified for a population of even 300,000 people dispersed over a forty mile length; secondly, if people are able to satisfy their various needs close to home, then the demand for journeys of the length which the rapid transit system would accommodate is not likely to constitute a large proportion of the travel demand. Taking these items into account, together with the likelihood of a modest rate of population growth, it seems probable for the foreseeable future that this type of service will be provided by express 'buses sharing road space with private cars. It is also probable that the express 'bus service and the local 'bus service may in some instances be the same vehicle, since it might run from say Inverness to Dingwall as a limited stop express service and then operate a multi-stop circuit in Dingwall, before returning as an express service to Inverness. The detailed arrangements for these services will have to be worked out by the 'Bus operators and the Traffic Commissioners and have to be carefully adjusted to the programme of development.



Railway cutting: Alness

The third level in the hierarchy of public transport is primarily related to travel between the Moray Firth Area and other parts of the country. This can be by sea to the docks at Inverness and Invergordon, by scheduled air services to Dalcross Airport, by private air flights to Dalcross, Evanton and Tain, by rail and by road. The primary function of British Rail is recognised as serving freight and personal travel for distances of fifty or more miles. The distances between the Moray Firth and the major centres of activity in Great Britain, and the intentions set out in the Transport Bill now before Parliament, mean that this service from British Rail will be important for the movement of people and crucial for the movement of goods to and from the area. A proliferation of rail stations within the Moray Firth Area would interfere with the efficiency of this service and is therefore inadvisable.

Railway bridge over River Alness

Provided that British Rail can offer an efficient and competitive freight haulage service the main provisions of the Transport Bill need not be feared, but representation might be made to the Minister of Transport to modify the proposed levy on road haulage for abnormal undivisible loads which cannot be handled by British Rail. In view of the distances involved, the proposed levy could well inhibit any enterprise requiring road transport for heavy loads from operating in the Area.

The strategy of development is therefore based on the public transport and goods haulage needs which can be summarised as follows:-

(a) Walking journeys, intense up to one third of a mile.

(b) Local 'buses to within one third of a mile of the majority of homes - stops at one-third to half-mile intervals.

(c) Express 'buses on high speed route with stops at not less than half mile intervals.

(d) Goods movement within the Area largely by lorry.

(e) British Rail and air services for movement to and from the Area.

(f) Lorries for movement to and from the Area of goods which cannot be handled by British Rail.

The Private Car. In the introduction to the Ministry of Transport publication "Traffic in Towns", Sir Geoffrey Crowther, Chairman of the Steering Committee summarised the problem in the following words:-

"Regarded in its collective aspects as 'the traffic problem' the motor car is clearly a menace which can spoil our civilisation. But translated into terms of the particular vehicle that stands in our garage we regard it as one of our most treasured possessions or dearest ambitions, an immense convenience, an expander of the dimensions of life, an instrument of emancipation, a symbol of the modern age. To refuse to accept the challenge it presents would be an act of defeatism."

An opportunity exists in the Moray Firth Area to plan for the motor car in such a way that the benefits of use would be available to the owner without imposing on the community the social and economic disadvantages of the collective traffic problem. This would be an added attraction to prospective immigrants, particularly if their ability to use their cars were uninhibited, not only in the Moray Firth Area, but equally in the whole region within which they will seek recreation and other opportunities.

The preparation of a plan to achieve the maximum personal freedom in the choice of method of travel, at minimum social and economic cost to the community and the nation, is based on the application of a series of principles which have been derived from studies in existing towns and in new towns. The most important of these are as follows:-

<u>The Planned Units</u>. Within each planned unit with a primary function which might be residential, industrial, commercial, educational, or recreational, the degree of vehicular accessibility should be considered against standards of safety, amenity and freedom from noise and nuisance. An essential characteristic of a planned unit is that no vehicles are attracted into it which do not have a reason for being there.

<u>Segregation of Vehicles and Pedestrians</u>. Within each planned unit pedestrian activity should

be considered in three categories; trips between the unit and major attractors outside it such as schools, shops and public transport stops; random movements within the unit such as children at play, and visits between buildings; and vehicle-generated movements, as in the case of people moving to and from cars, and loading and off loading from delivery and service vehicles. Of these three groups of pedestrian activity complete segregation should be considered for the first, but the design should recognise the inevitable mixture between vehicles and pedestrian activities in the last two groups.

Direction of Movement of Vehicles and Pedestrians. Vehicular movement can be confined and disciplined by the road layout and by bollards and kerbs, but experience shows that pedestrians cannot be restrained to anything like the same degree, and while the organisation of each planned unit should aim at maximum convenience for both vehicle user and pedestrian, it is desirable that pedestrian trips out of the unit should be directed away from the roads carrying heavy traffic. This is best achieved by making the vehicles move into and out of the unit in a direction away from the major pedestrian attractions while the footpaths lead directly towards them.

Size of Planned Units. In order to minimise the nuisance and danger arising from the conflict of vehicles and pedestrians in the planned unit the size of each unit should be controlled, so that no inevitable pedestrian-vehicular conflict is present on a road carrying peak hour traffic volumes in excess of 300 passenger car units. This figure therefore becomes one of the threshold figures in deciding community sizes.

Layout of Planned Units. The layout of the roads within the planned unit should effectively control the speed of vehicles to about 20 m.p.h. and should also incorporate adequate standards of inter-visibility between vehicles, and between vehicles and pedestrians, separate facilities for standing vehicles, and provision for turning and manoeuvring.

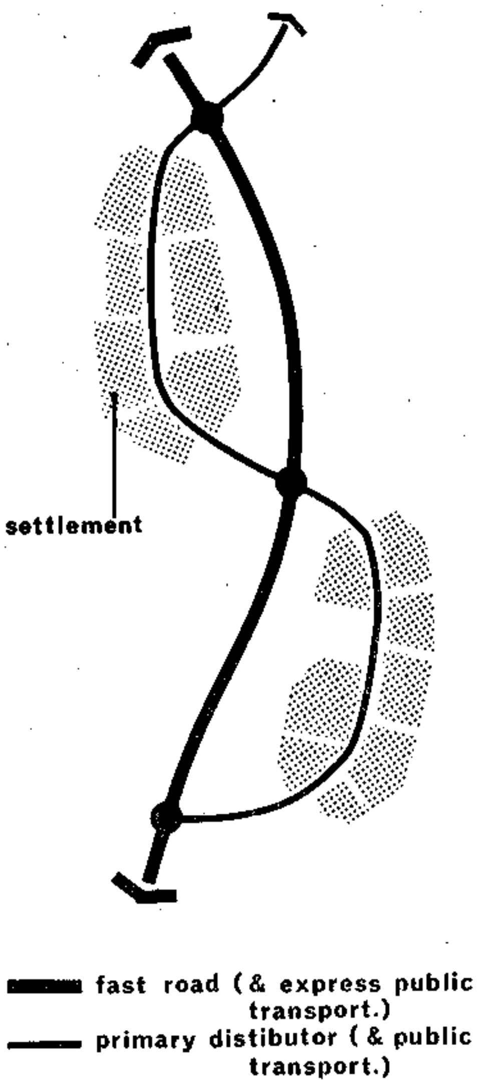
Road Hierarchy by Function. It is essential for both efficiency and safety to substitute for the old multi-purpose road a hierarchy of roads with clearly defined functions. The first group in this hierarchy are those roads whose primary function is to serve terminal vehicles, that is, vehicles that are coming to a stop in the area. These are termed Service Roads and provide access to parking areas, garages, service yards and buildings. The second group are the Main Feeder Road and Distributor Roads which make up the network for moving vehicles and have no frontage access or terminal facilities though they may have 'bus lay-bys. A hierarchy of Distributors is necessary so that Primary Distributors on which the traffic moves at perhaps 40 m.p.h. can feed down on to Local Distributors where speeds are 30 m.p.h. or less and these in turn feed down on to Main Feeder Roads where vehicles are slowing down, and should be moving at 20 m.p.h. or less.

The Service Roads are served from the Main Feeder Roads, but the number of levels in the hierarchy for any particular settlement will depend on the size of the urban area and the arrangement of the planned units.

Road Hierarchy by Journey Length. The cost and efficiency of a road system depends very largely on the capacity of the junctions, which depends on the amount of mixing and separation of traffic. It follows therefore that if streams of traffic which have no need to mix can be kept separate then cost/efficiency is improved. Recent theoretical studies on town form* have demonstrated this, hence it is accepted that on any transportation spine vehicle journeys of under four to five miles should be excluded.

Phasing. The rate and scale of development in the Moray Firth Area will vary from time to time and it is important that the supply of road space should at any time be in balance with the demand. An objective in the preparation of the strategy must therefore be that it should lend itself to rational phasing and that any phase can, if necessary, be considered as the final stage.

* "Transportation & Land Use Structures" Jamieson, Mackay and Latchford - Urban Studies - November, 1967.



Regional Road Hierarchy

A Transport Strategy. The application of these principles to the particular circumstances of the Study Area has produced the concept of a transportation spine which is illustrated here. It consists in general terms of a Fast Road for vehicle journeys over four to five miles in length, with junctions at approximately two mile intervals. Primary Distributor Roads weave across the Fast Road serving the adjacent developments and connecting to the Fast Road at these junctions. Thus vehicles on journeys of greater length than four to five miles are syphoned off the Primary Distributor on to the Fast Road. The principle could be described as a kind of "Aarons Rod" where the rod is the Fast Road and the snake is a Primary Distributor.

In a similar way, though increasingly modified by other planning considerations, the lower categories of Distributor and Feeder Roads would loop about the Primary Distributor, and from these the Service Roads serve the actual buildings. Express 'buses would operate on the Fast Road, and local 'buses would operate on the Distributor Roads, thus allowing short and long-distance travel by private or public transport to operate on separate roads, and providing the maximum range of travel in a given time. Thus each loop of Primary Distributor attracts on to itself only traffic which has a purpose in the development it serves and this characteristic applies equally to the Local Distributors, Feeder and Service Roads.

The objectives in respect of the segregation of vehicles and pedestrians that seem most realistic are achieved by containing each development within a Local Distributor so that vehicles are disciplined to move out and round the perimeter of the area while pedestrians move directly towards the points of attraction. Within the enclosing Local Distributor there is complete flexibility to create planned units of varying size and character within the discipline of a maximum of 300 cars per hour on the Service Roads.

It will only be necessary to build the Primary Distributors for each community as and when it is developed, and the Fast Road which will lie in open country where the phasing of its expansion will not impinge on proposed or existing settlements, would be a progressive development of the existing trunk road re-located and improved as a consequence of the success of industrial promotion in the Area.

The Location of Employment.

In a fundamental sense it is true to say that the capacity of the Moray Firth area is determined by its capacity to accommodate industrial growth, since without this there can be no substantial increase of population. Also, because the criteria for locating industry are in some ways more stringent than those for locating residential development, and because it is essential in the circumstances of the Moray Firth to make the development proposals attractive to incoming industrialists, we proceeded first to develop a strategy for job locations, and subsequently adjusted it to suit the distribution of homes. Industrial capacity is thus dependent on three interlocking issues. Are there sufficient sites suitable physically, and if so, can they be developed efficiently in relationship to their transportation demands? The resulting strategy must also be socially feasible in terms of the distance and choice of journeys to work.

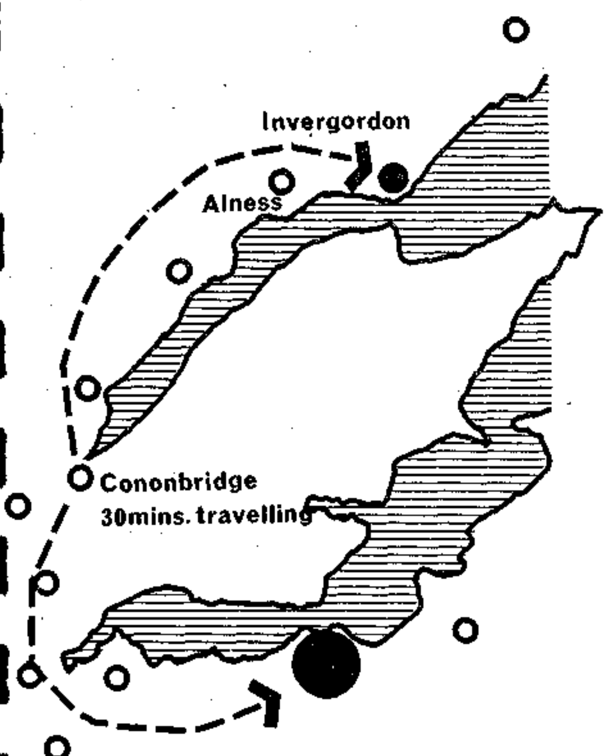
Muir of Ord

Jobs. Major industrial sites require extensive areas of almost flat land and in Map 2.1 the areas of land flatter than 1 in 30 are shown to be concentrated at Invergordon, in the Muir of Ord - Beauly vicinity and east of Inverness. Each of these major locations has a special characteristic; thus Invergordon is the only site immediately adjacent to deep water, east of Inverness is close to the airport and the only existing urban settlement of any size, while Muir of Ord is midway between these two potential growth points. These three sites are also readily served by the existing trunk road and rail routes, and as can be seen from Map 2.9 there are substantial areas of land suitable for residential development in close proximity to them. In addition further suitable sites exist at Evanton, Tore and Dalcross.

Our strategy for the location of jobs had also to recognise both the initial build up of new manufacturing employment at Invergordon and the important existing concentration of service jobs at Inverness. The distance between these two centres is about 35 miles. In order to avoid over-concentrating the location of employment with the consequent inefficient use of the transportation facilities created by tidal flows of work journey travel, other sites for manufacturing and service employment are required. This is the important role that the sites at Evanton, Tore and Dalcross perform.

The inevitable concentration of jobs at Inverness and Invergordon in the early stages of development also suggests that a good transportation system should connect these two, and that it would be sound transport economics to locate the additional jobs in several modestly sized groupings on sites close to this transportation spine.

Homes. As many workers as possible should be within acceptable travel time of a wide range of job opportunities, and we know what the acceptable work journey travel distances are for different types of worker, travelling by foot, car, public transport or rail. These vary greatly, but we also know that all kinds of people journeying to work exhibit similar characteristics in the time they are prepared to travel. Thus, for example, we know that about 50% of workers would prefer to have a job within 15 minutes travel time from home and a further 40% are prepared to travel between 15 and 30 minutes from home. Since all forms of public and private transport should be able to provide a service of less than 60 minutes between Inverness and Invergordon, it therefore follows that a strategic location for workers would be about the mid-point between these two settlements. At this location those who are prepared to travel 30 minutes to work would be within that time of both Inverness and Invergordon, and since Inverness and Invergordon are likely to remain the main employment centres this suggests that some of the early residential expansion should be located in the Dingwall/Conon Bridge area. It has been noted however that 50% of workers will prefer to work within 15 minutes travel time of their home, and so other early accommodation will be required within this range of Invergordon. A similar provision is currently being made in Inverness.

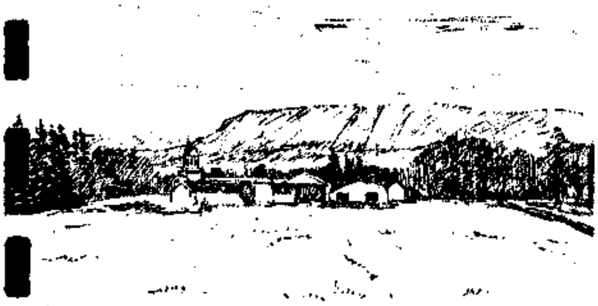


First Job Opportunities

The conclusion is that Alness and the Maryburgh/Conon Bridge Area are well placed sites for early housing development, and additional settlements which will meet people's travel time requirements should be dispersed along the transportation spine between Inverness and Invergordon. A further significant dispersion of the travel to and from Inverness and Invergordon would be achieved by settling some workers north of Invergordon and east of Inverness.

The reasoning which has been applied to journeys to work applies equally to other travel purposes such as shopping and recreation. The policy of maximum choice within a reasonable range again suggests dispersal rather than concentration into a small number of large units. Thus, given the foci at Inverness and Invergordon an effective transportation pattern requires a direct link between these centres from which are attached the various units of activity.

Although it depends on many assumptions which may change substantially in the future, we have estimated the capacity of the land suitable for industry in terms of jobs. We have assumed that industrial estates will have a density of about 30 workers per acre, when all expansion space is eventually taken up. These figures are based on recent practice with some allowance for additional car parking and production space per worker in the future. These figures do not apply to the Invergordon industrial area where we expect very special circumstances to result in industrial densities of less than 10 workers per acre. We compared this industrially derived labour force with that derived from the residential capacity of the Area and found it to be greater. In the absence of any firm data about the types of industry likely to come to the Moray Firth, and because of the uncertain nature of the assumptions about shift-working and activity rates (see Part Six: Land Use - Transportation Study) we based our testing of the traffic requirements on a distribution of employment which gives an average of 25 workers per acre. Despite this, a clear conclusion emerges that there is an ample number of industrial sites, which offer varying attractions to a wide range of manufacturing and service employment generators. Further, these sites can be efficiently served in transportation terms, and can be developed according to a strategy which is socially desirable since it will offer a choice of convenient employment opportunities.



Conon Mains : Cononbridge

The Provision of Services.

The fact that there is a very ample supply of water in Loch Glass and Loch Morie is an additional attraction to industry and there is also more than sufficient water in these lochs to serve any greatly increased population. The capital cost of providing this supply will be much less than for most communities in the Central Belt of Scotland, since the sources are much nearer the demand points.

Sewage disposal and drainage generally can be dealt with either in units corresponding to the separate communities or to pairs or groups of communities. It is expected that industrial effluent from the major industrial complexes will be purified by the industries themselves.

Power distribution has been discussed with the North of Scotland Hydro Electric Board, and no difficulty is anticipated.

Sewerage. It is apparent from a study of the area that it would be both more practicable and more convenient to deal with each community, or possibly small groups of communities individually rather than attempt to link all the developments together in one large drainage scheme. This conclusion is based on the following reasons:-

(a) The considerable length of coast line would involve long, flat and therefore large trunk sewers if the communities were to be linked.

(b) It is intended to undertake development of more than one area from the start. In these circumstances it would be more convenient and economic to phase the drainage of each area with the development of that area.

(c) Small sewerage schemes are more economic than large schemes which involve the use of larger diameter pipes.

Modern practice and the topography of the area therefore combine to confirm the use of the partially separate system of drainage for the area. In this system the foul sewage together with water from back roofs and yards would be taken to the sewer and all other rainwater and surface water would be taken to surface water drains. The foul sewers would be taken to treatment works and the surface water drains would be discharged at suitable points to convenient water courses. These points would have to be related to the needs of existing industry, for example, the distilleries, where river water is used.

Sewage Treatment. The problem of sewage treatment would also best be solved by dealing with the communities individually or in small groups, as circumstances and topography show to be desirable.

The capital cost of treatment would be slightly greater for smaller communities but this would be offset by the saving on the long lengths of trunk sewer which would otherwise be required. We estimate that the total cost of providing individual treatment works could be less than the cost of one large works taking into account the saving on sewers.

The operation and maintenance of the sewerage system and sewage treatment works could probably best be carried out on a regional basis. It is recognised so far as it is practicable and economic that sewerage systems should be arranged to gravitate to a few comparatively large works rather than to a large number of small works. This can mean that the catchment area for sewage treatment is on a regional basis which does not necessarily coincide with local authority boundaries and this could be carried out by sewerage Boards.

In the Moray Firth Development area the drainage services will no doubt be the responsibility of Ross County Council and Inverness County Council in their respective areas, and of the various Town Councils within their Burgh boundaries. A joint undertaking for sludge treatment and disposal might be considered to allow the treatment to be done centrally and sludge transported from the individual works by tanker, and consideration could also be given to disposal of the treated sludge by composting with domestic refuse.

Refuse Disposal. A convenient method of dealing with refuse disposal would be the establishment of several destructors and composting plants. Composting plants are available which can accept a proportion of treated sewage sludge which, while contributing little or nothing to the quality of the compost, is a convenient method of disposal of the sludge, which can be a serious problem.

<u>Water Supply</u>. In general the question of an adequate supply of water to the Moray Firth Development presents no problem, and will merely be a matter of developing the existing and as yet untapped resources of the area, which are almost unlimited.

In 1960, Ross and Cromarty County Council inaugurated the Loch Glass Regional Water Scheme, which serves the Black Isle and Easter Ross and provides for a population of 23,000. A total of 2 million gallons per day has been provided for in the first instance to cover both domestic and industrial needs but this quantity could readily be increased. The County Council has powers at present to abstract 3 million gallons per day from Loch Glass and it is estimated that up to 100 million gallons per day can be provided by developing the existing and adjacent catchment areas.

Loch Glass can thus supply sufficient water to enable the various developments in Ross-shire to be started pending further development of alternative sources.

In Inverness-shire the position is broadly similar but the County Council would need to be advised in good time because of the current programme of water supply improvement in the Beauly area.

<u>Electricity Supply</u>. It is to be expected that a supply of electricity to the Moray Firth Development will be made available by the North of Scotland Hydro-Electric Board from the grid sub-station at Beauly.

Settlement Hierarchy.

The examination of landscape opportunities, land restraints, and transportation possibilities has demonstrated that considerable development capacity exists in the Study Area. It is now necessary to see how far any proposed development can be arranged in settlements of different sizes, so that the many facilities required by the population can be provided economically. The facilities which will be required by any major development extend from frequently used ones for a small number of households to the more occasional needs of the subregion as a whole. Thus local shops, churches and primary schools are examples of the former while specialised shops, higher education institutes, hospitals and museums indicate the nature of the facilities that serve larger populations. Only if the distribution of development is arranged into a settlement hierarchy which encourages the provision of such facilities will our objective of designing a strategy that is both economically and socially feasible be attained.

Even if it might be possible to identify the present day population level necessary to permit each facility to operate efficiently, both economically and socially, our strategy must still adapt this to suit future conditions in the Moray Firth. Because it is impossible to forecast with any precision the optimum settlement size for such facilities as shopping, health, education, and indoor recreation, only a general outline of the likely settlement hierarchy can be obtained. It is important in this context to remember that as a result of the growing mobility of the population, there is now more freedom to decide the size of individual settlements. The population need no longer be limited to the catchment of a single shopping or employment or higher education centre, provided a good transportation system makes alternative centres accessible. The transportation system must allow everyone to be mobile when the need arises; whether it is a child walking to school, a works manager who has chosen to live fifteen miles from his work, or a student going by 'bus in one direction while his mother travels to the shops and a part-time job in another. This need for a very integrated public and private transport system and well defined pedestrian routes is basic to the plan, and applies as much to the needs of industry as it does to the labour force.

A wide range of studies into the size of catchment population that makes facilities socially and economically viable, has confirmed that a four-tiered hierarchy of settlements will provide the widest possible range of facilities. At the lower end of the hierarchy a population of between three and four thousand persons is sufficient to justify the provision of a primary school, a church, a district nurse and local shops, giving a sound functional basis for community development. It is not until 15,000 to 20,000 persons are reached that there is a major increase in the range of facilities that can be economically provided. With a population of this level, a major shopping centre catering for week-end grocery shopping, a secondary school, a health clinic, and facilities such as a small hotel, a branch library, a dance or assembly hall and a swimming pool, become viable. The very much wider range of facilities associated with large towns require a catchment population of more than 100,000 and it is only in the metropolitan centres such as Glasgow and Edinburgh in Scotland, that a full range of specialised services and facilities is available.

There are many reasons why a hierarchy of this kind does not exist everywhere in Britain to-day, and as we have explained in Part Three, our strategy, although based on this hierarchical concept, has adjusted it to suit local circumstances, in some places.

In the Moray Firth, Inverness is already established as the regional capital and contains the widest range of service facilities of any settlement in the Study Area. Given a possibility of population growth to 250,000 or 300,000 we had to consider whether Inverness should continue in this role, or whether it should be replaced or duplicated. Three major reasons led us to retain and develop it as the only regional capital in our strategy. First, recent increases in the scale of operation of many of the social services mean that unless centres like Inverness, with their extensive hinterland, expand, the quality of its service provision will begin to decline. Under these circumstances it is important to concentrate resources on maintaining and improving this important asset. Secondly, as is shown in Part Six (Inverness) we believe that the town, and its central area in particular has the physical capacity to meet the potential demand, provided full advantage is taken of the existing opportunities for modernisation of its structure, including redevelopment in its central area. Thirdly, since population expansion in the sub-region is likely to be steady rather than dramatic, and because to start with the regional centre will be located about 30 miles away from Invergordon, only Inverness is likely to provide for a long time to come a viable location for facilities and services of a sub-regional and regional nature.

Consequently, the other settlements proposed in our strategy are all about 15,000 persons in size, or much smaller at about 5,000 persons. Kirkhill and Dingwall are the two exceptions. In both cases the land restraints limit expansion, but proximity to Inverness will compensate Kirkhill for any limitations in the provision of facilities due to its intermediate size. Dingwall is rather different. A Royal Burgh since 1226, this small town of almost 4,000 persons is, apart from Inverness, the only important rural servicing centre in the Study Area. It already possesses successful marketing, administrative, and commercial facilities, and as a result, has a very dinstinctive character, which could readily be lost if too massive an expansion of the population occurred.

It has proved possible to combine ideal settlement size with the concept of providing a variety of urban environments because of the presence of existing towns and villages. Combinations of medium and small size with existing and new settlements provide a variety that ensures that incomers and locals equally have a choice. Thus one will be a small, long-established market town (Dingwall), others either like small new towns with new town centres (Fearn, Evanton, Brahan, Munlochy), or expanded and adapted villages (Alness), or long-established small villages (Maryburgh) carefully renovated. With each of these settlements goes a different life-style and varying level of social provision, and people will be able to choose the opportunity which attracts them most.

Each of the major new settlements with its population of 15,000 or more will have dependent on it, one or more smaller settlements within easy travelling distance. In this way each level of the hierarchy complements the role of settlements of other levels in the hierarchy, (see diagram) and provides as far as is economically possible a convenient distribution of social and commercial facilities. In addition, the distinctive character of existing communities is harnessed to provide a diversity of urban environments.

SETTLEMENT HIERARCHY

	Capital	Large Towns.	Small Towns
Population	65,000	15,000/20,000	circa 5,000

- Inverness
  - Fearn — Tain and Nigg peninsula villages.
  - Alness — Invergordon
  - Evanton
  - Dingwall — Strathpeffer
  - Brahan — Maryburgh, Conon Bridge
  - Muir of Ord — Beauly, Aultfearn, Belladrum
  - Kirkhill
  - Redcastle
  - Munlochy — Avoch, Fortrose/Rosemarkie, Cromarty
  - Kessock
  - Balloch — Ardersier

Phasing Opportunities.

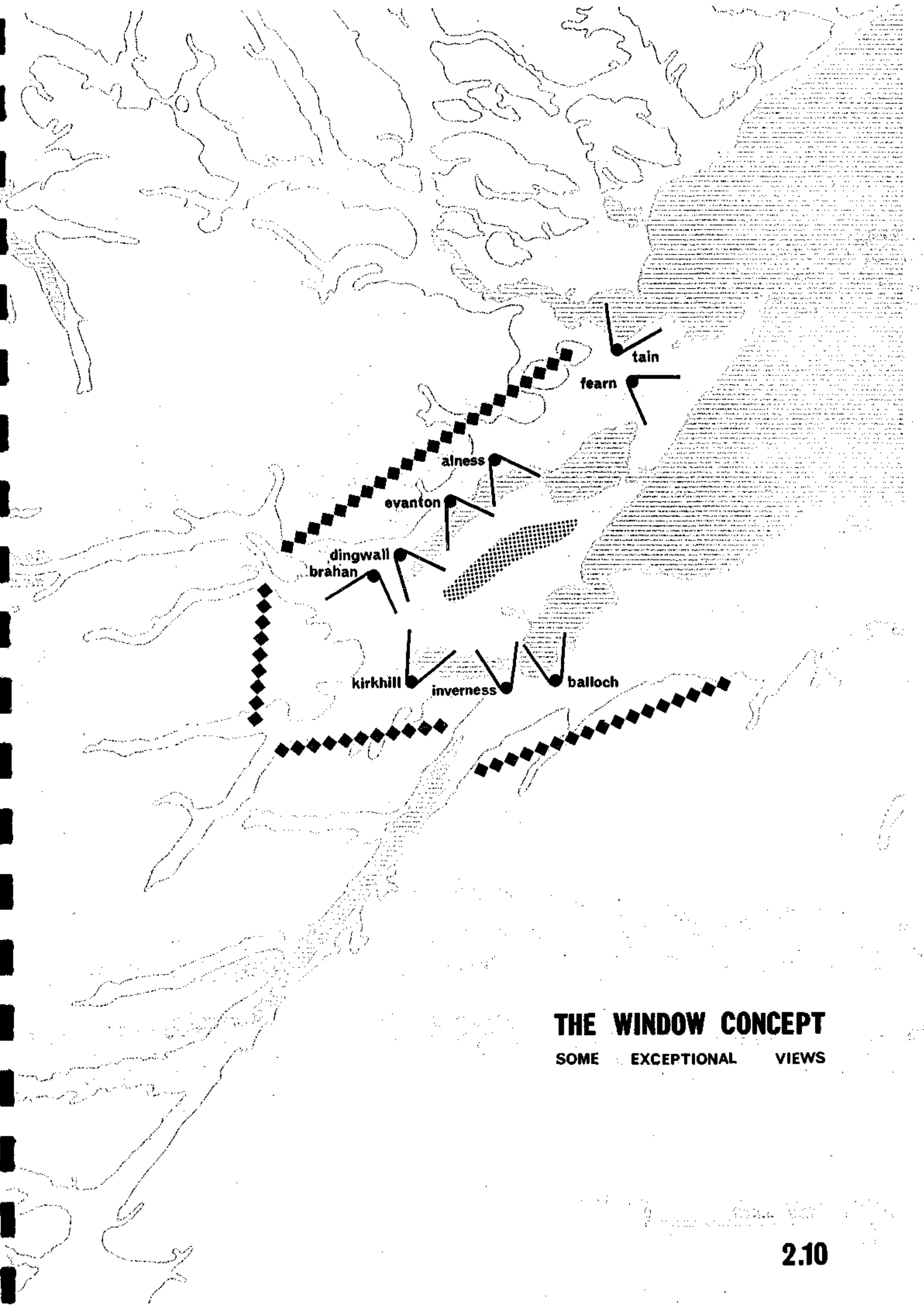
Flexibility in the strategy, which we have argued is so important, is achieved by having several alternative sites for both industrial and residential development and by avoiding development in a locality where very large infrastructure costs must be incurred at the outset. We believe it is a virtue of our strategy that it contains only one development with an exceptional infrastructure cost that must be incurred at the onset of development. This is what we have termed the 'Tore Option' which is not possible without a crossing of the Beauly Firth between Inverness and Kessock. Elsewhere, the strategy includes many development possibilities all with varying initial infrastructure costs, but none are of the magnitude of the Tore Option.

This discipline of investment thresholds applies not only to the choice of settlement but also to the development within each settlement. Since the rate of growth is not known, a method must be found to allow development to progress efficiently whether it happens rapidly, slowly or at varying speeds. If less than 2,000 persons are to be accommodated, the development should clearly be attached to an existing community or communities. When a larger population is expected, the development should be in parcels of about 4,000 persons since this is really the threshold for new social provision. In this way it is hoped that development will take place in workable parcels so as to give social identity and economic realism at all stages.

SUMMARY.

Having examined the landscape opportunities, the land restraints, the transportation possibilities, the physical, social and economic aspects of the location of employment, the adequacy of the services, the desirable settlement hierarchy, and the phasing opportunities, we conclude that a feasible and flexible strategy for growth is possible.

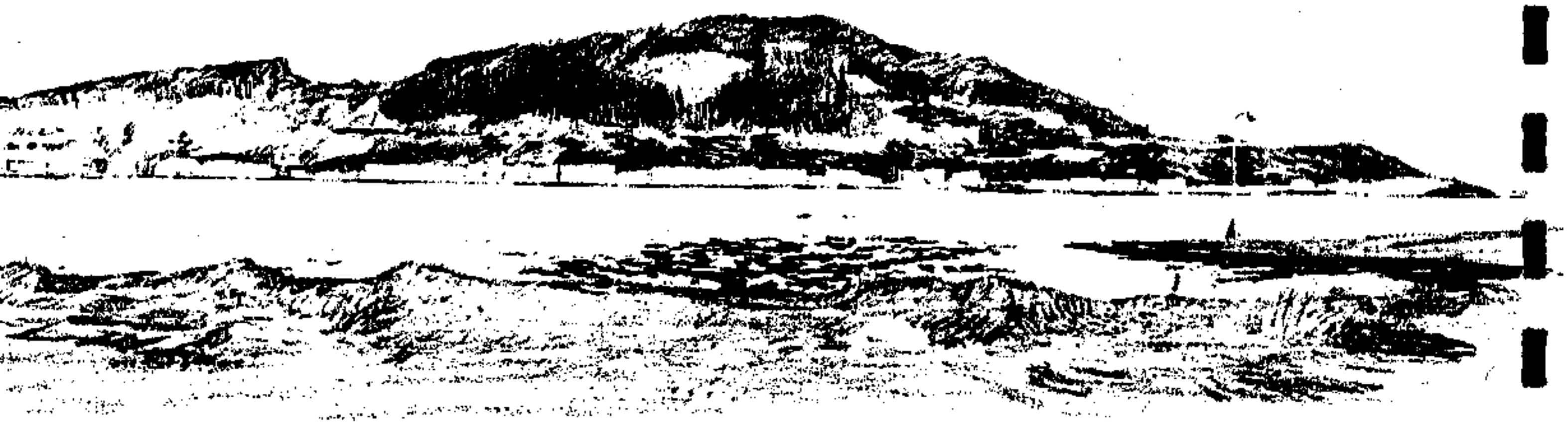
Inverness, the regional capital, must have a good transportation link with Invergordon, the first site proposed for industrial expansion. Many of the sites that are suitable for development and that can attach themselves readily to this transportation spine, have a wonderful environmental potential resulting from the natural landscape. As Map 2.10 shows the distant views of hill, water and mountain provide "windows" for each settlement and consequently help to define a recreational "green heart" role for the Black Isle.



THE WINDOW CONCEPT

SOME EXCEPTIONAL VIEWS

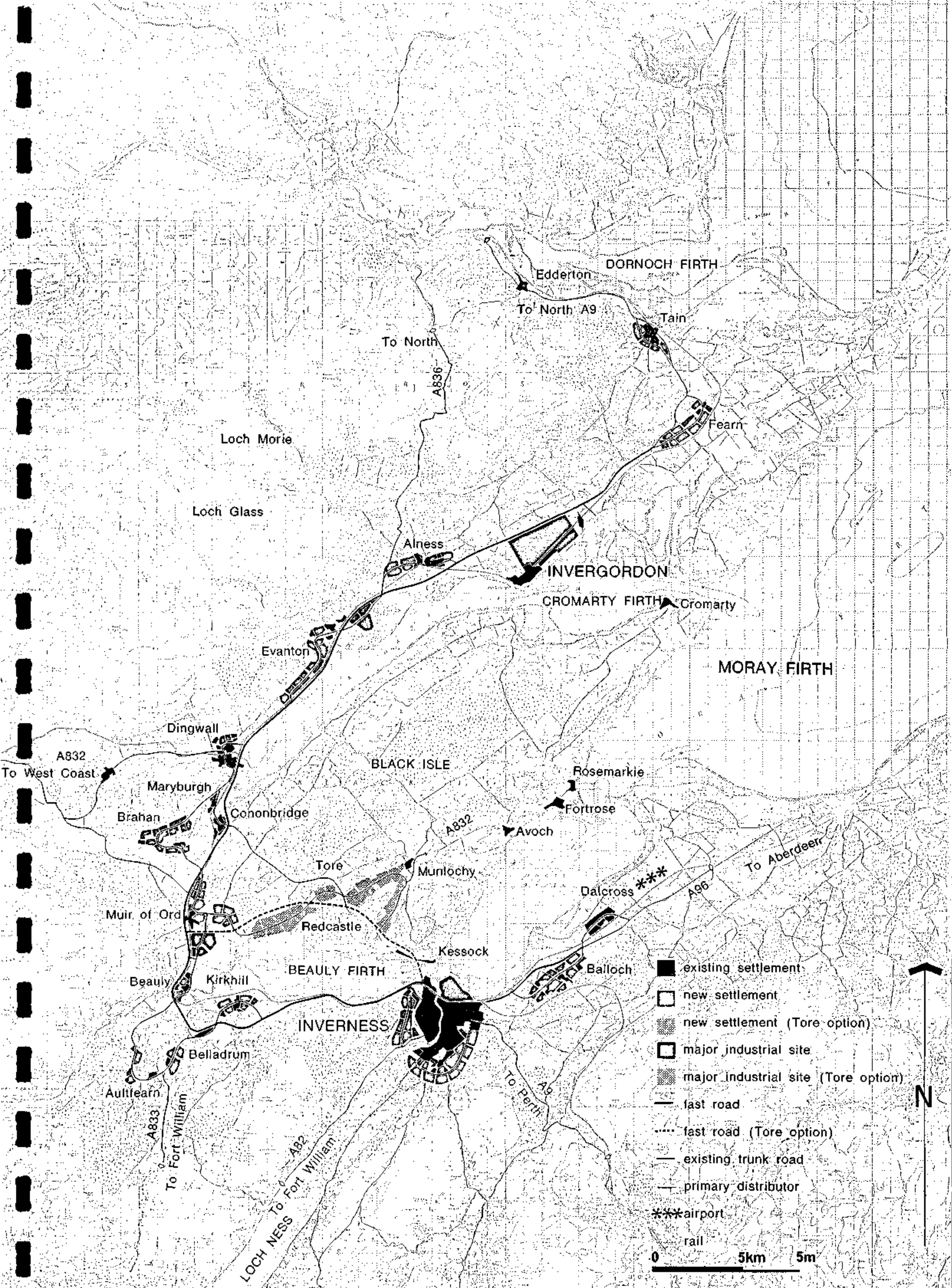
view up Beauly Firth from South Kessock



North Kessock from across Beauly Firth

PART THREE

SUB-REGIONAL STRATEGY



MORAY FIRTH STRATEGY

CONTENTS

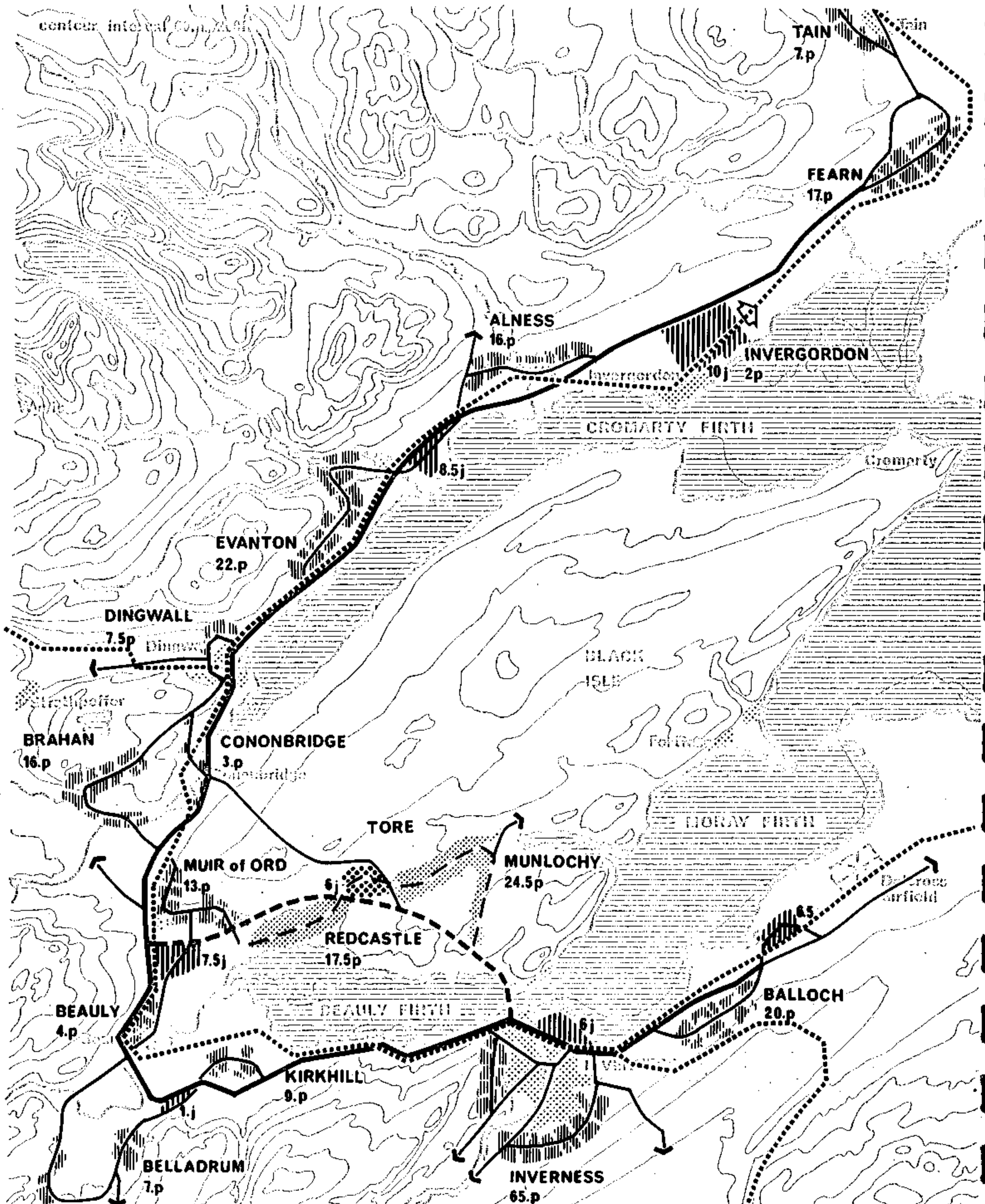
ILLUSTRATIONS

THE STRUCTURE.

Invergordon, the first site proposed for major industrial development is 35 miles by road from Inverness the historic capital and main administrative and commercial centre. To shorten this distance by a straight line connection across the Black Isle would be economically unjustified, taking into account the high cost of crossing the Cromarty Firth and the fact that such a route would completely by-pass the existing communities on the Cromarty and Beauly Firths. A crossing of the Beauly Firth at Kessock however is not such a major undertaking. It would give a direct route from Inverness to Dingwall and appreciably reduce the journey time to Invergordon and the North. At the same time it would open up possibilities of development on the north shore of the Beauly Firth and bring the recreational assets of the Black Isle within easier reach. However, the improvement of the existing trunk road from Inverness to Dingwall via Beauly is already justified by summer traffic flows. Thus, construction of the Kessock crossing is only justified if there is an immediate need to accommodate about 50,000 persons, which is the capacity of the Tore Option. Since no such immediate need is known, early improvement of the road to Dingwall via Beauly is expected.

North Kessock from across Beauly Firth

The transportation philosophy behind the strategy thus requires a search for sites for housing and industry within a limited band on both sides of the present trunk road, stretching from east of Inverness to north of Invergordon. In this situation there is a choice of a policy for concentration of settlement in a few large



new settlement

new settlement (Tore option)

major industrial site

major industrial site (Tore option)

totals for populations & jobs expressed in 1000's. p=population, j=jobs

railway

fast road

primary distributor

0 5 Kms. 5 Mls.

SETTLEMENT STRATEGY 3.1

centres, or a more dispersed pattern with settlements of moderate size. Very large settlements require a greater degree of certainty of completion than we can foresee at present in the Moray Firth area, to be fully cost-effective. Nor does concentration show up well on the test of feasibility, since obviously concentration at Inverness would be of little help to the primary industrial growth at Invergordon, while concentration at Invergordon or indeed at any point other than Inverness, would jeopardize the status of the Highland capital and create a potentially fatal rivalry in an area which is already struggling for survival. A third reason for rejecting the idea of concentration is that the diversity and flexibility of the opportunities offered by the existing settlements would be substantially lost. Further, it has been shown that a linear transportation pattern is more efficient than the more traditional radial and concentric pattern.

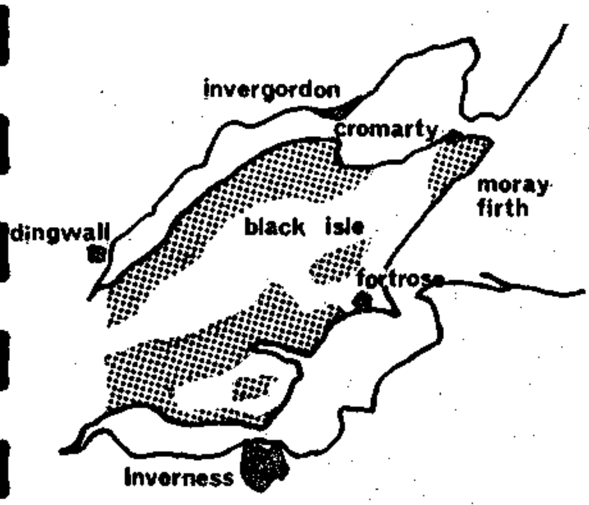
The capacity of the coastal strip from Tain to Balloch as determined by the examination of opportunities and constraints detailed in Part Two, amounts to approximately 250,000 persons in the settlements attached to the transportation spine (see map 3.1 opposite). To obtain the capacity of the whole sub-region the population living in existing villages (approximately 20,000) and on farms must be added. The population capacity of the proposed new developments has been derived by applying a gross residential density of 25 persons per acre to the areas of land suitable for development. This density was obtained from the Alness Study (Part Four) which can justly be regarded as a test at a larger scale of the concepts underlying our strategy. The table below gives the estimated existing and capacity population figures for the settlements shown on the strategy map.

	Estimated Populations	
	1966	Future
Tain	1,700	6,700
Fearn	200	17,000
Invergordon	2,300	2,000
Alness	1,500	16,000
Evanton	700	22,300
Dingwall	3,800	7,300
Maryburgh/Conon Bridge	1,100	3,000
Brahan	-	16,000
Muir of Ord	800	13,000
Beauly	1,400	4,100
Belladrum	300	7,000
Aultfearn	-	4,500
Kirkhill	100	9,200
Inverness	30,000	65,000
Balloch	200	20,000
Redcastle) Tore	100	(17,500
Munlochy) Option	200	(24,300
	44,400	254,900

The major employment concentrations shown on the strategy map have the following estimated capacities, based on the industrial densities discussed in Part Two (Location of Employment).

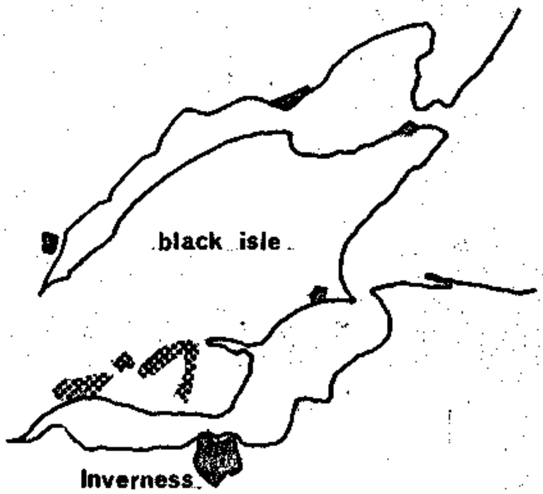
Site	Manufacturing Employment
Invergordon	11,000
Evanton	8,500
Muir of Ord	7,500
Tore	5,900
Kirkhill	1,200
Inverness	6,100
Dalcross	6,400
	46,600

Inverness is estimated to provide 25,500 service jobs. A further 1,600 manufacturing jobs and 41,000 service jobs are distributed among all the settlements.



Development potential on the Black Isle

At the present time the recreation opportunities offered in the sub-region are very considerable and the local economy has become dependent in an important way on the tourist industry. Last year (1967) the seasonal traffic increase in Inverness, between April and August was threefold. It has been our intention to enhance these recreational opportunities by the pattern of proposed development, rather than replace them with manufacturing opportunities. A major consequence of this is that only a very small portion of the land suitable for development on the Black Isle is recommended for development, and then only in the special circumstances which justify the Tore Option. However, we do see an important recreational and tourist role for the Black Isle. Elsewhere a wide range of important tourist and recreational opportunities exists in the surrounding mountains and coastlands and these will require careful exploitation, which can only be properly assessed by further study (see Part Six). A growth in the population of the sub-region must inevitably create new and improved opportunities for both tourism and regional recreational facilities. Indeed, in this way development can improve some of the qualities which make the area so attractive to development.



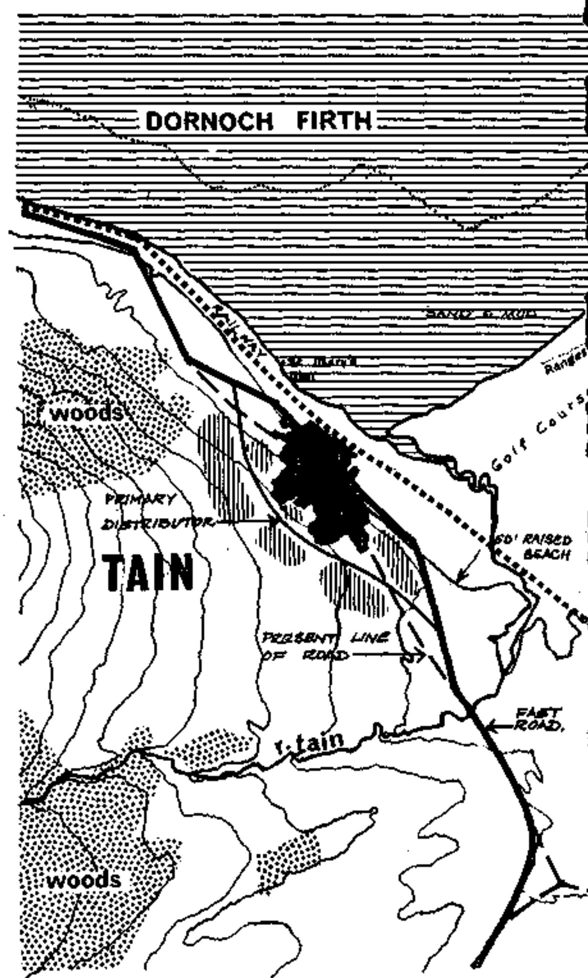
Development proposed on the Black Isle

At present it is difficult to establish or maintain recreational activities such as sailing or ski clubs, because the members drawn from the relatively small population cannot find the necessary financial support for clubhouses, jetties, moorings, ski-lifts, shelters and so forth. Given a substantial increase in population, these facilities would prove economically viable and would serve tourist and local alike.

THE SETTLEMENTS.

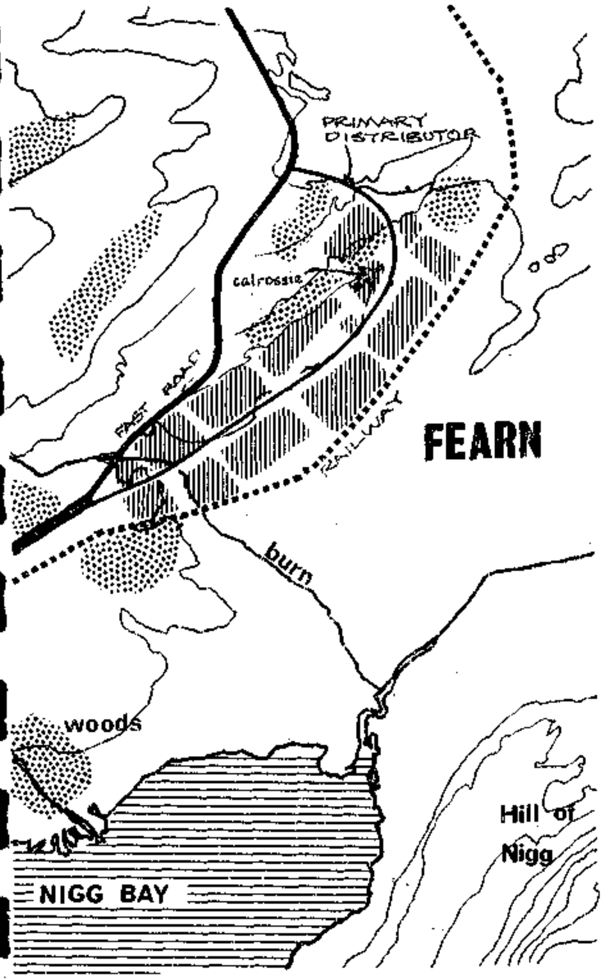
Invergordon. At the time of writing we do not know enough about the exact nature of the industries which may come to the industrial site to be able to gauge their impact on the Burgh itself. It seems probable, however, that Invergordon will become a sea port of significance for special cargo. In the absence of detailed industrial information we recommend that the town be contained within its present boundaries. No social capital is wasted because of this and Alness provides an ideal alternative location for residential development that is environmentally secure.

We also recommend that Invergordon should be made the subject of a separate intensive planning study as soon as the facts about incoming industry and its associated infrastructure are available, so that the port and other facilities can be integrated with a structure plan for the town.



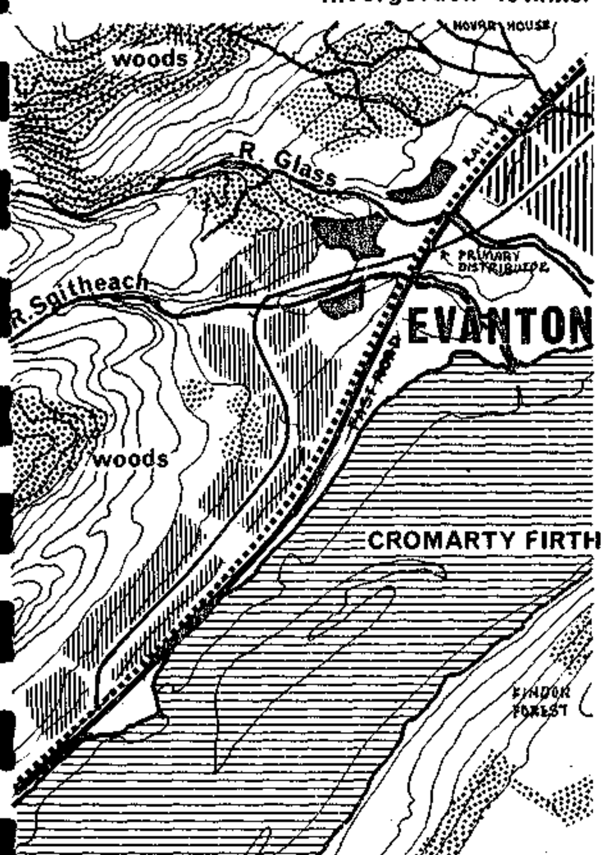
Invergordon 13 mins.
Evanton 17 mins.

Tain is a charming old Royal Burgh with extensive views overlooking the Dornoch Firth. In the longer term it could be readily expanded to about 7,000 persons mainly employed in Invergordon. The limitations to development are in respect of length of work-journey rather



Invergordon 0 mins.
Evanton 12 mins.
Dingwall 17 mins.

Invergordon 13 mins.



Dingwall 5 mins.

than topography.

Fearn is our proposal for a new town five miles north-east of Invergordon. This would be a long-term project giving a short journey to work at Invergordon when the other Cromarty Firth communities are nearing capacity. It lies on a ridge sloping south-east and is shielded from the Invergordon industrial development by the Balchraggan ridge. The site gives good views of the Hill of Nigg and there are many fine mature trees in the area. The site could comfortably contain a population of about 17,000.

Alness, a proposed town of about 16,000 would be the first settlement to be started. It is based on the existing village and is the subject of a fuller study in Part Four.

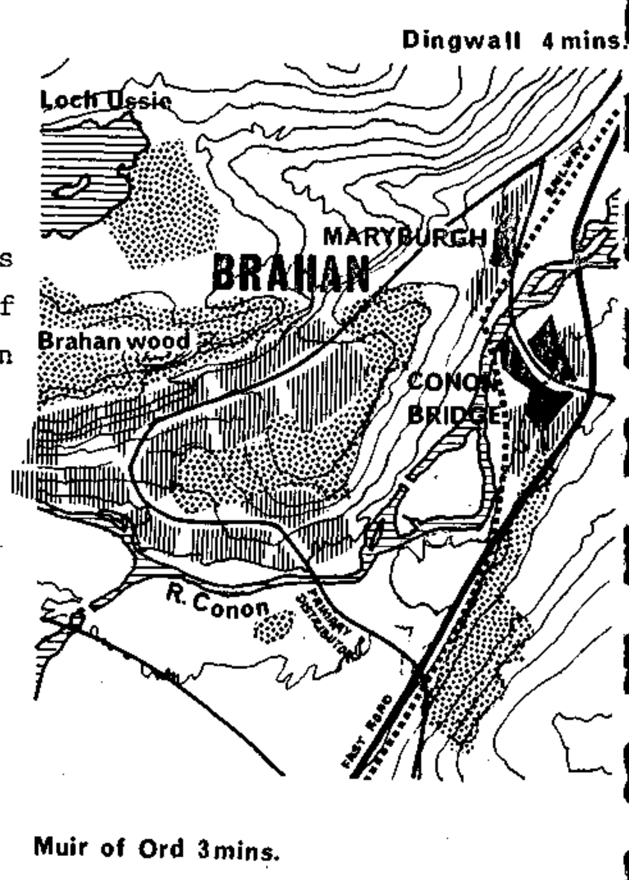
Evanton with a splendid 'window' to the Cromarty Firth is contained by woods and to the north-east by potential industrial development on 350 acres of flat land, and by the slopes of Cnoc Mhabairn to the north and west. Part of the town would lie on the south slope between the rivers Glass and Sgitheach. It is linear in form and could, within these boundaries, house about 22,000 people some of whom would work in the adjacent industrial estate while others could readily travel further east or west.

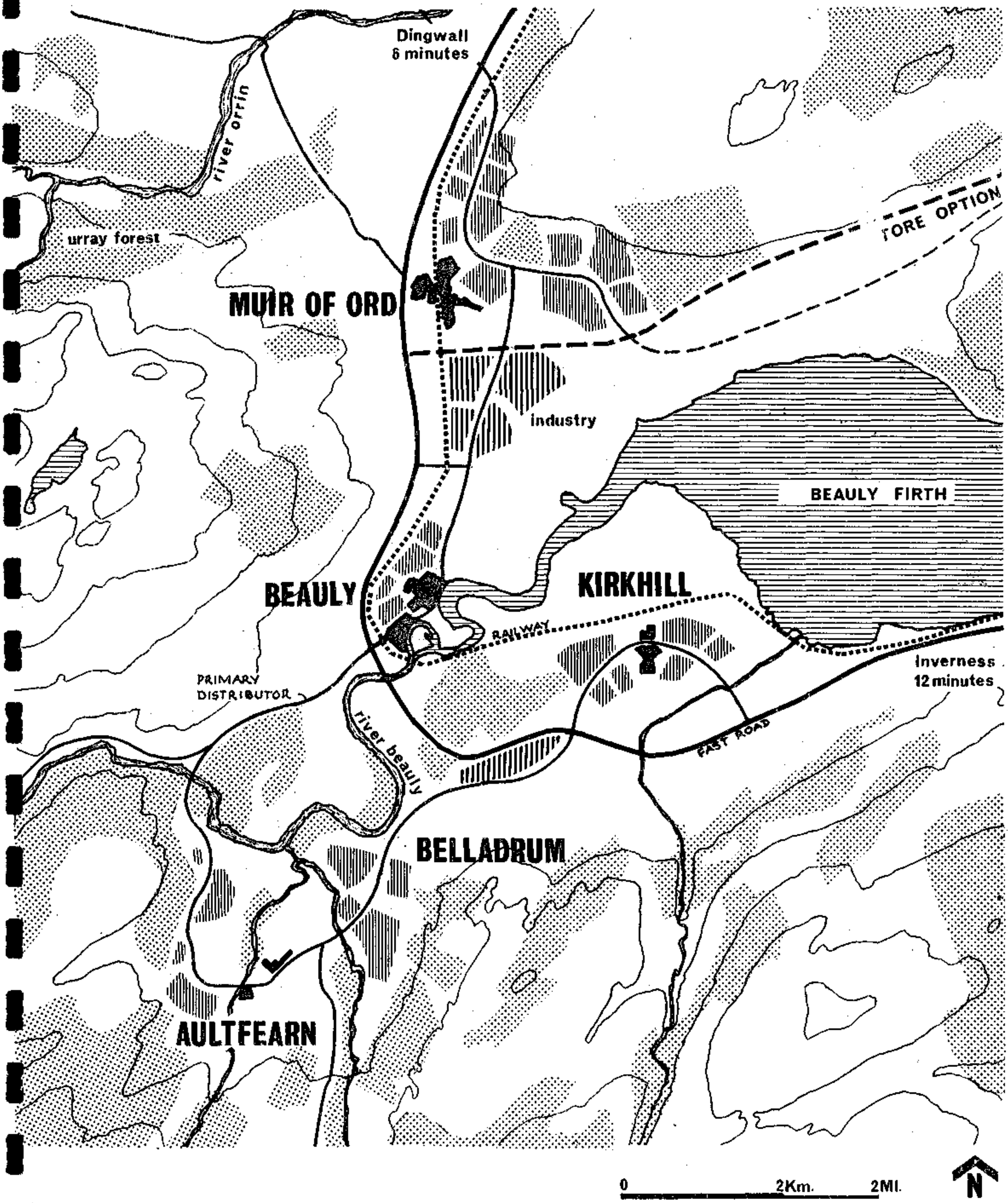
Dingwall can reasonably expand to 7,000 persons within its physical boundaries. The major problem confronting Dingwall will be the pressure for development of all kinds that arises as the expansion at Inverness and Invergordon takes effect. It was for this reason that we undertook a more detailed study, (Part Six), and we believe it is possible with careful planning and compatible development to retain and enhance the character of Dingwall as a rural servicing centre

Maryburgh/Conon Bridge could be expanded on flatter land to the south and west to take a total population of about 3,000 in the earliest phases of development of the Moray Firth strategy, thus giving an immediate choice of location for incomers to the area. Development would then be contained by the River Conon, the ridge to the north, the existing railway and the road proposals on the east. The character of the two villages should be maintained.

Brahan is a proposal for a new town of 16,000 inhabitants on the south slopes below Brahan Wood. It will have magnificent panoramic views of Strathconon to the west, of the wide sweep of the hills to the south, and of the Black Isle in the east. Its southern boundary will be the Conon River where the town centre shopping facilities could be located by the river side. There is virtually no existing infrastructure in this location to-day.

Muir of Ord. Quite extensive areas of flat land are already in industrial use here and we recommend the remaining flat land, to a total of about 300 acres, should be set aside for




Dingwall
6 minutes
river orrin
urray forest
TORE OPTION
MUIR OF ORD
industry
BEAULY FIRTH
BEAULY
KIRKHILL
RAILWAY
PRIMARY
DISTRIBUTOR
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12 minutes
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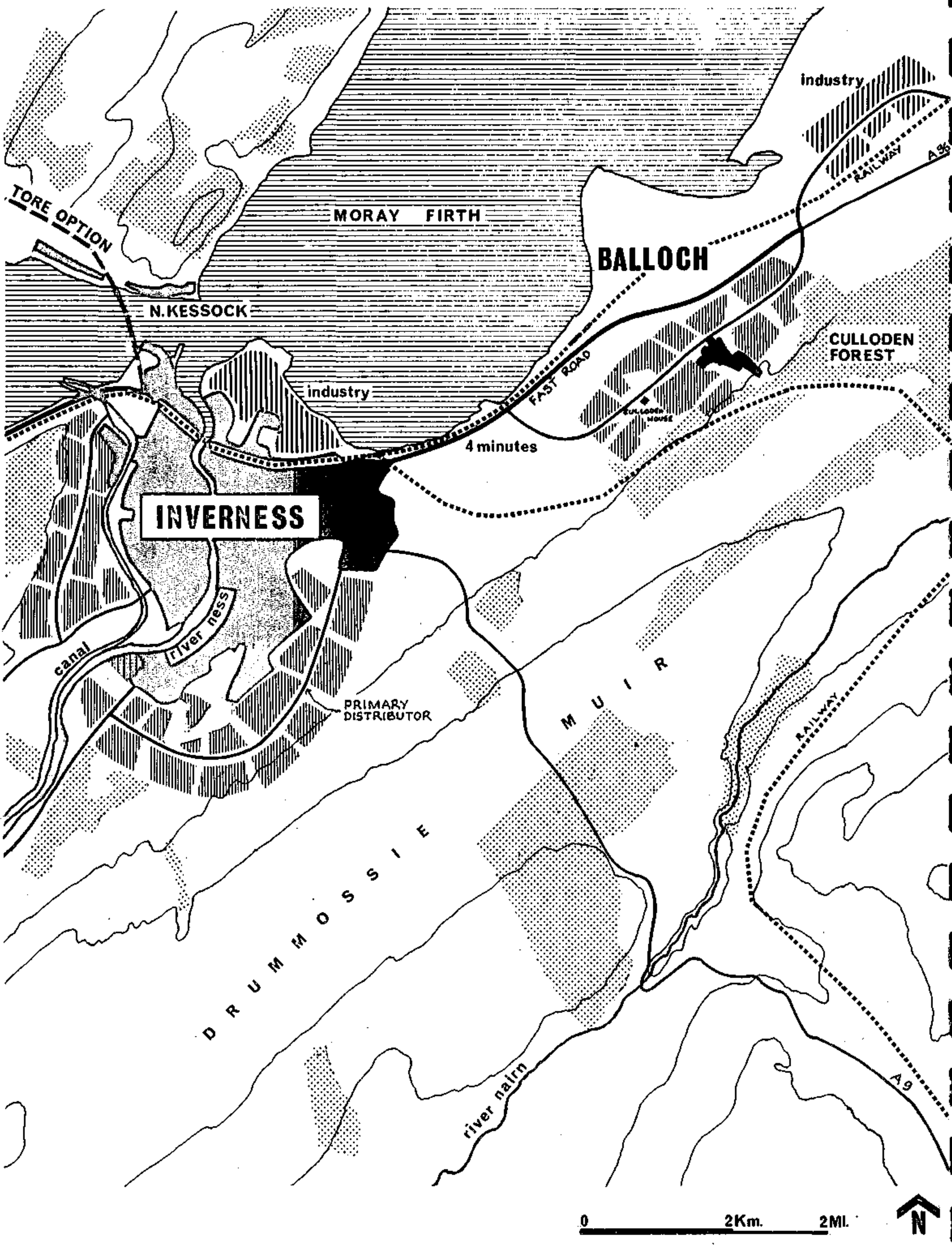

industry
RAILWAY
A96
MORAY FIRTH
TORE OPTION
BALLOCH
N.KESSOCK
CULLODEN FOREST
FAST ROAD
industry
4 minutes
INVERNESS
river ness
canal
PRIMARY DISTRIBUTOR
MUIR
DRUMMOSSIE
RAILWAY
river nairn
A9
0
2Km.
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N

this use. The town itself can be expanded within the boundaries of Bishop Kinkell Wood to the north, the railway to the west and the 250' (75 metre) contour to the east. This area could contain about 13,000 people who would have views of fine scenery all around the compass, particularly of Ben Wyvis to the north.

Main St., Beauly

Beauly has room for limited expansion to 4,000. To the north a green buffer is preserved between it and the Muir of Ord industrial site. It is bounded on the south and east by the River Beauly and on the west by the railway. The town square of Beauly is one of the finest in the area and need not be harmed by development proposals. Agricultural land quality is a restraint in varying degrees throughout the strategy (see Part Two), but in the case of Beauly it is more emphatic in relation to the other factors.

Aultfearn (4,500) and Belladrum (7,000) are proposals for new villages in the Beauly valley. They are low density residential settlements, each on its own tributary of the River Beauly. Aultfearn is bounded by woods and steep ground to the south with wide and beautiful views to the north. Belladrum is on a west slope below Black Wood with equally fine views to the north-west. Both villages are in a pastoral setting with mature trees.

Road North from Beauly

Kirkhill. Here there are about 50 acres of flat land suitable for manufacturing industries. We propose a small but virtually new town of 9,000 population based on the village and overlooking the head of Beauly Firth.

Inverness. The capital city will also require an early and separate study to ensure that it will be capable of fulfilling the roles now assigned to it (see Part Six).

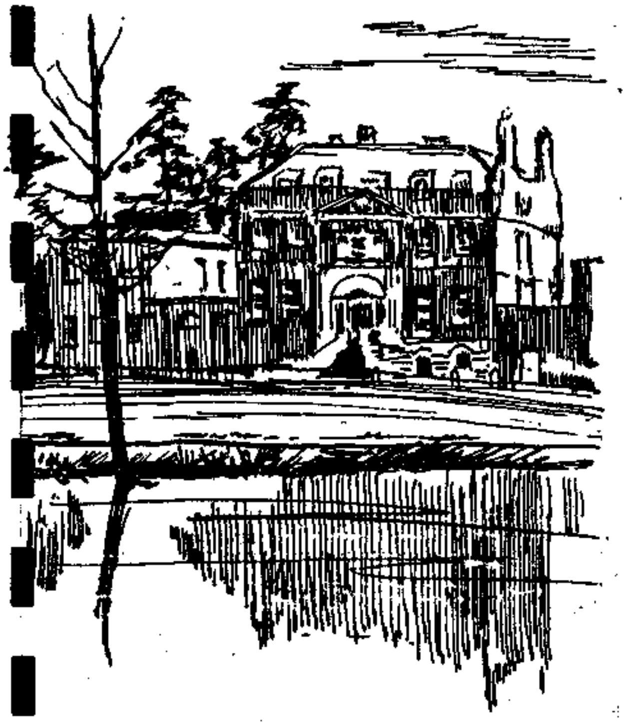
From our studies it seems that Inverness could be expanded to about 65,000 population by peripheral extension on the slopes which enclose the town. The limit of such expansion would be the exposure line on the 300' contour and the trough of cold air drainage along the River Ness. The views from these sites give a total panorama sweeping from Strathconon and Ben Wyvis across the Black Isle to the outer Moray Firth in the east.

Development to the south west would be halted by sharp ridges extending from Clachnaharry on the Beauly Firth to Charleston near the Ness, and by the need to preserve the recreational value of the riverside park land south of Ness Castle. There is no obvious physical limit to eastward development, but there is an opportunity to create a separate community at Balloch, which will house the population who would otherwise begin to cause congestion in the central area.

Any proposals for further expansion of Inverness should take account of the possibilities of the Tore Option which embraces potential residential development at Munlochy (24,300) and Redcastle (17,500) and potential industrial acreage at Tore. It is certain that when these communities together with Balloch are developed, they will have extremely close social and economic ties with Inverness.

Balloch is the site of a proposal for a new town of 20,000 population based on a small existing village, with a magnificent view of the Black Isle and the Ben Wyvis range across the Inner Moray Firth. The south boundary is Culloden Forest and the west boundary is the railway to Perth and the green zone flanking Inverness. The north boundary is formed by the railway to Nairn, and the east limit is formed by the proposed Dalcross industrial estate of about 260 acres. This estate is itself bounded by the air-field and by high quality agricultural land, and will draw workers from Inverness, Balloch, Nairn and smaller settlements around.

The structure plan for this new town should pay particular attention to the value of Culloden House as an historical and architectural asset. It was designed by Robert Adam and is one of the finest houses in Scotland.



Culloden House

THE TORE OPTION.

This has been included to meet two eventualities which, although not immediately likely, we consider could arise. The first is to meet the need for a large development (40,000 - 50,000 persons) which cannot be distributed among several smaller settlements. Under these circumstances the cost of a fixed crossing of the Beauly Firth could not be termed uneconomic. The second eventuality is that in the very long run, when all the spare capacity of the settlements closely attached to the transportation spine is used, this will provide for further expansion. In these circumstances Redcastle would develop before Munlochy, and to begin with would be attached to the transportation spine at Muir of Ord. Subsequently, as the population grew, the Kessock crossing would be constructed, which would allow development at Munlochy. It is because these development proposals are dependent on such very particular circumstances, that we have shown them in a distinctive colouring on the Strategy map.

Tore. There are about 240 acres of potential industrial land just south of this small settlement. This area is almost completely bounded by woods some of which are recent Forestry Commission planting.

Munlochy. This is a proposal for a new town of 24,000 population to be formed in a natural amphitheatre with a central saddle south-west of the existing village. It offers fine views down Munlochy Bay and across the Firth to Drumossie Muir. The development would be on the outer slopes of the formation and concentrated on those facing generally south. The boundaries are Kessock Forest and the top edges of the slopes, and although the town would be linked to the existing village, a new centre would be required nearer the fast road.

Redcastle is another new town proposal south west of Tore with capacity for about 18,000 inhabitants in one of the most beautiful settings in the area. It is on a raised beach above the Beauly Firth and its east and west boundaries would be the Gallow Hill and Spittal Woods respectively. The north boundary would be the line of the fast road between Inverness and Muir of Ord, and this will depend on gradient, farm boundaries, and junction possibilities. This south-facing site offers fine views of water and hill.

Amount of Land for Development

The estimated area of all land below the 500' contour between Edderton in the north and the Nairn County boundary in the east is 220,000 acres.

Proposed NEW built-up areas

(All communities listed except those in Tore Option).

General Residential	Acres	Proportion of all land below 500'
including primary school, shops and local open spaces.	6,900	
Industrial	2,200	
Total	9,100	4%

Tore Option communities (Munlochy and Redcastle)

General Residential	1,650	
Industrial	350	
Overall Total	11,000	5%

THE PHASING.

Our recommended strategy is flexible because it provides a variety of phasing possibilities. The expected pattern of development after the commencement of industrial expansion at Invergordon with its associated housing at Alness, (and housing for existing needs at Dingwall and/or Maryburgh - Conon Bridge) will depend entirely on the type of employment generator and its location requirements. As was pointed out in Part Two (Location of Employment), many possibilities exist. Further rapid growth at Invergordon by industries linked into a complex and dependent on sea transport would mean further expansion of Alness and possibly a start on housing at Evanton and Muir of Ord. Small scale industrial growth to service the industries at Invergordon suggests Evanton for both industry and housing. Industry very highly dependent on young female labour would locate at Inverness, while industry closely dependent on air transport facilities can be serviced best from Dalcross industrial estate. Any and all of these possibilities are readily accommodated by the strategy.

It is helpful therefore, to consider the proposed settlements under three headings, each relating to a particular phasing context.

(i) Expansions of existing settlements - at Tain, Alness, Evanton, Dingwall, Maryburgh/Conon Bridge, Muir of Ord, and Inverness. Some or all of these can be used to accommodate growth varying from the minimum rate and scale (with the appropriate social provisions) to quite large expansions.

(ii) New settlements of modest scale - at Brahan, Kirkhill, Fearn, and Balloch. These can accommodate a demand for accelerated population growth associated with "lumpy" job increases in such numbers as will justify promotion of one or more of these settlements. The order or choice would, of course, depend on the job locations.

(iii) New settlements of large scale - the "Tore Option". This will accommodate the need for a rapid, large scale, urban settlement associated with very substantial job increases anywhere between Dingwall and Ardersier.

Phasing in relation to transportation.

The location studies for the Fast Road are aimed at a tangential relationship to the possible development areas tempered by considerations of engineering feasibility of line, level and cost.

Wherever practical, between the settlements, the Fast Road line has been associated with the existing trunk road line or a currently proposed improvement as for example from west of Inverness to south of Beauly.

Where the present trunk road passes through existing settlements new lines have been selected to by-pass these, and the existing roads have largely been incorporated into the hierarchy of Distributor Roads (e.g. Beauly and Muir of Ord). Thus the creation of the Fast Road can be a progressive development of the existing trunk road.

At Conon Bridge/Maryburgh the new road bridge now under construction has been incorporated into the Primary Distributor network, and the Fast Road has been located on a new line which in this instance differs from the line of the Trunk Road Order, which currently stands for a proposed by-pass of Conon Bridge and Maryburgh.

Detailed studies were made at Dingwall in order to ensure that the Fast Road was located on a feasible line and that the town could be re-structured to accord with the general proposals for Distributor roads.

At Invergordon we have proposed that access to the major industrial sites and to the port should be from feeder roads connecting directly to the Fast Road, which bypasses the town, and thus protect the existing community from the impact of industrial and port traffic.

The Burgh of Inverness will require a comprehensive planning study on a scale outwith the objectives of this report. Messrs. Jamieson and Mackay are engaged by the Burgh on a particular study of traffic and roads, and our joint consultations have satisfied us that the Burgh can be re-structured to fulfil its role in the Moray Firth Area.

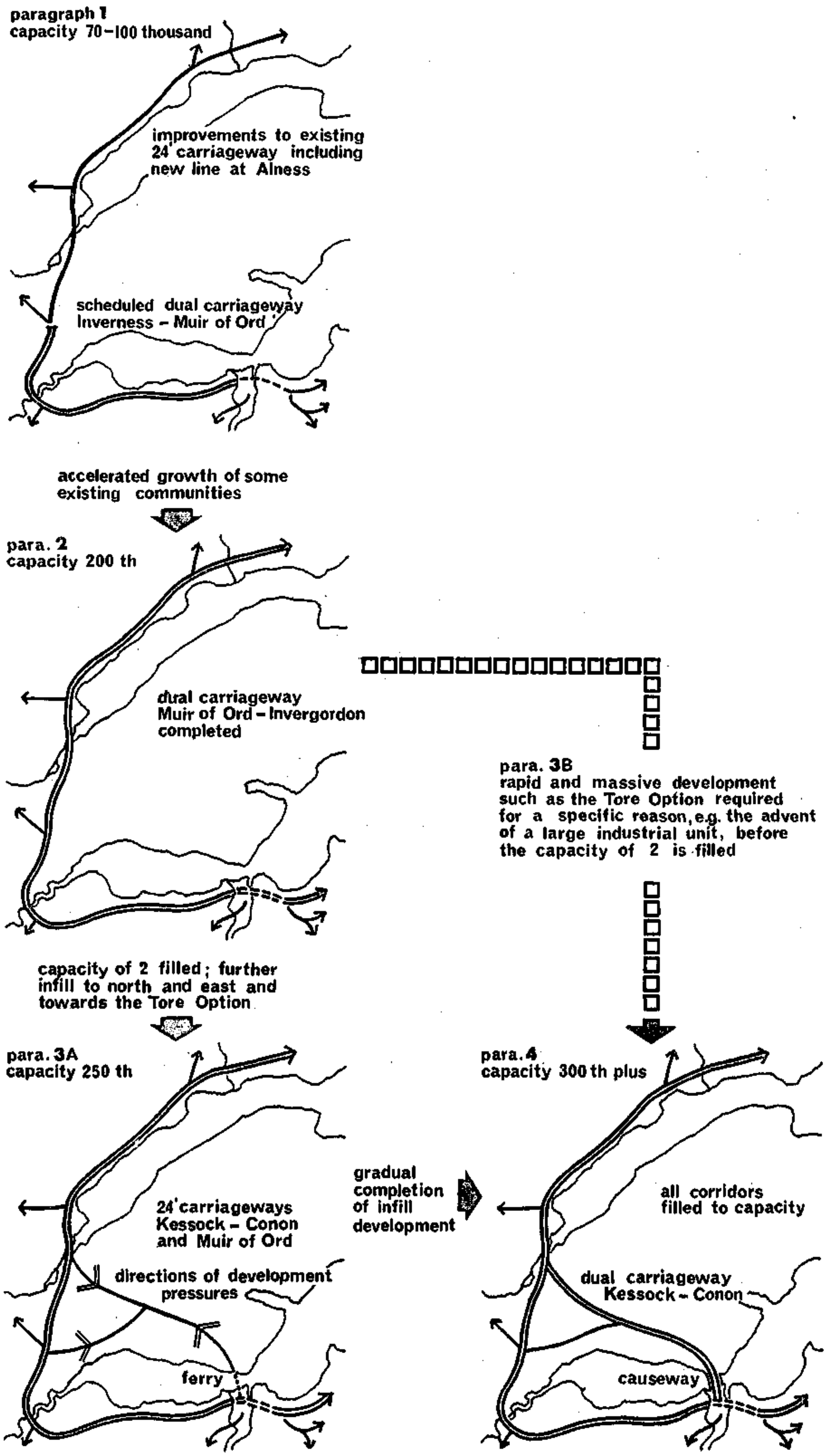
The establishment of a large scale development across the Beauly Firth from Inverness would create pressure for a permanent crossing of the Firth either by a bridge or a causeway. If the scale of the Tore Option development justified this crossing, then a logical outcome will be the creation of a direct road link from some point immediately west of Inverness to Conon Bridge. Such a crossing would, of course, require very specialised studies both as to type and location, but at this stage the proposal is too speculative to warrant detailed investigation and we do not recommend any change in emphasis on the improvement of the existing line of the trunk road from Inverness to Conon Bridge via Muir of Ord.

The Land Use/Transportation Study in Part Six sets out in full the traffic forecasts and lane requirements for the Fast Road and the Primary Distributor, at "saturated" car ownership levels and on the assumption that all development shown on the Strategy Map is complete.

Sequence of Growth.

It is the intention here to sketch the various ways in which the strategy could come to be fulfilled. In general terms there are two alternative sequences which differ because of the massive and rapid growth possibility which could arise as described in a previous paragraph on the Tore Option. Thus, although each phase in the sequence of growth offers a variety of development possibilities, the general sequence excluding rapid growth is described by paragraphs 1, 2, 3A and 4, while the sequence including this possibility is described in paragraphs 1, 2, 3B and 4 (see diagram 3.2).

The existing situation. Assuming that existing trends in the growth of tourism and small scale industries are enabled by the Board's policies



SEQUENCE OF GROWTH 3.2

to stem the decline of population, it is unlikely that these economic opportunities alone could create substantial growth of population. Emigration at a rate at least equal to the natural increase would continue to distort the age structure of the population.

Any growth of settlements would be likely to take the form of minor extensions to existing towns and villages, but a gradual build-up of traffic on the roads could be expected, in line with national trends in car ownership; and the promotion of tourism could lead to a considerable build-up of summer traffic. Traffic volumes already justify the construction of a dual carriageway from Inverness to Muir of Ord, a 24'0" road to bypass Dingwall, and will in the future justify a gradual upgrading to 24'0" of the existing road from Muir of Ord northwards.

In spite of the small scale of building activity in these circumstances, it would be very possible for badly sited sporadic development to mar those qualities of the landscape which are most generally admired; vigilant development control, and guidance for developers, based on studies of individual settlements would still be needed if the development potential is not to be squandered.

1. New Industry at Invergordon not followed by general expansion. It is quite possible that the major industry now expected for Invergordon creating about 2,000 jobs, will not be followed by a large growth of other industry. A planned expansion of Alness, and of Conon Bridge/Maryburgh, and Dingwall to a lesser

degree, would then be needed to provide employees with a choice of places to live in. The effect of a sudden influx of industry at Invergordon would justify an accelerated programme of road improvement to form a fast link with Inverness. This would require a new line of 24'0" trunk road from Invergordon to Muir of Ord, where it would join the dual carriageway already needed for the west bound traffic from Inverness.

It is difficult to tell what effect such a change would have on the long term population trend, but if, as hoped, additional young families remain in the area, the level of social provision will have to recognise this.

2. New Industry at Invergordon followed by others throughout Moray Firth Area. The major industries at Invergordon may bring in their train a wide range of secondary industries, leading to a general expansion. The secondary industries can be located on a choice of sites, such as Evanton, Muir of Ord or Kirkhill, and communities could be expanded and developed at some or all of the planned settlements between Invergordon and Inverness, to give a good range of job opportunities and choice of places to live. The order in which settlements would be developed would depend on the rate of industrial growth at any particular location. The settlements most suitably placed for expansion would be Alness, Evanton, Dingwall, Maryburgh - Conon Bridge, Muir of Ord and Inverness itself. New communities at Brahan and Kirkhill can accommodate populations of 16,000 and 9,000 respectively if justified by the scale of demand. A general

expansion of this order could be expected eventually to reach about 200,000 persons and the traffic it generated would justify a dual carriageway from Invergordon to Inverness.

3A. <u>Continued expansion on the basis of slow growth</u>. Assuming that the estimated capacity of the corridor between Inverness and Invergordon is eventually reached, and industrial growth continues steadily, then further areas for development would be required.

The pressures would probably be greatest on the area between the two Firths at the west end of the Black Isle. Continued expansion of employment opportunities at Inverness and Invergordon can be met by development at Tain and Fearn in the north and Balloch to the east of Inverness.

Although this appears to be a very long term possibility at present, there is ample suitable land for development in the Black Isle. The existing roads to Muir of Ord and to Conon Bridge by Kessock, would be brought up to 24'0" and would be linked to Inverness by the ferry. Subsequently as the demand generated by new development built up, the construction of a causeway link would be justified. The traffic flows would then also warrant the upgrading to dual carriageway of the road from Kessock to Conon Bridge. This would increase the choice of routes available in the area from Tain to Ardisier, the whole area being by then the scene of considerable activity and movement, accommodating 250,000 or more persons. (See para. 3A and 4 on Sequence of Growth diagram 3.2).

4. Capacity achieved by steady growth. It is reasonable to assume that if sufficient industry is attracted to the area to generate a sub-regional population of 250,000, then further expansion will occur, based on the momentum established in earlier phases of development. Making full use of the Tore Option a figure of 300,000 or more is estimated to be the capacity of the sub-region. Such a long term estimate is, of course, highly speculative at this stage.

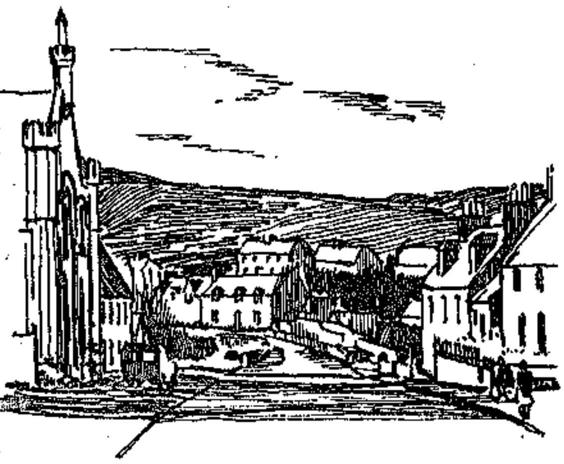
3B. Capacity achieved by rapid growth. The same order of capacity could be arrived at in a somewhat different way if it is assumed that while the settlements on the Invergordon - Beauly - Inverness link were being developed by a gradual process of growth, a sudden advent of major industry with many new jobs were to arise. This sudden demand for large scale accommodation would justify a large development at the east end of the Black Isle, which would in its turn justify the provision of dual carriageway links to Inverness and Invergordon before full capacity was reached on the Inverness - Beauly - Invergordon route.

It must however be pointed out that although this is a possibility which has been considered in the phasing exercise, there are no grounds at the present time for supposing that such a major influx will happen, and the slower build-up of coastal towns and villages towards a more modest population figure seems the more likely pattern of events.

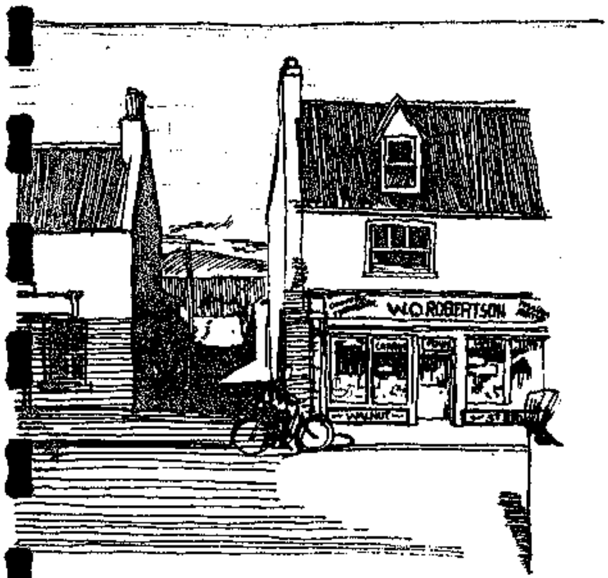
PART FOUR

ALNESS STUDY

CONTENTS.



Bridge Alness



High Street Alness

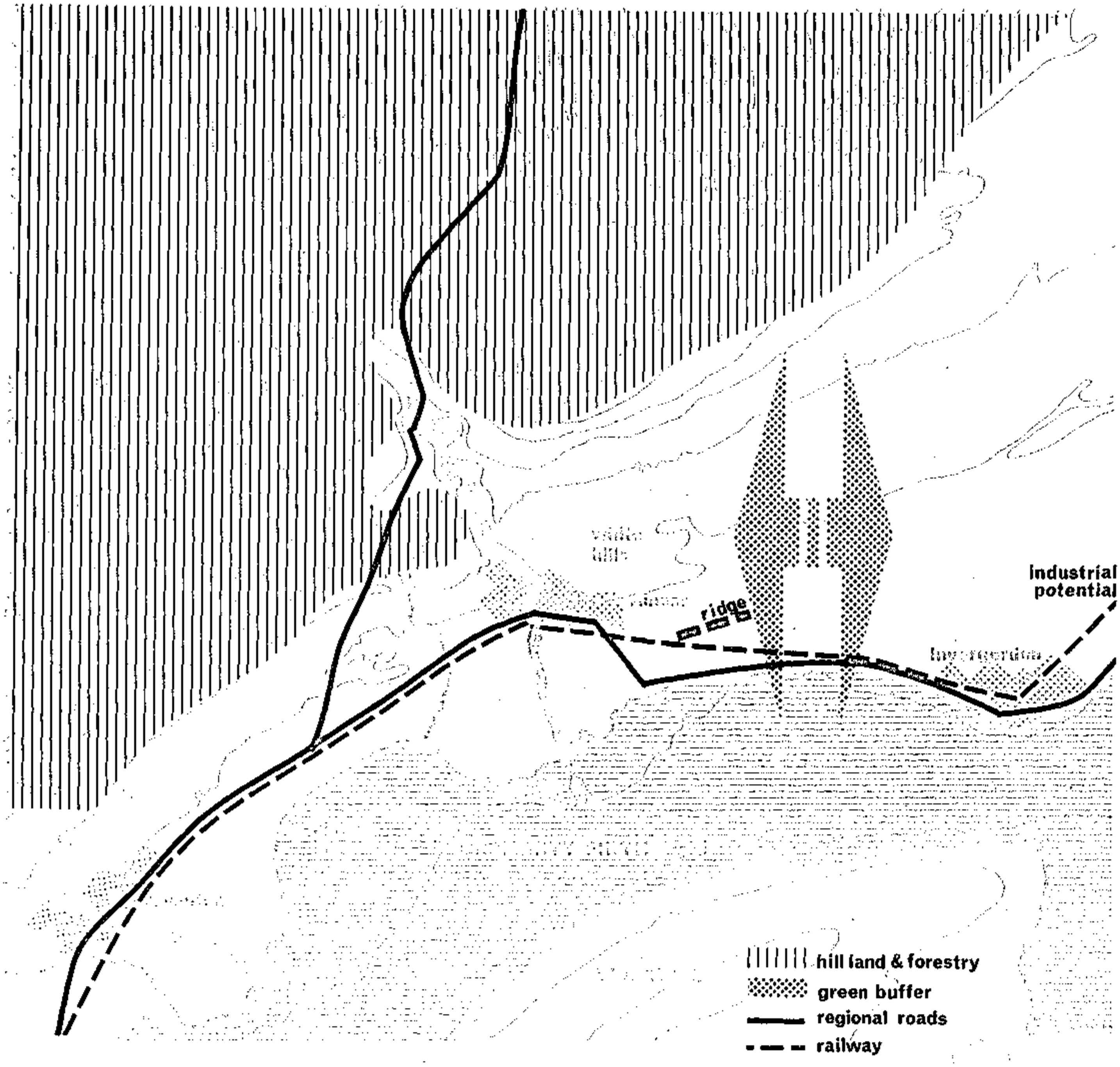
ILLUSTRATIONS.

RESTRAINTS AND OPPORTUNITIES.

In the sub-regional study the Alness area was considered suitable for urban development with a population in the range 15,000 to 20,000. This preliminary assessment was then tested against a more detailed study of the physical restraints, the ability of the existing village to accommodate change, journey to work patterns, road networks and the various thresholds for shopping, schools and other social needs. The analysis revealed that a township of around 16,000 can be developed at Alness, with the existing village as its nucleus, taking full advantage of the favourable aspect and fine views. The rate of growth will clearly depend on the scale and nature of industrial development, but the town can be built up by localities which provide a workable community at intermediate stages of growth. More detailed studies have been done to ensure that the qualities of the area can be exploited in housing layout and design. (See Housing Study: Part Five).

Area of Search.

The Alness area is clearly defined to the north by steep afforested mountain land and to the south by the Cromarty Firth shoreline, see Map 4.1. The east and west boundaries cannot be defined so precisely, since they are partly dependent on the strategy of self-contained areas of development, and partly on physical and visual restraints; but to the east, the prominent ridge north of Belleport pier is the containing feature used to define the edge of the

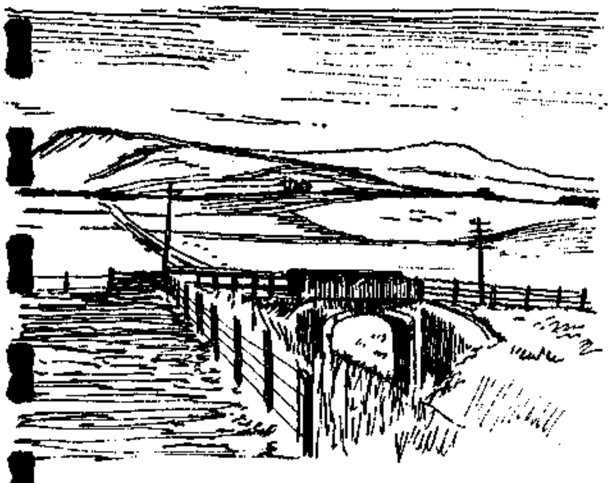


AREA OF SEARCH 4.1

"green buffer" between Alness and the industrial area at Invergordon; and to the west, hill forestry reaches down to within a mile of the Firth, and this natural boundary is reinforced by the converging pattern of regional roads and railway.

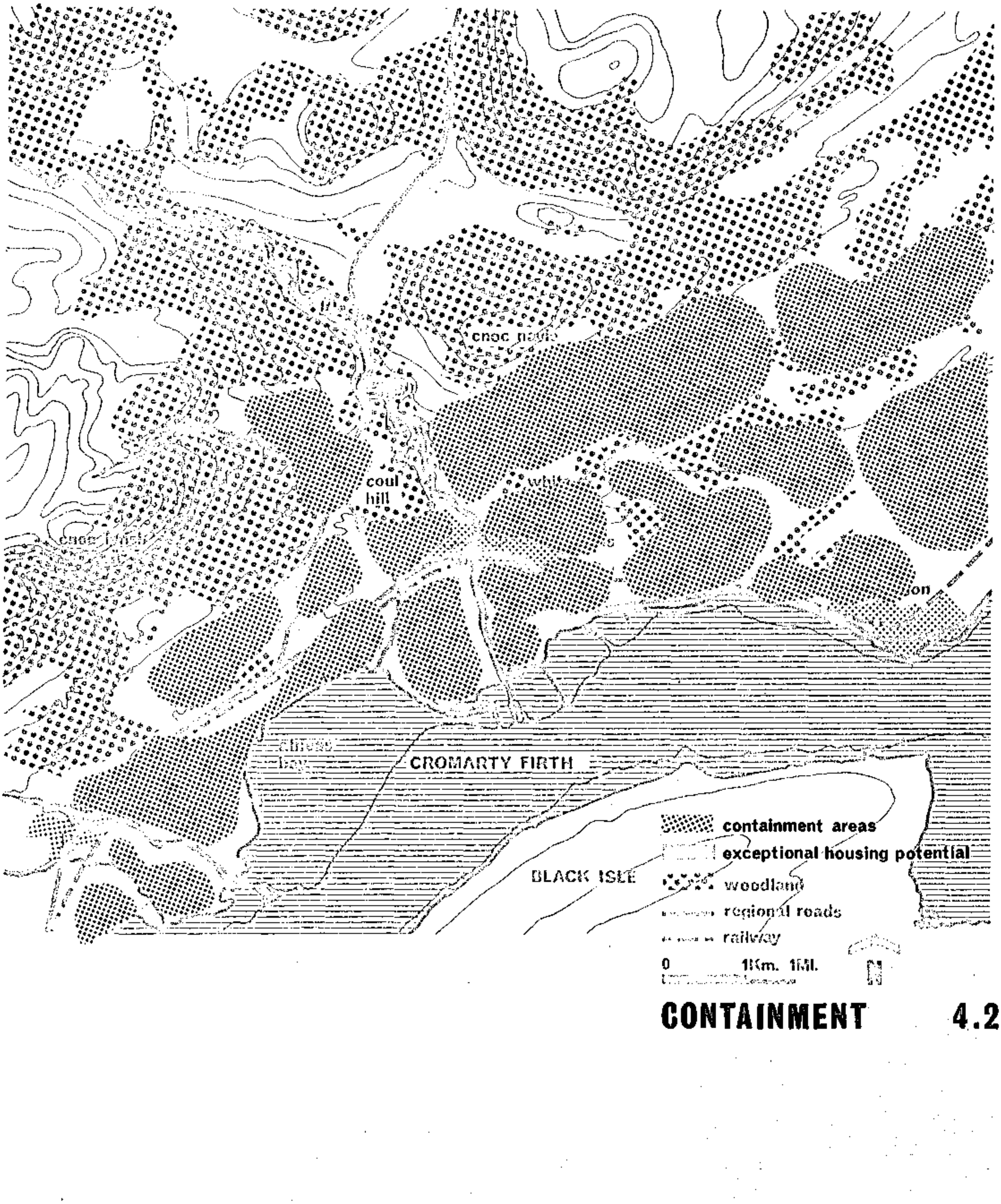
Within the area of search we made a detailed study of local conditions such as geology, topography, soils, rivers, drainage, climate, vegetation and wild life and at the same time examined the area from a landscape point of view, to define the main areas enclosed by natural and man-made barriers. Within these containment areas were a number of high amenity, sheltered, south facing slopes which were potentially excellent for housing development and are shown on Map 4.2.

The setting of Alness is dominated by the association of mountain and sea and the exceptional breadth of views which include the Sutars, the wide sweep of the Black Isle and the hills to the south-west between Strath Glass and Strathconon. West of Alness, Cnoc Fyrish rising to about 1200 ft. (400 m.) is a well known landmark in the district. The arable scenery of the lowlands contrasts with the dark wooded hills of the Highland edge, and the deciduous trees near the rivers, form a break between the strip of farm land to the east and the narrower coastal area to the west.



Cnoc Fyrish from Invergordon

The range and variety of scenery is striking at all seasons, particularly when the sun throws the westerly hills into relief and reveals the features of the landscape with unusual clarity.



CONTAINMENT 4.2

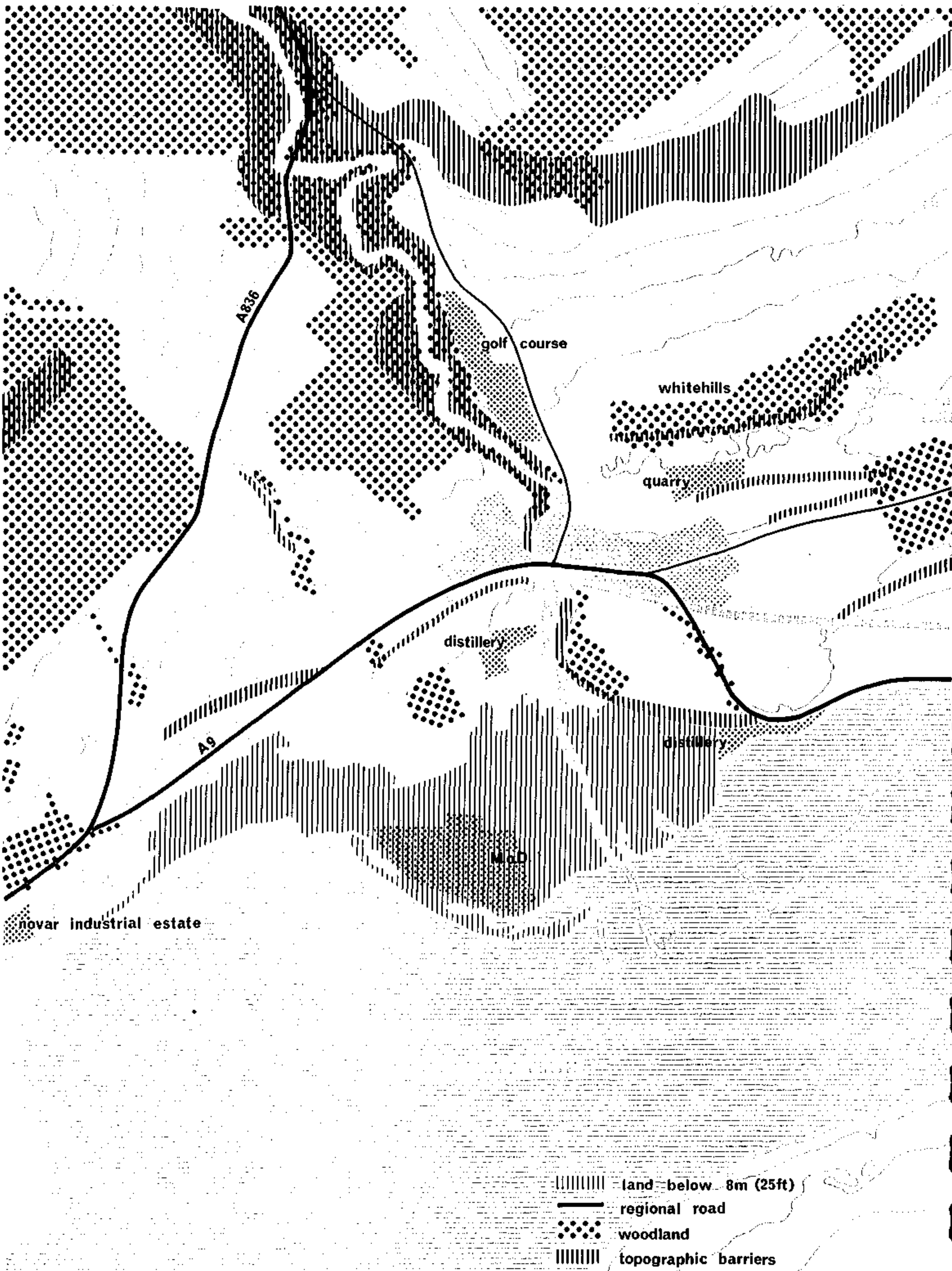
Topography and Soils.

The main features of the land form are the shoreline of the Cromarty Firth, the coastal zone, the hill foot zone and the main hill zone or Highland edge already shown on Map 2.0.

The shoreline consists of sand and shingle beaches east of the Alness delta, with extensive mudflats stretching westward across Alness Bay. The coastal zone slopes gently up to the 100 foot (30 m.) contour and is a mile or more in width. There are no rocky outcrops, although most of the features follow a pattern of ridges which lie parallel to the Firth, and there is an almost continuous cover of till over the whole area, overlain in some places by later fluvio-glacial and marine deposits.

The hill foot zone lies between the hundred foot (30 m.) and four hundred foot (120 m.) contours and is about a mile wide. It extends above the highest tide mark of the late glacial sea comprising a mixture of glacial erosion and deposition, and includes contrasting areas of till and of sand and gravel ridges, similar to those in the coastal zone; gravel is in fact quarried in the White Hills area. The main hill zone comprises rough and forested ground rising about 1300 ft. (400 m.) at Cnoc Fyrish and over 800 ft. (250 m.) at Cnoc Navie.

As Map 4.3 showing topographical barriers indicates, land steeper than 1:5 has been regarded as unsuitable for normal development and land below 25 ft. (8 m.) has also been eliminated since there would be a number of drainage problems so close to the Cromarty Firth.



WOODLAND & TOPOGRAPHY 4.3

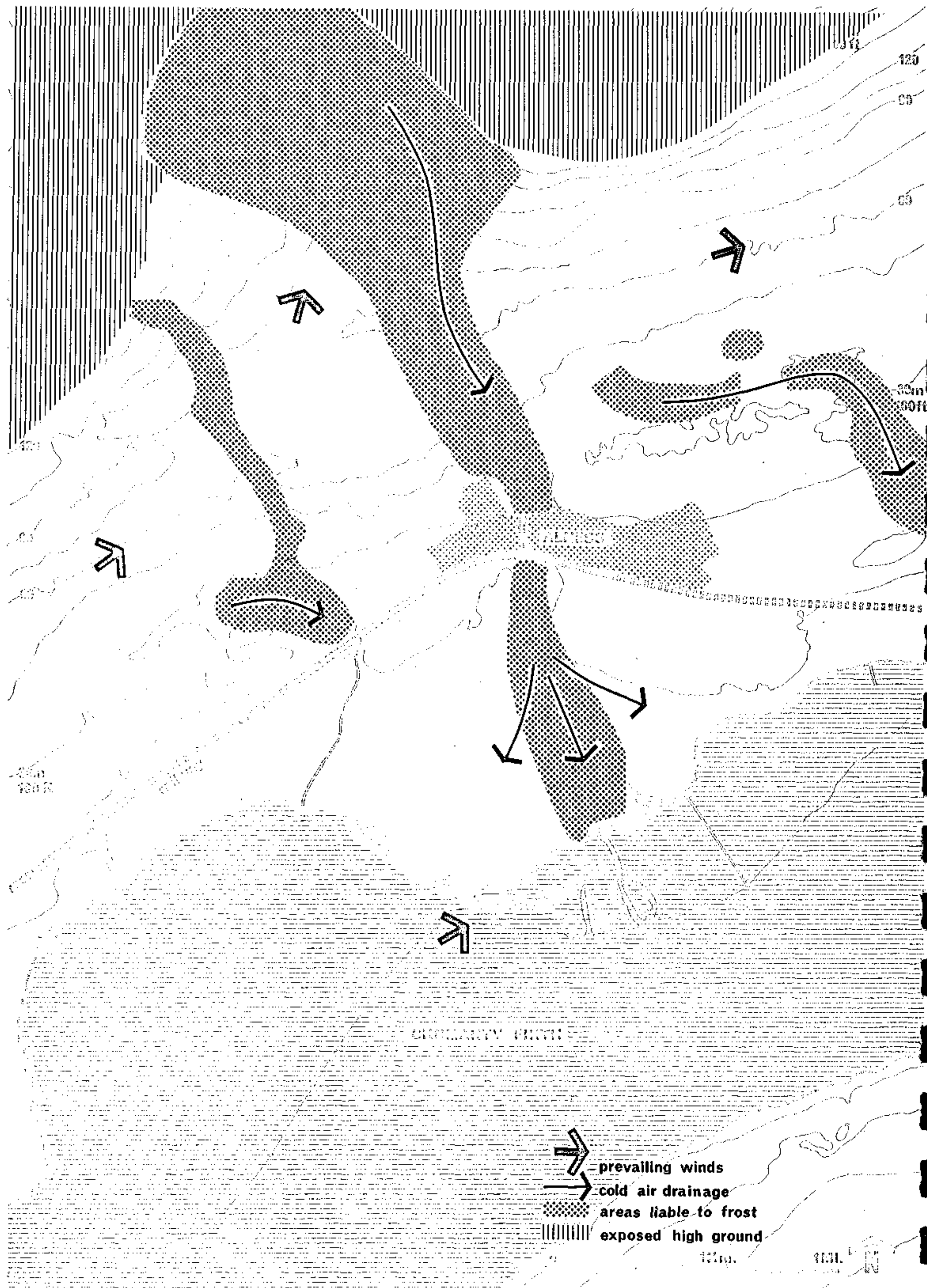
Climate.

In spite of the high ground to the north, the dominant climatic influence is maritime, and Alness is relatively free of frost except in the cold air drainage lines along river valleys. (See Dr. Caborn's report in Appendix 3). Parts of the area are exposed to the prevailing south westerly wind which is channelled by the grain of the land form; the slopes are mainly south facing and receive good solar radiation, although there are a number of north slopes associated with ridges. The climate is generally dry with an annual rainfall of about 30".

Ground with particular liability to frost arising from cold air drainage routes, and exposed high ground regarded as unsuitable for development, are shown on Climate Map No. 4.4; and the 500 foot (150 m.) contour represents the upper limit of development on south facing slopes under predominantly maritime influence. The exposure limit varies under different conditions, as the sketches of exposure roses in Part Two, page 23, indicate.

Rivers.

The main watercourse, the Alness river, rises on Beinn Chaisteil and flows through Loch Morie, winding through the coastal hills in a gorge, from which glacial material has been removed and deposited in the delta. The river banks in the delta area have been stabilised, and a weir allows fresh water to be drawn off for the Dalmore distillery. The Contullich Burn rises on the north side of Cnoc Fyrish,


prevailing winds
cold air drainage
areas liable to frost
exposed high ground
30m
100ft

CLIMATE

Fields behind Invergordon

flows down a narrow ravine into Alness Bay, and one of its tributaries which rises further west has been canalised along a flat valley to enter the main stream less than a mile from its mouth. Teaninich Distillery draws water from the Contullich Burn just below the railway line. Care will be needed to protect the supplies to these industries, and surface water will have to be collected and discharged below their draw-off point.

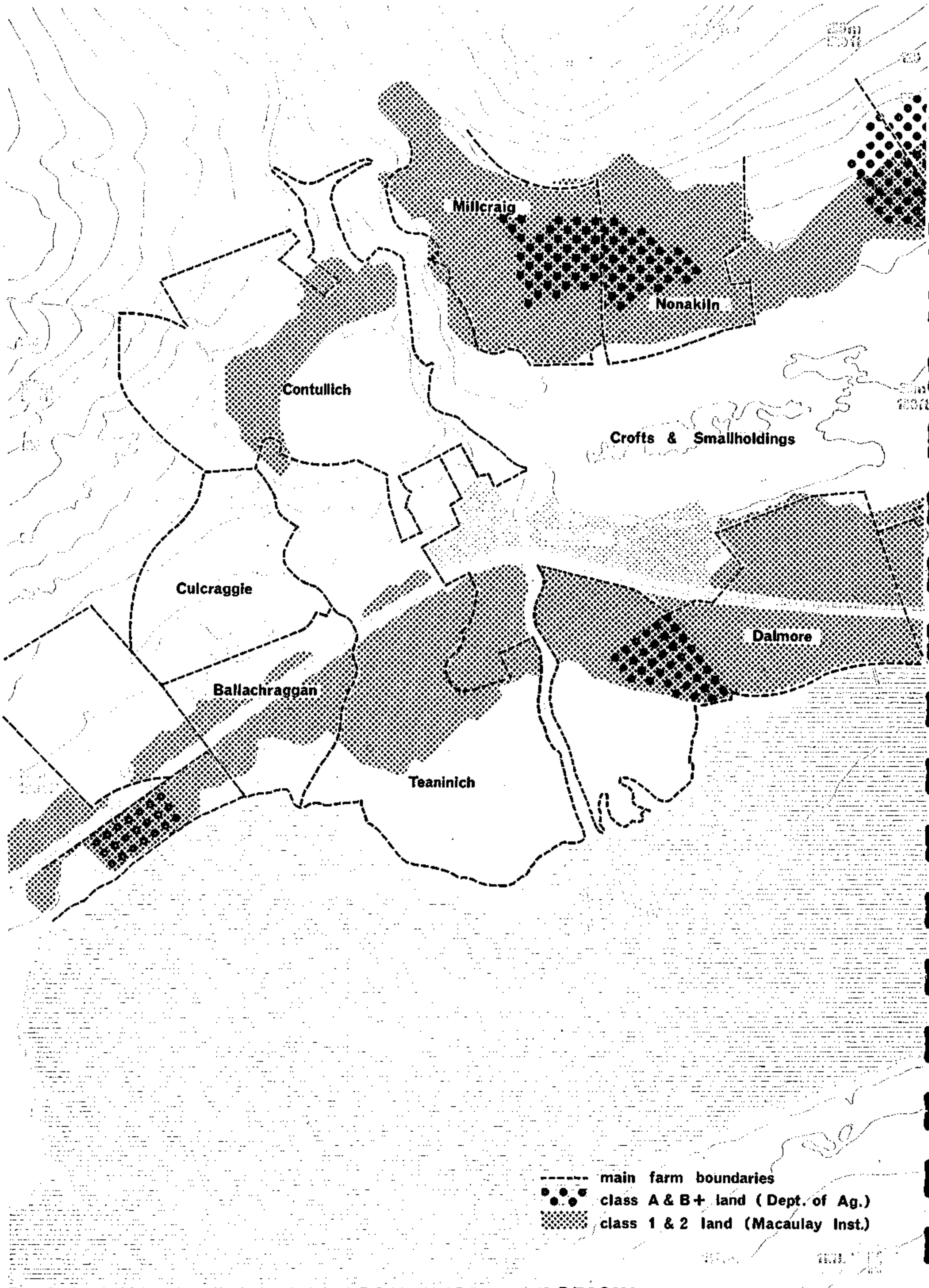
The poor drainage conditions in the White Hills area are due to the natural grain of the land.

Wild Life and Vegetation.

As the Nature Conservancy Report says in Appendix 4 the Alness Bay mudflats are among the most important feeding grounds on the Cromarty Firth for a great number and variety of duck and wading birds, including mallard, teal, dunlin, redshanks, knots, bar-tailed godwits, snipe, curlew and both whooper and mute swans. It is one of the main Scottish wintering grounds for widgeon, and as many as 3,000 have been counted there. The mudflats in the bay support the eelgrass and other reeds on which wild-fowl feed. (See Part Two Map 2.6).

Entrance to Teaninich House: Alness

In the coastal farmland, trees are found mainly on river banks, and around farms and houses. These are mostly deciduous, including Beech, Elm, Sycamore, Oak and Birch, and there are also groups of amenity planting round Teaninich House, Dalmore House and Coul Cottage, which also help to give shelter to Alness village. These areas are useful reserves for native flora and fauna,



AGRICULTURE

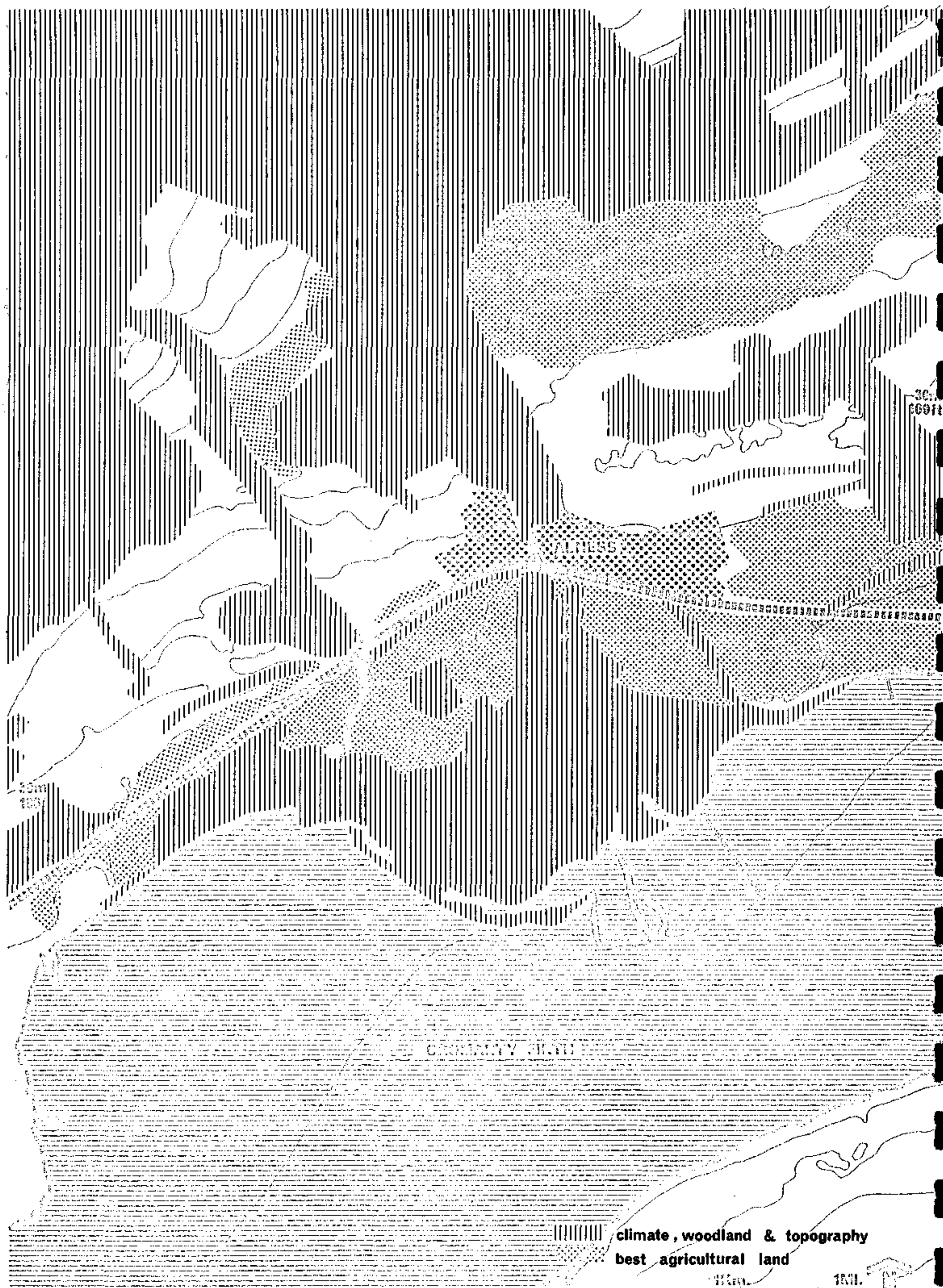
and the exposed rock in the gorge provides interesting plant habitats. Large areas at Coul Hill and White Hills are planted with Conifers on the poorer soils of the hill foot zone, and some semi-natural and scrub woodland occur. Up to about a thousand feet (300 m.) above sea level virtually all the land capable of supporting trees is used for forestry, but above this height, heather and ling become the dominant plant forms.

The main vegetation restraints on development were the established areas of woodland (See Map 4.3), but it must be recognised that these also provide an attractive environment for nearby development.

Agriculture.

Land of high agricultural quality in an area which is partially dependent on agriculture for employment is another constraint on development. Agriculture Map 4.5 shows land assessed to be the most productive Classes A and B by the Department of Agriculture, and land subject only to minor limitations to cultivation in Classes I and II of the Macaulay Institute. The map shows that the best land under both assessments is to the south of the railway or north of the White Hills area, and it also indicates the boundaries of the main farm units.

In Easter Ross generally the growing of barley has increased in recent years and the growing of oats has declined. Seed potatoes also form an important crop and pasture is an element in the normal rotation, but a more important one on poorer land.



SUMMARY OF RESTRAINTS 4.

Most of the farm land is capable of sustaining cultivated crops, the best generally lies either below the hundred foot contour, or east of Alness River, between 150 feet (40 m.) and 300 feet (80 m.); here the farms are relatively large and most have a good yield. Between these two strips the land has limitations in use resulting from topography and drainage, and farm units tend to be smaller, yielding less.

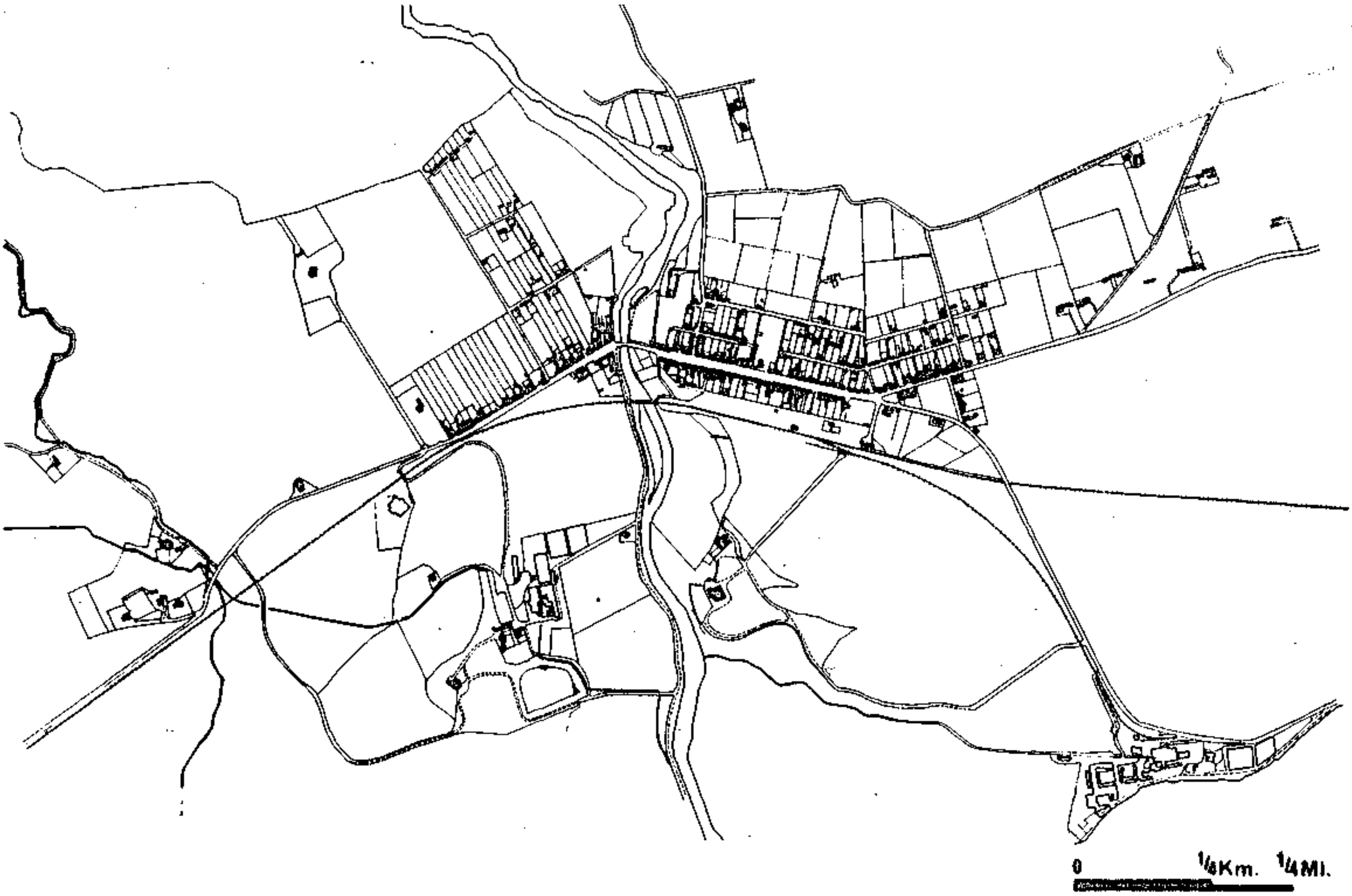
On the arable farmland the upper part of the soil profile has been altered by cultivation over the years, and the top soil horizon has a fairly high level of organic matter, so that the structure and moisture retaining capacity are improved. On the flatter ground, as at Culcraggie, drainage channels are necessary to help to control the water table.

In the past, the Highland edge area up to 1200 feet (370 m.) has generally been afforested and managed as parts of private estates; more recently additional areas have been planted by the Forestry Commission, and plantations mainly of pine and spruce now occupy most of the land which is not capable of sustaining arable crops.

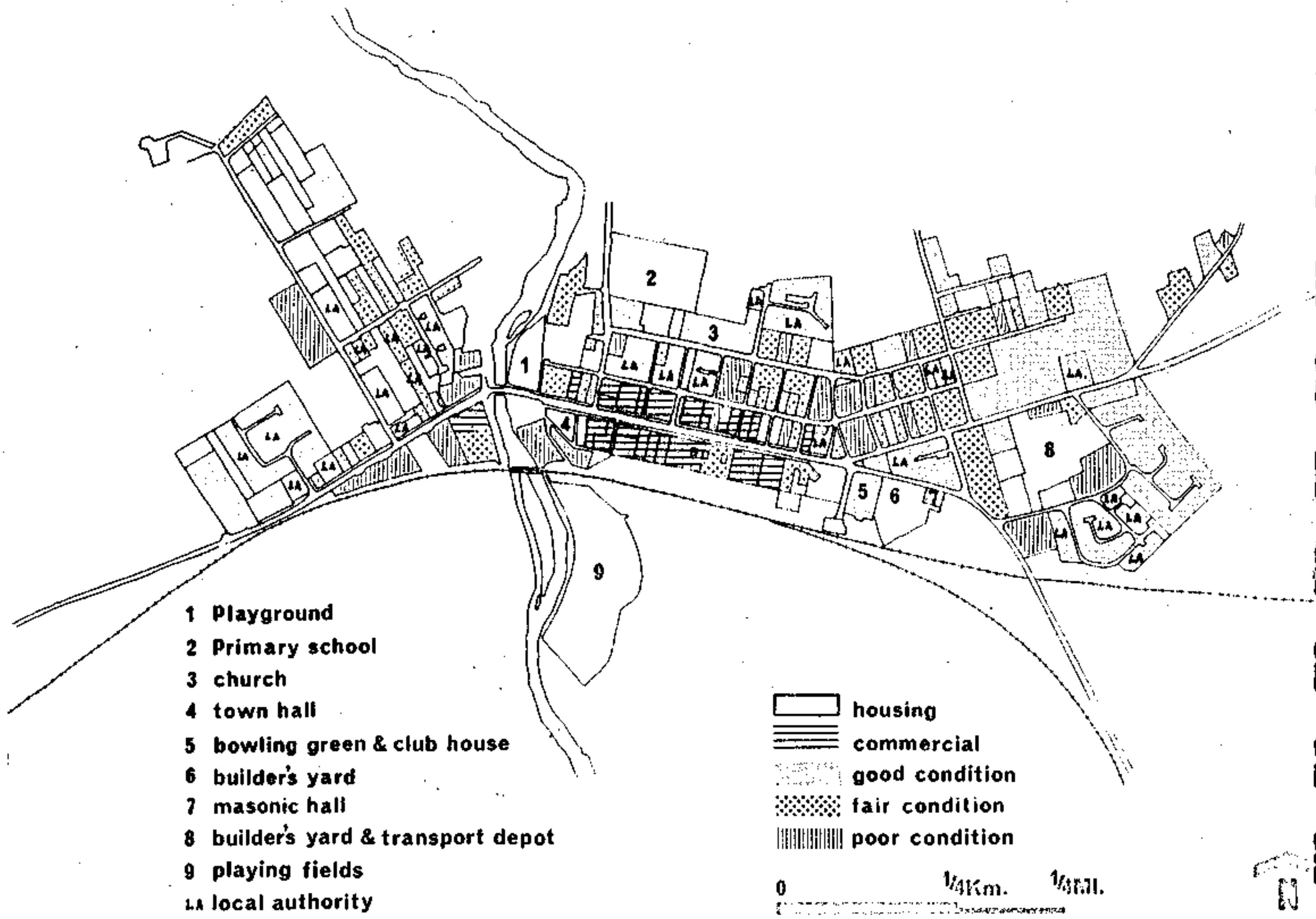
Forestry : Black Isle

Summary of Restraints:

The combined effects of the broader physical restraints has been summarised on Map 4.6 to reveal the areas which are physically suitable for development. The Map also shows areas of best agricultural land, derived from both the Macaulay Institute's and the Department of Agriculture's classifications.



ALNESS : 1906



EXISTING USE & CONDITION 4.7

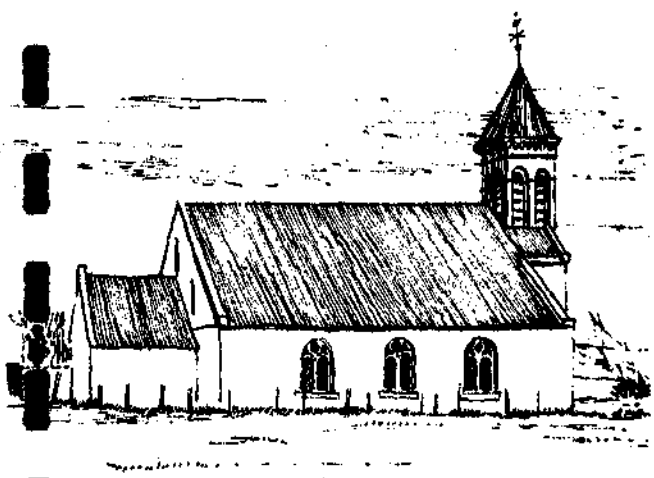
Although the use of agricultural land for urban development cannot be completely avoided the best land is preserved if it is practical to do so and as far as possible farm boundaries are kept intact.

The Existing Village.

Alness contains a mixture of opportunities for and constraints on development. These are now examined in the light of its future role as the centre of a sizeable township.

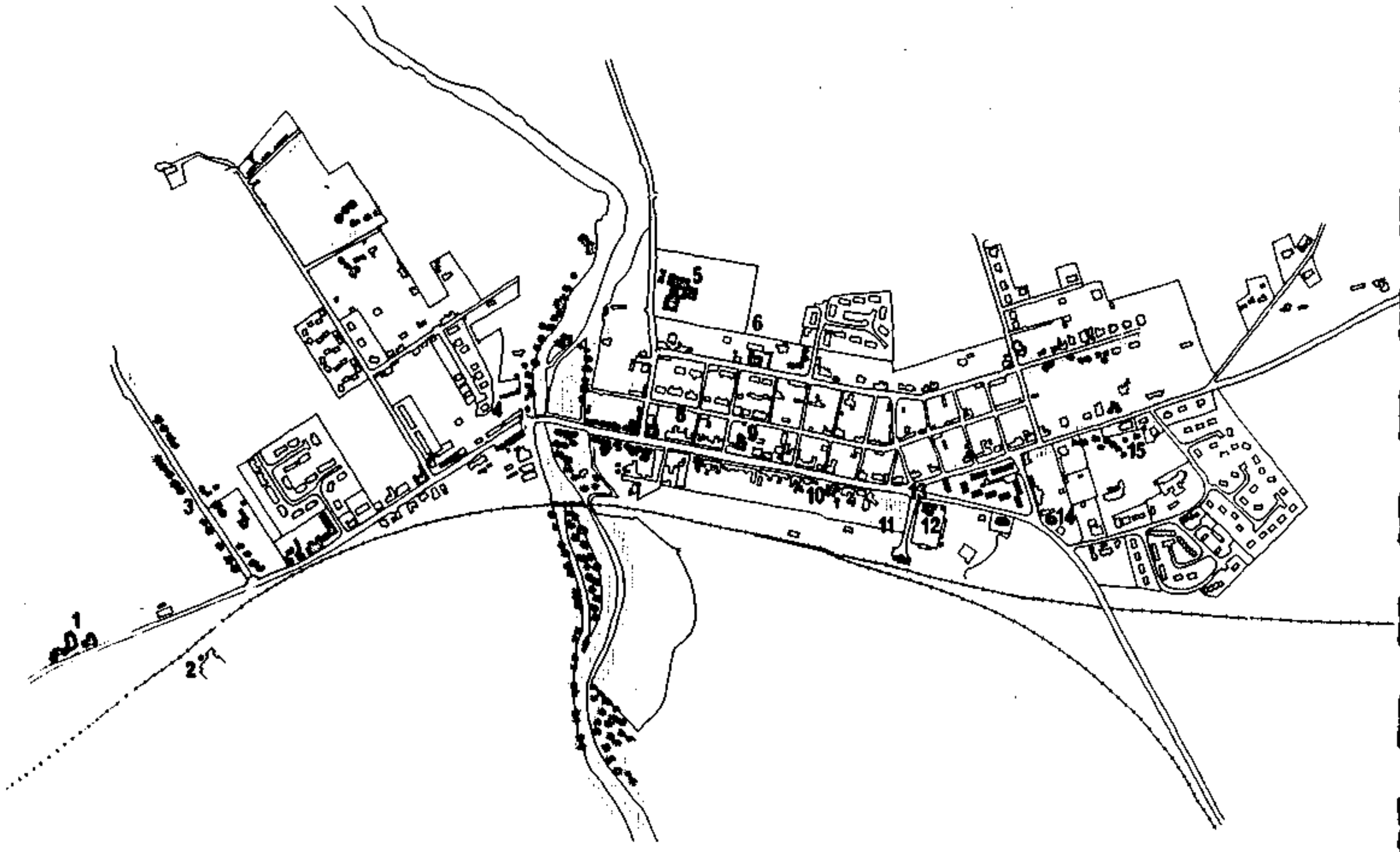
Alness is situated about midway along the northern coast of the Cromarty Firth. Invergordon lies some 3 miles to the east, Dingwall 11 miles to the south-west, and Inverness, while only 15 miles to the south as the crow flies, is over 30 miles away by road and rail. The population at present is around 1600.

Like many of the small towns and villages strung along the fertile northern coastline of the Cromarty Firth, Alness began as a small service centre, supplying the needs of the surrounding agricultural communities. Growth took place slowly, although the clearances and enclosures during the 18th and 19th Century forced people into the villages. Early plans of Alness show large plots of land, mostly feued, that are typical of settlements created or added to at this time, as can be seen on Map 4.7.



Coul Church : Alness

The Alness river, which flows through the village, marks the boundary between the parishes of Alness to the west and Rosskeen to the east. The two parts of the village were at first orientated towards the parish schools and kirks which



focal points

1 church tower
2 silo
3 avenue to coul cottage / fine trees
4 local authority house
5 primary school
6 skyline
7 church
8 stone walls
9 bank
10 hotel
11 view to parkland
12 clubhouse
13 monument
14 fine tree
15 good scale

building groups of fair visual quality
building groups of good visual quality
areas of attractive character

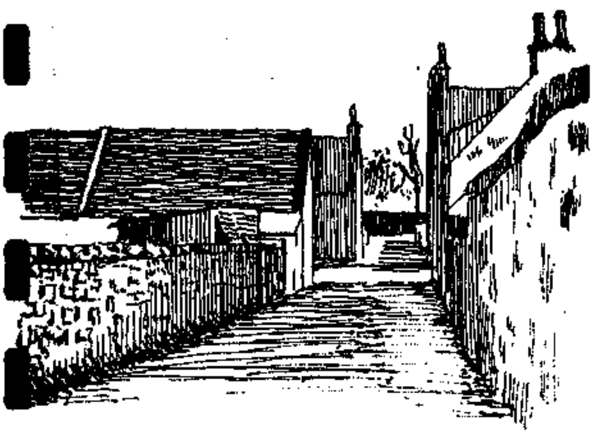
until the end of the 18th Century all lay outwith the village; but by mid 19th Century, with the population around 500, the emphasis was changing from parish to village. A school for "females" was built in the western part of the village, later followed by non-conformist churches and Bridgend School.

The separation caused by the parish boundary had also affected the social structure, layout, and public services, since most of the village activities were concentrated on the east bank of the river, and continued to grow there after the station for the Highland Railway line to Invergordon was sited just south of the High Street.

Expansion in the last 50 years has been contained within the village, generally by infilling on large plots of disused garden ground.

<u>Condition and Character</u>.

Alness has suffered neglect during the years of agricultural depression and unemployment, and there is still evidence of this in the condition of some of the buildings in the village. Although the High Street which contains most of the social facilities, has a group of buildings at the western end which contribute character to the village, the most important and striking asset is the sheer beauty of the surrounding landscape.



Lane Alness

At present the village shops and services provide for most of the everyday needs of the people living there, with Invergordon acting as the agricultural service centre for the surrounding area, and Dingwall as the main shopping and

Cnoc Fyrish

River Alness

Avenue to Coul Cottage

market centre. Primary education is catered for by a new school to the north of the High Street, while older children travel either to Dingwall or Invergordon for their secondary education.

The survey of existing use and condition shown on Map 4.7 helped to assess the opportunity and need for change, and also shows existing services and social facilities. Buildings, groups and areas which contribute to the character and townscape of the existing village are shown on Map 4.8. Sensitively interpreted, these areas would add quality to the expanded township.

Existing Communications.

The trunk road from Inverness to the North (A9) intersects the Struie Road (A836) at a point just west of Alness, and continues through the centre of the village towards Invergordon.

The main north-south railway line from Inverness to Wick and Thurso passes through Alness, but passenger facilities have been withdrawn and only sidings remain. The nearest passenger station is Invergordon which also has the nearest port facilities, (See Part Six, Invergordon), although there is a disused pier at Dalmore built by the Air Ministry during the last war. The region is served by the Dalcross Airport east of Inverness, but there is also an operational landing strip at Evanton, 2 miles from Alness.

Employment.

Alness reflects the existing regional

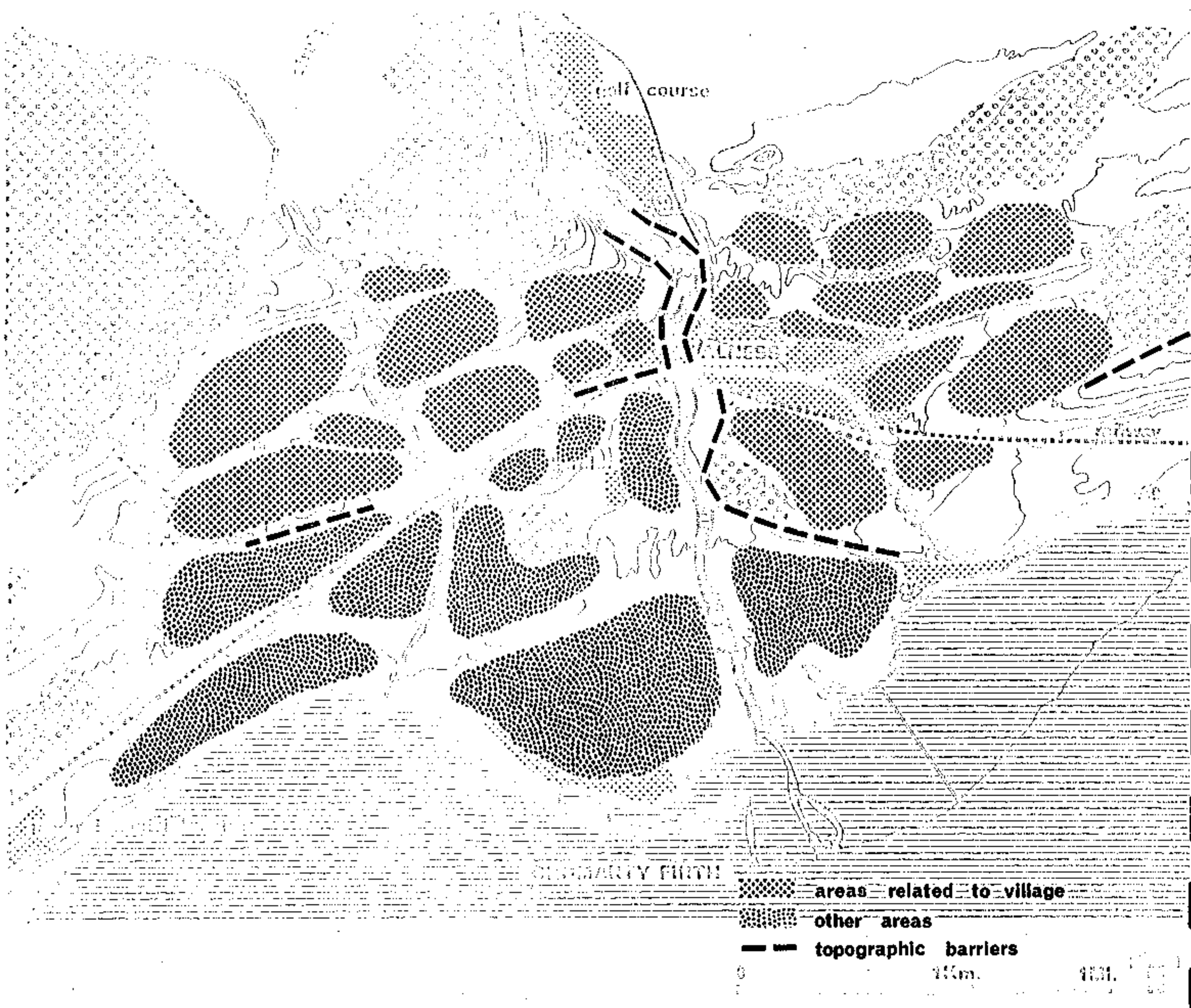
employment situation, with 80% of its labour force in service industry and the remainder distributed equally between primary and manufacturing industry. The two distilleries, Dalmore and Teaninich on either side of the village comprise the manufacturing industry.

DEVELOPMENT CONCEPT.

The accelerated growth of an existing community offers a number of positive advantages for the incoming population. The established services should help to integrate the newcomers, whose arrival will in turn, ensure the maximum use of existing education, commercial and social facilities, some of which are at present under-used. As the population steadily increases so the range of choice and opportunities available to the people already living in the village will be enlarged.

The existing centre can be given a role in the overall plan, and where feasible, expanded in scale to meet the needs of the growing population. This allows established patterns of movement to be maintained, reducing the need for temporary measures; and new developments can be grafted on to existing communities so as to provide from the outset, a desirable choice of places to live. The impact of additional population on the existing service should also encourage the improvement of the public transport system both within the community and between settlements.

The sub-regional strategy included the principle that every settlement should enjoy a view. The pattern of development for Alness reflects this aim. It is not possible to provide every individual house with an outlook of equal range, but the principle of enabling as many as possible to enjoy the characteristic assets of the area can be applied throughout the planning process.

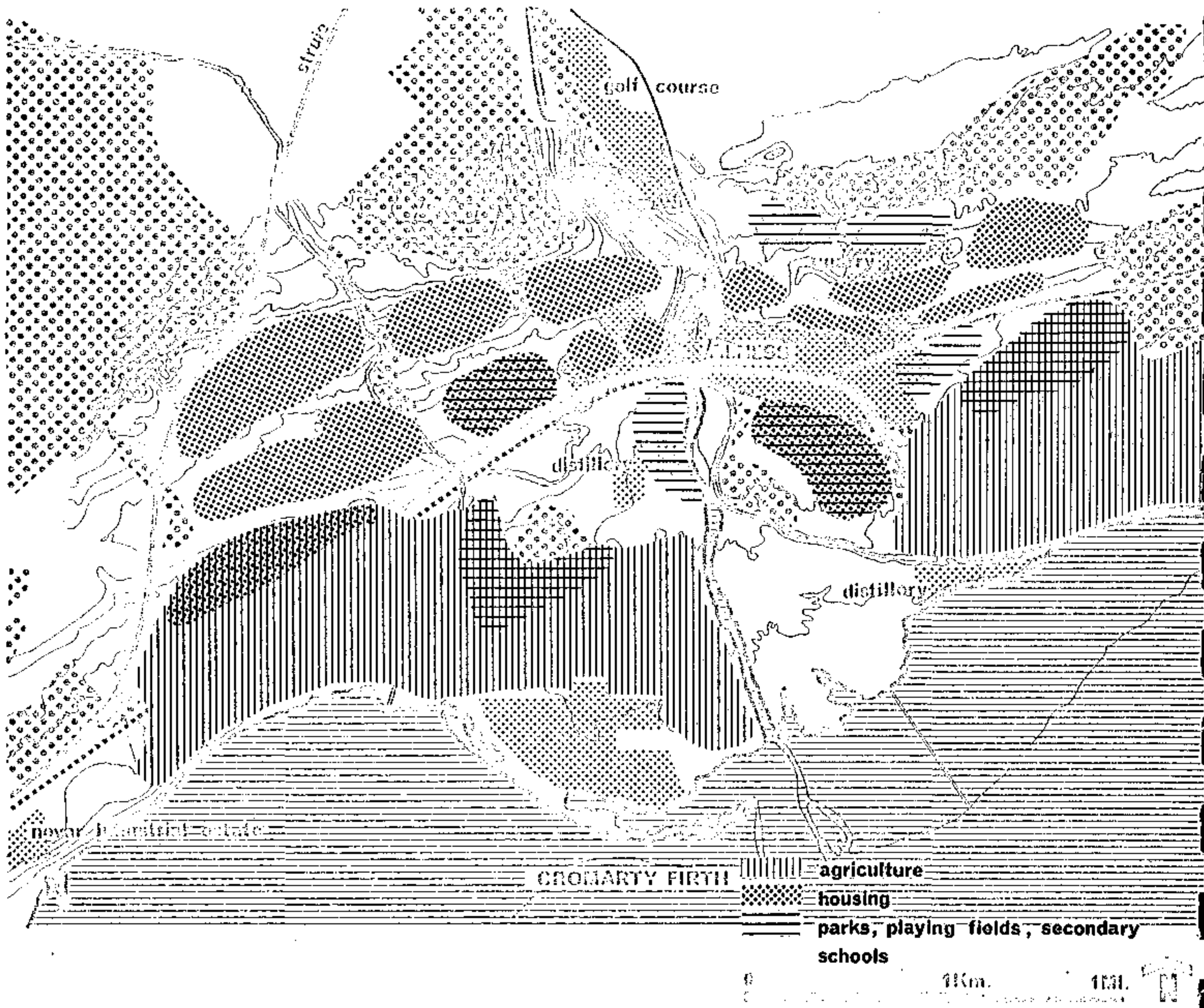


CONTAINMENT AREAS 4.9

Gradient and Containment Studies.

At Alness the pattern of settlement has been influenced by the land form. The area defined by the Summary of Restraints drawing 4.6 was examined in more detail in gradient and containment area studies. In general land steeper than 1:5 is considered unsuitable for building, between 1:5 and 1:30 there is a range of slopes suitable for housing, and between 1:30 and 1:50 in addition to housing it is suitable for certain industries and commercial buildings. On slopes of less than 1:50 land is particularly suitable for playing fields and larger scale industry, though this does not of course imply that it is unsuitable for other uses. The greater part of the land between 1:5 and 1:15 lies above the 100 foot contour and is characterised by views to the Black Isle from south facing slopes, while that between 1:15 and 1:30 is on the lower slopes which have considerable asset of views to Cnoc Fyrish west of the area. These areas are all suitable for residential development. Below the 100 foot contour there is a choice of sites with gradients suitable for playing fields and secondary schools. Concentration of playing fields is desirable to allow the maximum variety of activities, both outdoor and indoor, to be provided for.

An example of gradient analysis at a larger scale is shown on drawing 5.2. In the containment study, drawing 4.9, those areas which are physically and visually related to the existing village are indicated and from these it is possible to derive the latent suitability for various land uses shown on Map 4.10, taking into account the opportunities for shelter and



LAND USE SUITABILITY 4.10

outlook offered by a combination of favourable aspect and topography; and thus the possibilities for housing and school sites, open spaces and potential routes for pedestrians and vehicles are identified.

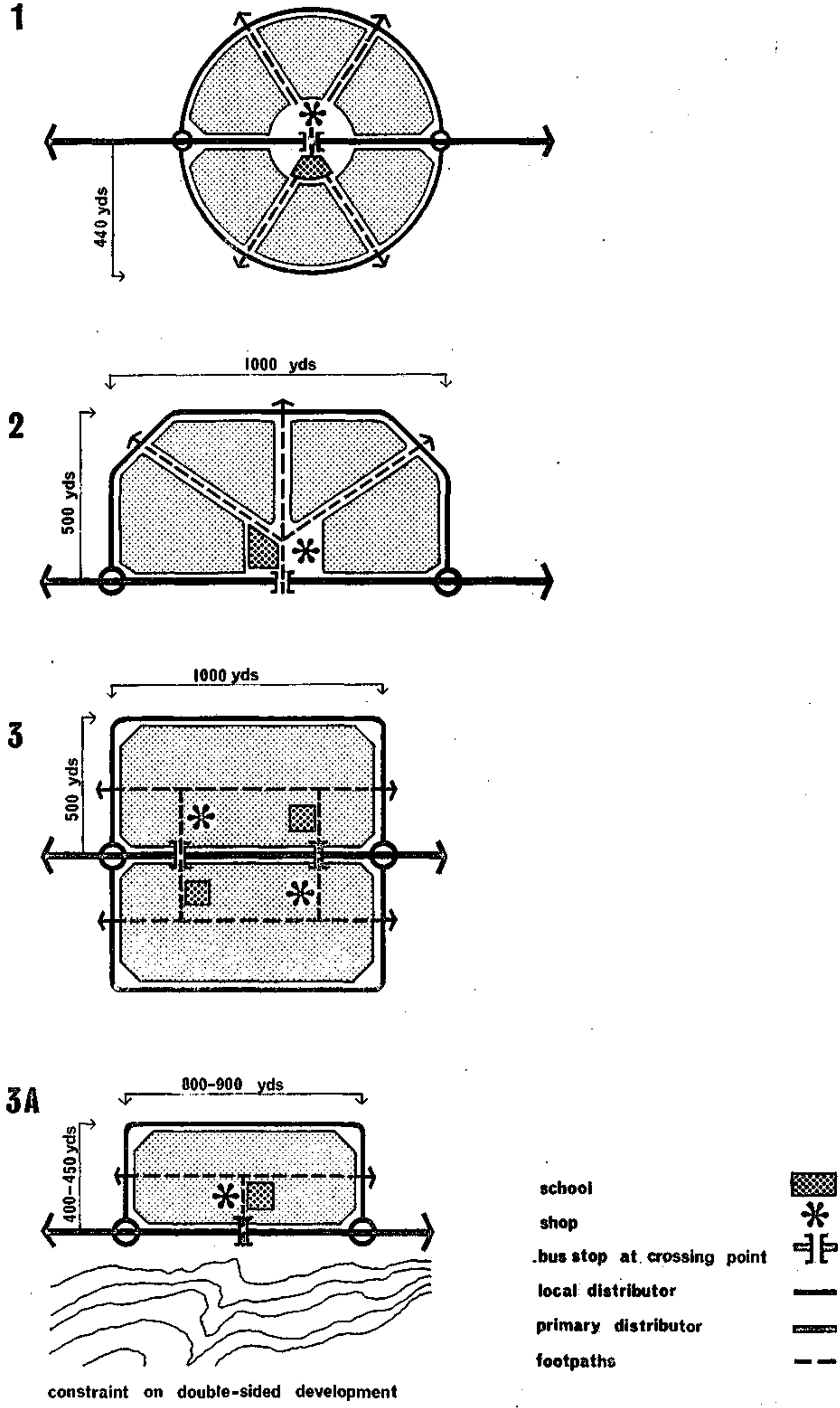
Locality and Settlement Patterns.

The social and economic needs of the new community were considered in a parallel study to the land requirements, in order to decide on the settlement form, taking the locality as a basic unit.

The population of a locality was assumed to be within a range of 3500 - 4500, which would support a two-stream primary school, a local convenience goods shopping centre and such other social provisions as a church, meeting rooms, a district nursing service, a public house and, in conjunction with other units, an economic and efficient public transport system. These provisions can clearly be arranged in a number of different ways, and of the many alternative concepts which were considered for the localities three are illustrated on drawing 4.11.

Alternative Locality Forms.

(1) This has the inherent disadvantage, that the locality, which has the qualities of a neighbourhood, is bisected by the public transport route. If this route could be reserved for public transport only, then it would be possible to minimise the intrusion, but with the linear form and the comparatively small scale of the total development it would not be economic to



ALTERNATIVE LOCALITY FORMS 4·11

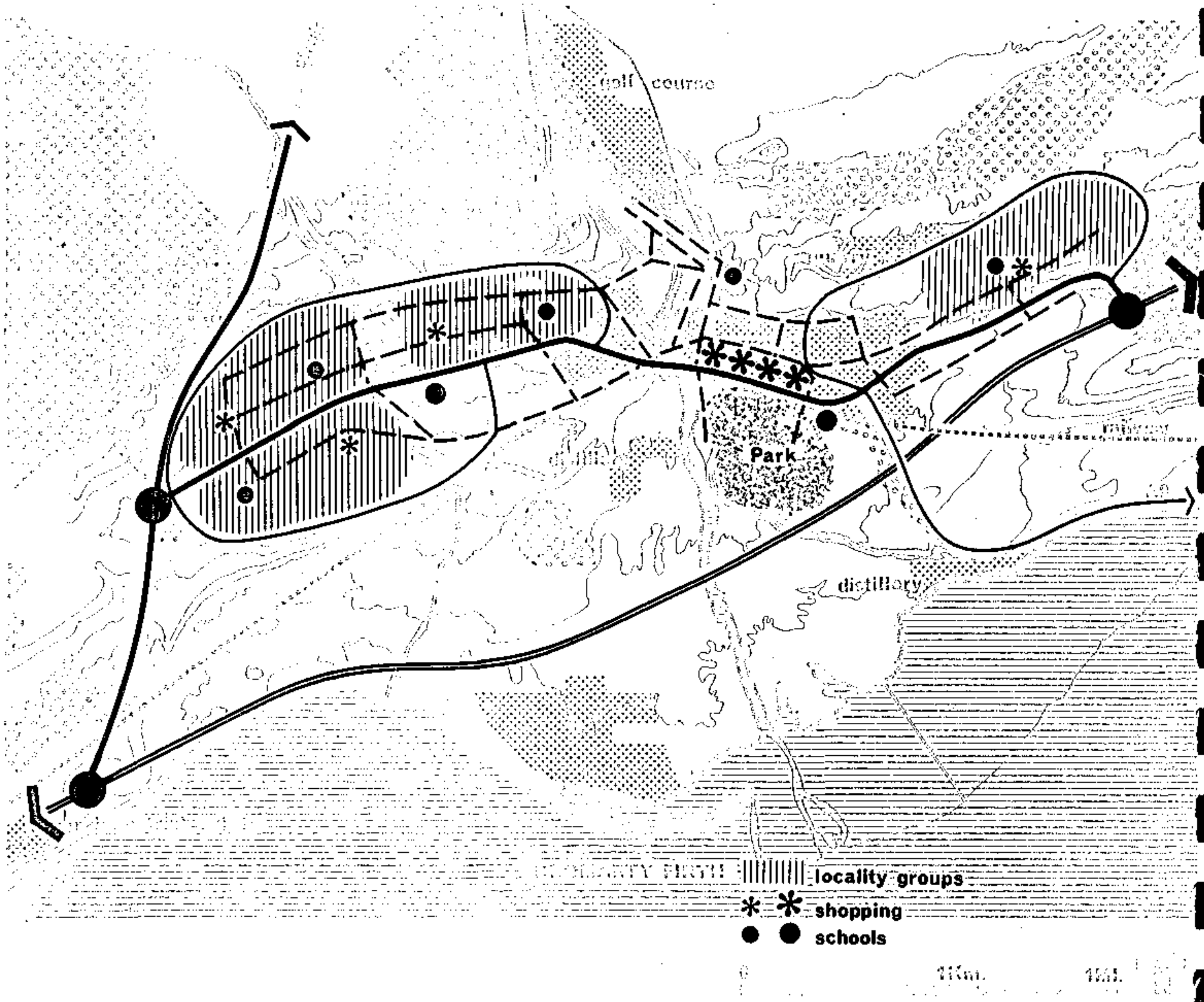
provide separate systems. This means that the primary distributor must also carry all vehicles including those moving through to other localities or out of the town. To fulfil this function the distributor road would need to be designed for speeds of 40 m.p.h., which would create a physical and social barrier dividing the locality.

(2) This alternative locates the principal pedestrian generators, school, shops and bus stops so that the residential unit is not divided by the primary distributor, but here the disadvantage is in the increased walking distances from the periphery to the main facilities.

(3) Here maximum use can be made of the primary distributor and public transport system if a similar unit can be located on the other side of the distributor road. Then, by the provision of two crossings, and siting of the schools and shops to make the two complementary, more social flexibility, and a wider range of choice can be achieved.

The third alternative has therefore certain advantages where a double unit can be developed, and is preferred in these circumstances, though the second alternative could, by a closer development form, be made to work satisfactorily when only one side of the road is suitable for development as shown on Fig. 3A.

The average walking distances in the last two alternatives are very similar. The distance to bus stops is shorter in (3) than in (2) whereas to school it is slightly longer though nowhere more than 700 yards. For shops, the



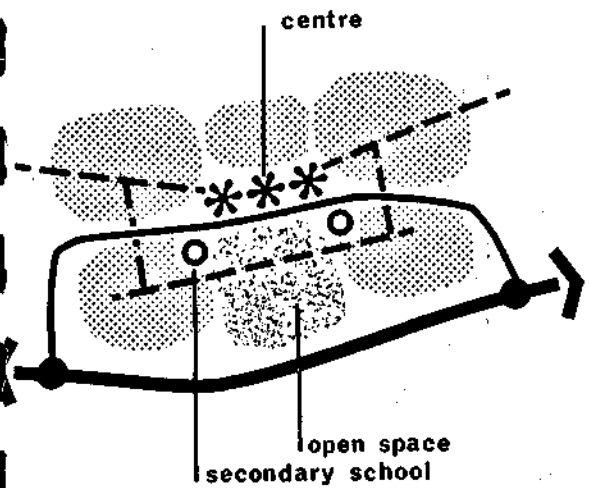
DIAGRAMMATIC SETTLEMENT 4.12

distance is about 500 yards in both cases, but (3) has the advantage of offering the choice of two local centres. The siting of schools accessible to two localities could also allow flexibility of administration as well as of social activity.

The advantages of the third alternative make it on balance the preferred locality form.

Settlement.

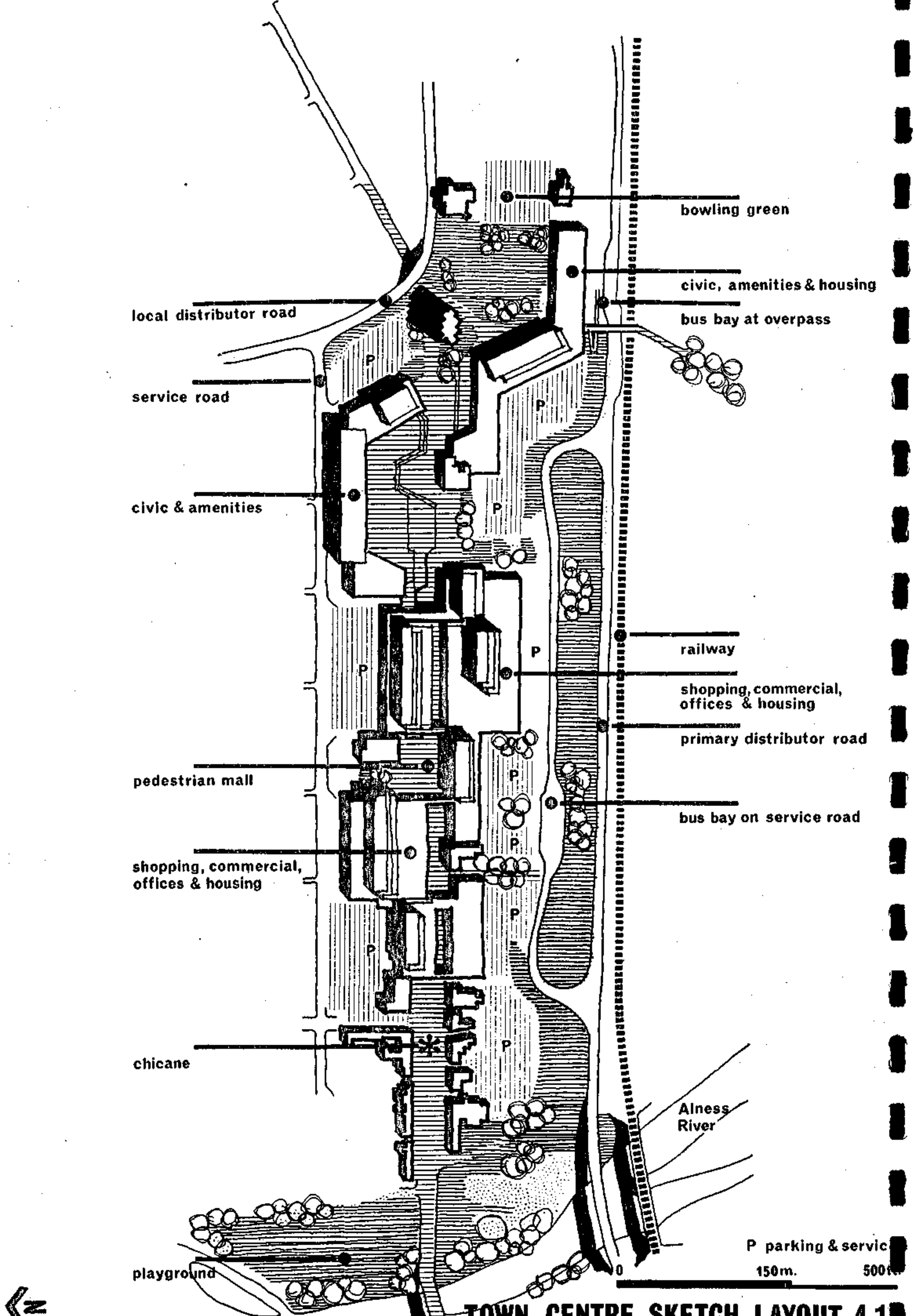
As we have said in Part Two (settlement hierarchy) the grouping together of localities to reach a population of 15-20,000 means that a number of additional needs must be considered. Provision must be made for the town centre with its shopping and social facilities, for secondary schools and playing fields, for town parks and for communication links to the regional roads. Normally the siting of industry would also be an important factor but in the case of Alness the need for industrial sites is greatly reduced because of its proximity to Invergordon. The sketch shows an arrangement of localities to form a settlement with a population of 15,000-20,000.



Locality Grouping to form Settlement

The application of this concept to the land suitable for development at Alness is shown on the diagrammatic settlement Map 4.12. This shows a linear sequence of localities including the existing village, served by a primary distributor road which in turn links the whole settlement to the regional road network.

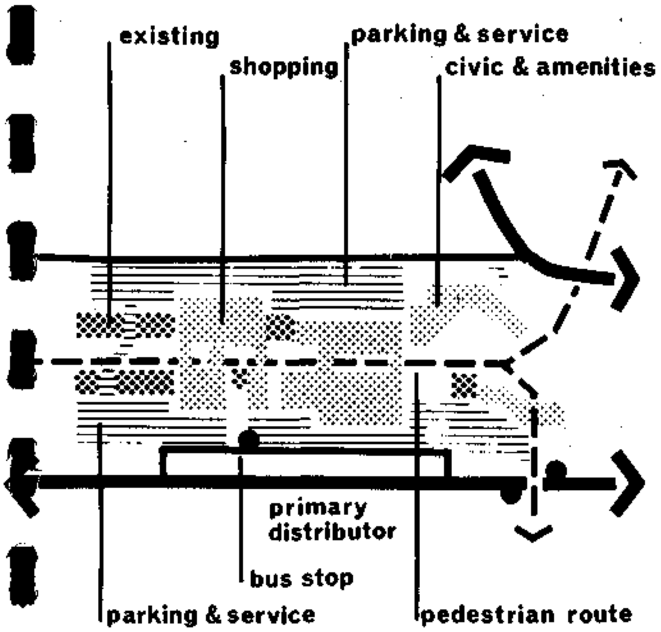
The requirements of the many necessary land uses were then sieved and tested, to arrive at an overall settlement plan, of which one locality was



TOWN CENTRE SKETCH LAYOUT 4.1

then considered in detail (Part Five). One of the results of these two studies was that the information derived from them was fed back for use in the capacity estimates of the sub-regional study.

The localities occupy most of the built up area and in general are located on the higher ground; the settlement is about 2½ miles (4 km.) in length extending from Obsdale in the east to the Struie Road (A836) in the west with an average width of approximately ½ a mile (¾ km.). To the north it is contained by the White Hills and the ridge and woodland at Coul Hill, and to the south the limiting factors are the regional road, railway and the ridge running from the Manse near Contullich Burn to the Struie Road. Improvement of these areas and access to them and to the river, are important to the plan.



Town Centre Diagram

<u>The Central Area.</u> The present study suggests that Alness village should become an integral part of the new settlement. The role of the existing High Street can expand to meet the growing needs as the township develops, and buildings can be replaced as they become obsolete, with forms adapted to the central area needs at that time. There is spare capacity in the present centre which contains 13,600 sq.ft. of shopping, and the new town centre shown as a sketch layout on Drawing 4.13, is located in the present High Street, so as to take advantage of the existing shopping, as well as the considerable potential for development and existing patterns of movement.

The shopping parade, which includes a group of existing buildings at the eastern end, opens

Black Isle from Coul Hill

The Sutors from above Alness

out at that end to include the other major public buildings and associated spaces. It provides about 60,000 sq. feet of retail space and a further 60,000 sq. feet for service areas, and is designed to serve the needs of people living in and around the centre itself, and those of the town as a whole.

Vehicular access on the south side is from the primary distributor, and on the north side from one of the local distributors, with the possibility of a link between car parks and service areas across or over the pedestrian shopping street. These service and parking bays, accommodating some 600 cars would allow direct access to the centre, while the main footpath system links the centre to the localities and to the 'bus stops on the primary distributor.

Residential areas. Some residential areas, or localities are described in greater detail in the Housing Study in Part Five. They are approximately the equivalent of Professor Colin Buchanan's "environmental areas". * Localities are linked to each other and to the Town Centre by a footpath system which also serves the primary schools, the local shops and the 'bus stops; they are based on the "containment area" studies of the natural features of ground form, trees, and hedges, which are used to help to define and enhance the built environment and to produce a sequence of pleasant places.

Vehicular movement is generally at right angles to the main footpath system and outwards

* Traffic in Towns, H.M.S.O.

to the surrounding local distributor roads, which in turn connect to the primary distributor or transportation spine of the town.

Industrial Area. Major industrial areas for residents of Alness are at Invergordon, Evanton and Muir of Ord. Within the settlement itself there are the two existing distilleries of Dalmore and Teaninich, and north of Teaninich a new site of about 20 acres has been reserved for industrial use. This is physically and visually screened from the settlement by the Inverness-Wick railway embankment, and could accommodate service industries for the town, and other light industries offering employment opportunities for both men and women.

Secondary Schools and Major Open Space. Secondary schools and major open spaces have been located on the flatter land within the settlement, accessible to public transport and cars as well as pedestrians. One of the secondary schools is sited south of the town centre and adjacent to the town park and major playing fields, so that all the facilities can be combined, and used by the community as a whole, to allow a high standard and range of activities. The other school site with its playing fields adjoins the residential localities west of the town centre and a further area of some twenty six acres has been planned for playing fields east of the existing village so as to act as a buffer between the housing areas and the regional road.

It is proposed that the White Hills area north of Alness be replanted and upgraded when the gravel workings are exhausted, and the existing 9-hole golf course alongside the Alness river has been extended to create a full 18-hole course. It is also suggested that the Coul Hill woodland be made accessible to the public in order to extend the range of recreational interest.

Communications.

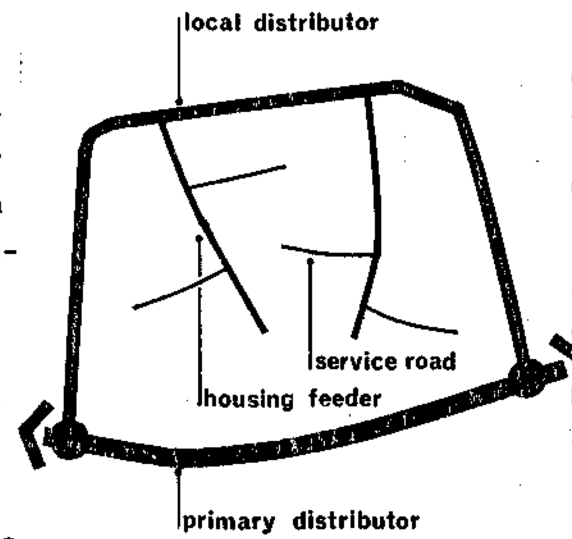
Footpaths. The main pedestrian routes through the town will cross primary or local distributor roads, only by segregated crossings. The footpath pattern extends outwards from the town centre and links locality centres by crossings of the primary distributor road at points which coincide with public transport stops. This should encourage interchange between localities which would otherwise be separated by the primary distributor.

Within the residential areas smaller footpaths lead from the housing towards the main routes, but here complete segregation from vehicles is not attempted as the section on courtyards in Part Five explains.

In contrast with the more functional main pedestrian routes, a series of "wander" paths have been designed to take advantage of the natural opportunities alongside the Alness river and Contullich Burn. These paths lead northwards towards the White Hills and Coul Hill, and southwards towards the town park and Teaninich House policies. Further afield there are other footpaths such as those between Strath Rusdale and Ardgay, Scotsburn Wood, Tain, for country walking.

Roads. The town has been designed to meet the needs of a community with a high level of car ownership and all the principles of road layout planning described in Part Two of this Report have been incorporated.

The Structure Plan for Alness shown in colour at the end of this part, shows the Primary Distributor looping off the Fast Road in accordance with the transportation strategy for the sub-region. At the west end of Alness the first section of the Primary Distributor also carries traffic bound for the north along the Struie Road (A836) and thereafter it is located between containment areas in such a way that all houses are within acceptable walking distance of the 'bus service which the road will carry. Between the railway and the back of existing properties on Alness High Street there is undeveloped space, and this has been used to bring the Primary Distributor close to the proposed town centre in order to provide direct access from it to the centre's parking and goods servicing areas.



Settlement Road Hierarchy

As we have described in Part Two, the Local Distributor roads enclose the development localities so that all vehicles generated within them move outwards and round to the Primary Distributor while pedestrians will walk directly to the local shops, schools, and 'bus stops. The localities are connected to the peripheral Local Distributors by main feeder roads, from which service roads, mainly of cul-de-sac form, serve the housing areas. Circulation between the ends of culs-de-sac is arranged through courtyard areas and is controlled by chicanes, such as those illustrated in Appendix No. 5.

A detailed forecast of traffic and lane requirements for the Alness roads was made within the context of the sub-regional traffic forecasts, and this working may be found in Part Six. The Primary and Local Distributor Roads have been designed to prepared standards of horizontal and vertical geometry. These standards, the plan geometry and the profiles are all described in the Land Use Transportation Study in Part Six.

Rail. The main northern route from Inverness to Wick runs adjacent to the southern edge of the town. There are some existing sidings south of the town centre, and a private siding to the Dalmore Distillery, but passenger facilities at Alness have been withdrawn, and British Rail have indicated that Invergordon will continue to act as the main passenger and freight station for this area.

Air. The nearest airfield for scheduled flights is at Dalcross.

Social Services.

Social provisions can be divided into two categories, those which the central or local authority are bound to provide, such as health and welfare, general education, police and fire brigade services, and those which are optional both as to use and provision, such as societies and churches, clubs, and a wide range of voluntary youth activities. While the quality of the statutory provision can hardly be even throughout the country, the variety and range of

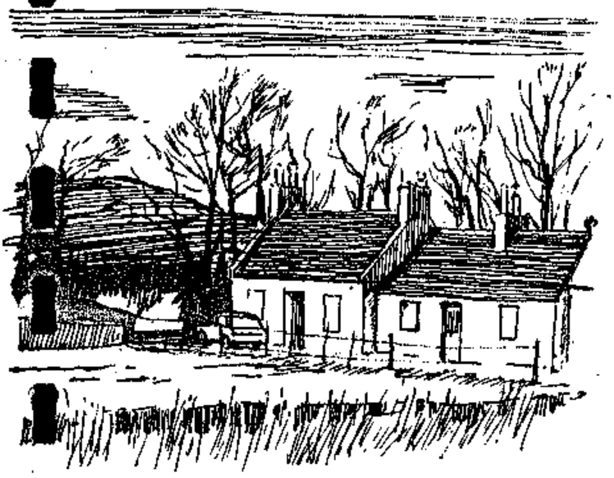

Path Alness

optional social services is very wide indeed. Much depends on the initiative of the administering authority, since the need for these services is not always self-evident to those who could benefit from them.

As regards the first group, it can be assumed that the incoming population would take up any spare capacity in doctors' practices and the small number of extra places available in existing schools, and that thereafter provision would have to be made in the new localities and the town centre as the need arose.

In general the existing education, health and welfare services in the County are of a high standard, and retain the personal relationships and sense of community which is often lacking in larger centres of population. It is most important that these qualities should be carried forward into the new situation, and certainly should not be lost to the present population because of new development. It would help to ensure this continuity if the necessary new provision of schools, medical and welfare services were kept in step with the rate of housebuilding; for while it is an advantage in the first instance to use up all the spare capacity in existing services, it could spoil their present quality if they were overstrained by delays in making adequate provision for incomers.

It is one of the advantages of adding to an existing village that no gap need occur between the provision of the new housing and of the necessary halls and meeting rooms to meet immediate social needs. The existing village and school halls in Alness can serve this purpose, and provide opportunities for newcomers and the present residents to meet.


Cottage, Alness

The management of a large housing programme in terms of administering the actual moving-in and settlement of families, selection of tenants in potentially compatible groups, and dealing with all the inevitable crises that follow family upheavals, will be a major task, if the rate of housebuilding is unusually high. The housing manager's job requires great skill and tact, and if the pressures justified it, a social development officer could help to ease the settling in process.


Back street Alness

Education. We have already mentioned the advantages to be gained by siting primary and secondary schools so that they can be of maximum benefit to the community in terms of multiple use of buildings and playing fields and as centres of social activity. In Alness each new locality supports a primary school, and an extension of the existing village school may be needed to accommodate the County Council's proposed housing at Shillinghill. These schools are related to walking distances on footpaths, with segregated crossings where necessary, but the secondary schools, though also walking distance for a good number of children, can also be served by 'buses. Although nursery school sites are not shown sites could be found in each locality, either beside the primary school or near the local shops. Except for possible evening classes in the secondary schools, further education centres are likely to be elsewhere, either at Dingwall, Inverness, or possibly further afield, and no provision is made for this at Alness.

While the existing halls and meeting rooms will be a useful first provision, as the township grows, a local need for accommodation for clubs and social gatherings will also build up, and these can be associated with the local shops, or possibly use suitable existing buildings. Outdoor recreation areas for all ages have been provided, and covered play space could also be built as and when required. The older children of incoming families uprooted from their familiar surroundings are likely to need most help to settle down, and although the Moray Firth offers a wide range of interests for this group, much depends on local youth organisations, and schools, but if the rate of arrival is high some professional help might be required.

Health and Welfare. There is some spare capacity in local doctors' practices, which will be gradually taken up. Each locality would probably require two district nurses, preferably living nearby, and the Town Centre could accommodate doctors' surgeries or a clinic. The present local hospital is at Dingwall where a new health centre is also proposed. In the long term however, with new settlements at Alness, Evanton and Fearn, it may be that one or more of these communities would support health centres or other local provisions. The regional hospital for the area is Raigmore at Inverness.

As regards the normal social provisions and services related to the town centre, such as branch offices of welfare services, banks, library, restaurants and cafes, the town centre already contains some of these, and has the necessary capacity to accommodate a gradual increase in provision.

Density.

For the present study, where attracting people into the area is a given requirement, we recommend that the development should be at a moderate density, but at the same time should not be so low as to produce uneconomical provisions of services and transportation. In a study which ranges from sub-regional scale to housing layout, it is to be expected that the areas used to calculate density at the regional, settlement, and locality levels would include different amounts of other land uses.

Information at the sub-regional scale is required in order to arrive at an estimated capacity for the total settlement pattern, existing and proposed. Many land uses cannot be predicted now, perhaps not for a number of years, so that the population figures must necessarily be approximate. A settlement pattern was evolved from the initial landscape reconnaissance and the basic social and economic constraints, and this was then broken down into areas according to their primary function. In the case of those suitable for residential use a gross residential density figure of 25 p.p.a. was applied. These residential areas included distributor roads, incidental public open spaces, schools, playing fields, churches and other uses normally occurring in a housing locality; but unlike overall town density calculations, did not include town parks, golf courses, major industry, or other principal land uses.

In the more detailed settlement study at Alness, a check was made to ensure that this was a reasonable figure, allowing standards of lay-out capable of exploiting the natural landscape qualities in the area, while maintaining economical and functional design of roads and services. This method seemed preferable to a calculation based on an Overall Town Density area, since the amount of land included for an industry, or railway, a park or a golf course, could vary so much from settlement to settlement that the resulting figures would have very little meaning except for comparison with other towns. However, a calculation was applied to Alness as a check and the Overall Town Density figure was about 17 persons per acre or 57 acres per thousand persons, which is comparable with the New Towns in the London Region and is lower than the Scottish New Towns, where the average is 23 persons per acre. *

The study of housing layout which takes account of the special qualities and requirements of the locality, produces a net residential density range from 30 persons per acre at the periphery to small areas of up to 50 persons per acre near the local centres, giving an average of 38 persons per acre for the locality. While it is not a large sample on which to base standards for other settlements, the layout takes account of the principles which are basic to the sub-regional and settlement studies and as a generous amount of flexibility is being allowed for, it seems reasonable to expect that other developments could

*Land for New Towns by Robin H. Best
Town and Country Planning Association 1964.

be sufficiently near in their requirements to allow comparisons to be made for density purposes.

The following tables are taken from the distribution of land uses shown on the Alness Structure Plan.

TABLE 1. ALNESS: Density of Development

	Persons per acre	Acres per thousand persons. (a.p.t.p.)
NET RESIDENTIAL in specific housing layouts in the Coul Hill Area, increasing from 30 at the periphery to 50 near local centres.	38	26.25
GROSS RESIDENTIAL Coul Hill Locality	25	40
TOWN DENSITY OVERALL	17	57.15

TABLE 2. ALNESS: Land Use Allocations (population 16,000).

		Acres	Acres per thousand persons	Persons per acre
1. Housing				
New	330			
Existing	89	419	26.25	38
2. Education				
Secondary	37			
Primary	39	76	4.75	
3. Open Space				
Public Open Space	99			
Playing fields	62			
Golf course				
existing	34			
extension	89	284	17.75	
4. Industry				
New	20			
Existing	5	25	1.6	
Total of Four Main Uses		804	50.35	20
5. Other Land Uses				
Town Centre	12			
Roads:				
Primary	44			
Local	41			
Railway	10			
Cemetery	2	109	6.8	
Total Urban Area		913	57.15	17

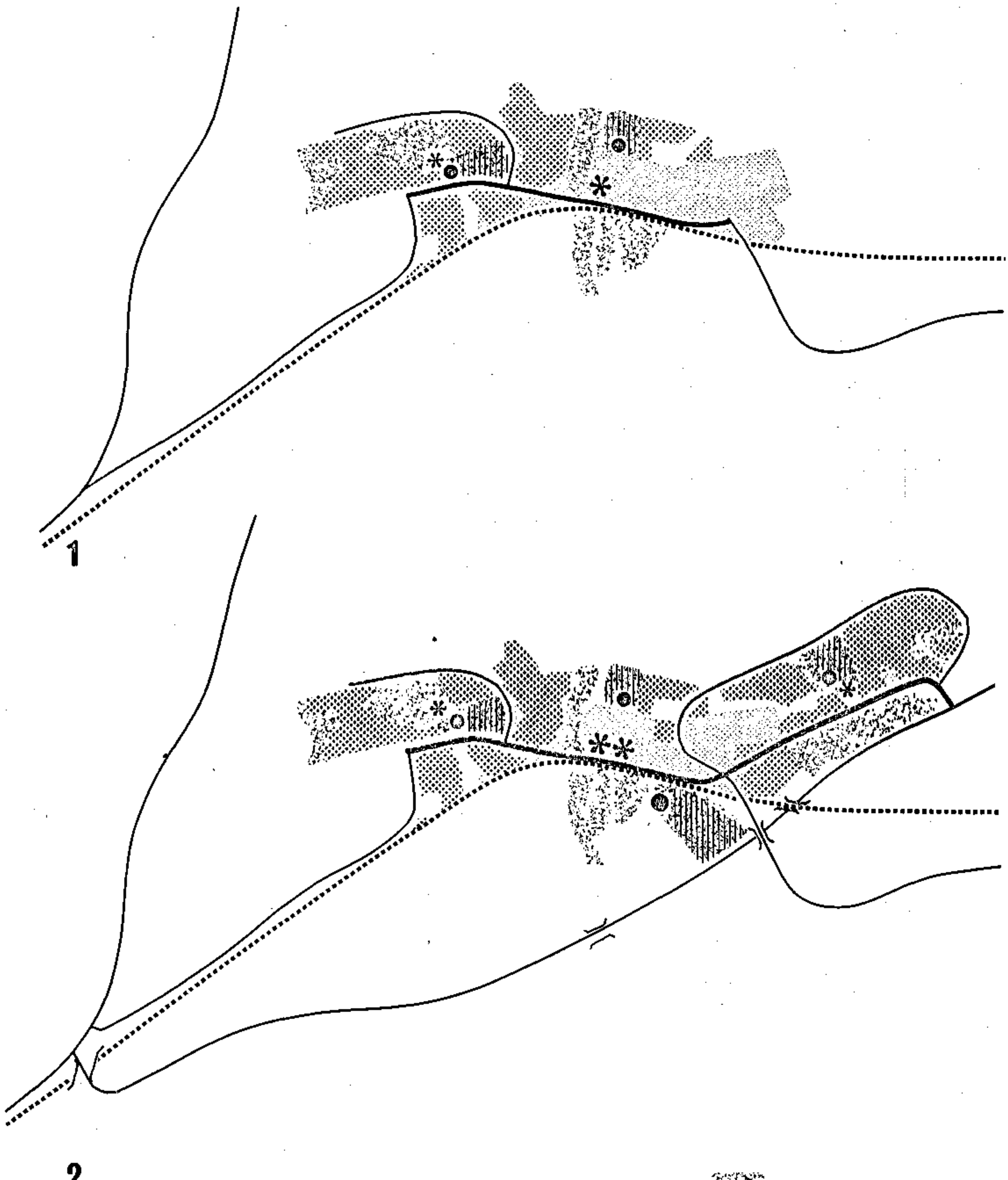
TABLE 3. ALNESS: Density Comparisons.

	Alness		(1) 8 London Region New Towns	(2) 3 Scottish New Towns
	acres	a.p.t.p.	a.p.t.p.	a.p.t.p.
Housing	419	26.3	28.9	16.6
Education	76	4.8	5.1	3.3
Open Space	284	17.8 (3)	9.9	10.4
Industry	25	1.6 (4)	5.3	6.1
4 main uses	804	50.5	49.2	36.4
Residual uses	109	6.8	8.0	6.5
Total	913	57.3	57.2	42.9

(1) and (2) Taken from, Land for New Towns, R. Best, p.59.

(3) The presence of the golf course in a small town, by New Town standards inflates this provision.

(4) Because the Invergordon industrial estate is not included in these figures, this provision is below the English and Scottish averages.



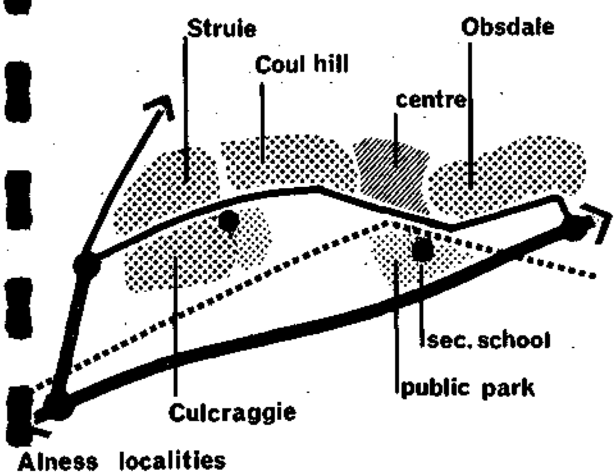
open space
schools open space
housing
shopping
schools

ALNESS PHASING 4.15

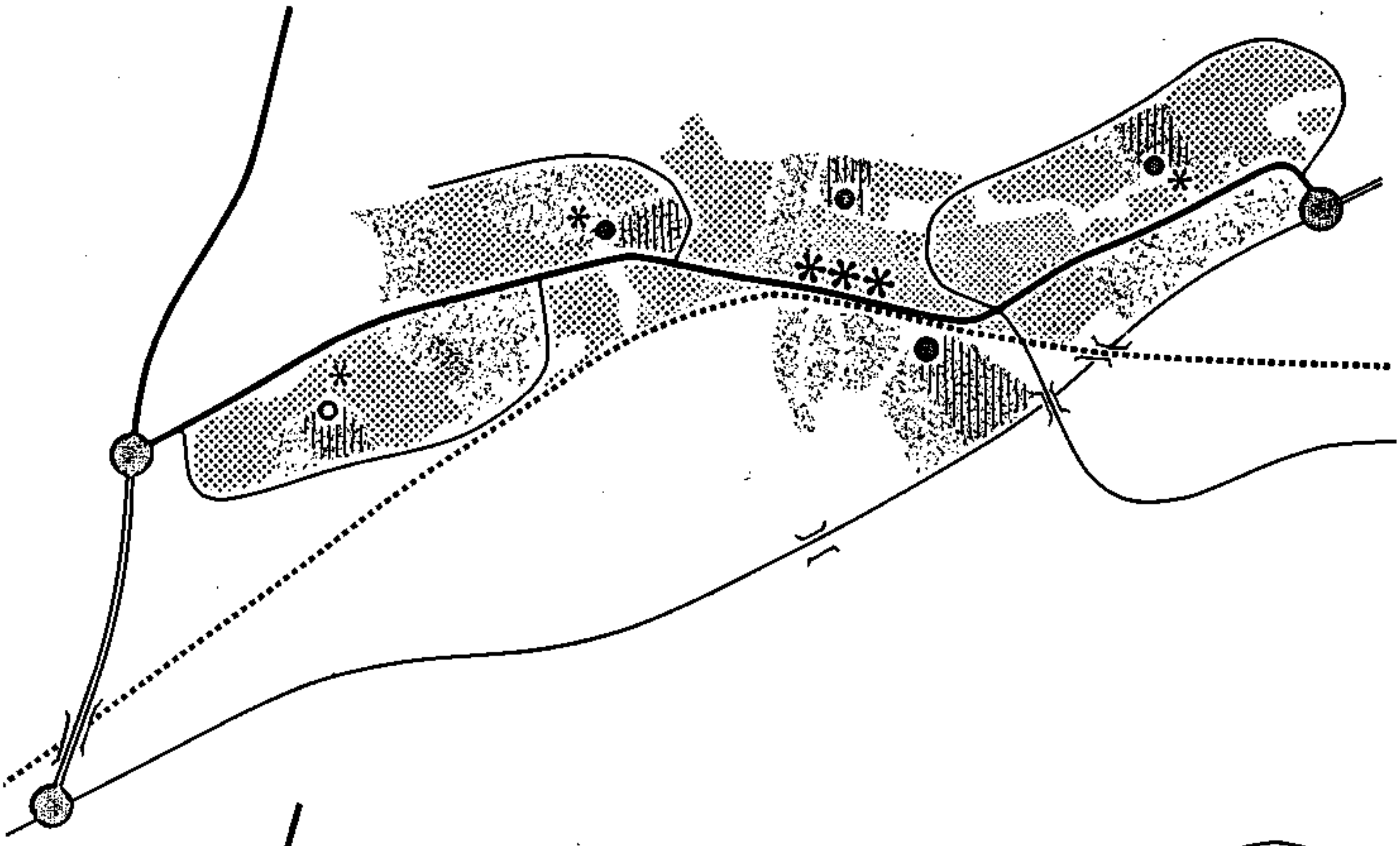
Phasing.

We have concentrated on illustrating the preferred way in which the settlement would grow, without placing a time interval on each phase; but certain assumptions have had to be made about the timing of building the regional Fast Road and these are mentioned below.

Phase 1. The settlement is phased to grow by localities, and for reasons fully explained in Part Five the locality known as Coul Hill has been selected for the first phase of development. As with subsequent localities, Coul Hill will contain its own primary school as well as a local shopping and social centre. The amenity of the existing housing on the west bank of the Alness River would be upgraded, as shown for example in drawing 5.14 Area D. At the same time the County Council's proposed housing at Shillinghill could be built, and if so, it may be necessary to extend the existing single stream primary school to two stream. The Alness River bank area would be improved and the part of the footpath alongside the river started, while south of the existing village work would be started on the first part of the town park area which is next to the existing playing fields.



The A9 would be intersected just west of the Coul Hill area and diverted north to the new primary distributor, which will pass to the south of the existing shopping centre. This will allow development to take place freely as the centre begins to expand to meet its new role. East of the centre the primary distributor will join the existing A9 leading to Invergordon.



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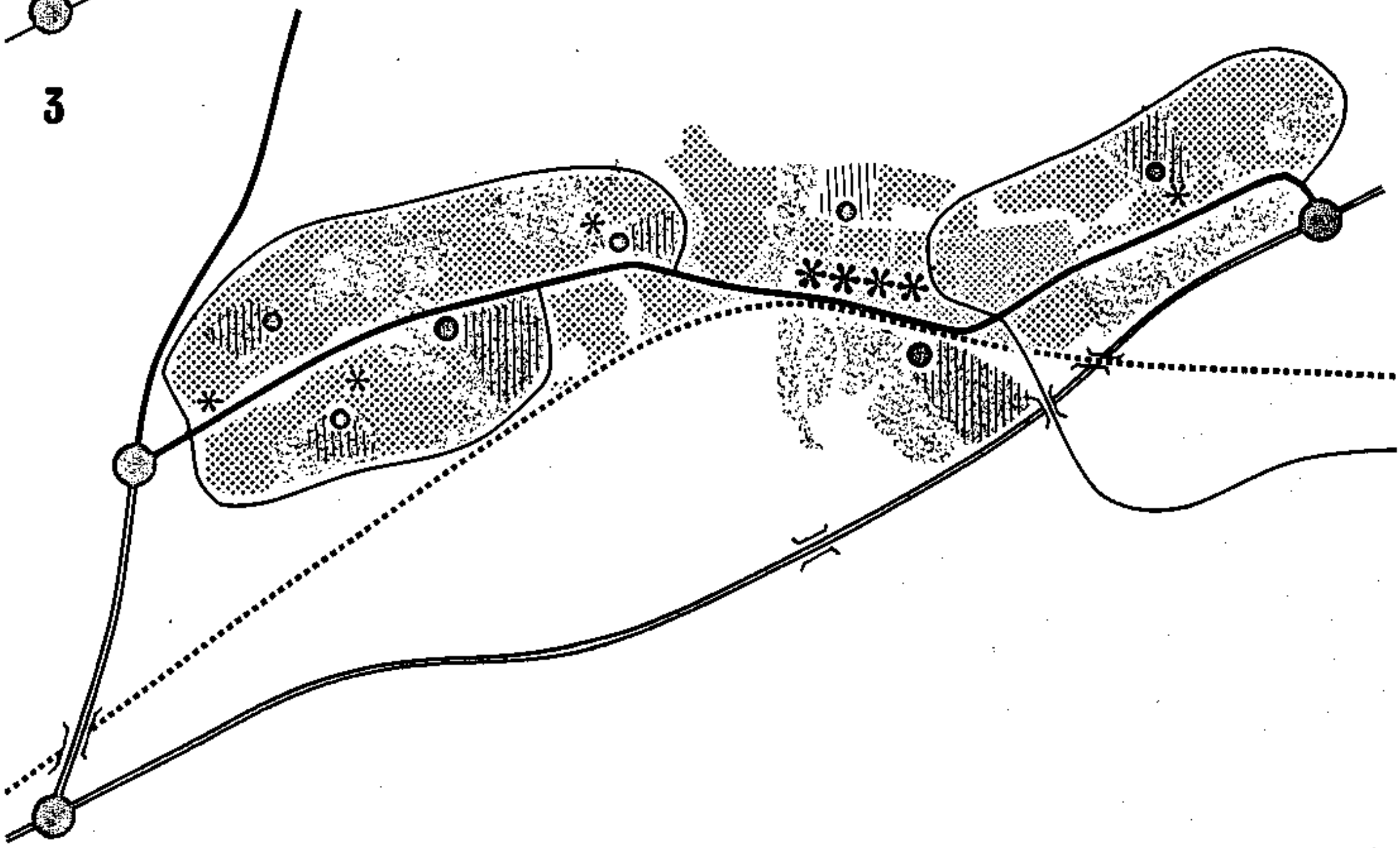


4

open space
schools open space
housing
shopping
schools

ALNESS PHASING 4.16

Phase 1 would allow accommodation for some 3,700 persons at Coul Hill and some 350 persons at Shillinghill.

<u>Phase 2</u>. The Obsdale locality east of the existing village will be the focus for development in Phase 2. As with Coul Hill, the locality will contain its own primary school and shopping group and will be served by its own local distributor road, which will run round the edge of the locality. South of Obsdale, work will begin on the playing fields and a small amount of new housing will be built immediately east of the existing village. Access from Obsdale to the playing fields will be via an overpass across the primary distributor road. This Overpass will be linked in turn to the bus stop on the primary distributor.

A secondary school will be built immediately south of the existing village and access, via an overpass from the main footpath system, will be across both the primary distributor and railway lines and will also lead to the town park. Preparation will begin on the industrial area for the town during this phase.

At this stage of development it has been assumed that the growth of the work journey trips, industrial and regional traffic will make it necessary to construct the first lane of the Fast Road. This road will connect temporarily with the A9 just west of the A9 and A836 Struie Road Junction via a new bridge across the railway line. The Fast Road will then pass south of the town, joining the new section of primary distributor at the eastern end of Obsdale. During this phase, which would cater for some 3,700 persons, the centre would continue to expand and some redevelopment of existing properties north of the centre could be expected.

Phase 3. Development will be concentrated at the Culcraggie locality and as before a primary school and local shopping centre will be built. At this point the primary distributor road will be linked through to the A836, and 'bus stops provided at under-passes in the locality. The area to the east of the locality will develop as playing fields in preparation for the secondary school in Phase 4. The locality will be served by its own local distributor which will return to the primary distributor just east of the Struie Road.

At this stage of development the Fast Road will be extended west towards Evanton and the Struie Road increased to two lanes in each direction, joining the Fast Road just south of the railway line. East of the town the Fast Road will also be increased to two lanes in each direction to cope with expected traffic flows.

During this phase, which would cater for some 3,500 people, further development will take place in the centre and the town park will be completed.

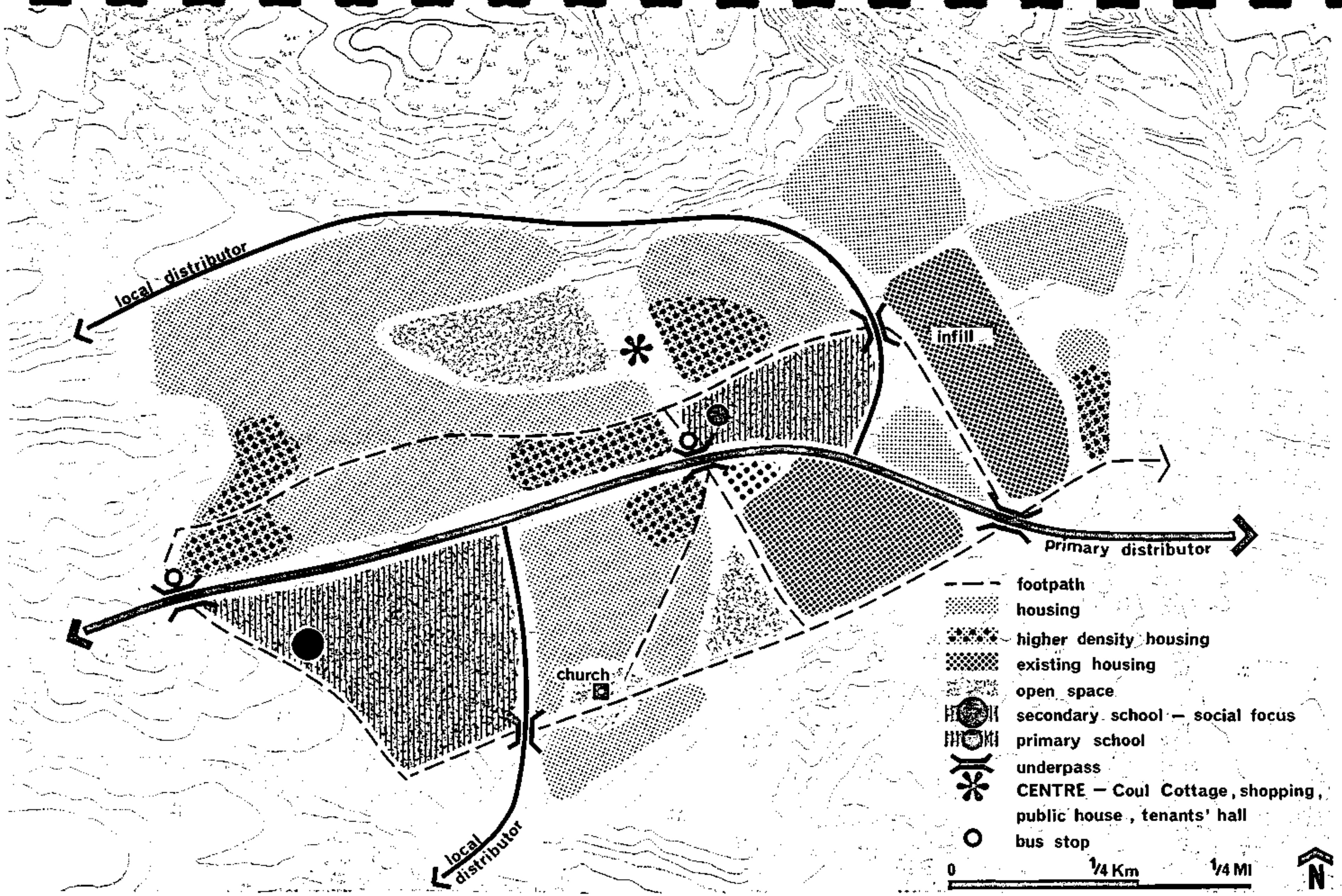
Phase 4. The Struie locality will be built, providing a link back to the primary distributor for the local distributor road serving Coul Hill. One of the considerations for phasing this area last was that it will look across the completed

Culcraggie locality to the Cromarty Firth, while the views from Culcraggie will be to the south and west, but not north to the construction work in progress at Struie. The secondary school at the eastern end of Culcraggie will be built during this phase and it is anticipated that the Fast Road will have to be increased to two lanes in each direction at this stage.

Phase 4 will accommodate around 3,500 people some of whom will be located in the town centre where further development will be taking place.

Present Population			1,500
Phase	1	(Coul Hill	3,700
		(Shillinghill	350
	2	Obsdale	3,700
	3	Culcraggie and Central Area	3,325
	4	Struie and Central Area	3,250
Total			15,825

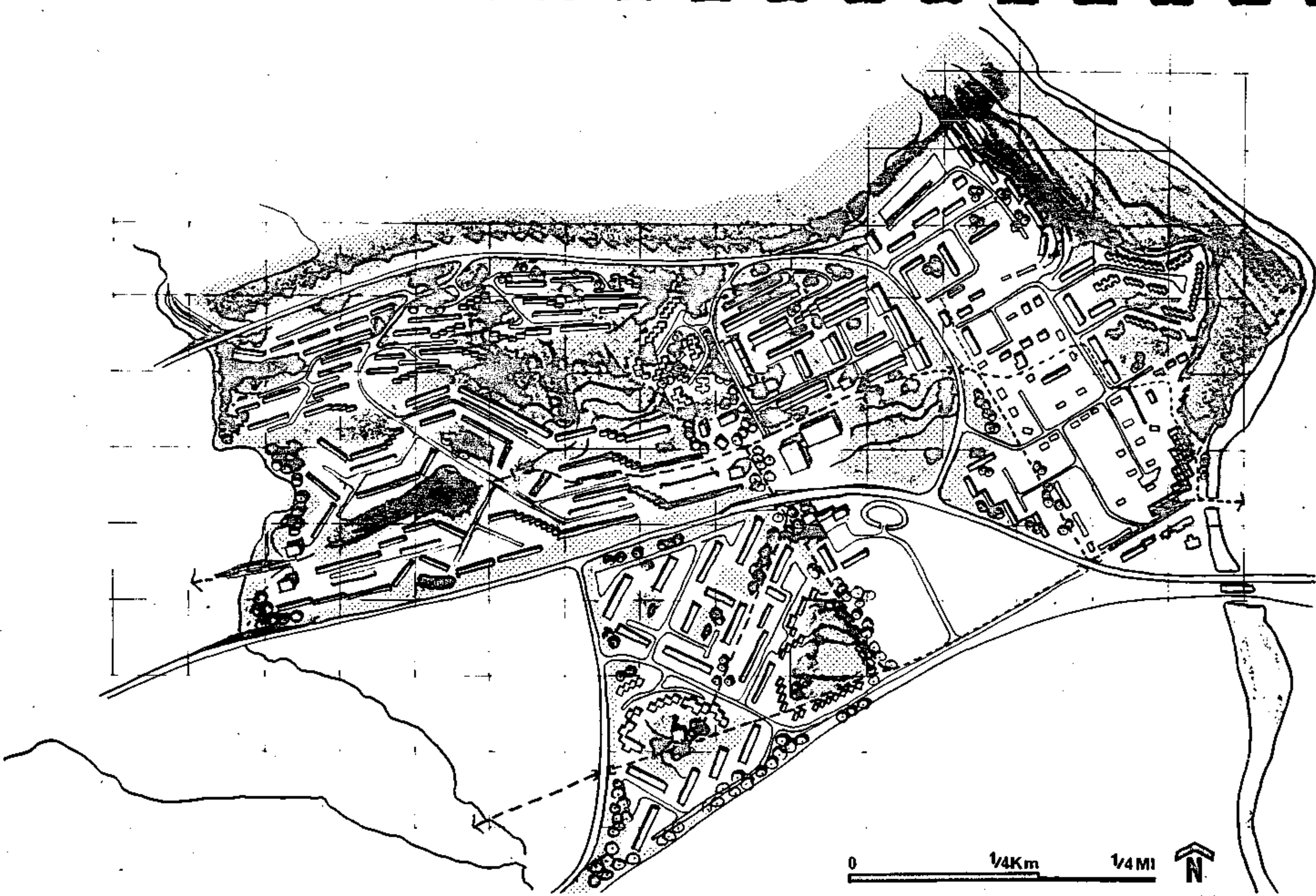
The drawing shows extension to the golf course during this phase but it could in fact be carried out at any time according to demand.



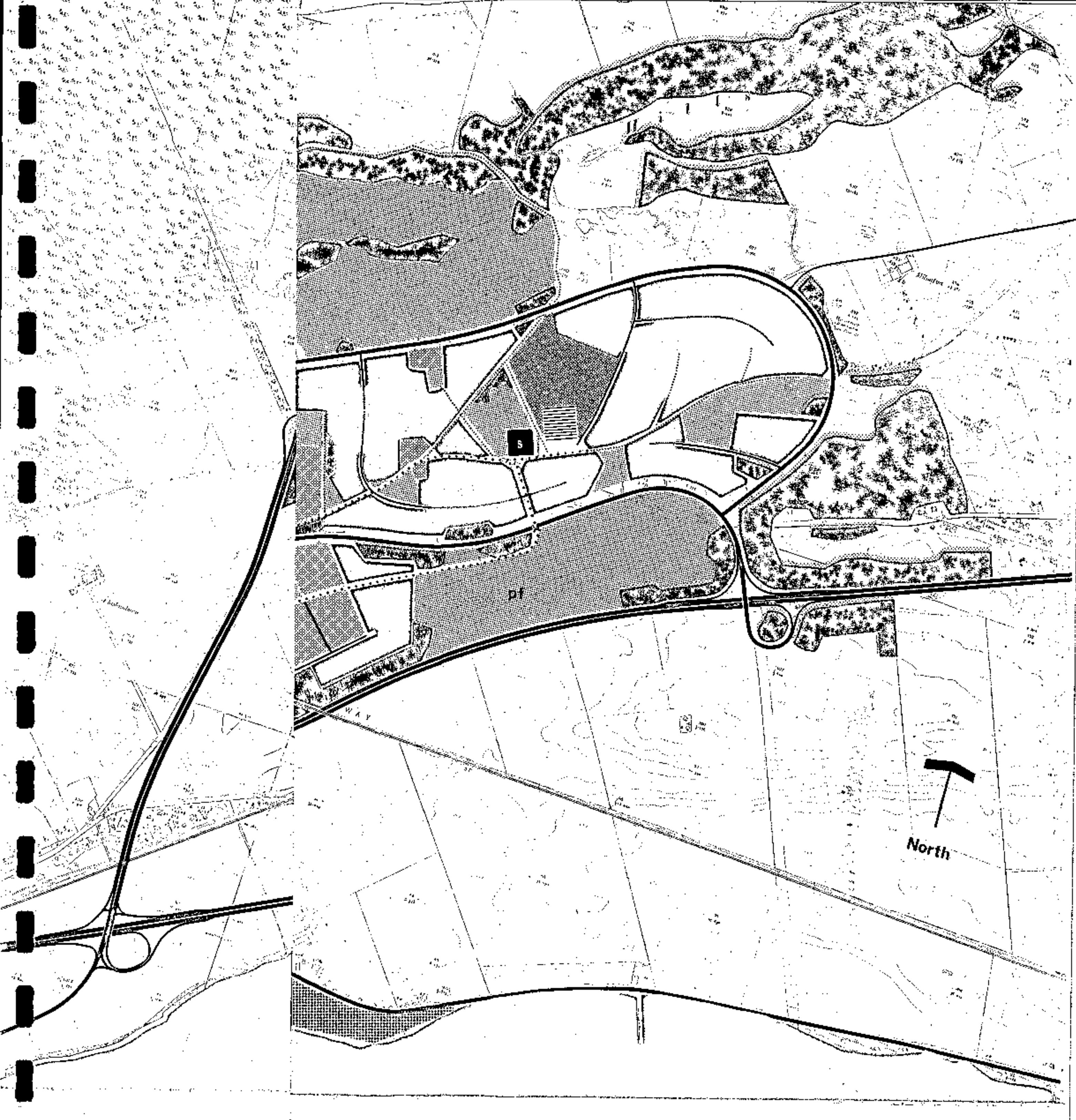
LOCALITY DIAGRAM 4.17

The Next Step.

The Coul Hill locality was chosen to demonstrate the housing potential which can be achieved in the Moray Firth. Drawings 4.17 and 4.18 show the preliminary steps from the structure plan toward a more detailed examination of a particular locality. Drawing 4.17 shows diagrammatically the planning concept and arrangement of the various elements that make up the locality, while drawing 4.18 shows the sketch stage reached after more detailed investigation of land form and social needs had been carried out (see drawings 5.1, 5.2, 5.3). This investigation is described in Part Five.



SKETCH LAYOUT COUL HILL 4.18



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ALNESS STRUCTURE PLAN

PART FIVE

HOUSING STUDY

CONTENTS.

Lane leading to High St Alness

ILLUSTRATIONS.

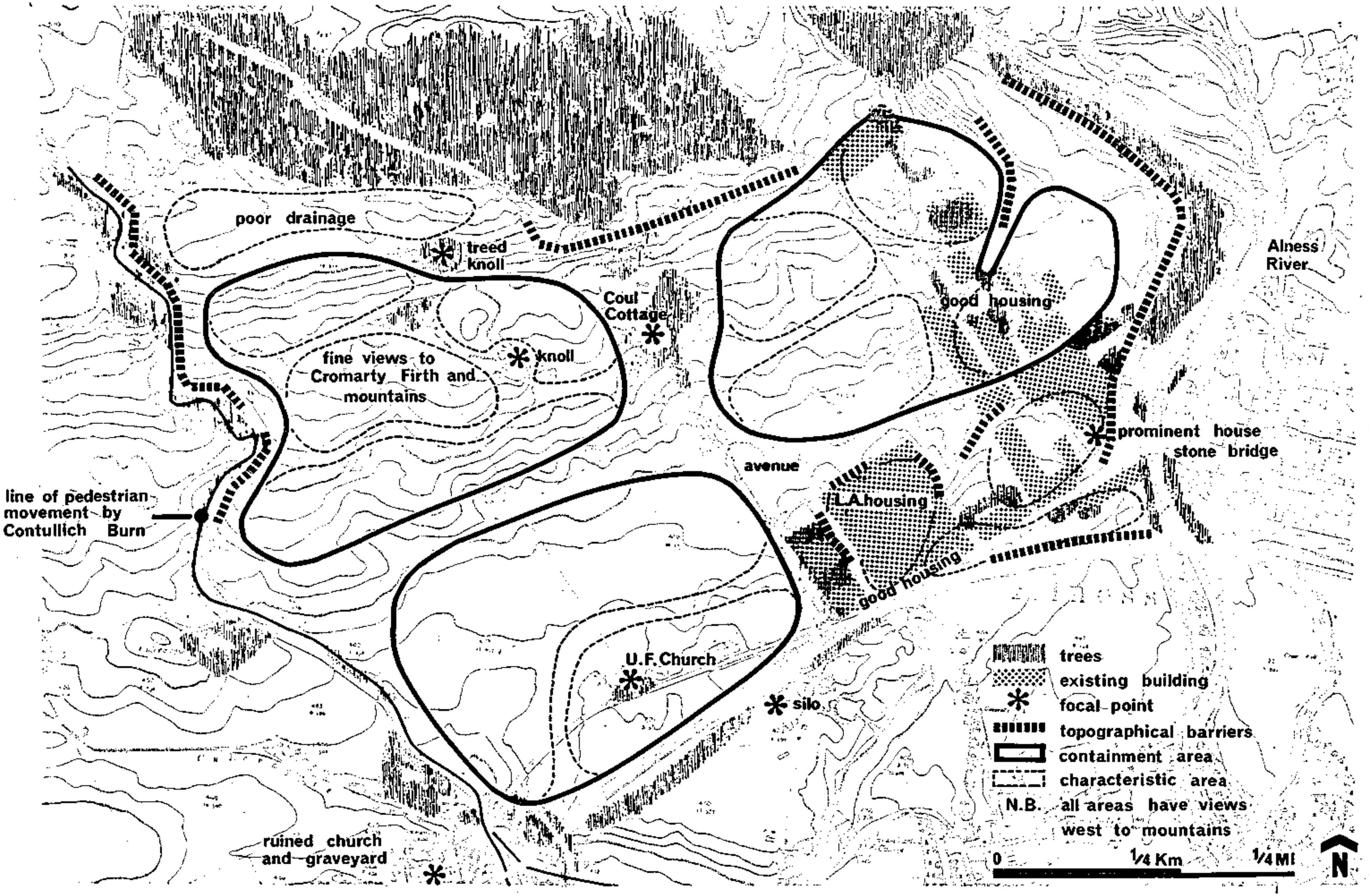
<u>HOUSING STUDY</u> with particular reference to <u>COUL HILL, ALNESS</u>.

Within the basic framework established by the structure plan one locality was studied in some detail. The main purpose was to establish and demonstrate appropriate planning principles which make use of the environmental potential of the area.

The Coul Hill area was chosen for illustration for a number of reasons. It is quite a large parcel of land mainly in one ownership conveniently close to the town centre of Alness. It is also a very attractive site, offering a variety of opportunities for exploiting the landscape characteristics of the area, and it is visually and topographically well contained, with a clear identity. It lies reasonably close to the existing roads which will serve it in the early stages of the Alness development.

The first principle was to make an appraisal of the physical and topographical characteristics. Town scale studies drew attention to the general character and to the restraints imposed by the landscape on potential development, and within localities, as with the town as a whole, identification with the surroundings depends on achieving a sympathetic balance between human adaptation and the natural features.

In order to achieve this balance, further study was made of the characteristics within the locality such as slopes, knolls, soils, tree groups, hedges, aspect and views. (See Drawing 5.1 which shows characteristics within the Coul locality of Alness.)



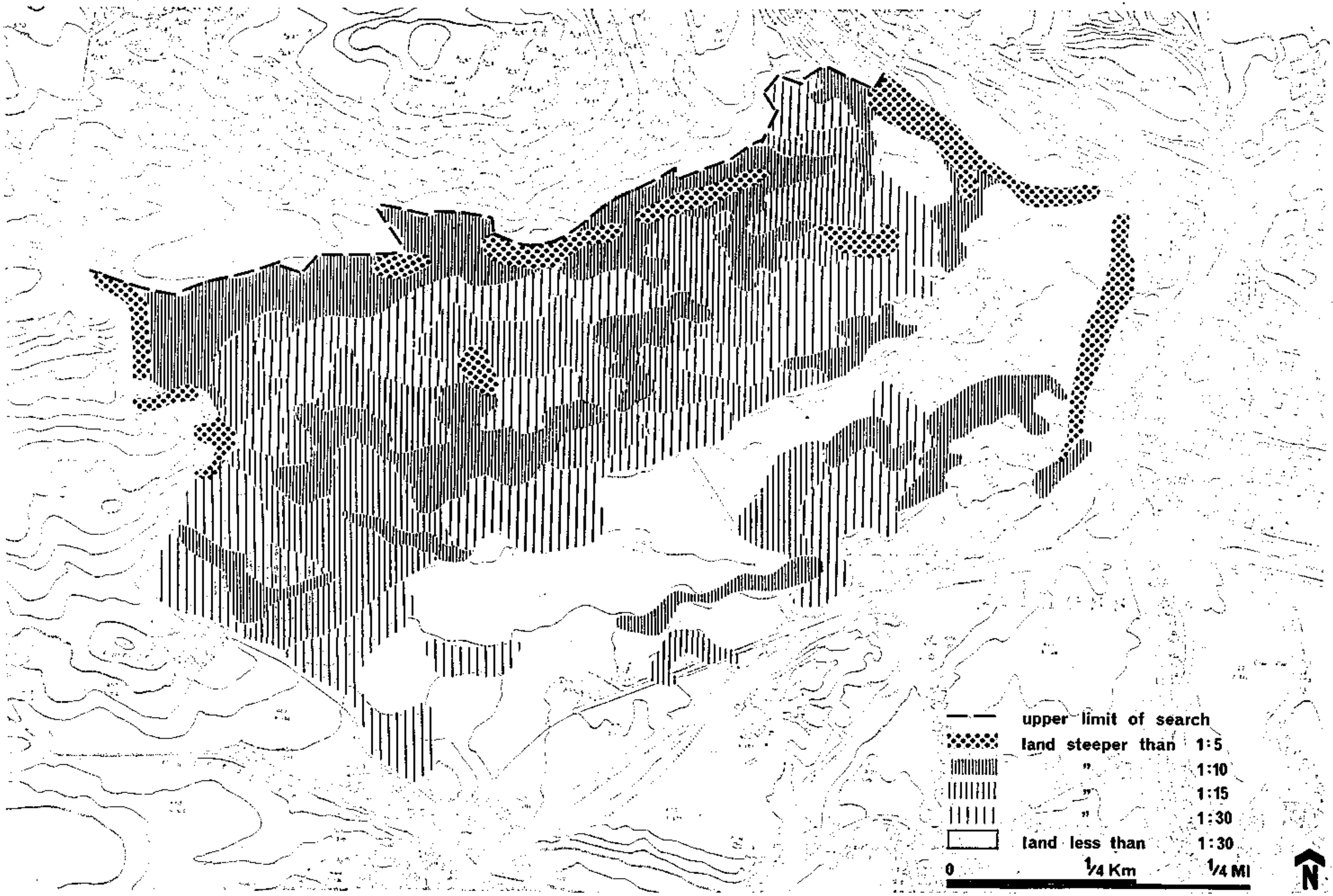
CONTAINMENT AREAS 5.1

Like others in Alness this site slopes to the south. (See Gradient Analysis Map No. 5.2). This makes it possible to give whole blocks and groups of houses a "window" to the south and a view of the Cromarty Firth. The sketch 5.7 shows how single storey houses form the window sill and the higher blocks on either side form the window jambs framing the view from the houses higher up the slope. This "window" principle which informs the sub-regional strategy, the town plan of Alness (See diagram 2.10) and now the locality layout leads to strong emphasis on contour planning and to conscious manipulation of the heights and placing of blocks and groups of houses to give this result. Thus variety of height, of form, and of situation is a bonus of the functional solution.

Variations on this theme occur, of course, with different gradients and directions of slope and view. On flatter areas it is sometimes possible to take advantage of the views of Cnoc Fyrish to the north west; or create a more introspective scheme by the River Alness, for instance.

The Alness river and Contullich burn form the east and west boundaries, and the trees surrounding Coul Cottage and the nearby church traverse the site from north to south. The north boundary is the local distributor road and the site is crossed by the primary distributor.

Each locality has, by definition, a small group of shops and a primary school. In this case the shops are grouped around Coul Cottage a fine Georgian house facing south which we



GRADIENT ANALYSIS 5.2

suggest could eventually be adapted to social uses. The sketch Fig. 5.4 shows the group formed among the existing trees. This group includes the primary school, and the 'bus stop is nearby. (See also layout plan 5.12).

OPEN SPACE.

We have made a distinction between three types of open space which we have called Public, Communal, and Private.

Within the locality at least one large area of open space will be required. This area should be readily accessible to housing and main pedestrian routes, and suitable for a variety of play and recreation. The scale of the provision is dependent not only on the population but on the accessibility of open and wooded areas. Potential sites for open space and primary schools have already been identified from the studies of gradient analysis and containment area "characteristics". (See drawings 5.12 and 5.7).

Within each residential unit or group of housing a proportion of open space should be treated as communal for the adjoining residents, and planned accordingly. Suitable play space for the youngest children should be incorporated within the communal open space. (See drawing 5.14). Play spaces should be close to housing areas, and on sheltered sites. Variations in ground features are quite desirable however, to encourage more imaginative activities.

One way of ensuring reasonable standards of layout and more particularly maintenance of these

Coul Hill from the South

Cromarty Firth from Coul Hill

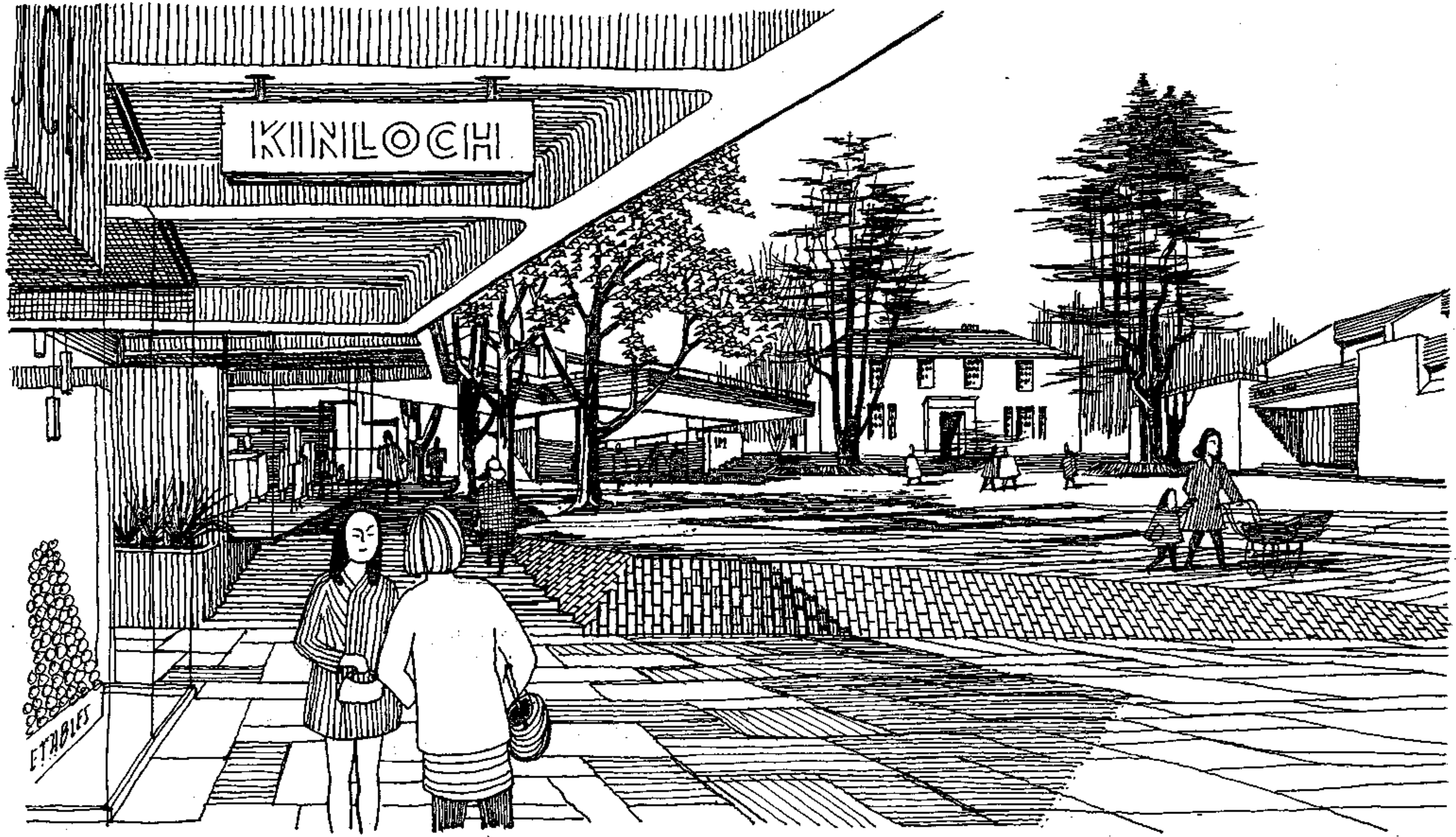
CONTAINMENT SKETCHES 5.3

smaller spaces, would be to let the financial responsibility for them rest with the group of residents who enjoy them. This in fact would be the most precise characteristic of "communal" by which it is distinguished from public and private open spaces.

The private outdoor space whether court, terrace, patio, balcony or garden is one of the major elements in a housing development. The importance lies in the freedom with which the resident can use this space, the visual influence of such use and the sheer scale of private space needs within a housing area.

Gardens. Provision of garden space will depend on a number of factors related to the site on the one hand, and the resident on the other. It is important to take advantage of south aspect and deeper soils where they occur and to allow ample gardens of up to 2,000 sq. ft. which will meet most needs. It is also important to relate the potential to the needs of the resident since both over- and under-provision of space can lead to frustration and disinterest, with a subsequent down-grading effect on the environment.

Various garden types are illustrated on Fig. 5.13. They include:- the small garden; suited to the cultivation of flowers and vegetables for the moderate household, and the larger garden; suited to the keen gardener, which is within the regular capability of a normal family to maintain, providing space for several simultaneous activities.

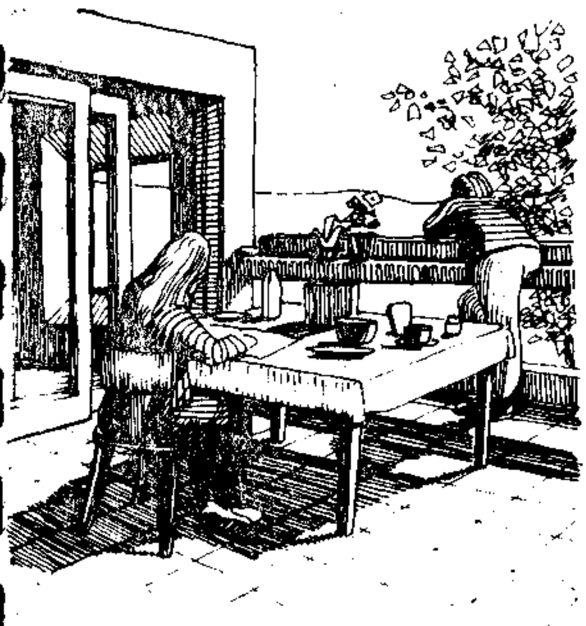


LOCAL SHOPPING AT COUL COTTAGE **5.4**

The proportions of each type of garden were influenced by the form of the layout, by soil and climatic conditions, slope and aspect, open space provisions and the effect of the layout on privacy. The final arrangement may be determined, however, as and when the resident demand becomes known, when it would be possible to take account of such factors as the amount of interest in gardening, the desire for garden produce, the expected length of occupation, shift work and traditional attitudes.

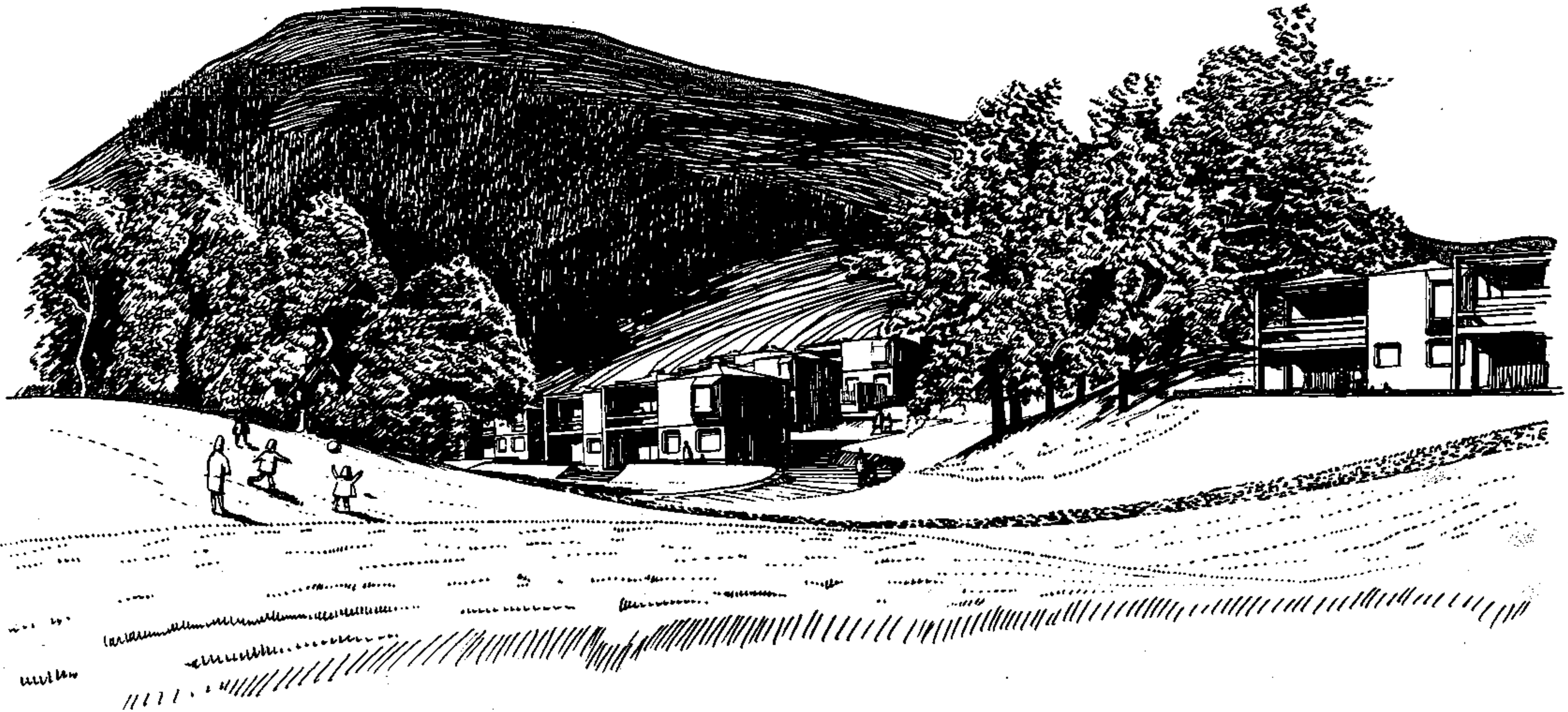
Hard Surface Space: This kind of private outdoor space will be in the form of terraces, patios, courts or balconies. These should be designed so as to catch the sun. Surfaces should be attractive, relatively maintenance-free and with good drainage. Space will be provided for pot plants, shrubs and flowers.

Associated with each dwelling should be a minimum private outdoor space large enough to allow the members of the household to sit out in comfort and enjoy the benefits of sun and fresh air, as the sketch shows.



Roof terrace near Contullich Burn Area A

Even with the improvement of clothes washing and drying machines, families with young children still require outdoor drying spaces and these are shown on drawing No. 5.16.



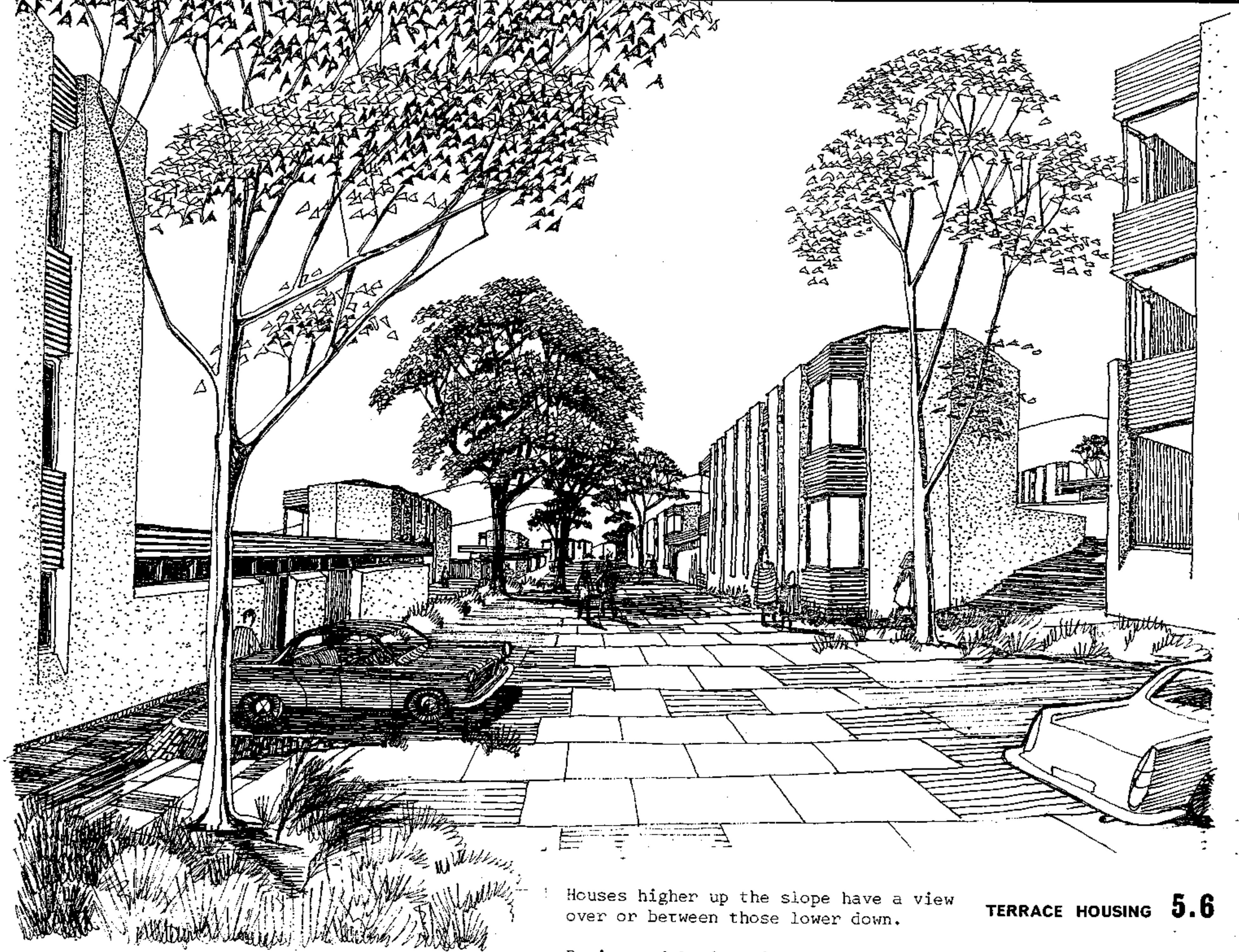
CNOC FYRISH FROM THE COUL COTTAGE AREA **5.5**

The Pedestrian.

The pattern of the containment areas and the details of slopes, focal points and views help to determine a movement pattern. The main footpaths will give views and glimpses of hill and firth between buildings along the route.

The main focal points include shopping, social facilities, churches, etc; public open spaces, 'bus stops, schools. Pedestrians will not follow a footpath merely because it is there. It should be made convenient and direct for them to reach any of the focal points from anywhere in the locality. The scale and treatment of footpaths must be appropriate to their relative importance and the scale and form of the adjacent buildings will also reflect this importance. The slight deviations from line, the opening and closing of vistas, and the variations in scale and treatment along a footpath should follow from a close investigation of site conditions and sympathetic design but not so as to obscure the clarity of the routing, which will be emphasised by the use of natural and man-made landmarks. In such ways each locality and group is given its own particular flavour and identity.

The footpath system is designed so that pedestrians need not cross or walk along major roads. The crossing of local distributor roads and major development roads is reduced to a minimum and their use as pedestrian routes discouraged. Care should be taken with the detailed planning and design of ramps and stairs connecting to 'bus stops and underpasses.



Houses higher up the slope have a view over or between those lower down.

TERRACE HOUSING 5.6

Paving and landscaping show that the pe[illegible]rian[illegible]s p[illegible]ity [illegible] the [illegible]are.

The Vehicle and the Pedestrian.

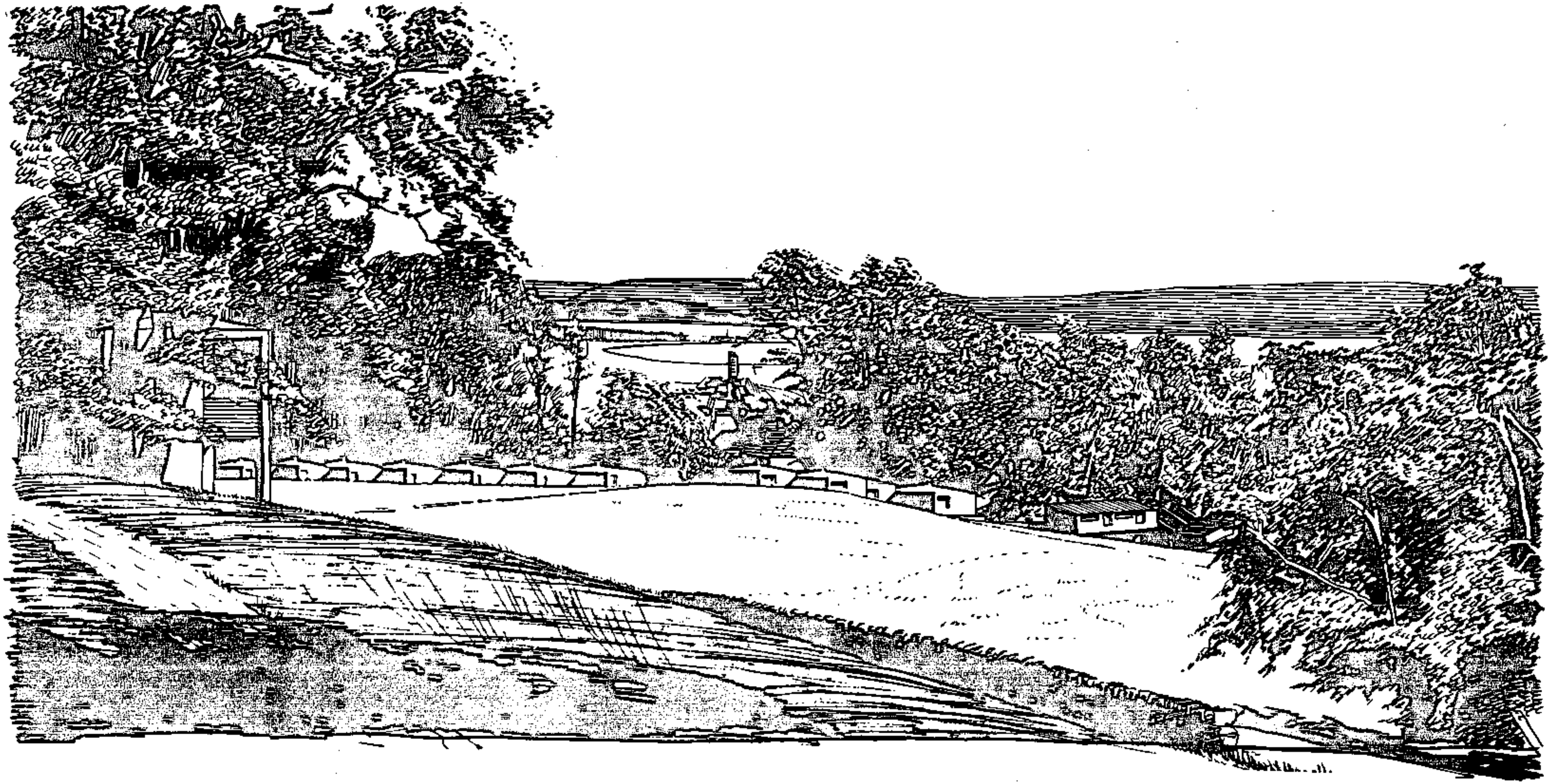
The siting of local distributor roads at the edge of localities follows from the containment and network studies. Over much of their length these roads will mark the transition between urban and rural landscape. Existing and new planting alongside the road is used to accentuate containment. In order to minimise the effects of noise the siting of the distributor roads is arranged to take advantage of the screening effect of ground contours, embankments and cuttings and to allow adequate physical separation of housing and traffic.

Once a car has entered the locality the distance to its destination will be relatively short and there are physical restraints on speeds exceeding walking pace. The roads are designed so as not to be obtrusive and the whole layout gives consideration to the pedestrian.

A feature of distributor and feeder roads is that buildings do not generally face the road with either front doors or living room windows except from a distance. This prevents immediate access to either front doors or garages from these roads and reduces the penetration of road noises into the houses. Pedestrian crossings are few but well marked.

Housing near Contullich Burn, area A

The generally accepted maximum walking distance from the car to the house and from the service vehicle to the house is 150 ft. (50m.), but is usually much less.

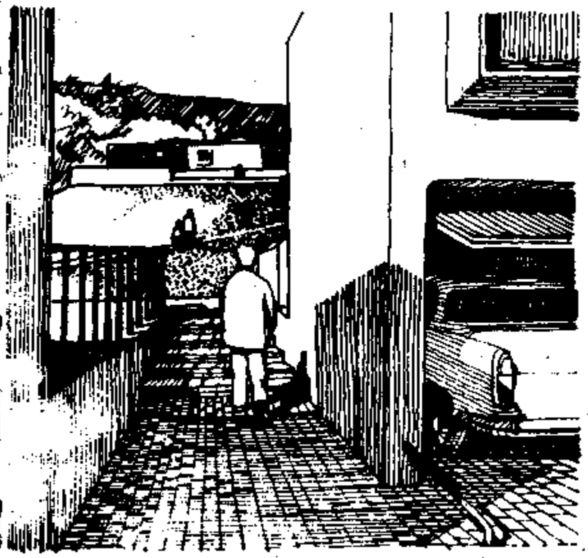


A'WINDOW'– view of Alness, Invergordon and the Black Isle from above Coul Cottage

5.7

Parking and Garaging. The large amount of space now required for ultimate garaging and parking is accounted for in the layouts and, to prevent it being unsightly and apparently wasteful, we incorporate some double deck car parks and garages on the ground or basement levels of terraces and flats even at some extra cost. Nevertheless it will probably be necessary for economic reasons to provide some of the car space in stages. This should be carried out sympathetically so as not to destroy the environmental quality.

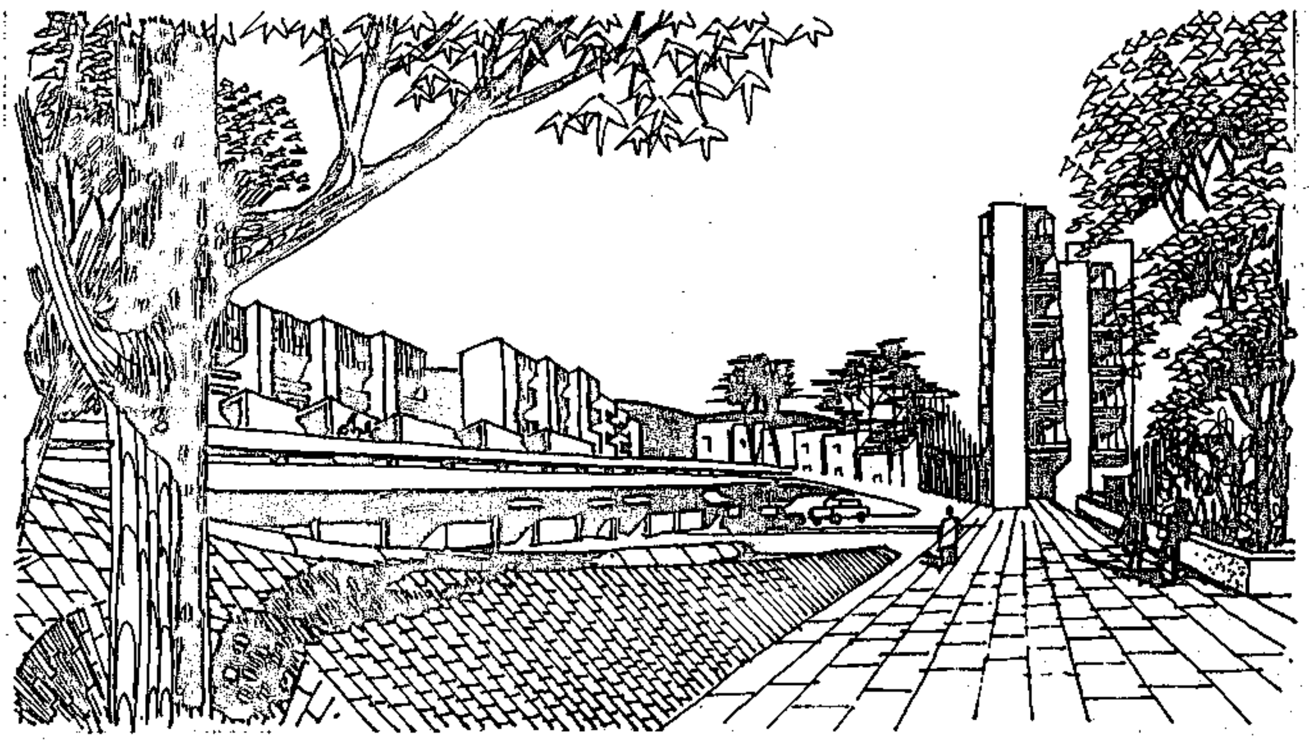
Limits of Pedestrian Segregation. On local distributor roads and main development roads (feeder roads) the car and pedestrian should be kept apart. By ensuring that pedestrian routes do not coincide with roads it is possible to restrict pedestrian/vehicular conflict to a small number of pedestrian crossing points which should be clearly visible and well defined.



Lane, Contullich Burn Area A

In some areas it was not possible to prevent pedestrian routes developing alongside the roads, for example at steep slopes, but in these cases footpaths are physically separated from the roads.

At the point where the motorist becomes a pedestrian, namely the garage court or parking area, it is by definition impossible to devise total pedestrian segregation. It is also the point from which milk and mail are delivered and refuse is collected, and perhaps because it has hard surfaces on which a ball can be bounced or a tricycle pedalled, it is also attractive to small children. It is the point giving the



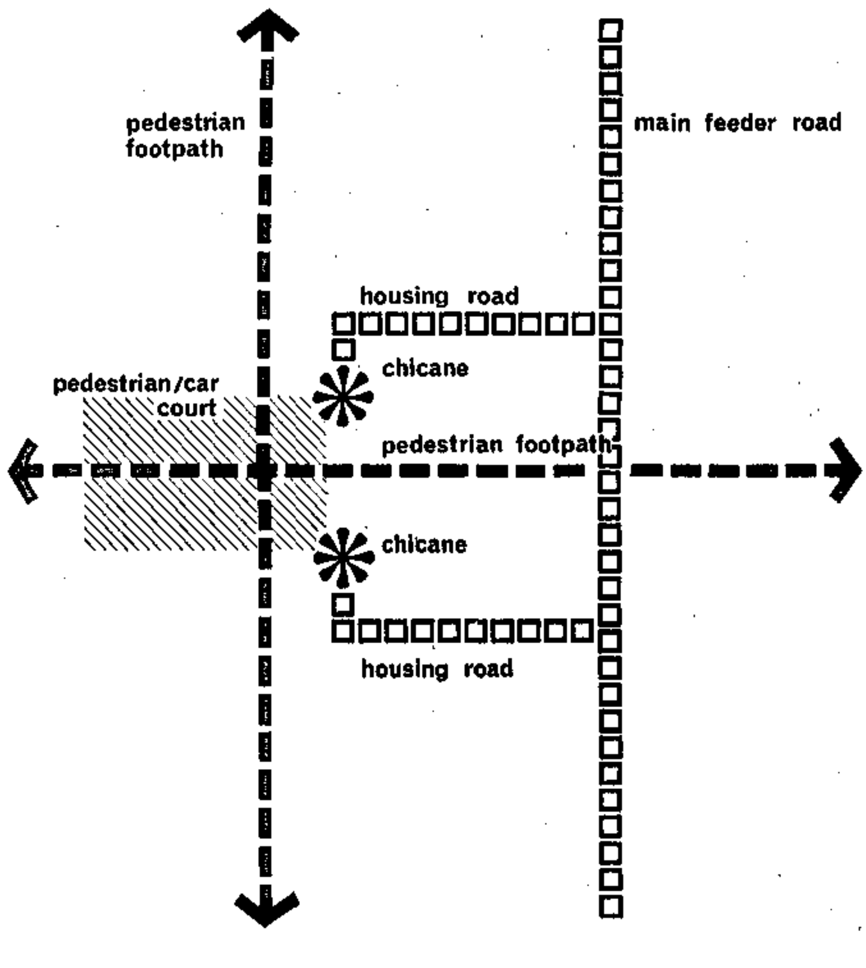
Terrace housing and flats at Coul,
with car parking deck over garages.
Area B.

shortest transfer distance from car to house and so it becomes the equivalent of a courtyard.

Since we must accept this mingling of feet and wheels at this point (but at this point only), it is now necessary to design it for safety. The first thing to do is to slow down the vehicle; this can be done by various sorts of chicane whose effect will be to limit speeds to ten or fifteen miles per hour, or even less. (See chicane diagrams Appendix 5 Housing and Traffic Standards). An equally important contribution, however, is in emphasising the pedestrian priority by the use of paving slabs, bricks, setts, cobbles and gravel instead of concrete or tarmac punctuated so as never to form a perspective of surface inviting drivers to accelerate; never in fact to have the appearance of a road in the usual sense, though strong enough to carry all normal vehicles.

These physical and visual inhibitions to speed allow the development roads to be designed in many cases as loops instead of culs-de-sac and this in itself will be an aid to delivery services, and reduce the dangers caused by reversing traffic.

Housing near Contullich Burn
area A



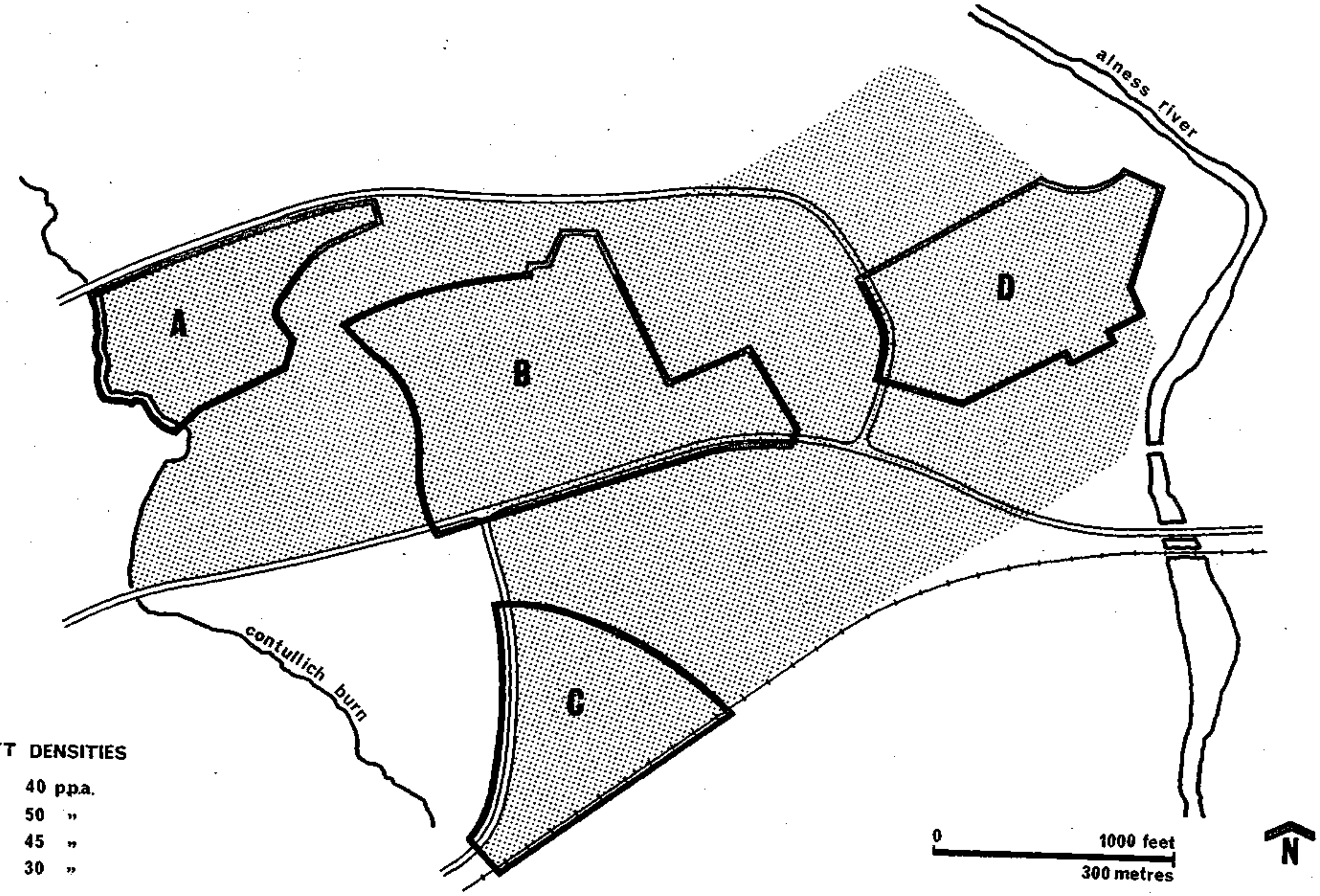
Area A : Contullich Burn

The site is defined to the north by a ridge and a strong belt of conifers. The western boundary is formed by the Contullich Burn which runs in a deep and thickly wooded gully. The land falls quite steeply southwards and the area commands a magnificent panoramic view across the Cromarty Firth to the Black Isle and sweeping from Cnoc Fyrish in the west to the Sutors in the east. It is possible to arrange that each house should enjoy at least a share of these exceptional views.

In the main, the houses are of the two-storey, single-aspect wide-frontage type. (Fig. 5.15). There is a half storey difference in ground level between front and rear of the houses. The entrance is at the rear or north side, mid level, and living areas can be at the upper or lower level, depending upon the view, and buildings in the foreground.

The main feeder road from the local distributor runs diagonally down the countours while the service roads run with the contours.

The main characteristic of the footpath system which runs naturally along contours east and west, or diagonally across them, will be a sense of enclosure and shelter. Westwards, the focal point will be Cnoc Fyrish and there will be glimpses of the Cromarty Firth between buildings. In contrast there are large communal open spaces by Contullich Burn.



NETT DENSITIES

A	40 p.p.a.
B	50 „
C	45 „
D	30 „

GROSS RESIDENTIAL DENSITY 22·6 p.p.a.

COUL HILL

KEY TO SPECIMEN LAYOUTS **5.10**

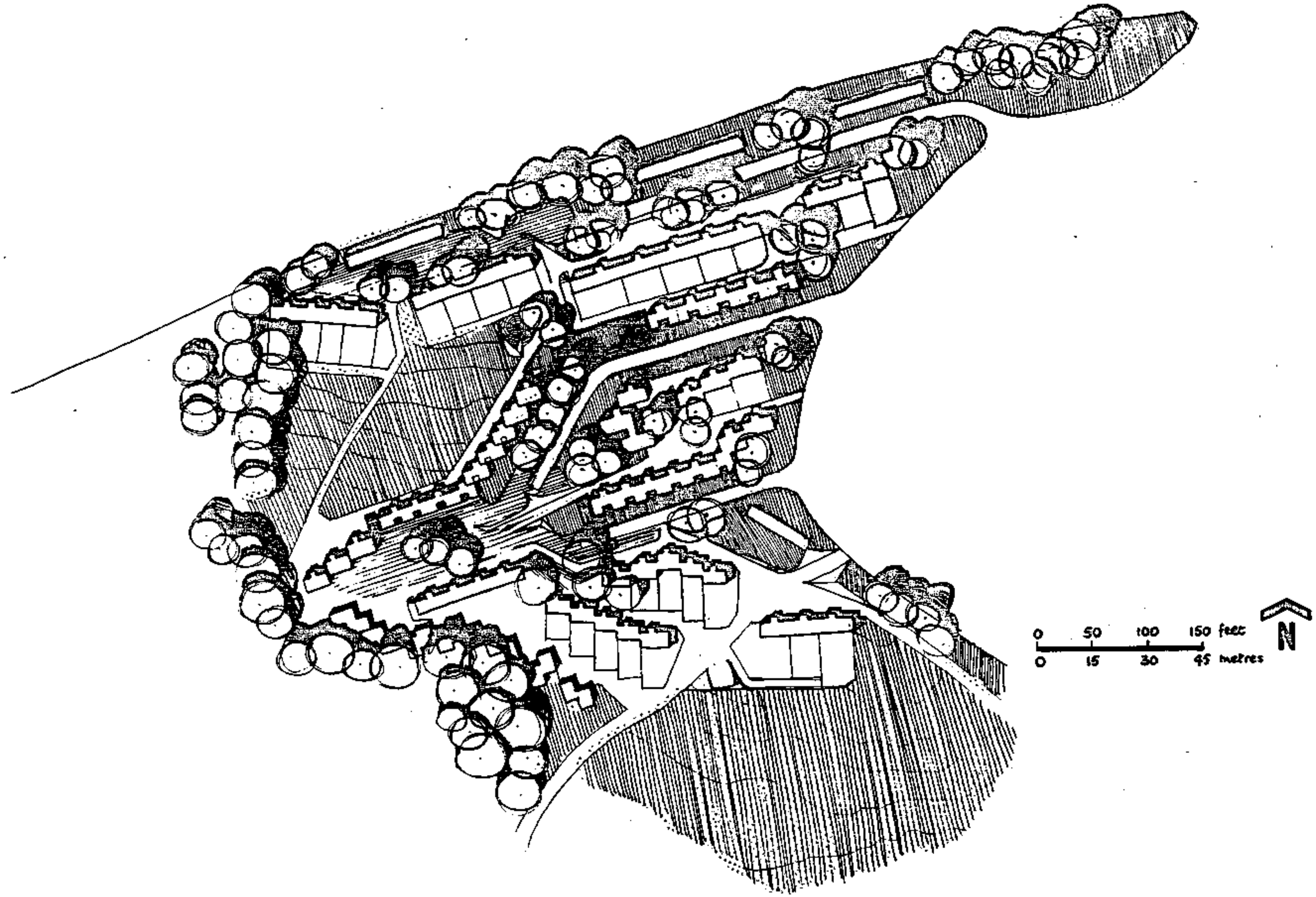
All dwellings, will have a private outdoor space which will catch the sun. Garaging is provided under single aspect flats, and in banks of garages on the periphery of the site. These, together with proposed planting, will act as a screen between the main roads and the houses.

The service road at the north is a cul-de-sac. It terminates in a courtyard where pedestrians and vehicles may mix safely. The courtyard area is entered through a chicane, as illustrated in Appendix 5. Further south, two service roads lead through chicanes to another courtyard allowing service vehicles to complete a loop without reversing.

Area B : Coul Cottage.

The elements influencing the housing layout are: to the north the major public open space, to the south the primary distributor road and to the east the locality centre (see Fig. 5.4) and the primary school. The land falls to the south with the contours undulating subtly. The views though less spectacular than from Area 'A' are still very fine.

So that each house will enjoy a view, terraces on this gently sloping site are generally 50 metres apart and the groups will vary from 2 to 3 storey including houses and flats. The building forms as in the Contullich Burn area, accentuate the flowing lines of the site. Houses have large gardens while flats have communal open space with childrens' play spaces. Two stub blocks of flats and narrow frontage terrace houses slightly increase the density



Nett Density	40 p.p.a.
Garages	1·5 per dwelling
Parking	2·25 places per dwelling

CONTULLICH BURN

AREA A 5.11

around the local shopping. The flats act as landmarks within the locality and for the town.

Single-storey houses for old people are located in the attractively wooded area north of Coul Cottage, near the local shops, the 'bus stop and the major open space. (See Fig. 5.7).

From the centre the main pedestrian way runs south to the 'bus stop on the primary distributor and the underpass to other parts of the town.

The shops are served from the rear by a loop road which is restricted by chicanes at suitable points on its length.

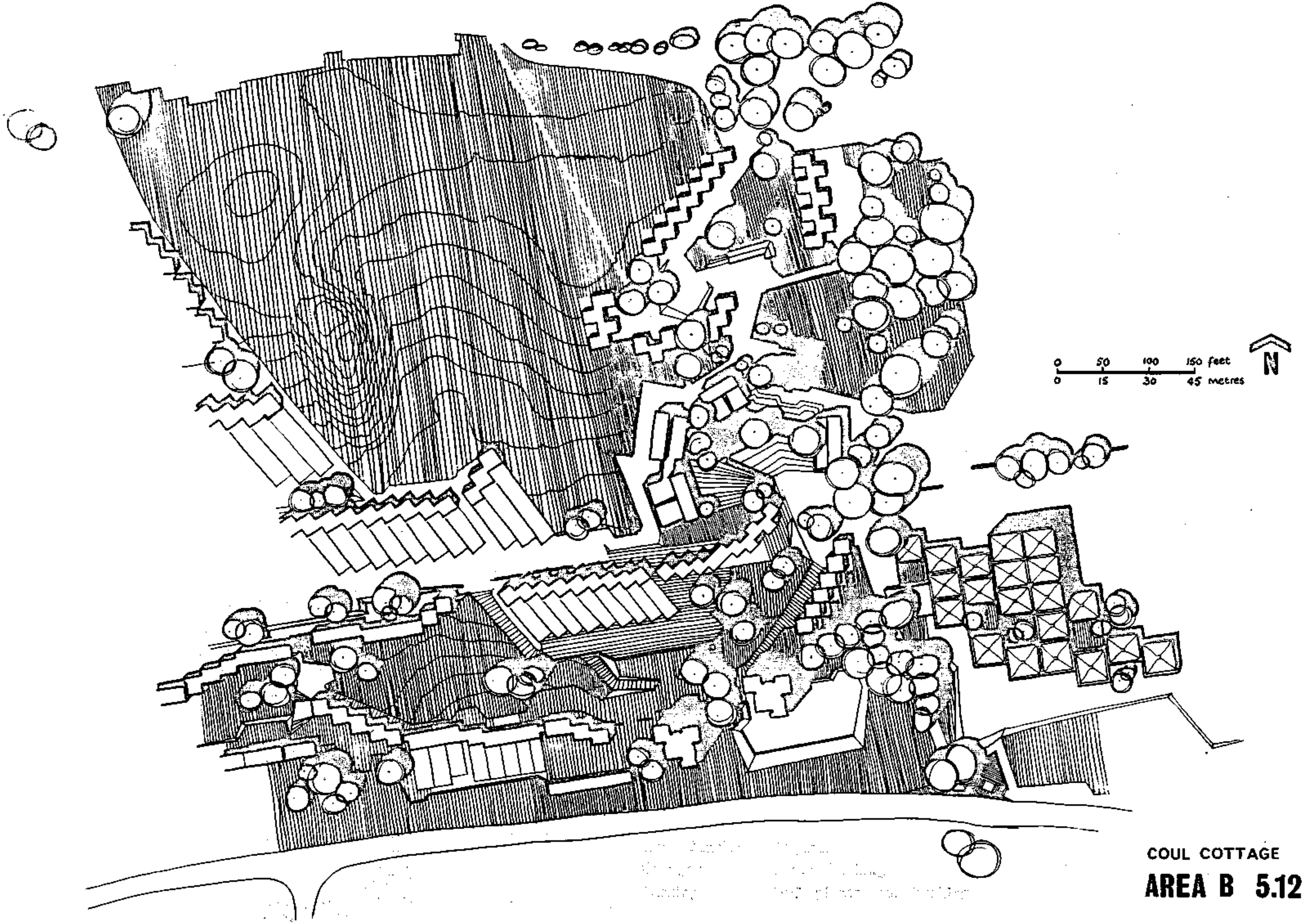
Garaging for the houses is provided at the end of gardens or in banks of garages with parking over, as shown in Drawing No. 5.8.

Area C : Coul Church.

This site is relatively flat and has little view to the south. However, in common with much of the area round Alness it has good views west to the mountains. The area is bounded on the west by the local distributor road and to the south by the railway. The major element in the layout design is the existing church and the fine trees grouped nearby.


Church near Coul Area C

Main pedestrian movement is east/west past the church on the line of the old A.9, taking advantage of the existing stone dykes.



COUL COTTAGE

AREA B 5.12

In the northern part of the site terraces of two-storey houses fan out from the church so that from the east it is seen against the backcloth of the mountains. Single storey housing is grouped around the church and its forecourt to create a quiet area.

The views of the Cromarty Firth from the area are to the south west and these will be framed by the three-storey terrace houses.

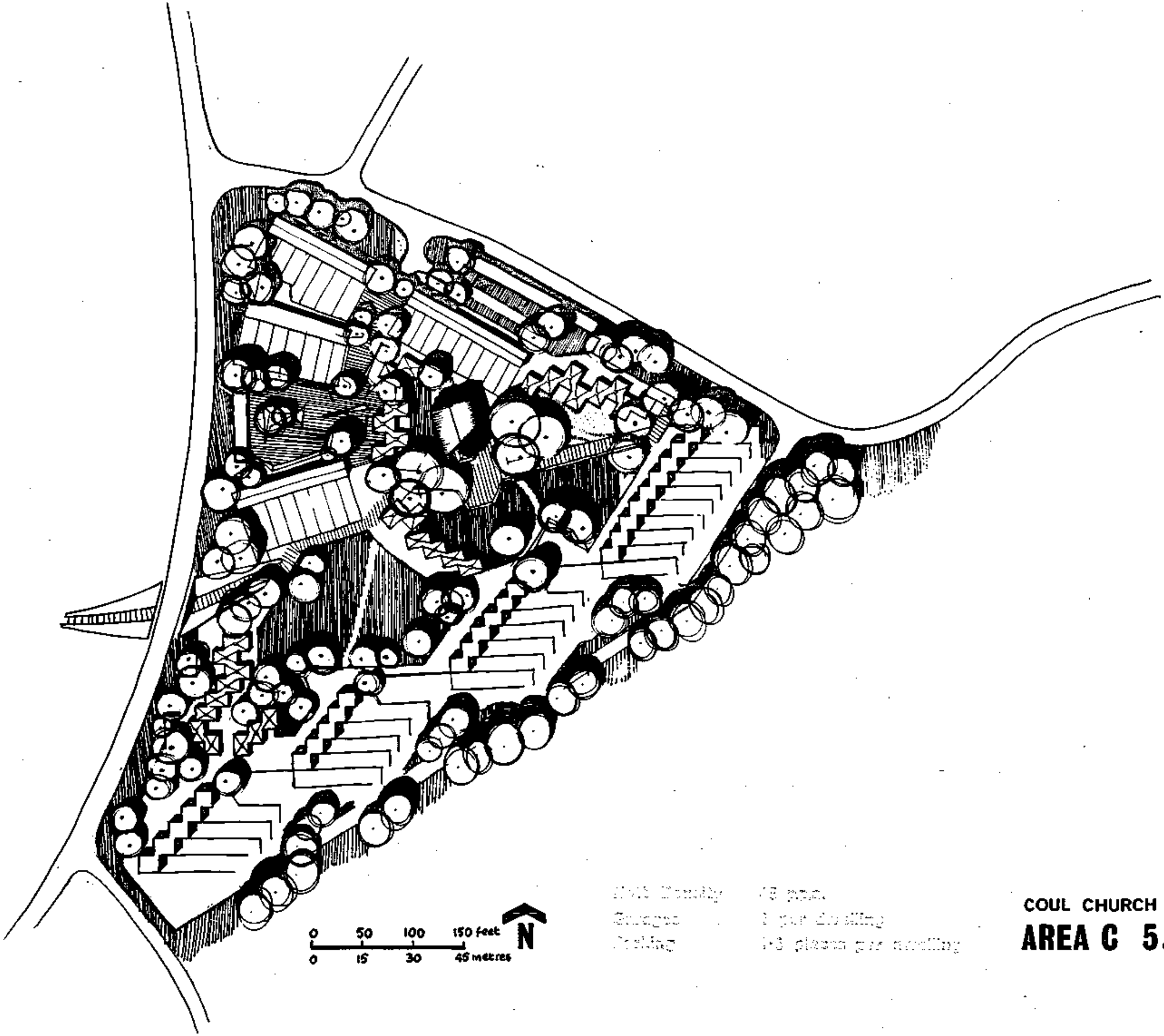
A high proportion of gardens can be provided because of the flat nature of the ground and the suitability of soil.

The three-storey houses have garages at the foot of their gardens while elsewhere garages are provided in banks. The two service roads are linked by chicane and courtyard, and car parking for the church is provided in the courtyard to the north-west of the site.

Area D : Alness River.

The site is relatively flat with views to the east and north-east. Most of the existing housing is pleasant and forms an area of good amenity. Bounded to the west by the local distributor road and to the east by the Alness River, off the main pedestrian routes yet close to the Town Centre, the site is well suited to private development.

Infill housing, composed of large individual or linked houses, is proposed for the western part of the site following and strengthening the character already established. Here roads, services and parking would be provided and infill



Garages — 1 per dwelling

Parking — 1·3 places per dwelling

COUL CHURCH

AREA C 5.13

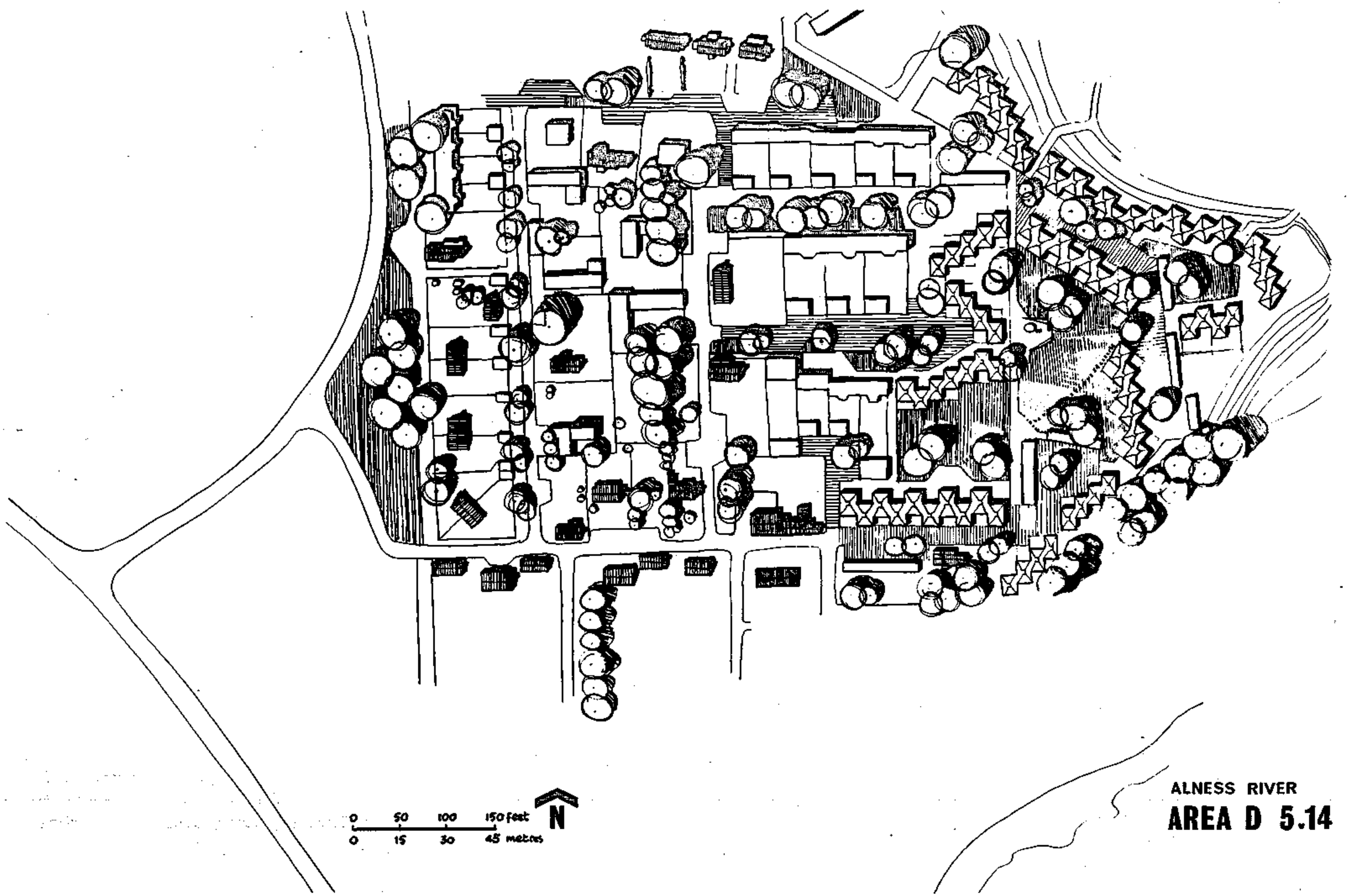
encouraged. A development of single storey housing is proposed on the flat ground to the east. (Fig. 5.16). These are twin patio type houses grouped around communal open spaces and service courtyards. Apart from a line of housing following the northern ledge of the plateau with views across the river this development would be inward looking and self contained.

Garage provision is high and at least one garage is attached to each dwelling. Extra garages are provided in banks closely related to the housing.

Accommodation Schedule.

Since no definite information was available as to the type and range of families likely to move into the area, it was necessary to make a number of assumptions based on comparative studies of New Town Reports and figures for the Scottish Pulp Mill at Fort William. The Pulp Mill has been more successful in attracting a larger proportion of "established" families with two or three children than most New Towns so far, and as it is hoped that development in the Moray Firth will attract some people who would not normally move into a new town, the Pulp Mill figures seem to be relevant to this situation.

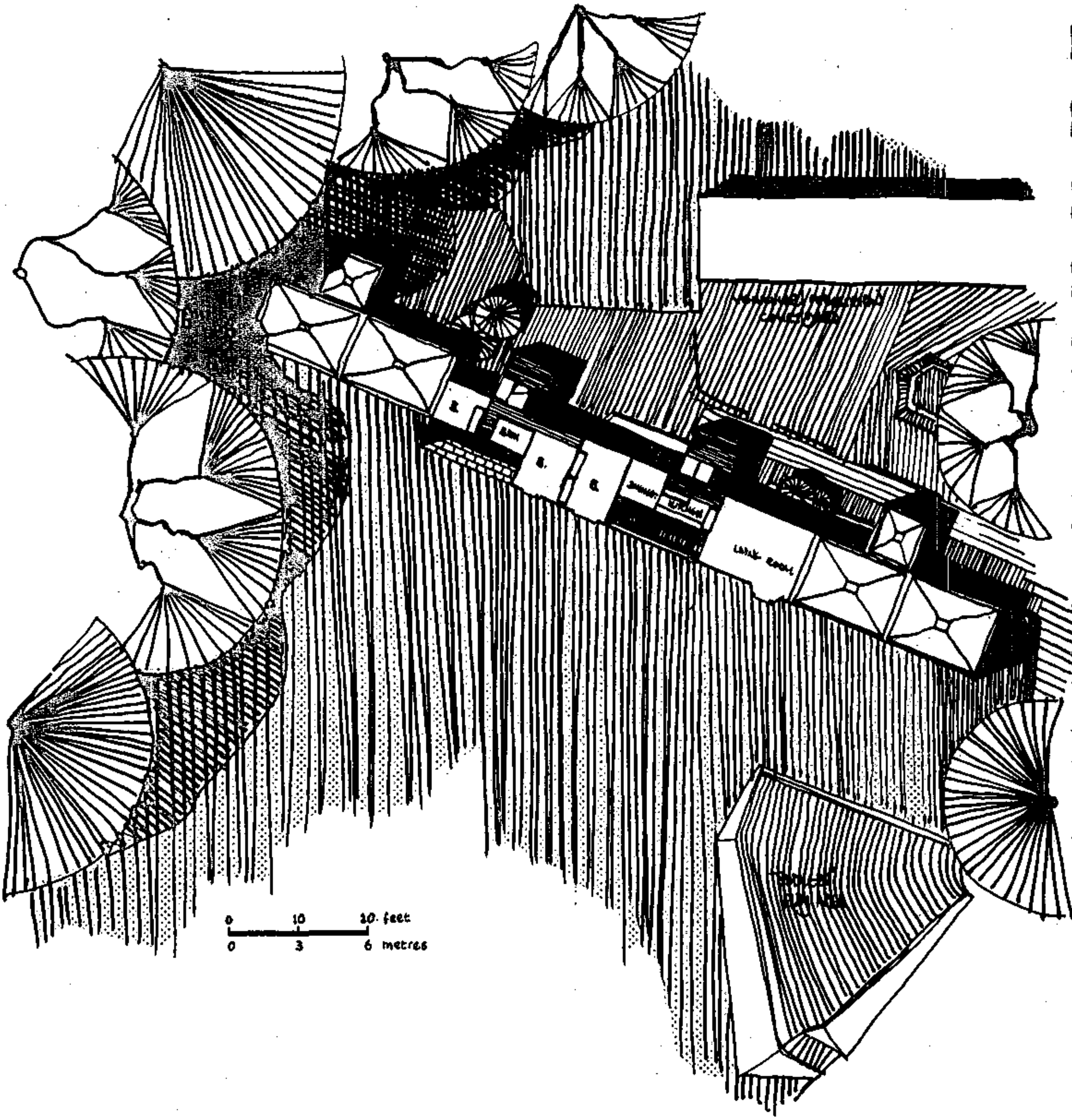
In the Coul Hill area about 1050 dwellings could be developed, and with the retention of most of the existing houses (approx. 130) the total population would be 4100, of which 3700 would be newcomers.


0 50 100 150 feet
0 15 30 45 metres
N
ALNESS RIVER
AREA D 5.14

The following table shows the overall proportions of different dwelling types, and the way in which these could be divided between houses and flats.

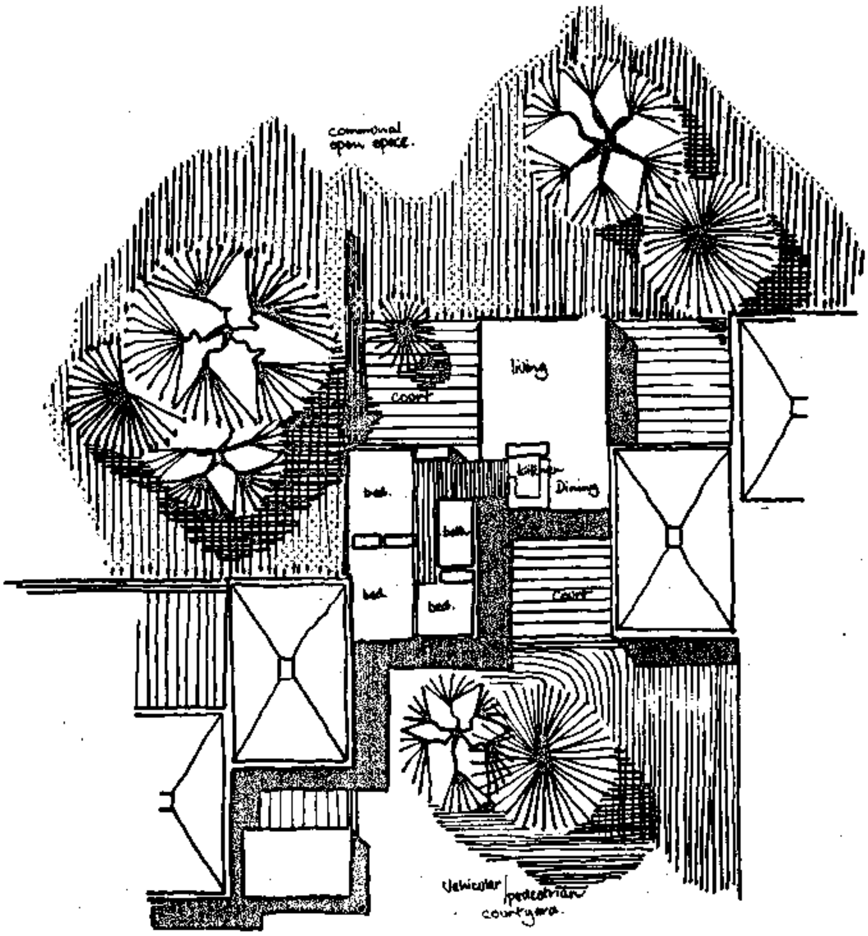
Bed Spaces	% of HOUSES Min.	% of HOUSES Max.		% of FLATS Min.	% of FLATS Max.	% of Total number of dwellings
2	4.5		+		7.5	12
		7	+	5		
3	16.5		+		7.5	24
		19	+	5		
4	21		+		4	25
		22	+	3		
5	26		+		1	27
		27	+	0		
6	9		+		0	9
		9	+	0		
7	3		+		0	3
		3	+	0		
Totals	80		+		20	100
		87	+	13		

These proportions will vary in individual areas. For example Area D which is designed for private ownership will have a greater number of larger dwelling types and houses than the average, while Area B will have more flats and smaller dwelling types than normal. Adjustments in the overall provision can be made if family sizes prove to be materially different from the estimates.

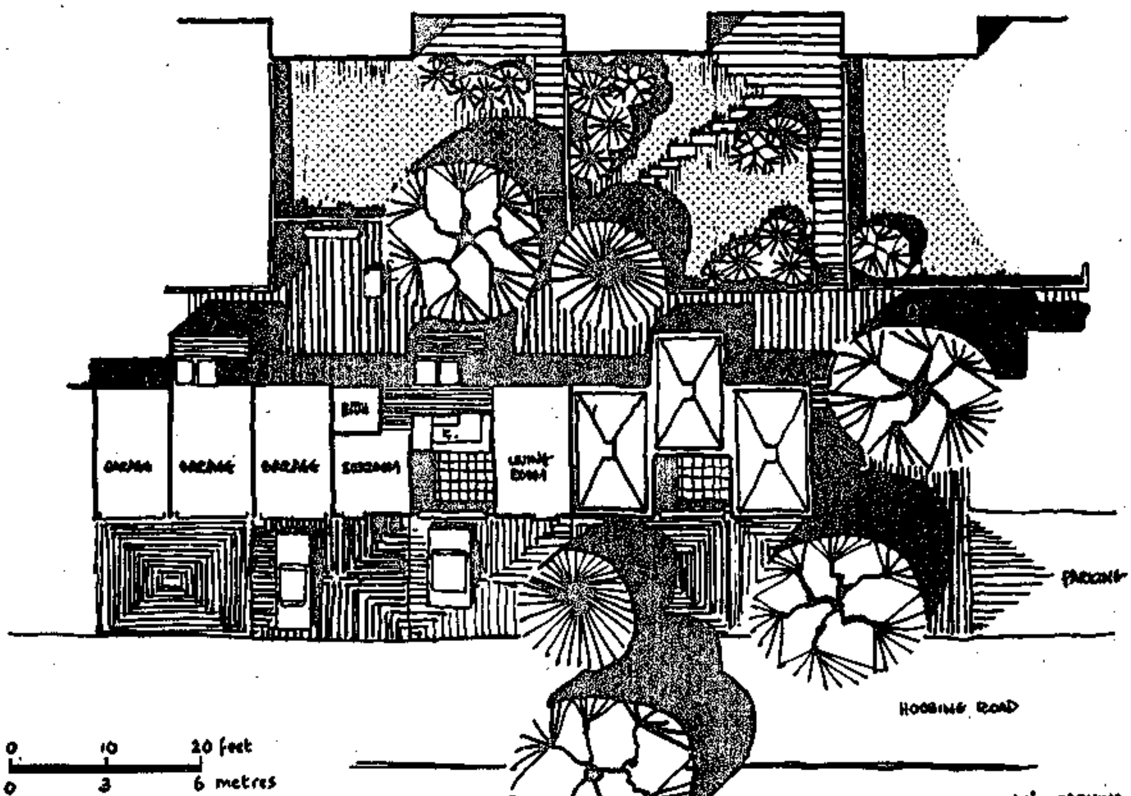


Single Aspect Split Level Housing – overlooking communal open space – (Views to Firth) – suitable for steep slopes

HOUSE TYPE 5.15



Single Storey Courtyard Housing (private development)



Single Aspect Flats over Garaging
(Views to Firth) – suitable for steep slopes

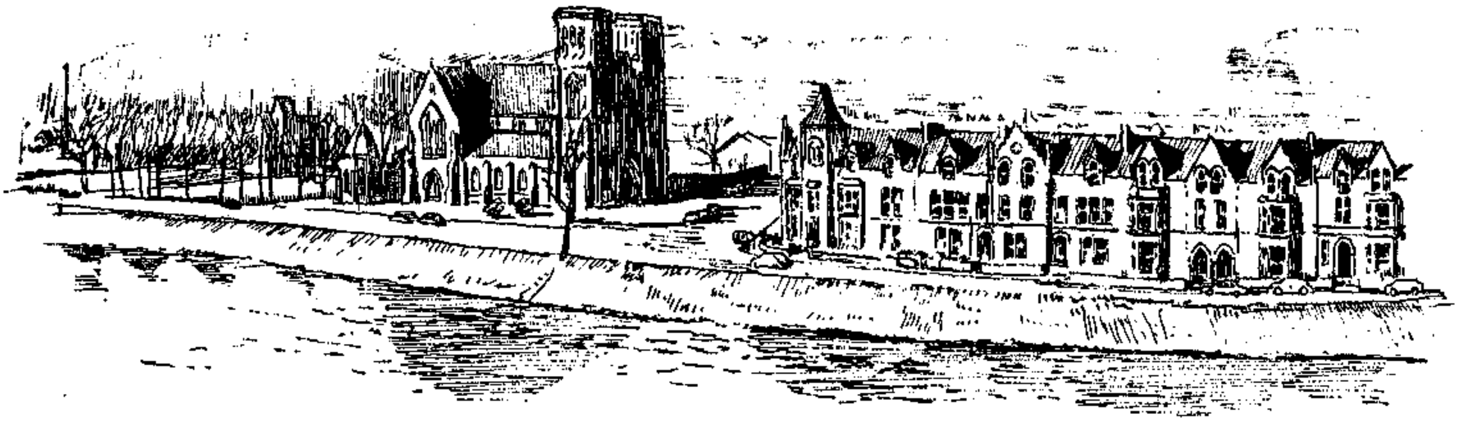
HOUSE TYPES 5.16

PART SIX

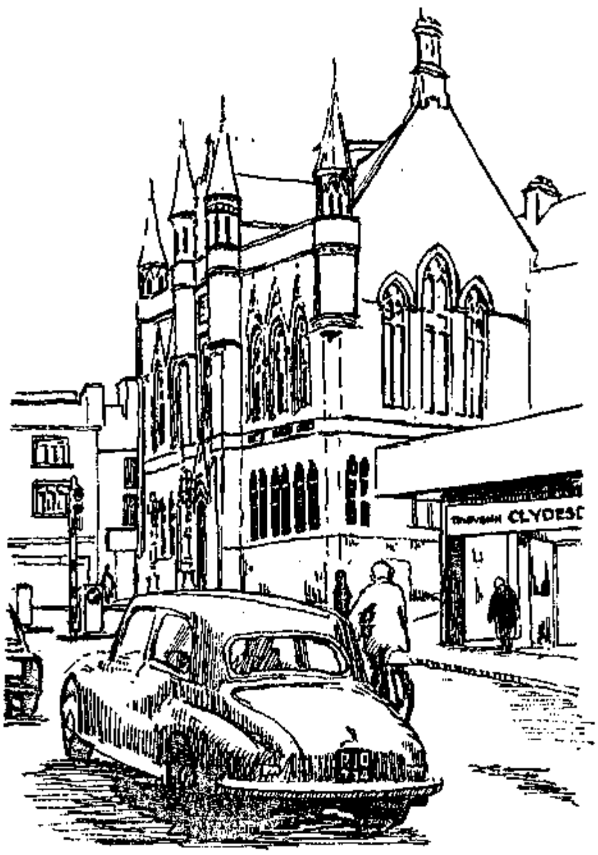
SUPPORTING STUDIES

SUPPORTING STUDY.

INVERNESS: Its role in the Strategy.



Cathedral and Ardross Terrace
View from Castle Gardens



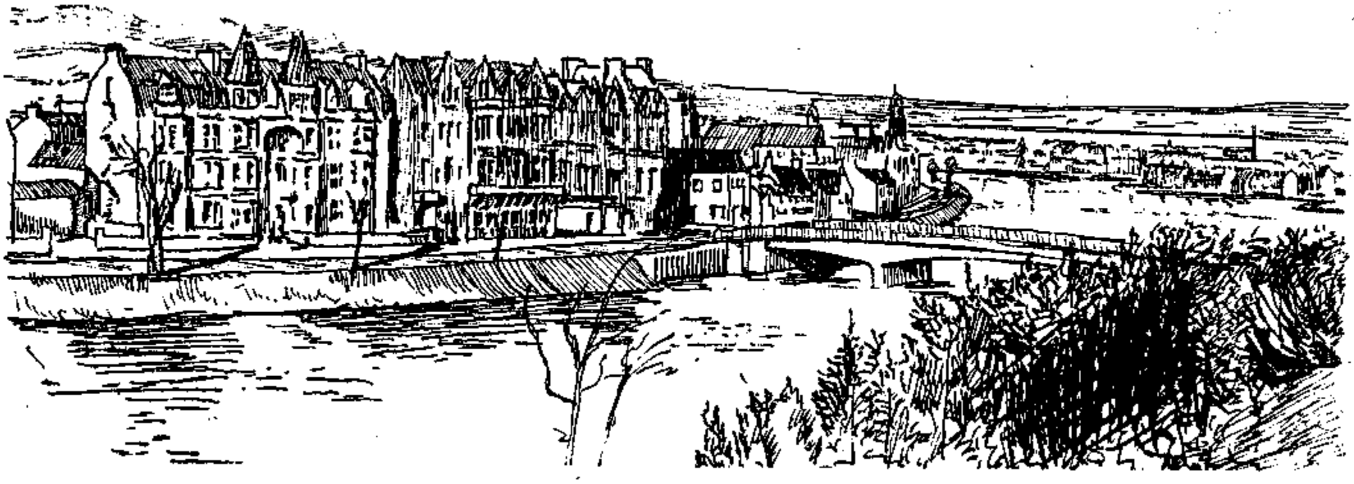
Town House and Castle Wynd
from High Street

INVERNESS

"gateway" to the Moray Firth, which implies that its various transportation facilities must be properly integrated for it to become an efficient transportation interchange. It is important not only that people within the region should be accessible to Inverness, but also that Inverness should be accessible to neighbouring regional capitals. Thirdly, our strategy has assumed that Inverness will accommodate the firms, establishments and institutions which will be required as and when industrial development creates population growth. Many, if not all, of these functions will require a location in the central area of Inverness. All of these roles are, of course, very closely inter-related; it is clear that unless Inverness has the transportation facilities required it cannot function as a capital, and this will not provide a viable location for regional services, so there will in turn, be little need for a substantial population growth.

Our planning studies have been in the nature of reconnaissances made to ensure that it was realistic to expect Inverness to perform these three roles in our strategy. There is an immense amount of detailed planning work required to bring our preliminary studies to the point where implementation can begin.

The proposed pattern of residential expansion is described in Part Three where the important point is made that in order to avoid an insoluble problem of central area congestion (with high car ownership levels in the future) it is necessary to limit peripheral expansion. As the Buchanan Report and other studies have shown, a population beyond 60,000 - 70,000 is extremely



The River Ness, Beauly Firth
and the Black Isle

Shops and offices, on
Baron Taylor's Street
Central Inverness

INVERNESS

difficult to cater for in terms of parking and access to the central area. It is largely for this reason that we show a possible development at Balloch (and the 'Tore Option' can also be regarded in this way) as an alternative to further peripheral expansion of Inverness. The detailed planning of the expansion of Inverness will have to include a careful study of the appropriate level of local shopping and service provision. The right balance must be struck between competing unnecessarily with the central area, and choking it with trade and traffic created by the absence of sufficient local shopping and service provision in the peripheral residential areas.

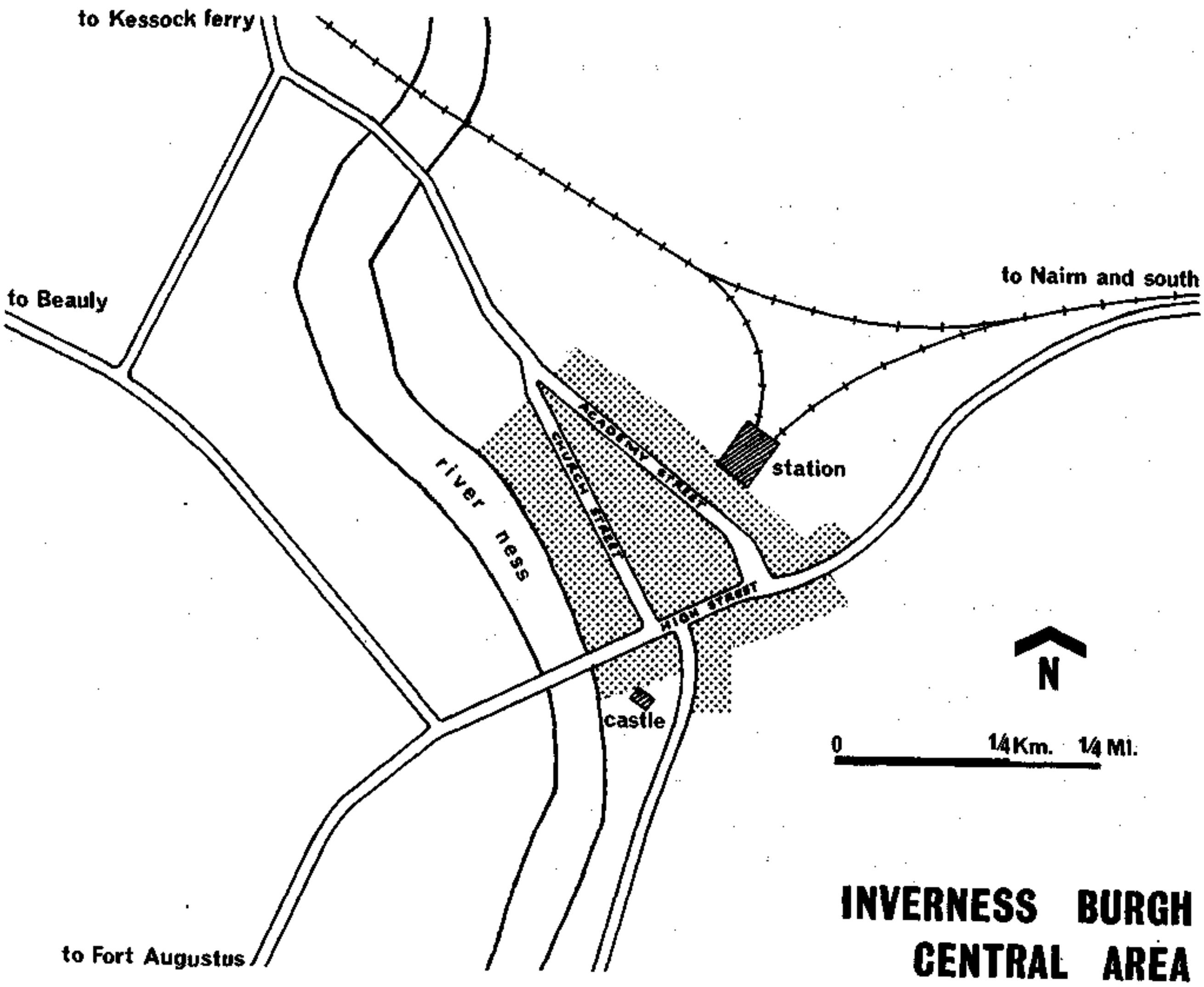
The traffic studies of Messrs. Jamieson and Mackay, currently being undertaken for the Burgh, have made it possible to assert that the major road facilities that would be required can be provided. A further important study should be made of the best way to obtain efficient and convenient interchange arrangements between the different long and short distance road, rail, and air services. This is primarily a question of access to the central area and the location of the termini, such as the railway station, long-distance 'bus station, air terminal, and car parks within the central area.

It is in the size and content of its central area that Inverness reveals its functions as an administrative capital and regional service and entertainments centre. Its administrative functions include a wide range of local and central government departments (e.g. offices of the County; Highlands and Islands Development

Board; Forestry Commission; Northern Regional Hospital Board; North of Scotland Milk Marketing Board; Department of Agriculture and Fisheries, Highland Area; etc.) together with a major hospital, technical college, and the regional offices of many nationally known commercial firms. Its commercial importance as a shopping centre is clearly shown in the following table derived from the 1961 Census of Distribution and Other Services, which compares it with four other similar sizes of town in Scotland.

Town & 1961 Pop.	All Retail Sales (£M)	Central £M.	Area Sales % of total.
Dumfries 27,300	7.7	5.7	74
Stirling 27,600	8.0	6.2	78
Inverness 29,800	7.9	5.5	70
Falkirk 38,000	9.5	5.6	59
Perth 41,200	11.1	7.8	70

In 1967, the Inverness central area (see diagram opposite page), contained almost 500,000 square feet of retail floor area, compared for example with 100,000 in Dingwall, and 15,000 in Alness. The Table on the following page shows the relationship of retail sales in 1961 to gross retail floor area in 1967.



INVERNESS BURGH CENTRAL AREA

Inverness Central Area.

	Sales 1961 £000's	Floor Area 1967 000's sq.ft.	Sales per sq.ft.
Food, Confectionery Tobacco and Newsagents	1807	104	17.4
Other retail	3676	362	10.2
Total retail	5483	466	11.8

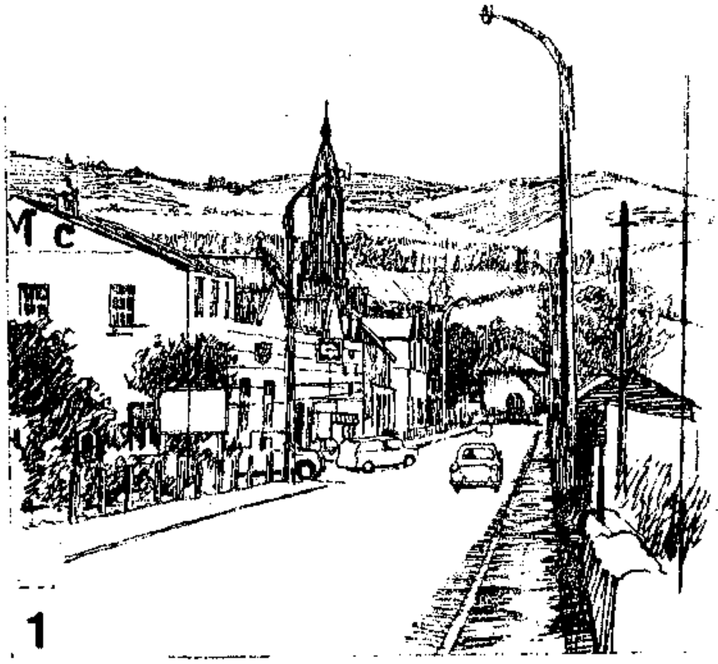
These figures of sales per square foot are slightly below average for existing town centres in Scotland, and are well below moden practice in new shopping centres. It is therefore clear that redevelopment would make possible a much larger volume of retail sales without any very significant increase in retail floor areas. It will, however, require a comprehensive study of purchasing power and retail outlets before a plan can be drawn up to ensure that local Inverness residents, regional shoppers and tourists' needs are all provided for in an efficient and convenient shopping hierarchy.

As has been pointed out, population growth in the Moray Firth area will increase the demand for land in Inverness central area. It is a difficult planning problem to ensure that such development takes place in a satisfactory manner and results in an attractive and efficient city centre. Particularly important among these demands will be increased provision for higher education. In our view a new university is likely to prove exceptionally difficult to obtain, but the alternative of a specialised 'Campus' attached to an existing Scottish University (Aberdeen is the obvious choice) seems quite feasible. It would be specialised, in the sense that the disciplines concerned would be directly relevant to the occupations, industries and interests of this part of the Scottish Highlands.

It cannot be stated too strongly that improvements in the accessibility of the central area, its partial redevelopment and expansion will become urgent problems once industrial development in the sub-region begins.

SUPPORTING STUDY.

DINGWALL: The future of an historic town.



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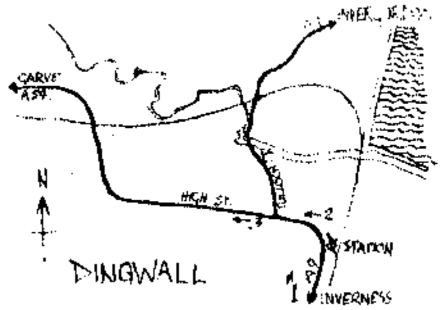

3

DINGWALL

Dingwall has a particularly difficult role to play in our strategy. This study indicates the main features which will have to be taken into account in implementing the modest expansion outlined in the strategy, if it is to be achieved without damage to the distinctive personality of the town.

Dingwall is the administrative capital of Ross-shire. Though few of its buildings are more than a hundred to a hundred and fifty years old it is a very old town indeed, and has strong historical associations with the fortunes of the Highlands. Some of the late 18th Century and 19th Century buildings though not always architecturally outstanding, have a vigorous and quite original quality in detail. Some of these buildings have been altered by modern shop fronts, but the quality and flavour of Dingwall as a rural market town and professional centre for the county, is evident not only in the buildings themselves but in the layout of the central area.

The task of the planner here is to allow the town to provide for the motor car and other 20th Century needs, without losing the quality and character of either the existing buildings or the groups they form, which are in Lewis Munford's words "time made visible", and to destroy them would be to destroy a part of our memory. The emphasis in this study, therefore, is on maintaining the special functions of Dingwall. If the town were allowed to grow so large that the central area would have to be remodelled to meet much greater commercial demands, its character

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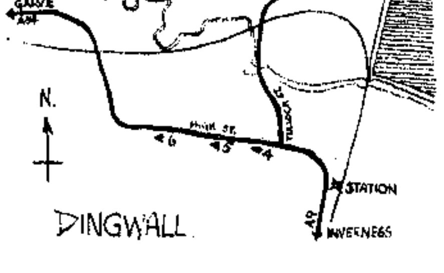


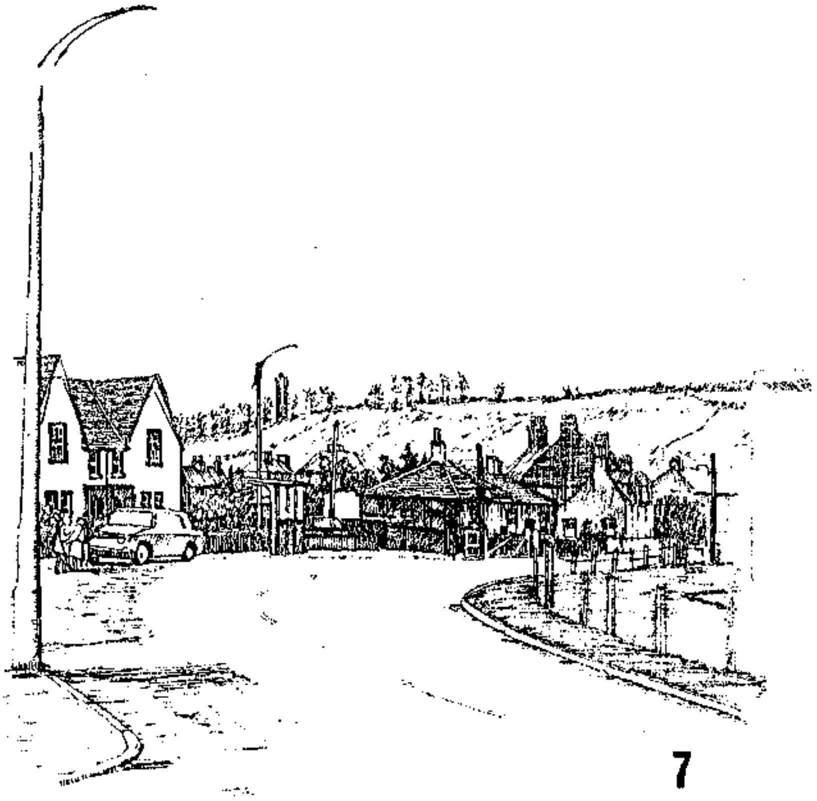
would be destroyed and the efficiency of its special functions impaired rather than improved.

We have had to ascertain the capacity of the town to continue its present function as an administrative, rural market and shopping centre when new centres of population and activity develop in the vicinity.

The town is conveniently placed to receive livestock and traders from the west as well as from the local farming community; and again, nothing seemed to be gained and much to be lost by changing the market town characteristics, although the need for and possibilities of expansion of the existing markets had to be examined.

The main shopping street is also the trunk road to the north and the main road to the west. It is congested by off-loading lorries, by shoppers' parked cars, and, particularly in summer, by through traffic; and as the pavements in the High Street are narrow, shopping is hazardous. The land behind the shops, as commonly happens in old towns, is taken up with other non-intensive uses.

Before Dingwall's position in the shopping hierarchy could be decided, it was therefore necessary to find out whether or not the shopping situation could be improved, firstly by drawing off the through traffic, secondly by providing off-street parking and rear servicing, and thirdly by an actual increase in shopping floor space. A condition of these improvements was that the appearance and scale of the street frontages, should be preserved and if possible enhanced.



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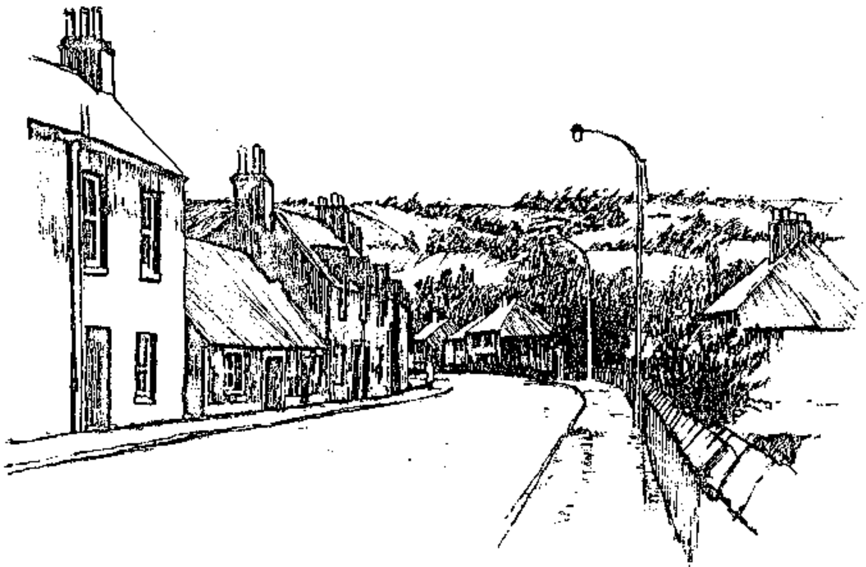
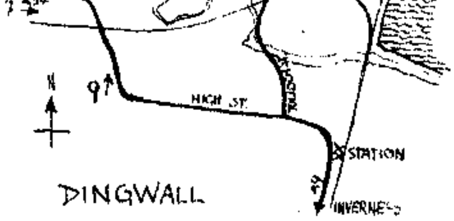



INVERGORDON
A9
GARVE
N
9
HIGH ST.
STATION
DINGWALL
INVERNESS

9

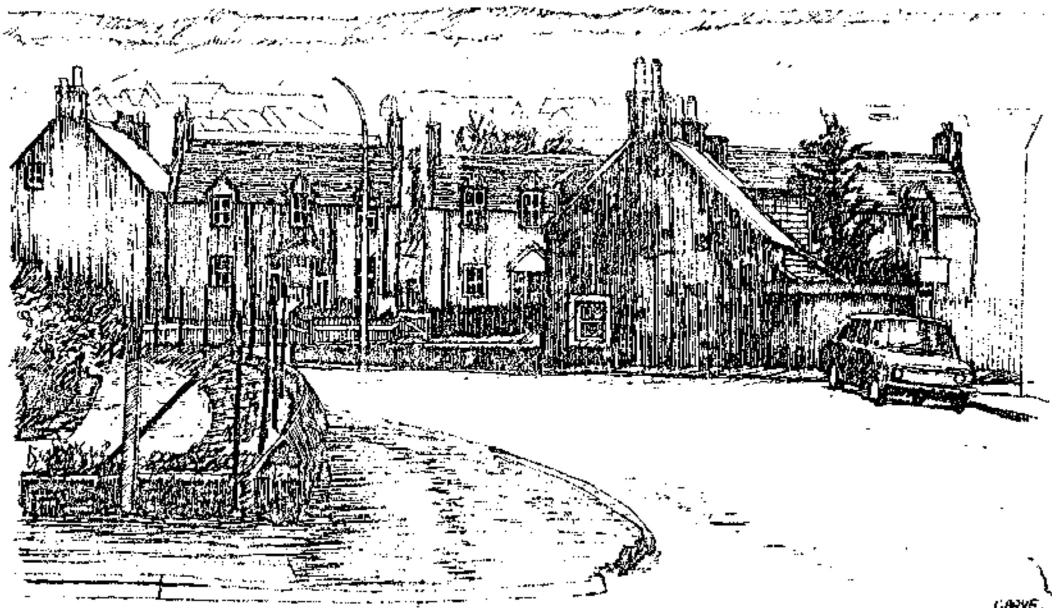
The study showed that it was possible to provide for both town traffic and the through traffic, and at the same time establish parking areas closely related to the shopping, administrative and market centre; and servicing to nearly all shops could be carried out from the rear. Figures showing the shopping floor areas were obtained from the County Assessor. These serve to confirm Dingwall's importance in the area, since there is 99,000 sq. ft. of shopping space. A separate and detailed study will be necessary to assess the floor area needs of Dingwall in its expanded role; and we have assumed for the purpose of our study that the central area will be expanded slightly.

It is particularly important that any development at Brahan should include its own shopping provision from the start, in order to avoid excessive pressure in Dingwall town centre.

The Survey and Reconnaissance.

Three scales of study were undertaken for Dingwall, the first to assess the potential for expansion, the second to examine the existing town, and the third a more detailed examination of the town centre.

The survey material and notes reproduced on the following pages are not part of a finished study but illustrate the approach we used.



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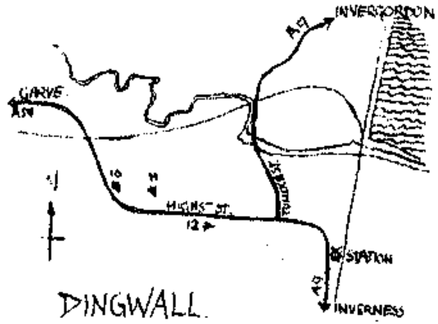

INVERGORDON
A9
GARVE
HIGH ST.
STATION
A9
INVERNESS
DINGWALL

11

12

<u>Conclusion</u>. (See sketch Structure Plan)

The conclusions of this exercise in terms of the sub-regional study were that Dingwall would expand by 3,000 people, and continue to function as an administrative, professional and market centre; and that if the necessary steps were taken, the shopping centre could be improved and somewhat expanded in keeping with these functions, and to cater for the increased population in the vicinity.

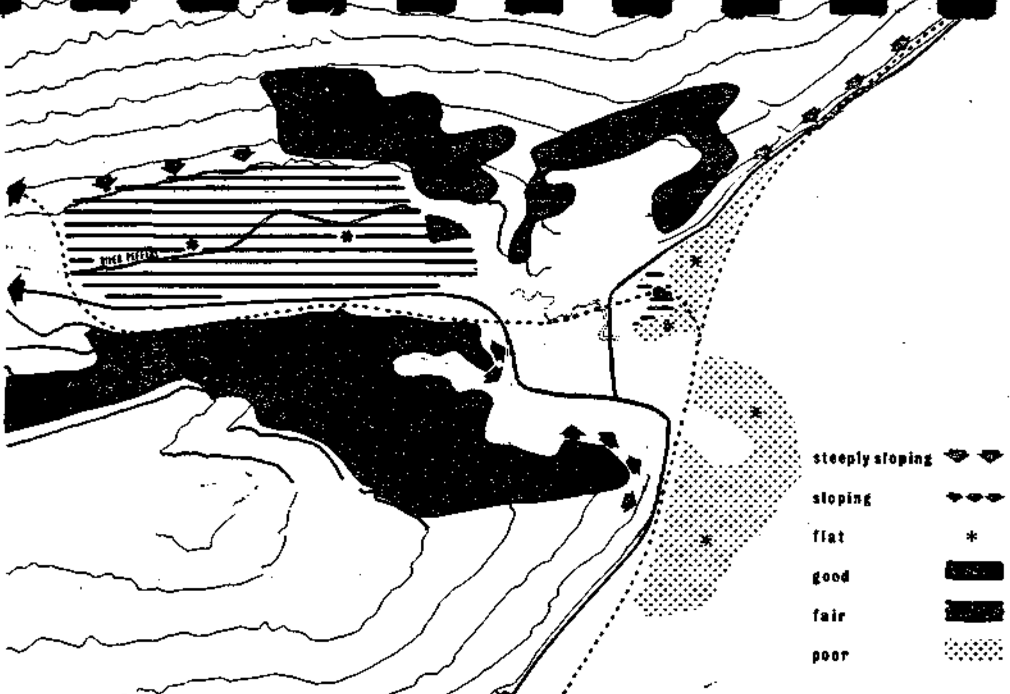
At present there are plans to build a further education centre at Dingwall to cater for vocational training such as building trades, handwork, etc. With development of industry in the Cromarty Firth there will be a demand for a much wider range of training and educational facilities which we consider should be sited in Dingwall, since they would be complementary to its role as a "specialised" centre.

Because the older parts of the central area are interesting in character and of some architectural quality, the detailed planning to achieve improvements will need particular care. The suggested trunk road bypass shown on the plan would, however, give some immediate relief to congestion in the centre, particularly from summer traffic, and rear servicing and parking could be obtained as and when the opportunity arose, until it became feasible to give over the main shopping parade to pedestrians.

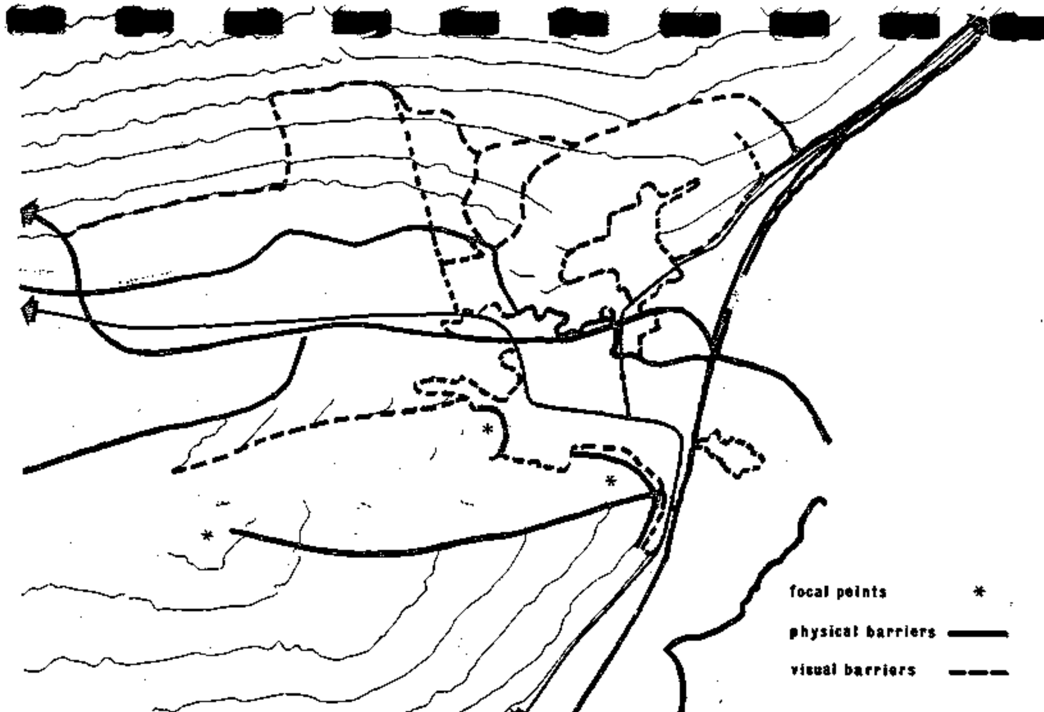
With a general increase of activity and prosperity in the Highlands which the realisation of the Board's plans should bring, the administrative role of Dingwall would tend to attract the professional classes. In time this should lead to growth in the range and diversity of cultural as well as recreational activities, and help to retain the individuality of the town.

The capacity study showed that the town could increase its population from 4,000 to 7,000 without destroying its character, and the sense of enclosure that Dingwall has at the moment. To allow a limited central area growth to take place in an existing town of character there are necessarily some compromises with the ideal layout which might be achieved in completely new development; but the basic requirements are not different in principle, and the aim in each case should be to provide safety, comfort, shelter and the framework for prosperity.

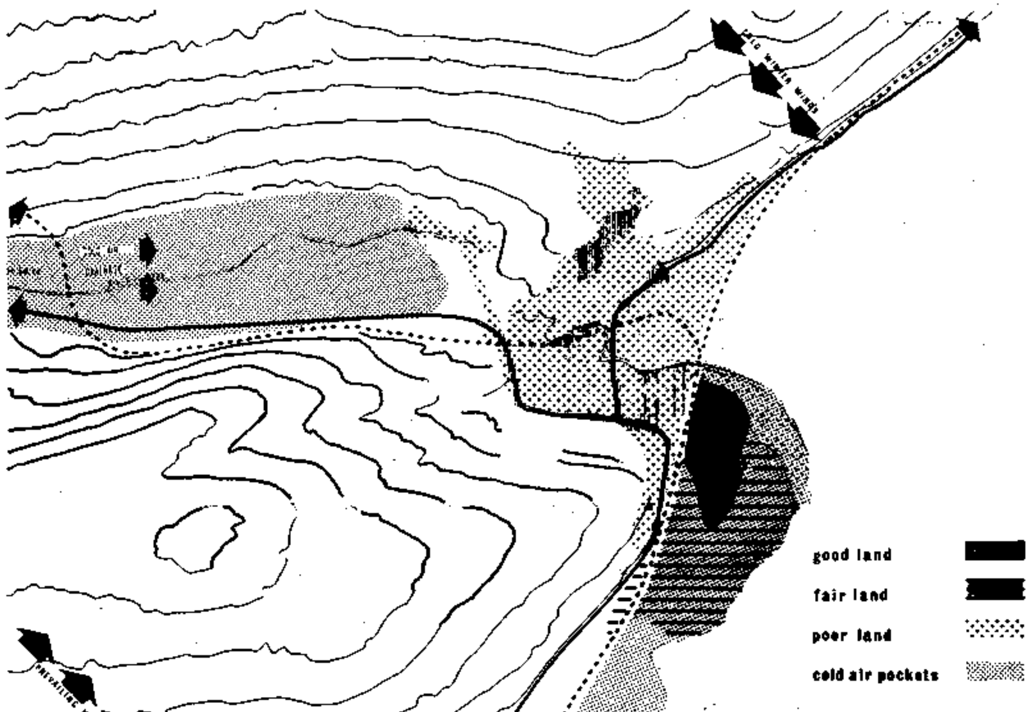
(Some notes from the reduced Survey drawings are reproduced in type script opposite the Settlement Containment Map).



1 gradients · drainage



3 barriers



2 agriculture · climate

roads

railways

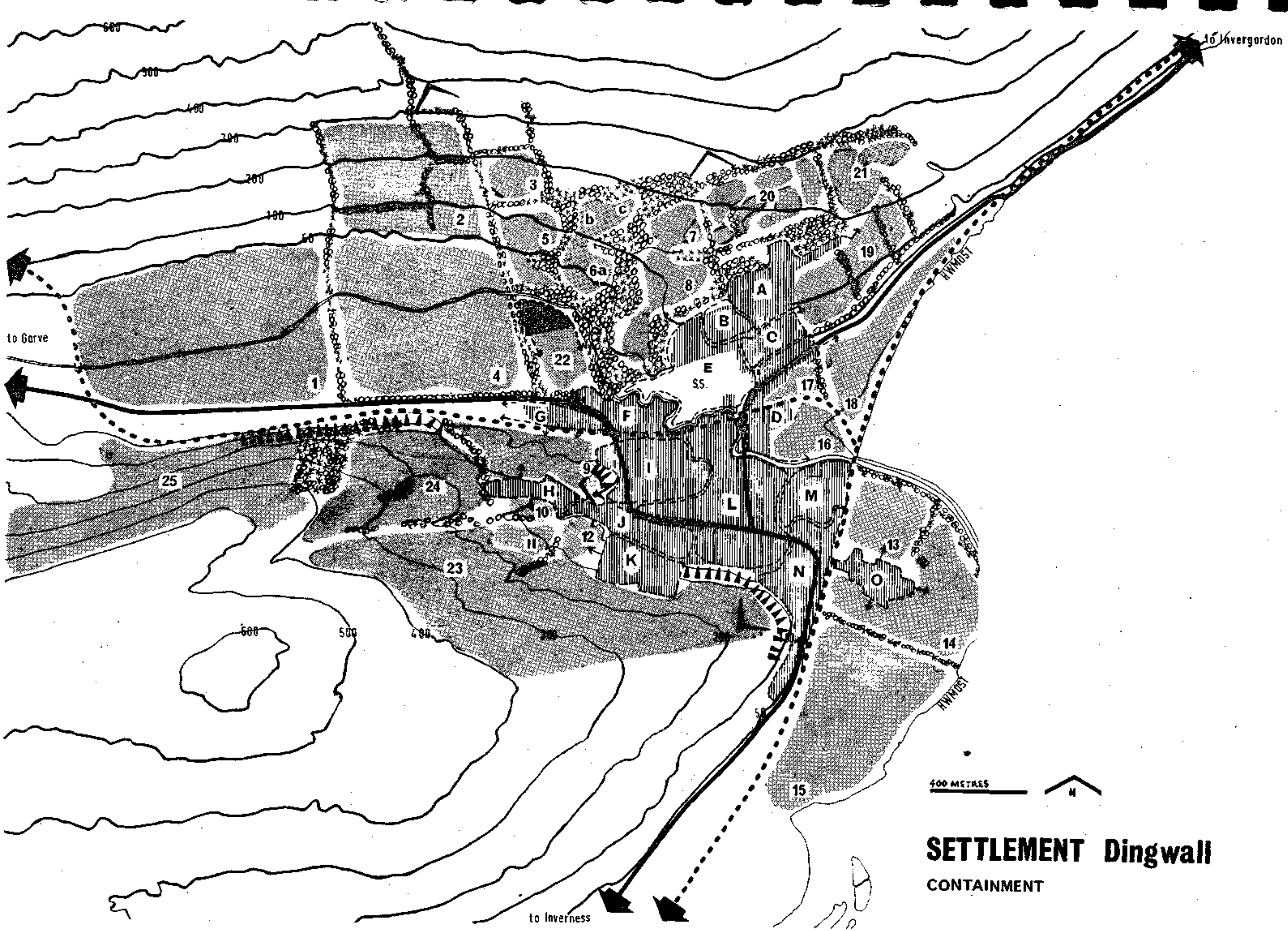
existing development

contours (100' interval)

SETTLEMENT Dingwall
Land · physical analysis

Survey Reconnaissance Notes for containment and suitability Maps.

Areas.	1 and 4	Flat land with local undulations, contained by railway on embankment at west end. Good agricultural land; with some drainage difficulties. Suitable for building, but would depend for interest on the layout.
	2.	South aspect, good views to firth, poorer agricultural land than 1 and 4 - sheltered from winter winds, but steep in places, good drainage, mature trees. Suitable, but could be expensive to develop because of underbuilding.
	6 a,b,c.	a) 2 terraces, steep slopes between, south aspect, sheltered by mature trees, well drained, views into industrial estate. Well-treed, gulley between 5 and 6a. Used for grazing.
		b) as above, but flatter, fallow at present.
		c) Undulating land, well contained by trees, but no views. Separated from (b) by a slight ridge running north-south.
	7 and 8	Southerly aspect, well contained by good trees; gentle slope but seems well drained. Sheltered. Now used for grazing. Suitable for low density development.
	9.	North-east aspect, steep slopes at south-west corner. Visible from within and round the town. Good views, although south-west knoll forms a barrier. Railway forms northern boundary. Electricity pylons may be problem.
	10.	Small area suitable for infilling to round off existing development.
	11.	Very steep; should be left open to set off development on lower slopes.
	12.	Fairly steep, north-east aspect, well drained. Used for grazing. If developed, could link with existing areas.
	13.	Flat, contained by tree belts and railway to north and east, and existing development to south. Used as caravan camping site, could be improved by treatment of canal, and drainage high water table (see drainage map.)
	14 and 15	As 13 above, used for grazing, somewhat contained by trees and hedgerow. Drainage problems - not suitable for development.
	16.	Tipping area. Could possibly be developed when filled.
	17.	Flat land, recently grazed. Seems better drained than 18. Railway would be barrier to development.
	18.	Flat, badly drained, adjoining tip. Cut off from adjoining areas by railway and road. Unsuitable for development.



SETTLEMENT Dingwall

CONTAINMENT

Areas 19. Southerly aspect, fairly steep, and very steep at east end. Well drained, good views. Arable land, western end more suitable for development. Could be tied to existing Area A.

20. Very good aspect and views, ground undulating, quite steep in places. Mature trees, very suitable for development.

21. As for 20 but less undulating. Good tree belt along north and west boundaries.

22. Flat land, contained by tree belts to south and east. Zoned for industry, and suitable for this use.

23, 24, and 25. These areas have the following limitations:

(a) north facing exposed slopes with poor aspect,

(b) no natural boundaries to contain development.

(c) the steep slopes would make road access difficult and increase costs.

Reconnaissance of existing development.

Area A. Southerly aspect, sloping slightly to south-east and steeper towards south.

B. Sloping to embankment at west and south. Southerly aspect. Good mature trees of Tulloch Castle estate to north.

C. Southerly aspect, gentle slope to south-east.

D. Flat land, contained by railway, canal and sloping ground.

E. Two terraces, southerly aspect. Contained by trees north and west, by railway to south.

F. Low lying and flat, contained by treeplanting, and shoulder of hill to north-east. Open at west end.

G. Flat land, contained by Gallows Hill, and ridge to line of trees and railway.

H. Sloping from west to east, well contained. Aspect easterly.

I. Slight mound, with ground falling towards river.

J. Slightly sloping towards High Street. North-easterly aspect.

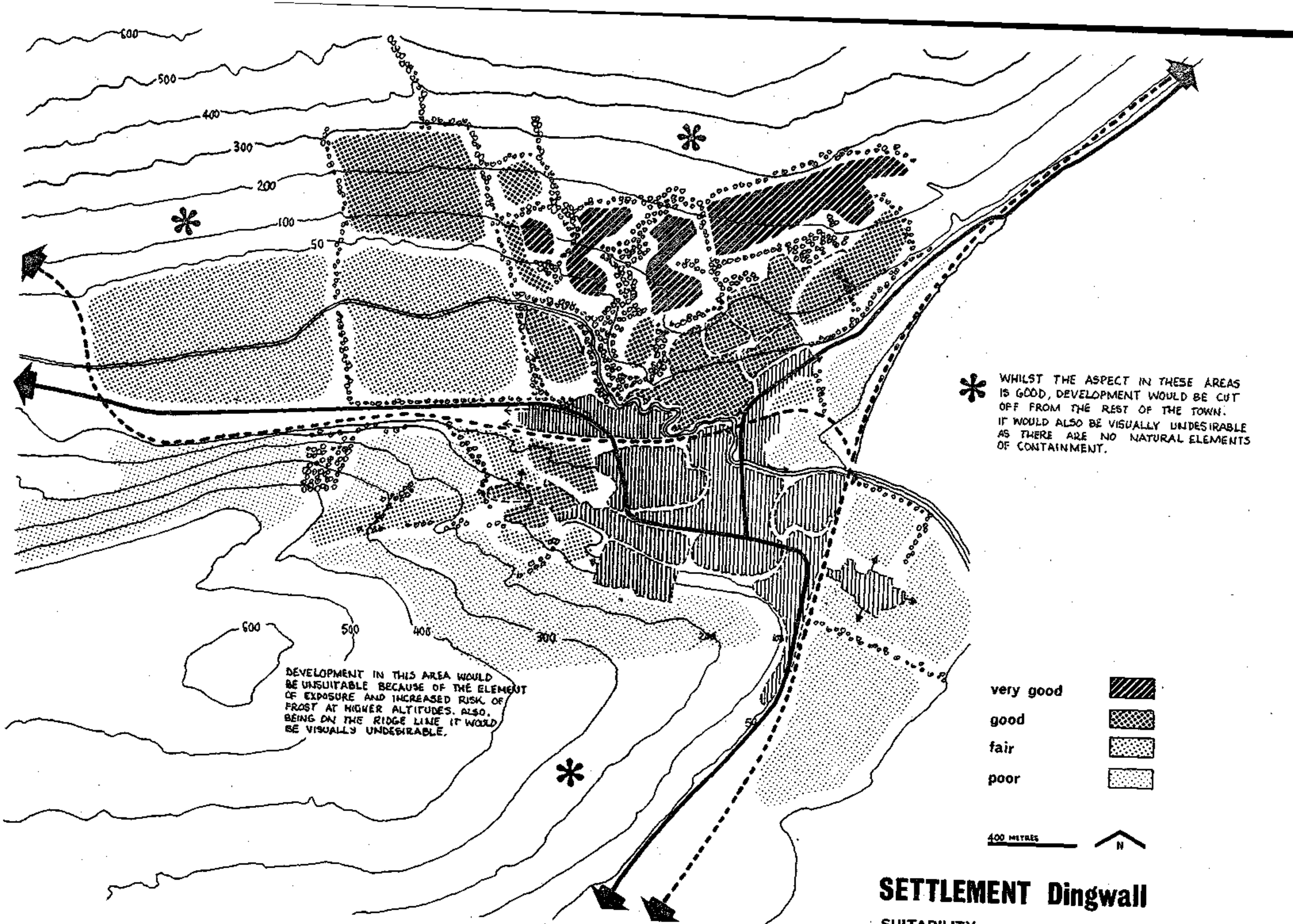
K. North aspect, good views, steep slopes.

L. Flat land, contained by river to north, trees to east.

M. Flat land, trees within the area.

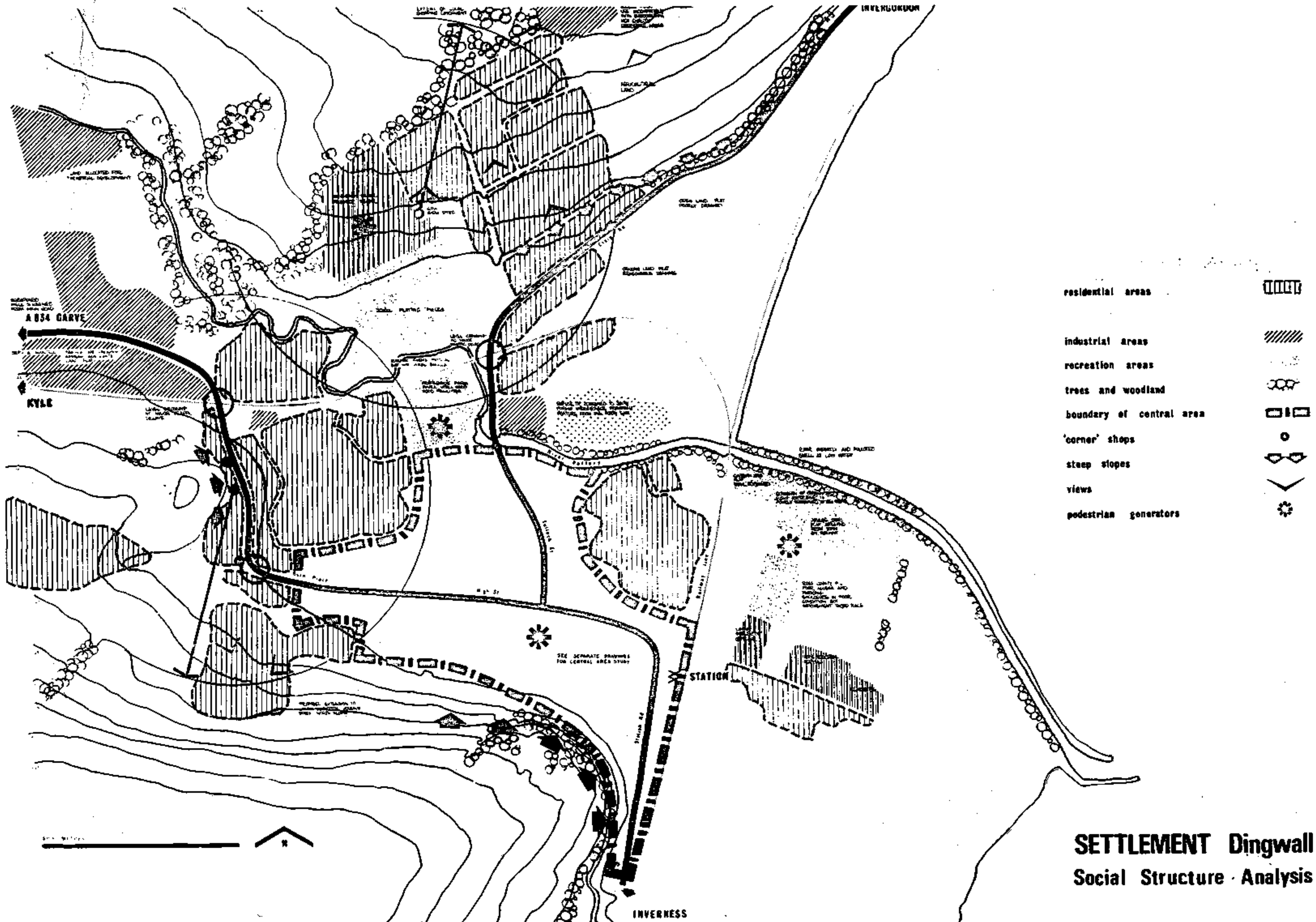
N. Flat land contained by hill to west, railway and embankment to east.

O. Flat land, contained by trees to north east, east and south.

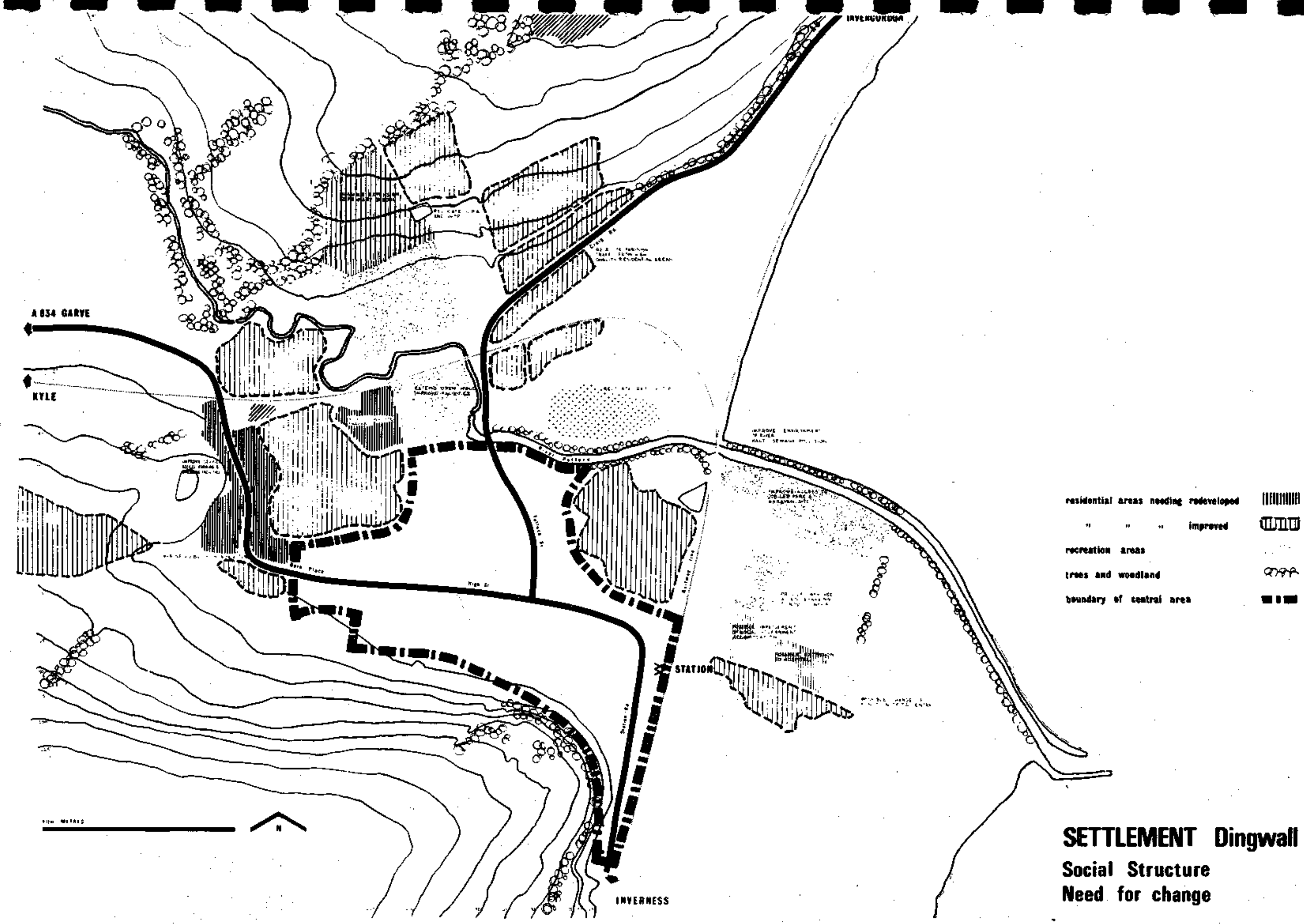


SETTLEMENT Dingwall

SUITABILITY

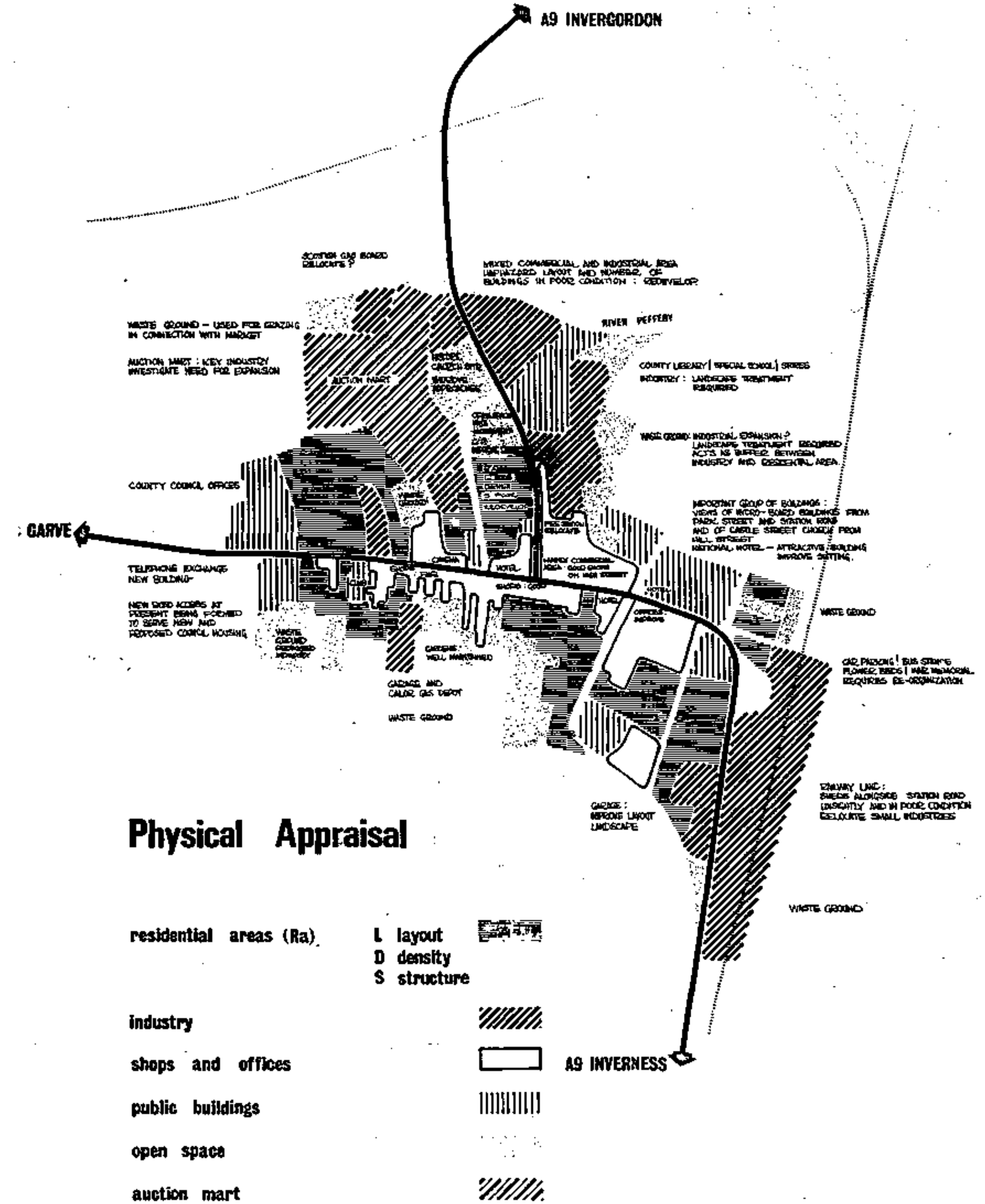


SETTLEMENT Dingwall
Social Structure · Analysis

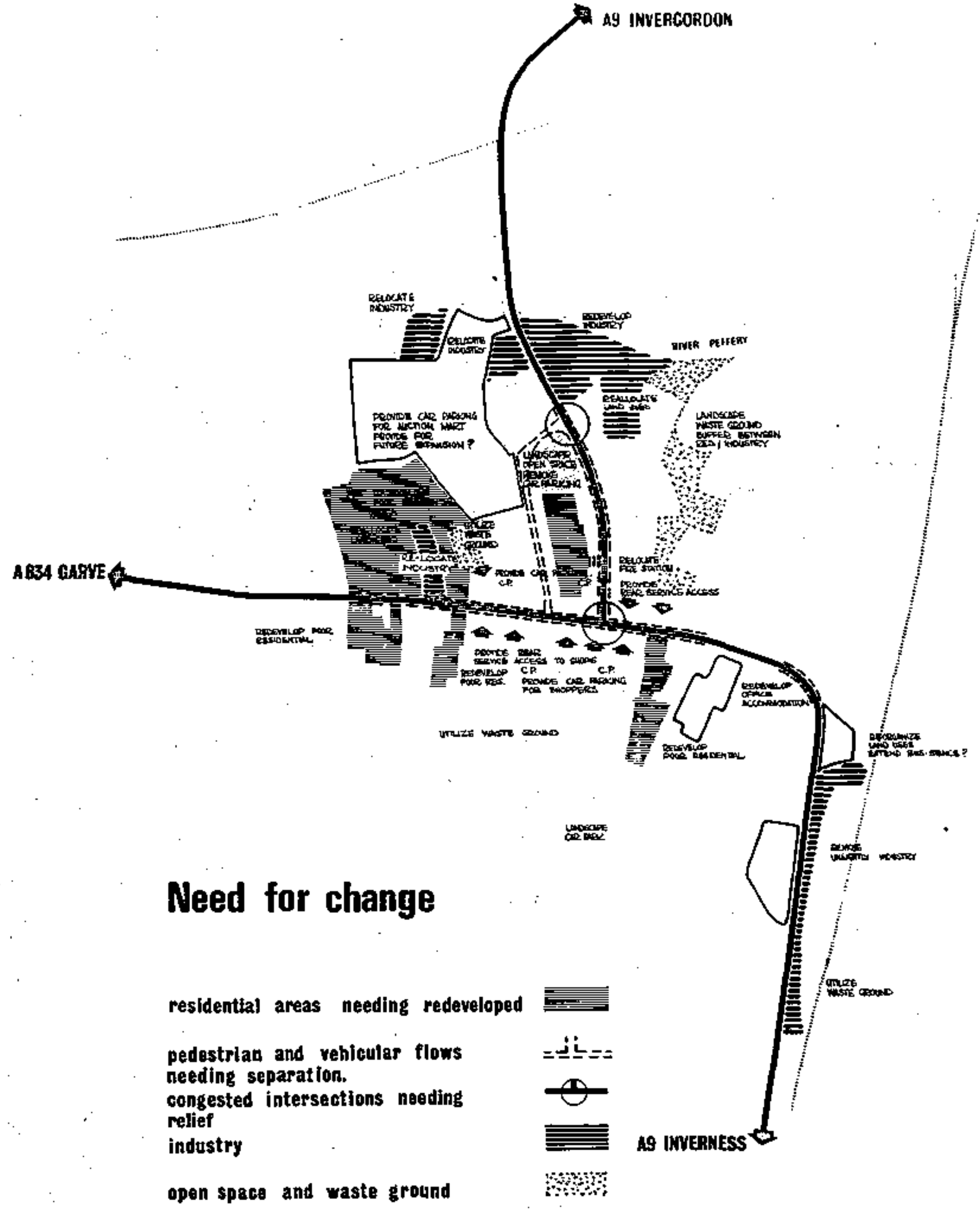


SETTLEMENT Dingwall

Social Structure
Need for change



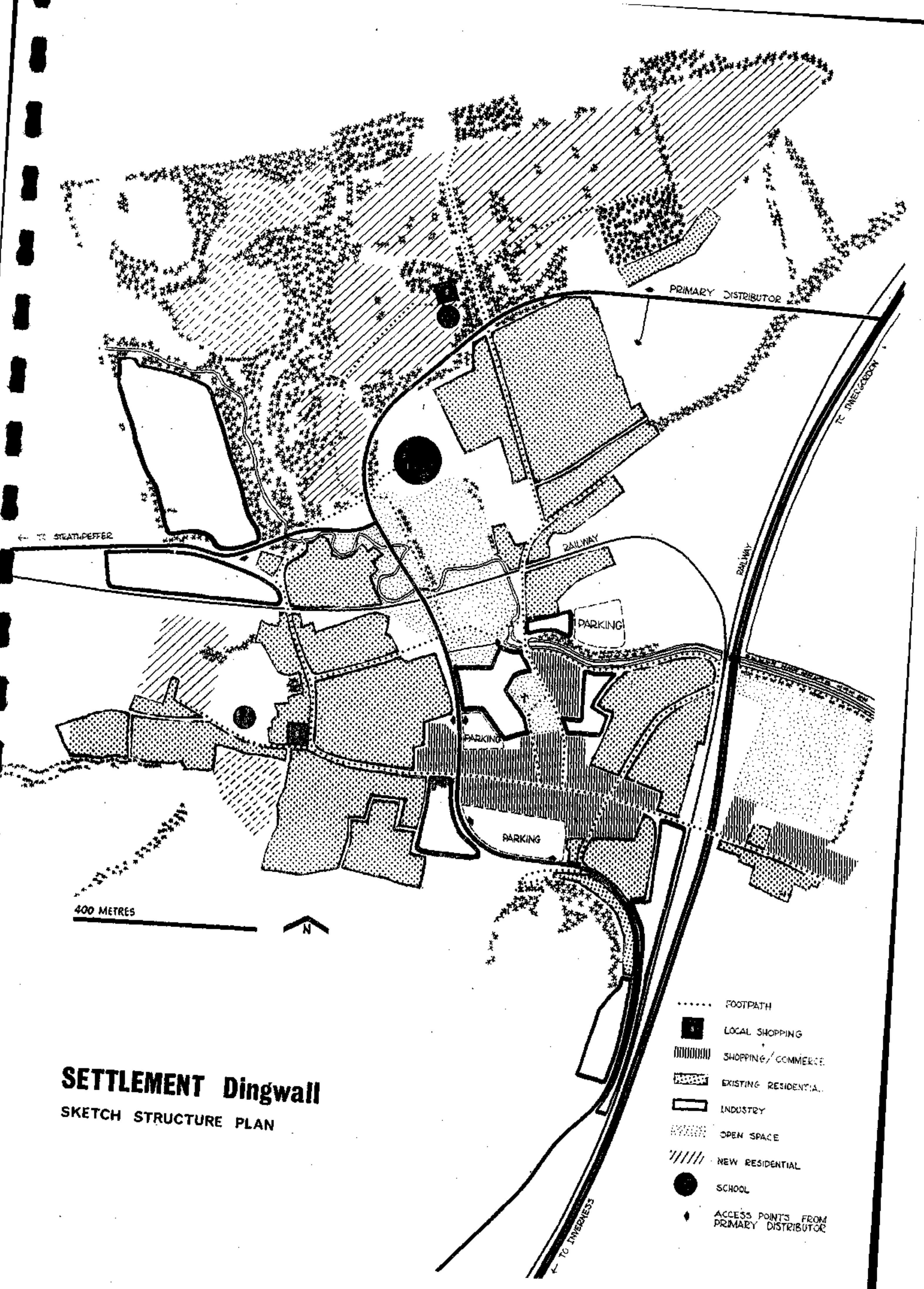
Physical Appraisal



Need for change

SETTLEMENT · Dingwall

Social Structure/Central Area



SETTLEMENT Dingwall

SKETCH STRUCTURE PLAN

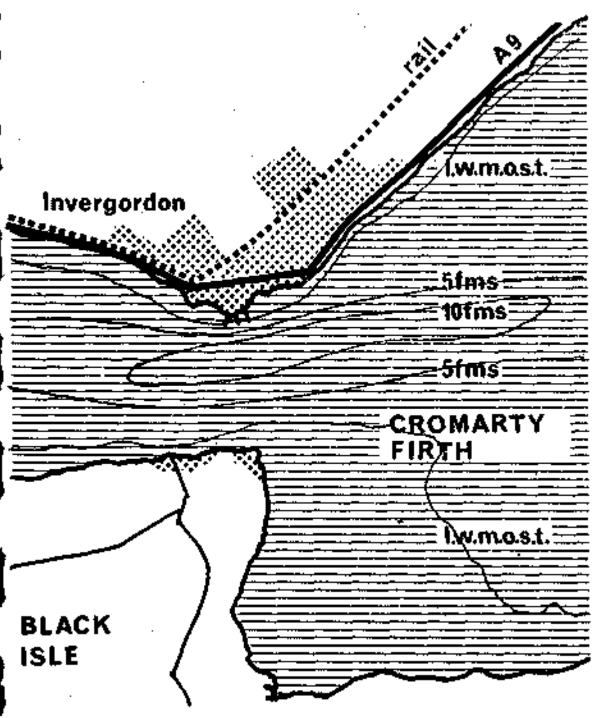
SUPPORTING STUDY.

INVERGORDON: consequences of industrial proposals.

INVERGORDON.

Few, if any, sites now remain in the United Kingdom offering suitable physical conditions and services for major industrial complexes such as aluminium smelting or the petro-chemical industry. These are large consumers of power and water, as well as land, whose raw material has to be imported. They can be offered extensive sites of suitable flat land for development at Invergordon, well placed for railhead, deep water port and road transport.

Invergordon has therefore become very attractive to industrialists, for although the nearest markets in the United Kingdom are at some distance, it is well placed for exporting by sea to Europe and further afield. Consequently the town is now a focus of lively attention and strong emotion both locally and nationally. This interest is likely to generate pressures which may make it more difficult to ensure that the land and the choice of development possibilities are safeguarded for those industries whose special needs can only be met here since land suitable for an industrial complex could also be suitable for other more foot-loose industries. Because the attraction of Invergordon is due to the scarcity value of the combined facilities it offers, it is essential that these other industries who might apply to come to Invergordon, but are not directly linked to the complex, should be encouraged to go to alternative sites in the area.



It is fortunate that another of Invergordon's industrial assets is that the air currents of the region will cause maximum dispersal of any pollution at this point, (see Appendix 3 by Dr. Caborn which states "the site at Invergordon is topographically very suitable for dispersal of pollutants and for achieving the maximum abatement of the nuisance".)

At the time of writing the decision by a particular industry to come to Invergordon has not yet been made, and it is not therefore possible to make reliable predictions about the physical pattern which would best meet its special requirements; but these would no doubt include provision for handling raw materials and finished products, for power consumption, processing by-products, internal and external transportation systems, waste treatment and the use and subsequent disposal of large quantities of water as well as reservations for further expansion. The scale of demand will clearly vary from one industry to another.

Sharing of Investment. There are obvious benefits to be gained from a multiple use of servicing facilities, such as docks, sidings, and service roads. It is therefore desirable that a second major industry with similar physical requirements, should follow as soon as possible on the first. This could also insure that fullest use was made of the services and of the power source.

The kind of requirements which are known are the use of a deep water harbour, ample water and power supplies and good external transportation networks, since these are the reasons for locating industry at Invergordon. As far as possible preparations should be made in advance to bring the capacity of these services up to the level which the industries would be likely to need, and it is essential to safeguard a wide range of choice in their use. This makes the task of the Burgh Council difficult in the meantime, since it would be wise, with so many factors still unknown to delay all but the most minor developments in the Burgh, so as to keep the maximum number of options open. There is clearly no time limit for such restraint since Alness provides a wholly satisfactory site for any residential development that may be required. At present the value of adaptibility in Invergordon cannot be stressed too strongly.

Seafront Invergordon

In return for this restraint it seems likely that Invergordon will gain in the longer term, as a centre for the wide range of servicing activities associated both with the industry itself and generated by a major road, rail and port terminal.

Invergordon

Employment. The number of industrial jobs per acre which is generated by capital-intensive industries is comparatively small. It might start as low as three jobs per acre, while the industry is building up because it is usual to reserve large areas for later expansion, and cannot be expected to exceed 10 per acre when it is fully developed. This type of plant is run on a shift working basis, and the design of the roads serving Invergordon is based on this assumption. The service industries associated with maintenance and transportation will also produce employment in Invergordon.

<u>Implementation</u>. It is generally true that once a decision to build is taken, however lengthy the process leading up to it, the desire to see the project built is immediately very strong. This may be for good economic reasons, but in building works of the scale envisaged at Invergordon a sense of urgency must be coupled with good forward planning to ensure a smooth working programme.

It has already been said that new communities should keep pace with or precede the arrival of the industries. This parallel building programme will mean that Invergordon and its surroundings will be the focus of intensive building activity, probably over a number of years.

Given a very well integrated plan of action, many economies of plant and material could be derived from the scale of the project, but on the other hand chaos and congestion could ensue from a piecemeal development, particularly in the use of existing roads and services. Very close collaboration between all levels of local and central government and the industrialists will be essential. An overall building strategy administered by a supervising body with authority will be needed, served by experienced personnel who can carry the strategy through, cope with the inevitable crises in the field and keep up the necessary pace.

<u>Construction</u>. The construction labour force needed initially might amount to 2,000; over a short period this figure could double as the house building programme at Alness got under way

and as other industrial projects started. The impact of a temporary camp for this number of workers on Invergordon and its surroundings would be considerable. It would involve a large capital cost, most of which would have to be written off since very little is recoverable when camps of this sort are demolished. It might be possible to site the camp so that the services provided fit later into the general programme of development.

As an alternative to a camp on the ground with its inherent wastage, some investigation has been made into the advantages of using a large ship or ships to house the labour force. Taking advantage of the deep water harbour, a large ship could give a higher standard of accommodation than most labour camps provide, with a more favourable impact on the existing township, and avoiding the problems of extensive temporary works and services and the resulting problems of reinstatement. The ship would retain at least its scrap value or could be used for other projects. The use of the ship would of course depend on availability, but during the last year several were available for sale including the Queen Mary, as well as others which might have been negotiated for on rental terms. The comparative costs appear on a preliminary investigation to favour using a ship, and it seems desirable to discuss this alternative with possible developers and their contractors.

These notes on Invergordon indicate that the salient factors in any structural plan for the burgh cannot be quantified or brought to a conclusion until the basic decisions about the arrival of industry are made. The general strategy for the Moray Firth is intended among other things to give a breathing space for this to be done. Until the structure plan is complete no development should take place in the burgh or its vicinity in case it were subsequently to prove to be an obstacle to industrial development.

The outstanding items of information which must be available before making a structure plan are:

1. The type of industry. The expectation that the industry will consist of major plants with ancillaries in a linked complex makes it essential to know in detail the physical requirements before designating a site.

2. The sequence of industrial development.

3. The scale of the likely industrial development in general terms and the physical requirements of associated infrastructure (port, railway facilities, industrial waste disposal etc.).

A significant fact about the aluminium smelter development at Ordal in Norway is the near impossibility of bringing any companion industries to this very restricted fjord location. This has meant that after the dramatic growth of population from 700 to 7,000 has been achieved there is now restricted employment opportunity in the area for the children of the first generation of employees. The hindsight we now have of some of the harmful or restrictive effects of major industries in rural settings as at Fort William or Thurso or Ordal can, with great advantage become foresight at Invergordon.

SUPPORTING STUDY.

IMPLEMENTATION: the implications of fast growth.

CONTENTS

IMPLEMENTATION - the implications of fast growth.

The Moray Firth strategy is not tied to a particular approach to building construction, since the appropriate buildings technique depends on the rate of development required. In a region of this kind large scale rapid growth is an entirely new situation for which past experience is a poor guide. The paragraphs below describe the attitudes which help to make a fast rate of growth possible. Some of the problems are discussed independently at greater length by I. Buchanan and C. Allan in their report given in Appendix 2.

An estimated total population of about a quarter of a million by the year 2000 A.D. would require an average rate of housebuilding of about 1700 - 2000 per annum. Such a pace would not be likely to be achieved during the first few years, but would rise from about 700 houses per annum. It would be essential for all other forms of development, social and commercial, to keep pace with this.

HOUSE BUILDING. Three essential conditions must be met to achieve a fast rate of house building. The description of the method will be found in Appendix 5.

1. All services up to house connections and all site preparation, including hard and soft landscaping to be completed before any houses are erected.

2. House erection to consist of assembling a fully-finished kit of parts with no damage or dirt caused on site.

3. Final connections from houses to drains, water pipes, etc. to be made with short flexible lengths to give the tolerances necessary in setting out.

The process can be broken down into separate sections each of which could be the subject of separate contracts for site servicing, house erection etc., but the programme should be under unified management either by the employing agency or by a consortium of general contractors acting through one general manager whose function would be to co-ordinate effort and avoid the duplication and waste which at present plagues the industry.

The magnitude and pace of the swiftest of the various programmes would be quite beyond the resources of craft methods of organisation, and it should be noted that the alternative of using systematic methods of component manufacture on this scale can give an opportunity for a breakthrough in the raising of standards of accommodation, design and finish. Previous attempts to achieve these aims elsewhere have been handicapped at the outset by limitations of scale and programme. If there is indeed no such limitation here it will not be necessary to accept the standard house types which are generally designed to meet manufacturers' sales commitments in all parts of the country. On the contrary, a firm rolling programme will enable a manufacturer to co-operate in working to designs made specially for this situation.

The stock and variety of components could, if required, be made available for buildings other than housing and it may be possible to design schools, shops and community buildings within this range. The effect to be aimed at should be coherence and harmony comparable to the appearance of our towns when building materials were limited to stone, slate and timber.

Any proposals for the use of industrialised methods however should be sufficiently flexible to take account of the development of new techniques and building materials and they should also be able to absorb these, and indeed to encourage the growth of local industries.

<u>IMPLEMENTATION OF THE ROAD PROGRAMME</u>. The roadworks required to implement the objectives and principles of the communication system for the Moray Firth Development may be considered in two parts; first, the establishment of a fast trunk road from east of Inverness to north of Invergordon, and secondly, the construction of the Distributor and Development Roads associated with the building of the new communities, and with the re-organisation and expansion of those already existing.

The building of the Fast Road may proceed independently of the construction of the other elements of the infra structure, whereas the Distributor and Development Roads must be built as part of an integrated programme of construction for housing and industry.

Since dispersal of settlements and a high level of vehicle usage are important principles in the planning proposals, the establishment of length of fast trunk road is more crucial in the initial stages than breadth, and an early emphasis should therefore be placed on the creation of a high standard road all the way from Inverness to Invergordon.

The first impact of industrial and housing development at Invergordon and Alness will arise from construction traffic, and the sections of the existing A.9 traffic route which will be most severely affected will be in Dingwall and between Dingwall and Evanton. First priority therefore should be given to the construction of the Dingwall By-Pass and the improvement of the section of road between Dingwall and Evanton.

The A.9 from Inverness to Muir of Ord is already overloaded in the summer months and it is recommended that this section be constructed to dual 24' carriageway standards at an early stage.

A suggested target output of contracts for the trunk road reconstruction is an average of five miles each year, which, assuming an immediate start, would establish the first phase provision of the fast road between Inverness and Invergordon by about 1976.

Thereafter the road capacity can be expanded when this is justified by traffic volumes. Junctions should be spaced to final standards but may initially be on the surface, and here again expansion to higher capacity junction forms can take place when the need is imminent. In this way the provisions of the trunk road, and consequently the cost, will bear a sensible relationship to the traffic needs at any point in time.

Ideally, the fast road on its final line but capable of expanding its capacity should be on the ground from the outset, and the new and expanded communities could then loop off this line as and when they are developed. The three factors which will determine how soon this situation can be realised are Statutory Orders and Land Acquisition, availability of money, and rate of design and construction.

Statutory Orders and Land Acquisition. In the case of the trunk roads the responsibility rests with the Secretary of State through Roads Division of the Scottish Office, who use as their agents the County Councils of Ross-shire and Inverness-shire. In the case of roads designated as Principal Routes the responsibility rests with the County Councils assisted by grant aid from the Scottish Office. All other roads are the responsibility of the Local Authorities and are financed through the Central Government Rate Support Grant and funds raised directly by the Local Authorities. The burden of the Statutory Procedures will thus inevitably fall on the Scottish Office, the Local Authorities, and their Agents. The devlopment proposals will require these procedures to be pursued on a much larger scale than at present in this area. Thus, for example, a series of Trunk Road Orders might be published to clear the whole length of the trunk road from Inverness to Invergordon, and questions of land acquisition, agricultural severance, and accommodation works could be dealt with in one integrated operation.

Finance. It is unlikely that sufficient reserve funds are immediately available in the rolling programme of road expenditure of the Scottish Office, or that the Local Authorities could raise their proportion of the total expenditure on a sufficient scale. The finance for the Roads programme, as indeed for most of the infra structure costs, must be presented to and accepted by the Treasury as essential financial implications of successful industrial negotiations. Only in this way will Roads Division of the Scottish Office, and the Local Authorities be relieved of the necessity to consider finance for this development at the expense of some other project under their jurisdiction.

Design and Construction. The clearance of statutory procedures and of finance is important to the possible rate of design and construction but there is evidence that the design work is often critical in determining the rate of implementation. Working parties set up by Central Government have made searching investigations into current 'design-and-build' practices and two conclusions are common to them all. These are that to be efficient the construction industry must have a programme of work for several years ahead and that there should be an earlier association between designer and builder.

A detailed study of these government reports has been made in order to prepare comprehensive proposals for the design and construct operation. The object has been to accommodate the recommendations of the Government Reports, and to eliminate the weaknesses of the present methods, while also ensuring cost efficiency and public accountability.

Most of the foregoing remarks apply to the distributor and development roads as well as to the trunk road; the main difference being that in these cases constructions should be to final standards at the outset, so that as each community is completed it becomes a self contained entity which will not be disturbed by subsequent building operations in the area. The programming of these roads will, of course, be intimately related to the development of industry and housing and to the establishment of supply and disposal services.

A preliminary assessment of the resources of the road building contractors of proven quality who already operate in the area shows that they are capable of accomplishing the proposed programme without detriment to similar work in other parts of the Highlands. Since the construction industry could be one of the largest employers in the area for many years, the work could be used to stimulate the growth of stable employment in those firms, of all sizes, who already operate in the Highlands, provided their work can be shown to be cost-efficient and of high quality.

LANDSCAPE. At each stage of the planning and design process discussed in this study the qualities of the natural landscape have been a basic influence. The completed environment will be identified with the immediate, and surrounding scenery, and the use of decorative detail can be reduced. This policy will result in simplified landscape construction, conducive to efficient workmanship, reduction of outlay and practical maintenance.

The seasonal nature of landscape construction is normally hampered by haphazard building programmes. A planned and reliable programme of Basic Site Works and Erection could introduce a degree of flexibility in the timing of landscape works to enable ground moulding, cultivation and planting to be carried out before main building construction. The simplification of operations, would improve landscape construction standards and a completed setting could then be achieved prior to occupation of houses, and planting would have every chance of success.

The mechanical properties of soils can change dramatically when the soils are disturbed, resulting in poor growing conditions and additional cost. Stress should be laid on the use of techniques and procedures which minimise ground disturbance. Topsoil surplus to local requirements can then be used for improvement of land outwith the urban area, if the scale of operations permits efficient soil transportation. The conservation of the mechanical properties of soil gives a basis of good growing conditions with minimum cost.

Even with a satisfactory design approaching good construction programming and techniques, maintenance costs over a period of 20 years will probably equal capital costs. The tendency for current administrative and financial systems relating to landscape work, in particular when carried out by local authorities, is to view capital and maintenance costs quite separately. This restricts design possibilities and detracts from the success of schemes. Greater concern on the part of residents for the appearance and upkeep of open space will result from a financial interest in the form of contributions related to the kind of environment provided. This has been shown in isolated instances in Britain, but in the circumstances of the Moray Firth development there could be much wider application.

COSTS. We have attempted to estimate the capital costs of the investment in housing, schools, shops, services, other community buildings and distributor roads which would be needed for the additional population contemplated in the strategy. The estimate can be best expressed as a rate per completed house of £6,200 at current prices. In addition to this the investment in the Fast trunk road would amount to £13m. without the Tore option and £18m. with this option. The latter amount may be modified when the precise form of the Beauly Firth crossing is determined and neither of these amounts include the cost of highway construction within Inverness Burgh. These figures compare with the correct overall costs for the new towns.

The first period of development to 1973/74 might include 5000 new houses which would be needed as a result of the direct and indirect employment created by the large new industries and would therefore imply an investment of some £40m. including £7m. for the trunk road improvement.

At 1700 houses per annum the whole programme of the strategy implies an annual investment rate of about £10m. on infra structure. The report by I. Buchanan and C. Allan (Appendix 2) deals with the first fifteen years of development and deduces a rate of investment of £15.5m. which embraces not only infrastructure but industry, port authorities and all other likely commitments of the building and civil engineering industries. To do this the only practical base from which they could work was the annual product in the country generally, but in this section the estimate of £10m. for infra structure has been adjusted, because the proportion of new housing to other work is very much higher in new towns than in the country generally. It is not practical to make an accurate adjustment from the statistics available and so we have estimated the infra structure on the internal data, i.e. by direct estimation of the likely cost of houses, services, roads, landscaping, shops, schools, public buildings etc. and comparing this with the cost of other new towns so far as they are known.

We have not discovered any special condition or circumstance which would lead us to expect that building and civil engineering costs would be any higher in this area than anywhere else in the United Kingdom provided always that the ample indigenous resources of basic heavy building materials are fully and sensibly used in preference to the imported article.

If however higher standards of accommodation and other amenities are to be offered extra cost will, of course, be incurred. The housing layouts we have shown allow the application of these higher standards, but the layouts do not in themselves pre-empt the choice of standards.

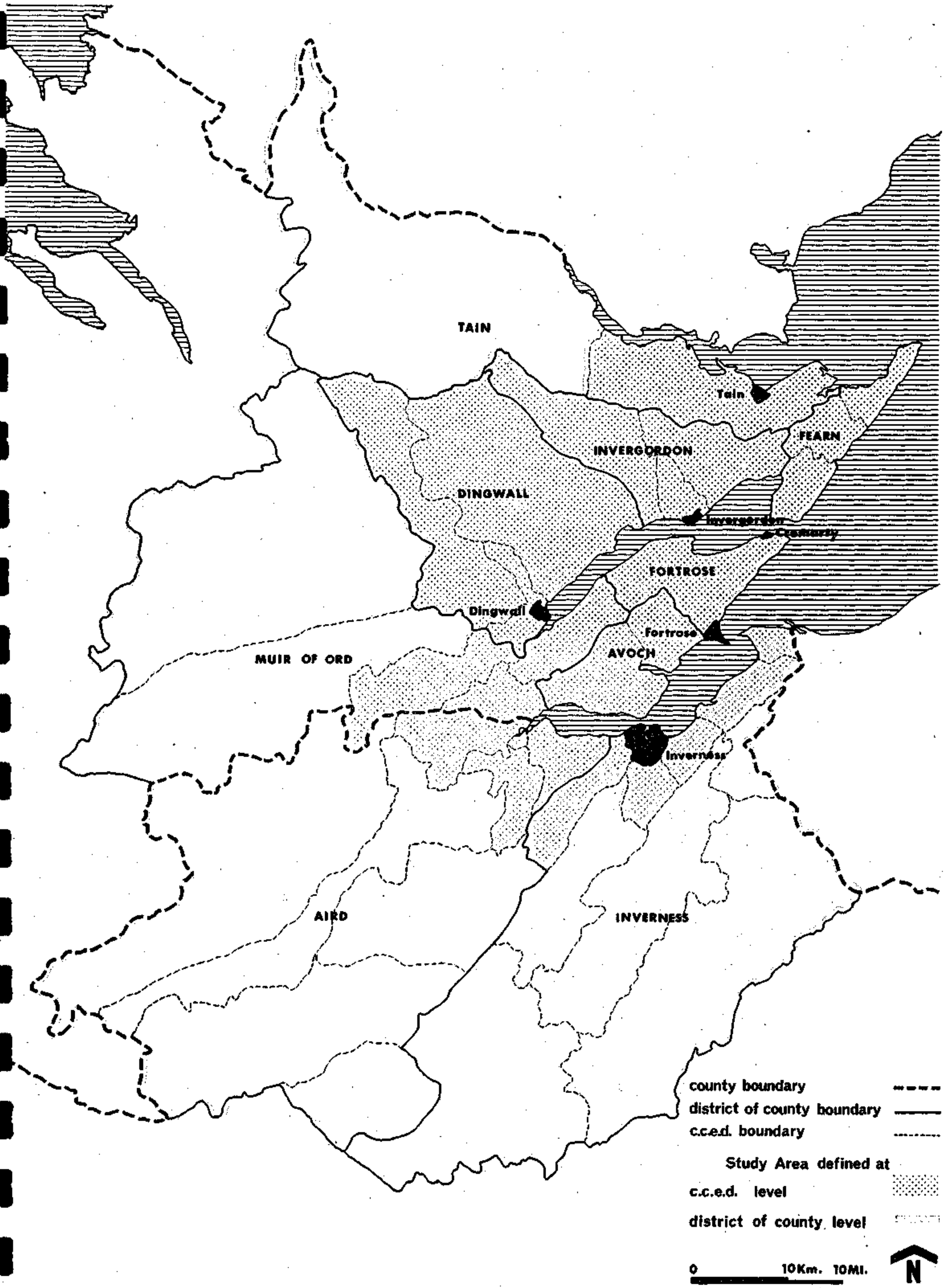
A FORM OF ADMINISTRATION. The administrative difficulties of pursuing a planned strategy for such a large area over a definite period will not be elaborated here. But they have to be faced, and we should be failing in our responsibilities if we made no suggestions whatsoever about ways of overcoming what could prove to be one of the most frustrating obstacles to progress.

A strategy pre-supposes an executive authority able to co-ordinate the timing and siting for building, and to advise on the control of spontaneous development. A precedent for such a body already exists in the Lothians Joint Planning Advisory Committee which works in collaboration with the Scottish Development Department.

In the Moray Firth the executive authority might consist of members of burgh and county councils nominated by each council, together with representatives from the Highlands and Islands Development Board, and the establishment of such an authority would anticipate, and must remain adaptable to any re-organisation of local government which might take place in the course of the next few years.

SUPPORTING STUDY.

POPULATION STUDY.



ADMINISTRATIVE AREAS

Table 1.

Study Area : Population 1966

		C.C.E.D.	D. of C.
Inverness County			
Inverness L.B.		30,410	30,410
Districts of County			
Inverness 7780			7,880
Ardersier	C.C.E.D.)		
Petty	")		
Inverness E	")	5,090	
" S	")		
" W	")		
Aird 6280			6,280
Kirkhill	C.C.E.D.)		
Beauly	")	3,220	
Kiltarlity	")		
Easter Kilmorack	")		
Ross and Cromarty County			
Cromarty S.B.		480	480
Dingwall S.B.		3,780	3,780
Fortrose S.B.		830	830
Invergordon S.B.		2,280	2,280
Tain S.B.		1,710	1,710
Districts of County			
Muir of Ord 4680			4,680
Urray	C.C.E.D.)		
Muir of Ord	")	3,660	
Urquhart	")		
Avoch 2730		2,730	2,730
Fortrose 850		850	850
Dingwall 3860		3,860	3,860
Invergordon 3220		3,220	3.220
Fearn 2210		2,210	2,210
Tain 1690			1,690
Edderton-Tain	C.C.E.D.	1,000	
STUDY AREA		65,330	72,890

Source: 1966 Sample Census.

POPULATION STUDY

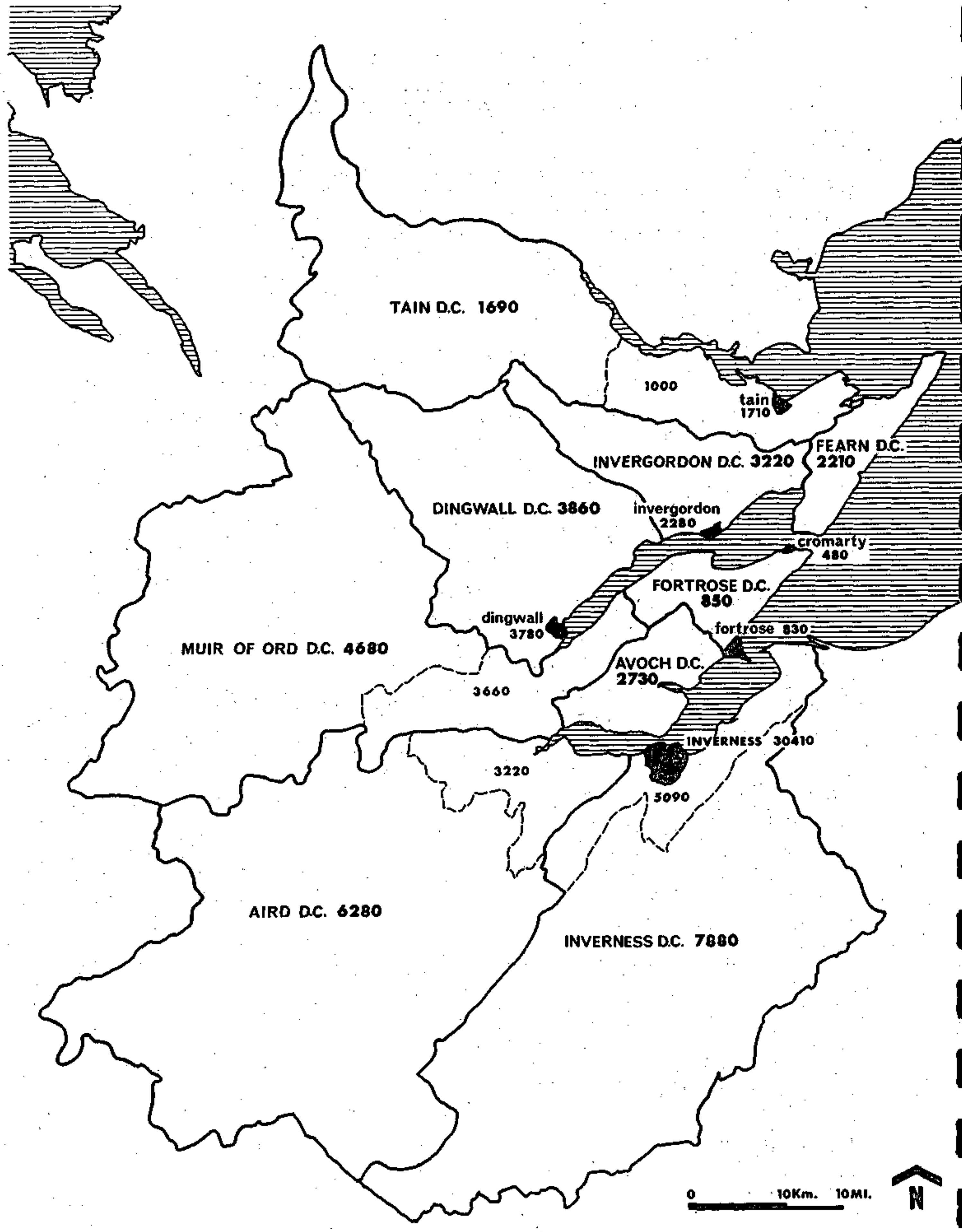
The Moray Firth between Tain and Inverness consists of the most easterly parts of Ross and Cromarty and Inverness Counties. For Census of Population purposes the landward areas of the counties are divided into Districts of County which are in turn divided into County Council Electoral Divisions (C.C.E.D's). The Study Area can thus be defined either as a group of Districts of County or in a more compact manner as a group of County Council Electoral Divisions (see Administrative Areas map). One Large Burgh (Inverness), and five Small Burghs (Dingwall, Invergordon, Tain, Cromarty and Fortrose) have to be added to the Landward population to obtain the total population of the Study Area. Table 1 shows that according to the 1966 Sample Census, 65,300 persons resided in the Study Area defined by County Council Electoral Divisions and 72,890 when defined by Districts of County. It must be noted that although the area included in the District of County definition is three times the size of the C.C.E.D. definition, its population is only about 10 per cent greater.

Distribution of Population. As the map of population distribution in 1966 shows almost half the total Study Area population is in Inverness Burgh. A further 15 per cent is distributed among the five small burghs but as the map of population distribution in 1961 (frontispiece) shows there are several non-burghal settlements larger than some of the small burghs; Beauly with 1,400 persons for example. In 1961 sixteen of these small settlements ranging in size from 200 to 1,600 persons accounted for a further population of about 9,000. The remaining 17,000 persons are the truly dispersed rural population, and they are widely distributed over the lowland almost entirely within 4 or 5 miles of the coast. The most densely populated landward areas are the coastal strip both east and west of Inverness which supports about 3,500 people, and the area around Muir of Ord. The Black Isle accounts for some 5,000 people outwith the burghs, who tend to concentrate in the western half of the peninsula and particularly around North Kessock. A further 5,000 people live along the Dornoch and Cromarty Firths and in the Fearn peninsula, and the burghs of Invergordon and Tain raise the population of this area to about 9,000. The valleys of Strathpeffer and the River Beauly, especially around Aultfearn, are also concentrations of rural population.

TABLE 2.

Distribution of Population 1966

		%
Inverness L.B.	30,000	46
Small Burghs, villages and hamlets	18,000	28
Dispersed rural	17,000	26
Study Area	65,000	100



POPULATION DISTRIBUTION 1966

Composition of Population. The proportion of females in the total population of the Study Area (53%) is only slightly above the Scottish figure of 52%. However, as Table 3 and the age and sex structure diagrams show there are quite marked variations within the Study Area.

TABLE 3.

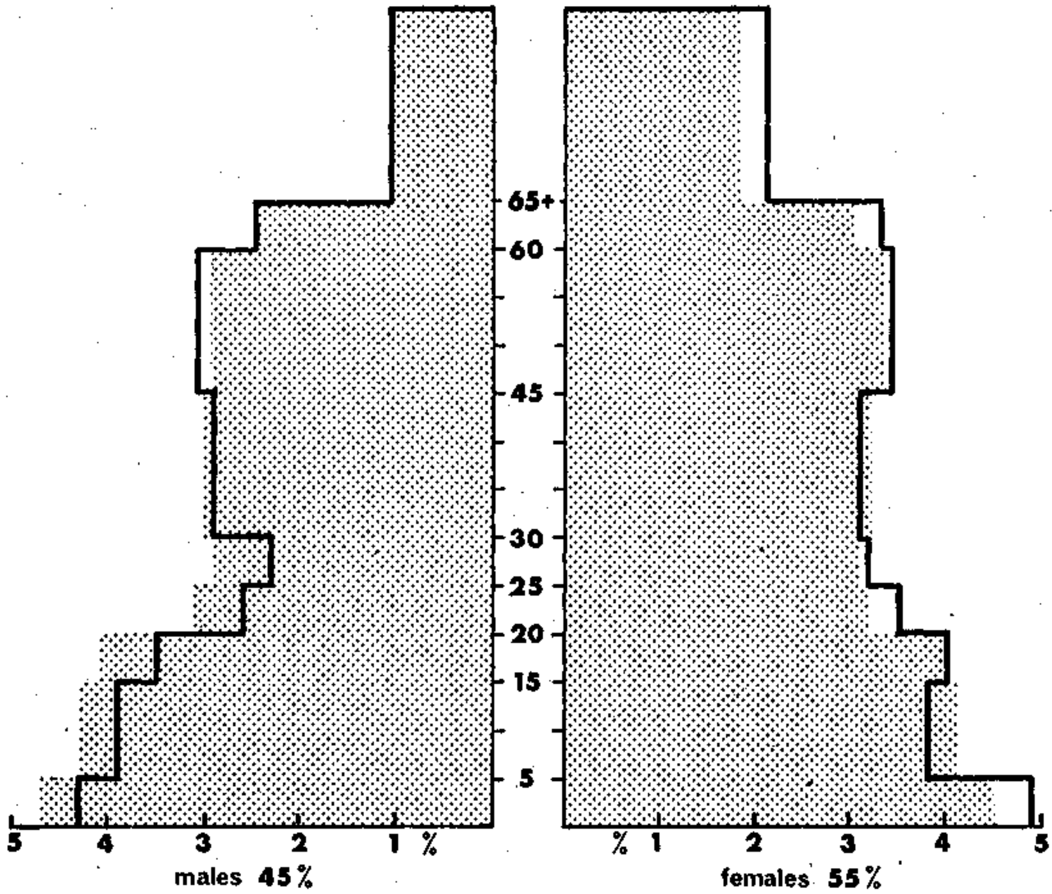
AGE and SEX STRUCTURE, 1966

	SCOTLAND			STUDY AREA (CCED level)			INVERNESS L.B.		
	persons	males	females	persons	males	females	persons	males	females
0-4	9.2	4.7	4.5	8.5	4.2	4.3	9.2	4.3	4.9
5-14	16.6	8.5	8.1	16.4	8.3	8.1	15.6	7.9	7.7
15-19	8.1	4.1	4.0	7.4	3.6	3.8	7.4	3.4	4.0
20-24	6.3	3.1	3.2	5.5	2.6	2.9	6.1	2.6	3.5
25-29	6.0	2.9	3.1	5.9	2.6	3.3	5.5	2.3	3.2
30-44	18.6	9.1	9.5	17.9	9.0	8.9	18.0	8.6	9.4
45-59	18.5	8.7	9.8	19.3	9.1	10.2	19.6	9.3	10.3
60-64	5.5	2.5	3.0	5.5	2.6	2.9	5.8	2.5	3.3
65+	11.2	4.2	7.0	13.6	5.1	8.5	12.8	4.4	8.4
ALL	100%	47.8	52.2	100%	47.1	52.9	100%	45.3	54.7

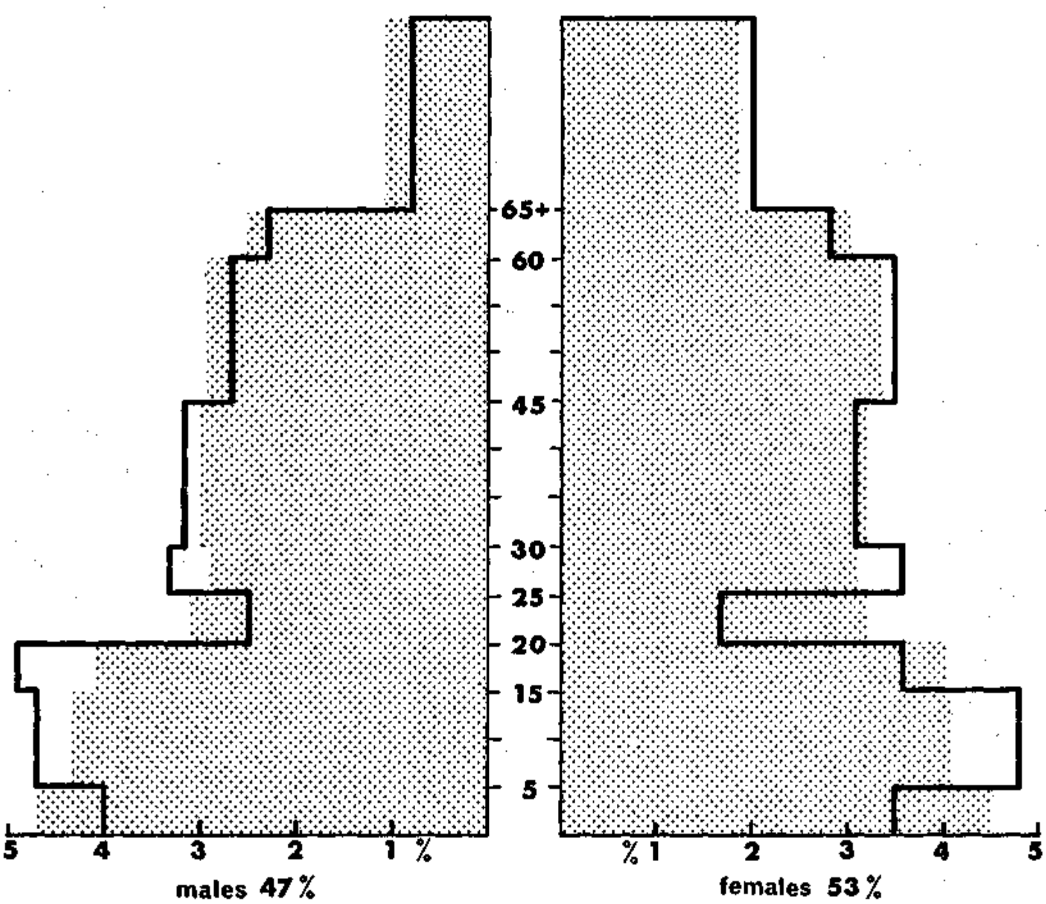
Source: 1966 Sample Census for Scotland.

Inverness Burgh has the highest proportion of females at 55%. The excess of females over males in the Study Area as a whole and in Inverness particularly, is concentrated in the 15-30 age group and even more in the 45 years and over category. Compared with Scotland as a whole the most marked differences are the substantially smaller proportion of young males (0-30 yrs) and the larger proportion of elderly females (65 years and over) to be found in the Study Area population.

The proportion of the population in every age category below 45 years is less than the Scottish average, and the proportion aged 45 years and over is 3.2% above the Scottish average. Thus the Study Area in 1966 clearly had an ageing population which reflected the many years of net outward migration in excess of the natural increase.



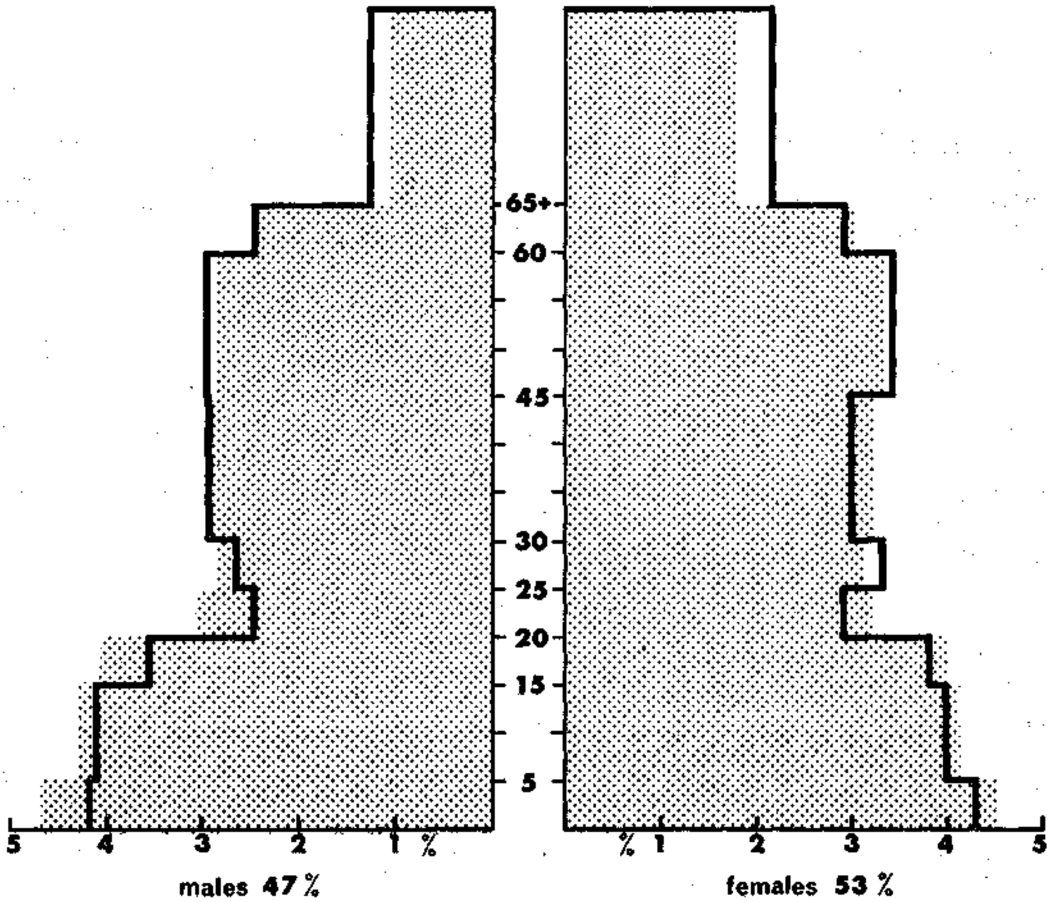
INVERNESS LARGE BURGH



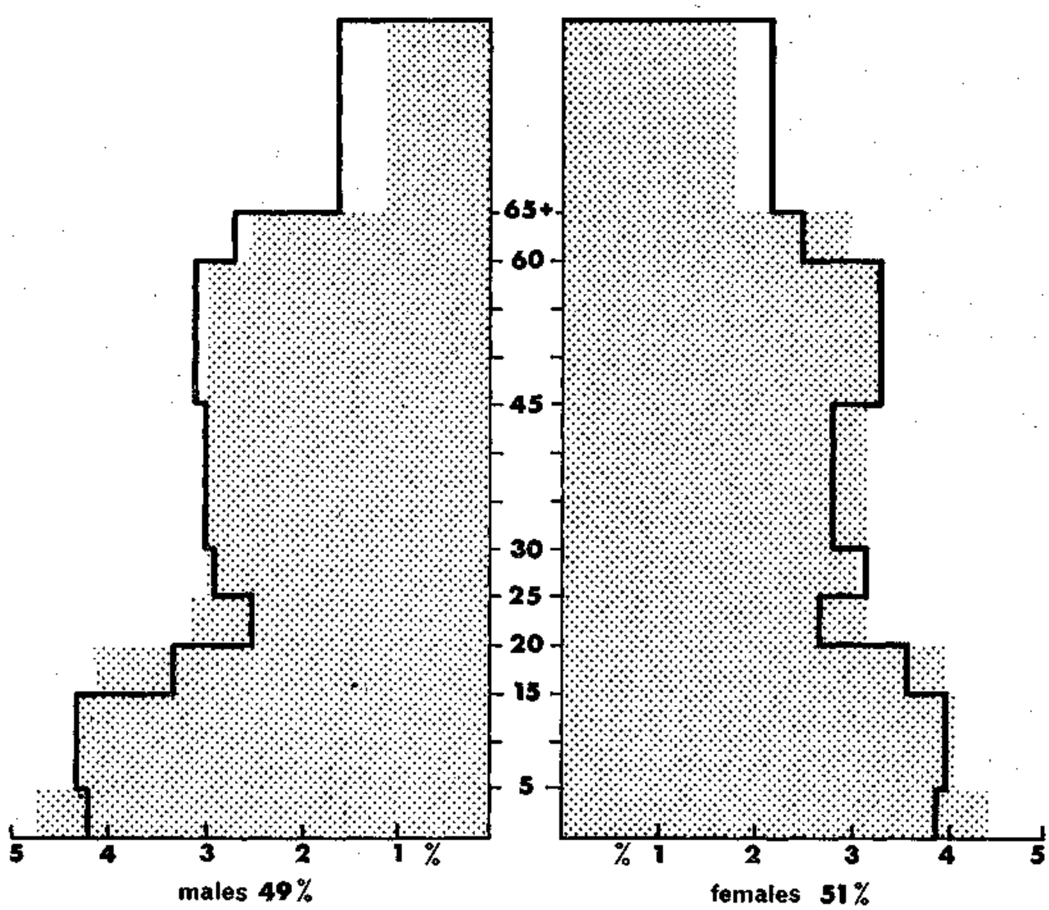
AGGREGATE OF 5 SMALL BURGHS

AGE STRUCTURE 1966

1966 Scottish age structure shown stippled



STUDY AREA cced level



LANDWARD AREA cced level

AGE STRUCTURE 1966

1966 Scottish age structure shown stippled

Population Change. The examination of recent changes in the population of the Study Area has to be made at the District of County level since no information on this topic is available at the County Council Electoral Division level. Table 4 shows that the Study Area declined by 2,185 between 1951 and 1966, equal to an average rate of 0.2% per year.

The overall rate of decline between 1961 and 1966 was ten times the rate of the previous decade, yet the population of the Burghs has shown an increase over the whole period since 1951. The rate of decline in the landward areas was, as Table 4 shows, particularly marked among males. Conversely the rate of increase in Inverness Burgh was fastest for females. Thus the Study Area's net loss between 1961 and 1966 was entirely accounted for by males.

The diagrams of population change between 1961 and 1966 by age category help to explain the age structure of the Study Area. In the landward areas only the over 65's show an increase while the Burghs have a more irregular pattern. The diagram for the Study Area as a whole shows clearly how 60 per cent of the decline in population is accounted for by declines in the 20-25 and 30-45 age groups. On present trends the population will continue to decline in total numbers and the over sixties will become an even bigger proportion of the total. Indeed, if we assume constant birth and death rates together with continuing net outward migration then the rate of decline must accelerate as the number of births fall.

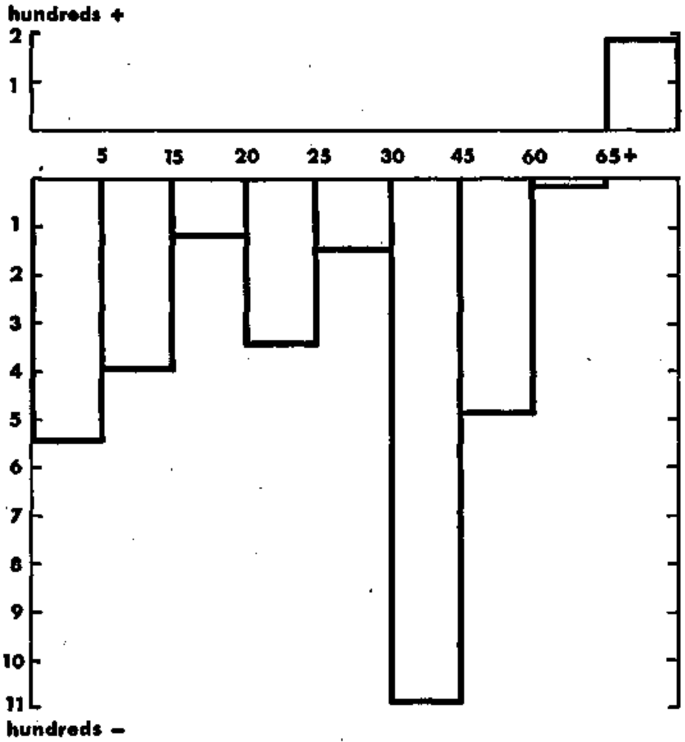
Future Population. It is virtually impossible that the existing population even by the end of the Century would grow to 270,000 without a very substantial volume of net inward migration. It would in fact take more than 40 years for the existing 70,000 to become 100,000 by natural increase alone given the present level of birth and death rates. To even approach capacity by the end of the Century would therefore require a very large volume of immigration. Because the age and sex structure of the potential immigrants is unknown and the rate and timing of the immigration flows is also unknown it is not feasible to forecast the future population by total numbers or by composition. The diagram (Past and Future Population Structure) illustrates a range of variation that could be expected on certain assumptions.

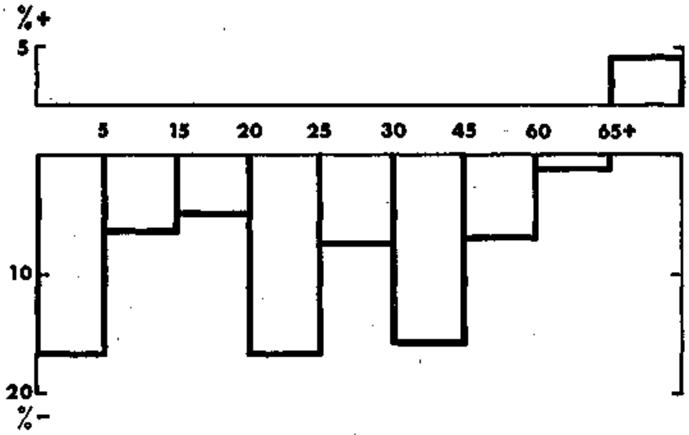
TABLE 4.

POPULATION CHANGE 1951-1966.

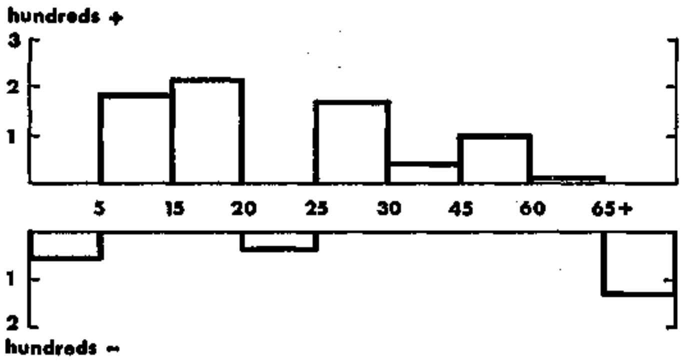
	1951			1961			1966		
	Persons	males	females	persons	males	females	perons	males	females
Inverness L.B.	28,107	13,165	14,942	29,774	13,848	15,926	30,410	13,780	16,630
Small Burghs	8,103	3,717	4,386	8,601	4,016	4,585	9,080	4,300	4,780
Landward Area	38,866	20,436	18,430	36,343	18,438	17,905	33,400	16,400	17,000
Study Area (D. of Co. level)	75,076	37,318	37,758	74,718	36,302	38,416	72,890	34,480	38,410

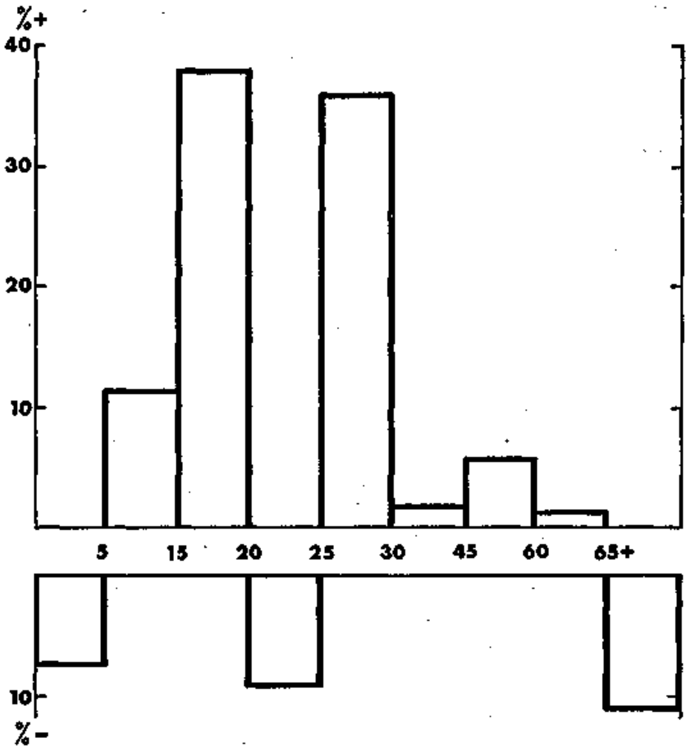
	Increase or Decrease.					
	1951 - 61		1961 - 66.			
	Amount	% p.a.	Amount	% p.a.	Males % p.a.	Females % p.a.
Inverness L.B.	+ 1667	+ 0.60	+ 636	+ 0.42	- 0.10	+ 0.89
Small Burghs	+ 498	+ 0.61	+ 479	+ 1.12	+ 1.42	+ 0.85
Landward Area	- 2523	- 0.65	-2943	- 1.66	- 2.20	- 1.04
Study Area	- 357	- 0.05	-1828	- 0.48	- 1.00	0.0
Scotland	-	+ 0.16	-	- 0.04	- 0.03	- 0.06
England and Wales	-	+ 0.51	-	+ 0.44	+ 0.48	+ 0.42



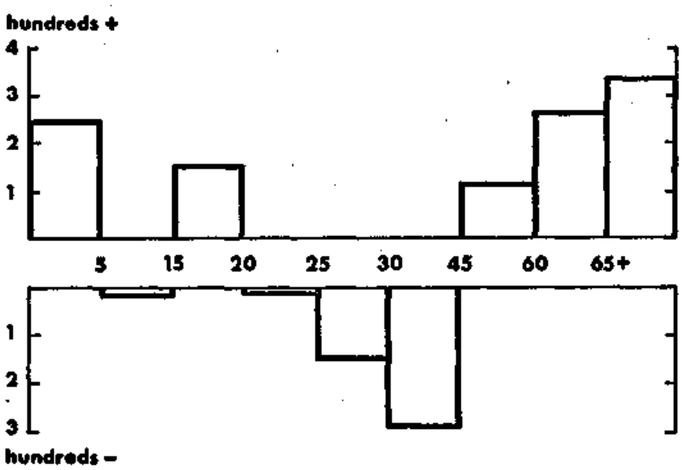


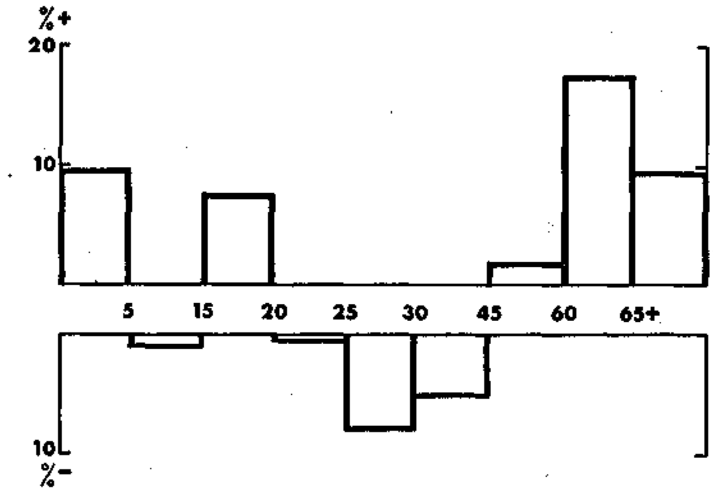
LANDWARD AREAS net decrease 2943 persons, 8·1%
district of county level





AGGREGATE OF 5 SMALL BURGHS net increase 479 persons, 5·5%

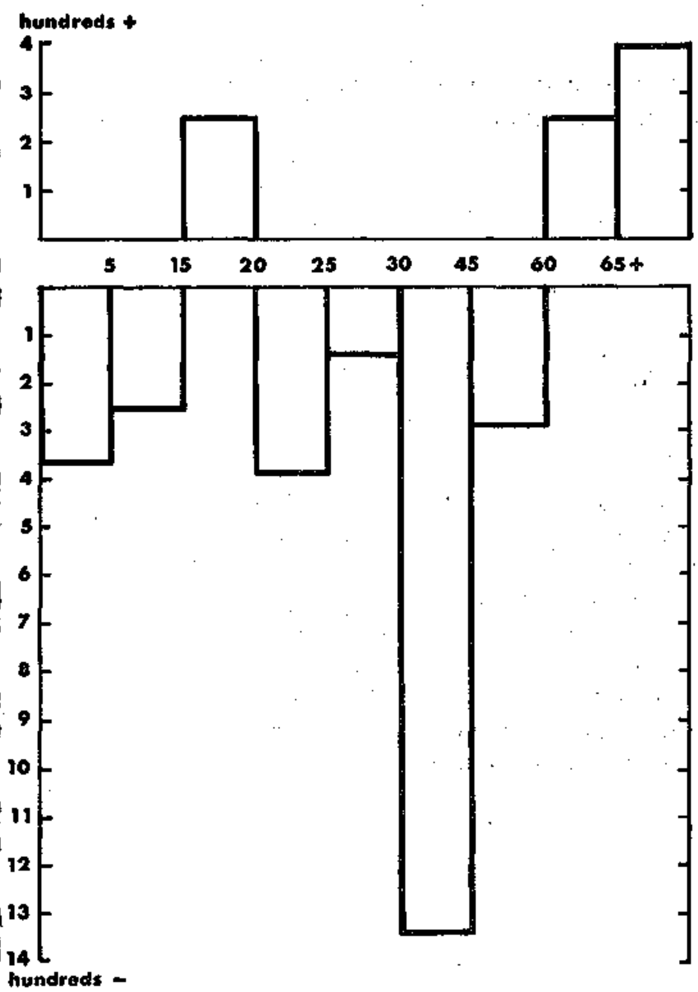


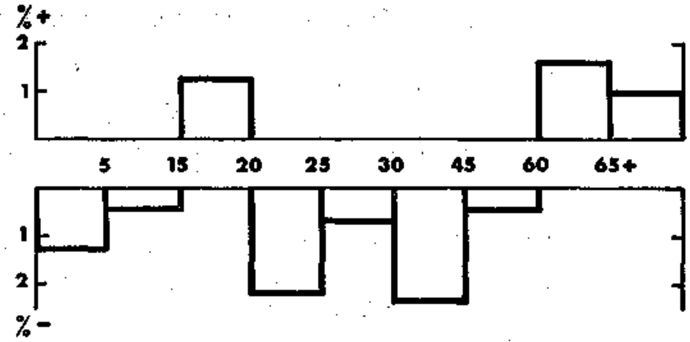


INVERNESS BURGH net increase 636 persons, 2·1%

POPULATION CHANGE 1961 - 1966

BY ADMINISTRATIVE AREA





STUDY AREA district of county level
net decrease 1828 persons, 2·5%

POPULATION CHANGE 1961–1966

A. This would be the outcome of slow growth over a very long period in which substantial outward migration occurred.

B. This reflects quite high rates of natural increase together with substantial outward migration.

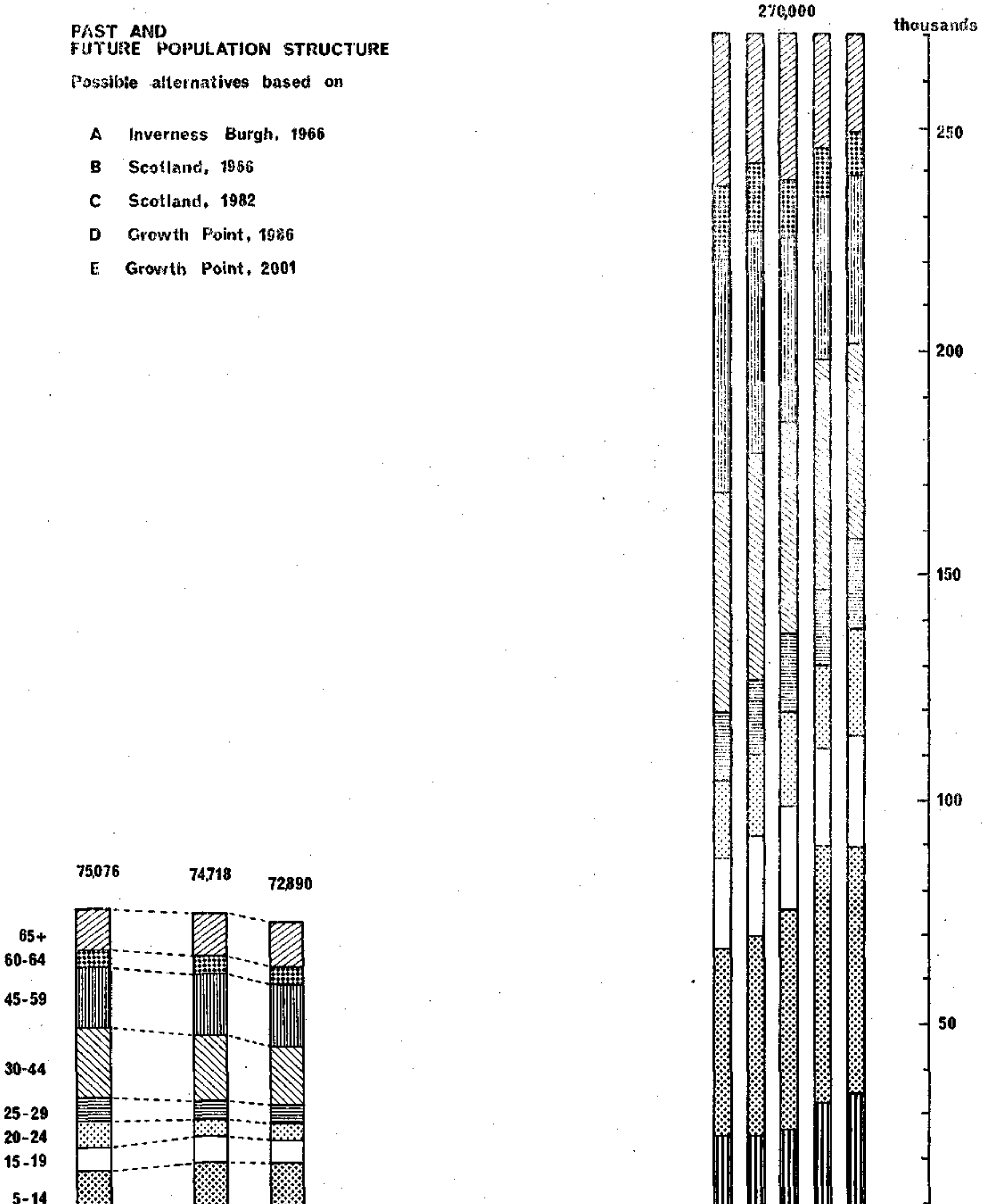
C. This assumes rising natural increase with declining outward migration during the period of the forecast. It reflects gradually improving economic opportunities.

D. and E. These compositions of population result from a situation in which there is substantial net inward migration. The typical immigrant population contains high proportions of children and young adults with very few old people. Thus sixty per cent of the Glasgow overspill population to date has been under 30 years of age compared to only just over 40 per cent in the Study Area. These age structures reflect very rapid industrial expansion on a large scale and clearly demonstrate the potential for continued growth that all immigrant flows contain.

PAST AND
FUTURE POPULATION STRUCTURE

Possible alternatives based on

A Inverness Burgh, 1966
B Scotland, 1966
C Scotland, 1982
D Growth Point, 1986
E Growth Point, 2001



SUPPORTING STUDY.

LAND USE TRANSPORTATION STUDY.

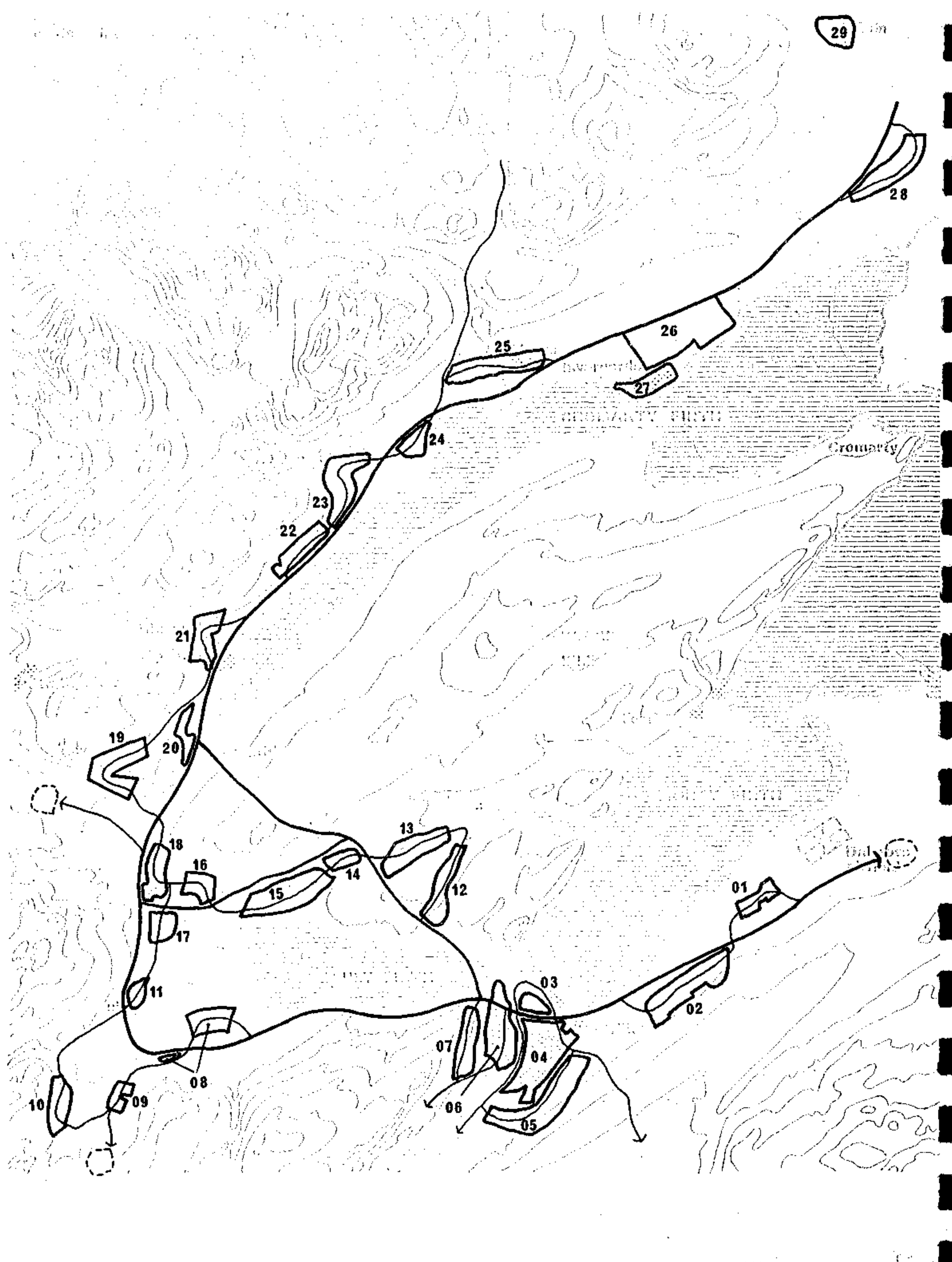
CONTENTS.

TRAFFIC ANALYSIS OF STRATEGY

The flexibility of the strategy for the Moray Firth makes possible very wide variations in timing, scale, and rate of development. The permutation of possible intermediate phases is too numerous to test and therefore the analysis which follows is based on the content of the Moray Firth Strategy Plan.

The scale and location of population growth in the Moray Firth Area will be controlled largely by the scale and location of work opportunities. Hence, in the preparation of a strategic land-use plan for the Area a paramount consideration relates to the identification of suitable areas for housing and industry and to the analysis of the capacity of these areas, so that a balance is maintained between the number of people and the number of jobs.

Of the many purposes for which people make journeys that which exhibits the most universal stability in its characteristics is the journey to and from work, particularly if travel by male and female workers is considered separately. In a situation where there is little relationship between what exists now and what is being tested forecasts of travel for purposes other than work are subject to so many unpredictable variations that it is difficult to justify attempts to make them, particularly as together they account for less than 30% of peak period travel demand and require locational and statistical planning forecasts which are almost impossible to make with confidence. The work journey alone accounts for the balance of more than 70% of the demand for road space in the peak period of an average day. Hence a forecast of travel by car drivers in the work journey, based on the planning analysis of residential areas and work places, provides the soundest base for the synthesis of future vehicle trips. Appropriate allowances can readily be made for additional vehicles on other less significant trip purposes before planning the scale and structure of the road system.



ZONE NUMBERS 1

LOCATION OF JOBS AND WORKERS

The area under study was broken down into 29 zones (see drg. 1) and the following assumptions were used to calculate the zonal content in terms of workers and jobs. These assumptions were arrived at after an examination of a wide range of sources including statistics of the existing national situation, national forecasts and other forecasts contained in recent expansion studies.

1. 45% of the population are workers.
2. 55% of jobs and workers are in service industry, the remaining 45% of jobs and workers are in manufacturing industry.
3. In service industry 43% of jobs and workers refer to females and 57% refer to males.
4. In manufacturing industry 31% of jobs and workers refer to females and 69% refer to males.
5. In view of their importance as service centres Inverness and Dingwall will contain an above average proportion of service employment. Thus the service jobs within all areas except Inverness and Dingwall are equal to the number of service workers in the area less 15% and this 15% was allocated to Inverness and Dingwall on a relative population basis.
6. 5% of the total jobs in residential settlements are assumed to be in manufacturing industry.
7. Manufacturing jobs in Industrial areas are related to the defined acreage of suitable land and to gross densities of 25 workers per acre with the exception of Invergordon where the gross density was 10 workers per acre.
8. With the exception of Inverness and Dingwall 80% of service jobs in each area are occupied by workers from that area.

9. Industrial jobs within residential areas are occupied by workers in that area.

10. 90% of the service labour force in Inverness and Dingwall work locally.

BASIC POPULATION, JOB AND WORKER DATA BY SETTLEMENT

Settlement	Population	Labour Force		Jobs	
		Service 55%	Manuf. 45%	Service	Manuf.
Tain	6,700	1,660	1,360	1,410	80
Calrossie	17,000	4,210	3,440	3,580	210
Invergordon	2,000	490	410	500	
*Invergordon					10,960
Alness	16,000	3,960	3,240	3,370	200
*Evanton					8,530
Evanton	22,300	5,520	4,520	4,690	280
Dingwall	7,280	1,800	1,480	2,480	120
Maryburgh	3,000	740	610	630	40
Brahan	16,000	3,960	3,240	3,370	200
Muir of Ord	13,000	3,190	2,610	2,710	
*Muir of Ord					7,470
Redcastle	17,500	4,330	3,550	3,680	220
*Tore					5,850
Munlochy	24,300	6,000	4,900	5,100	300
Beauly	4,100	1,020	830	870	70
Kirkhill	9,200	2,280	1,860	1,940	
*Kirkhill					1,170
Belladrum	7,000	1,730	1,420	1,470	
Beaufort	4,500	1,110	910	940	
*Inverness					6,100
Inverness	65,000	19,530	9,790	25,530	
Balloch	20,000	4,950	4,050	4,210	
*Dalcross					6,420
	254,880	66,480	48,220	66,480	48,220

These assumptions and these basic population figures when combined gave tables 1-6 from which the male jobs and male workers in each zone, and the female jobs and female workers in each zone were obtained. These are shown in tables 8 and 9.

*Industrial areas.

Zonal Totals Of: TABLE 1.

1. Service workers.
2. Locally employed service workers.
3. Service workers seeking jobs outside home zones.

Zone	Population	Service Workers	S/W Locally Employed	S/W Seeking Jobs Outside Home Zone	Zone
01	0	0	0	0	01
02	20,000	4,950	3,368	1,582	02
03	0	0	0	0	03
04	15,800	4,750	4,275	475	04
05	23,000	6,910	4,352	2,558	05
06	17,700	5,310	3,352	1,958	06
07	8,500	2,560	1.616	944	07
08	9,200	2,280	1,552	728	08
09	7,000	1,730	1,176	554	09
10	4,500	1,110	752	358	10
11	4,100	1,020	692	328	11
12	11,300	2,790	1,904	886	12
13	13,000	3,210	2,191	1,019	13
14	0	0	0	0	14
15	17,500	4,330	2,944	1,386	15
16	6,000	1,472	1,000	472	16
17	0	0	0	0	17
18	7,000	1,718	1,167	551	18
19	16,000	3,960	2,696	1,264	19
20	3,000	740	504	236	20
21	7,280	1,800	1,620	180	21
22	10,000	2,475	1,682	793	22
23	12,300	3,045	2,070	975	23
24	0	0	0	0	24
25	16,000	3,960	2,696	1,264	25
26	0	0	0	0	26
27	2,000	490	400	90	27
28	17,000	4,210	2,864	1,346	28
29	6,700	1,660	1,128	532	29
Totals	254,880	66,480	46,001	20,479	

TABLE 2.

Zonal Totals Of:

1. Manufacturing Workers.
2. Locally employed manufacturing workers.
3. Manufacturing workers seeking jobs outside home zones.

Zone	Population	Manuf. Workers	M/W Locally Employed	M/W seeking jobs outside Home Zone	Zone
01	0	0	0	0	01
02	20,000	4,050	0	4,050	02
03	0	0	0	0	03
04	15,800	2,380	0	2,380	04
05	23,000	3,470	0	3,470	05
06	17,700	2,660	0	2,660	06
07	8,500	1,280	0	1,280	07
08	9,200	1,860	0	1,860	08
09	7,000	1,420	0	1,420	09
10	4,500	910	0	910	10
11	4,100	830	70	760	11
12	11,300	2,279	160	2,119	12
13	13,000	2,621	140	2,481	13
14	0	0	0	0	14
15	17,500	3,550	220	3,330	15
16	6,000	1,205	0	1,205	16
17	0	0	0	0	17
18	7,000	1,405	0	1,405	18
19	16,000	3,240	200	3,040	19
20	3,000	610	40	570	20
21	7,280	1,480	120	1,360	21
22	10,000	2,027	126	1,901	22
23	12,300	2,493	154	2,339	23
24	0	0	0	0	24
25	16,000	3,240	200	3,040	25
26	0	0	0	0	26
27	2,000	410	0	410	27
28	17,000	3,440	210	3,230	28
29	6,700	1,360	80	1,280	29
Totals	254,880	48,220	1,720	46,500	

TABLE 3.

Zonal Totals Of:

1. Service Jobs.
2. Service Jobs occupied by local workers.
3. Service jobs available for workers from other zones.

Zone	Service jobs	Service jobs Occupied by Local Workers	Service jobs available for Workers from Other zones	Zone
01	0	0	0	01
02	4,210	3,368	842	02
03	0	0	0	03
04	13,880	4,275	9,605	04
05	5,440	4,352	1,088	05
06	4,190	3,352	838	06
07	2,020	1,616	404	07
08	1,940	1,552	388	08
09	1,470	1,176	294	09
10	940	752	188	10
11	870	692	178	11
12	2,371	1,904	467	12
13	2,729	2,191	538	13
14	0	0	0	14
15	3,680	2,944	736	15
16	1,251	1,000	251	16
17	0	0	0	17
18	1,459	1,167	292	18
19	3,370	2,696	674	19
20	630	504	126	20
21	2,480	1,620	860	21
22	2,103	1,682	421	22
23	2,587	2,070	517	23
24	0	0	0	24
25	3,370	2,696	674	25
26	0	0	0	26
27	500	400	100	27
28	3,580	2,864	716	28
29	1,410	1,128	282	29
Totals	66,480	46,001	20,479	

TABLE 4.

Zonal Totals Of:

1. Manufacturing Jobs.

2. Manufacturing jobs occupied by local workers.

3. Manufacturing jobs available for workers from other zones.

Zone	Manuf. jobs	Manuf. jobs occupied by Local Workers	Manuf. jobs available for workers from Other zones	Zone
01	6,420	0	6,420	01
02	0	0	0	02
03	6,100	0	6,100	03
04	0	0	0	04
05	0	0	0	05
06	0	0	0	06
07	0	0	0	07
08	1,170	0	1,170	08
09	0	0	0	09
10	0	0	0	10
11	70	70	0	11
12	140	160	0	12
13	160	140	0	13
14	5,850	0	5,850	14
15	220	220	0	15
16	0	0	0	16
17	7,570	0	7,470	17
18	0	0	0	18
19	200	200	0	19
20	40	40	0	20
21	120	120	0	21
22	126	126	0	22
23	154	154	0	23
24	8,530	0	8,530	24
25	200	200	0	25
26	10,960	0	10,960	26
27	0	0	0	27
28	210	210	0	28
29	80	80	0	29
Totals	48,220	1,720	46,500	

TABLE 5.

Zonal totals of workers seeking jobs outwith home zones sub-divided by occupation category and sex.

Zone	Total Service Workers	Male S/W 57%	Female S/W 43%	Total Mnfg. Workers	Male M/W 69%	Female M/W 31%	Total Male Workers	Total Female Workers	Zone
01	0	0	0	0	0	0	0	0	01
02	1,582	902	680	4,050	2,795	1,255	3,697	1,935	02
03	0	0	0	0	0	0	0	0	03
04	475	271	204	2,380	1,642	738	1,913	942	04
05	2,558	1,458	1,100	3,470	2,394	1,076	3,852	2,176	05
06	1,958	1,116	842	2,660	1,835	825	2,951	1,667	06
07	944	538	406	1,280	883	397	1,421	803	07
08	728	415	313	1,860	1,283	577	1,698	890	08
09	554	316	238	1,420	980	440	1,296	678	09
10	358	204	154	910	628	282	832	436	10
11	328	187	141	760	524	236	711	377	11
12	886	505	381	2,119	1,462	657	1,967	1,038	12
13	1,019	581	438	2,481	1,712	769	2,293	1,207	13
14	0	0	0	0	0	0	0	0	14
15	1,386	790	596	3,330	2,298	1,032	3,088	1,628	15
16	472	269	203	1,205	831	374	1,100	577	16
17	0	0	0	0	0	0	0	0	17
18	551	314	237	1,405	969	436	1,283	673	18
19	1,264	720	544	3,040	2,098	942	2,818	1,486	19
20	236	135	101	570	393	177	528	278	20
21	180	103	77	1,360	938	422	1,041	499	21
22	793	452	341	1,901	1,312	589	1,764	930	22
23	975	556	419	2,339	1,614	725	2,170	1,144	23
24	0	0	0	0	0	0	0	0	24
25	1,264	720	544	3,040	2,098	942	2,818	1,486	25
26	0	0	0	0	0	0	0	0	26
27	90	51	39	410	283	127	334	166	27
28	1,346	767	579	3,230	2,229	1,001	2,996	1,580	28
29	532	303	229	1,280	884	396	1,186	626	29
Totals	20,479	11,673	8,806	46,500	32,085	14,415	43,758	23,221	

TABLE 6.

Zonal totals of jobs available for workers from external zones sub-divided by occupation category and sex.

Zone	Total Service Jobs Available	Male S/J/A 57%	Female S/J/A 43%	Total Mnfg. Jobs Available	Male M/J/A 69%	Female M/J/A 31%	Total Male J/A	Total Female J/A	Zone
01	0	0	0	6,420	4,430	1,990	4,430	1,990	01
02	842	480	362	0	0	0	480	362	02
03	0	0	0	6,100	4,209	1,891	4,209	1,891	03
04	9,605	5,475	4,130	0	0	0	5,475	4,130	04
05	1,088	620	468	0	0	0	620	468	05
06	838	478	360	0	0	0	478	360	06
07	404	230	174	0	0	0	230	174	07
08	388	221	167	1,170	807	363	1,028	530	08
09	294	168	126	0	0	0	168	126	09
10	188	107	81	0	0	0	107	81	10
11	178	101	77	0	0	0	101	77	11
12	467	266	201	0	0	0	266	201	12
13	538	307	231	0	0	0	307	231	13
14	0	0	0	5,850	4,037	1,813	4,037	1,813	14
15	736	420	316	0	0	0	420	316	15
16	251	143	108	0	0	0	143	108	16
17	0	0	0	7,470	5,154	2,316	5,154	2,316	17
18	292	166	126	0	0	0	166	126	18
19	674	384	290	0	0	0	384	290	19
20	126	72	54	0	0	0	72	54	20
21	860	490	370	0	0	0	490	370	21
22	421	240	181	0	0	0	240	181	22
23	517	295	222	0	0	0	295	222	23
24	0	0	0	8,530	5,886	2,644	5,886	2,644	24
25	674	384	290	0	0	0	384	290	25
26	0	0	0	10,960	7,562	3,398	7,562	3,398	26
27	100	57	43	0	0	0	57	43	27
28	716	408	308	0	0	0	408	308	28
29	282	161	121	0	0	0	161	121	29
Totals	20,479	11,673	8,806	46,500	32,085	14,415	43,758	20,163	

TABLE 7.

Zonal Totals Of:

1. Male jobs available for workers from other zones.
2. Male workers seeking work outwith their home zone.

Zone	Male jobs available for workers from other zones		Male workers seeking work outwith their home zone.	Zone
1	4,430		0	1
2	480		3,697	2
3	4,209		0	3
4	5,475		1,913	4
5	620		3,852	5
6	478		2,951	6
7	230		1,421	7
8	1,028		1,698	8
9	168		1,296	9
10	107		832	10
11	101		711	11
12	266		1,967	12
13	307		2,293	13
14	4,037		0	14
15	420		3,088	15
16	143		1,100	16
17	5,154		0	17
18	166		1,283	18
19	384		2,818	19
20	72		528	20
21	490		1,041	21
22	240		1,764	22
23	295		2,170	23
24	5,886		0	24
25	384		2,818	25
26	7,562		0	26
27	57		334	27
28	408		2,996	28
29	161		1,186	29
Totals	43,758		43,758	

TABLE 8.

Zonal Totals Of.

1. Female jobs available for workers from other zones.
2. Female workers seeking work outwith their home zone.

Zone	Female jobs available for workers from other zones		Female workers seeking work outwith their home zone.	Zone
1	1,990		0	1
2	362		1,935	2
3	1,891		0	3
4	4,130		942	4
5	468		2,176	5
6	360		1,667	6
7	174		803	7
8	530		890	8
9	126		678	9
10	81		436	10
11	77		377	11
12	201		1,038	12
13	231		1,207	13
14	1,813		0	14
15	316		1,628	15
16	108		577	16
17	2,316		0	17
18	126		673	18
19	290		1,486	19
20	54		278	20
21	370		499	21
22	181		930	22
23	222		1,144	23
24	2,644		0	24
25	290		1,486	25
26	3,398		0	26
27	43		166	27
28	308		1,580	28
29	121		626	29
Totals	23,221		23,221	

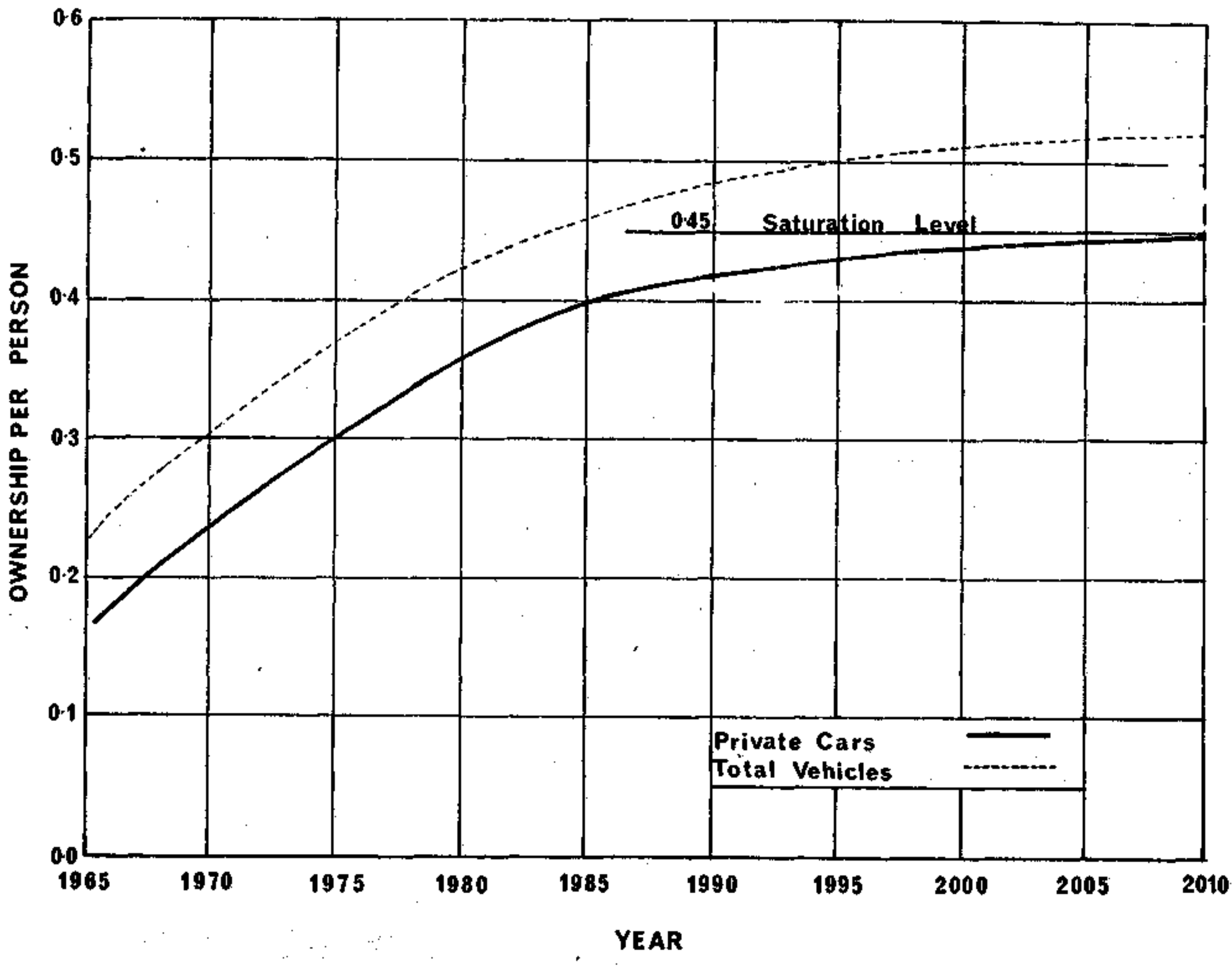
Testing Procedure

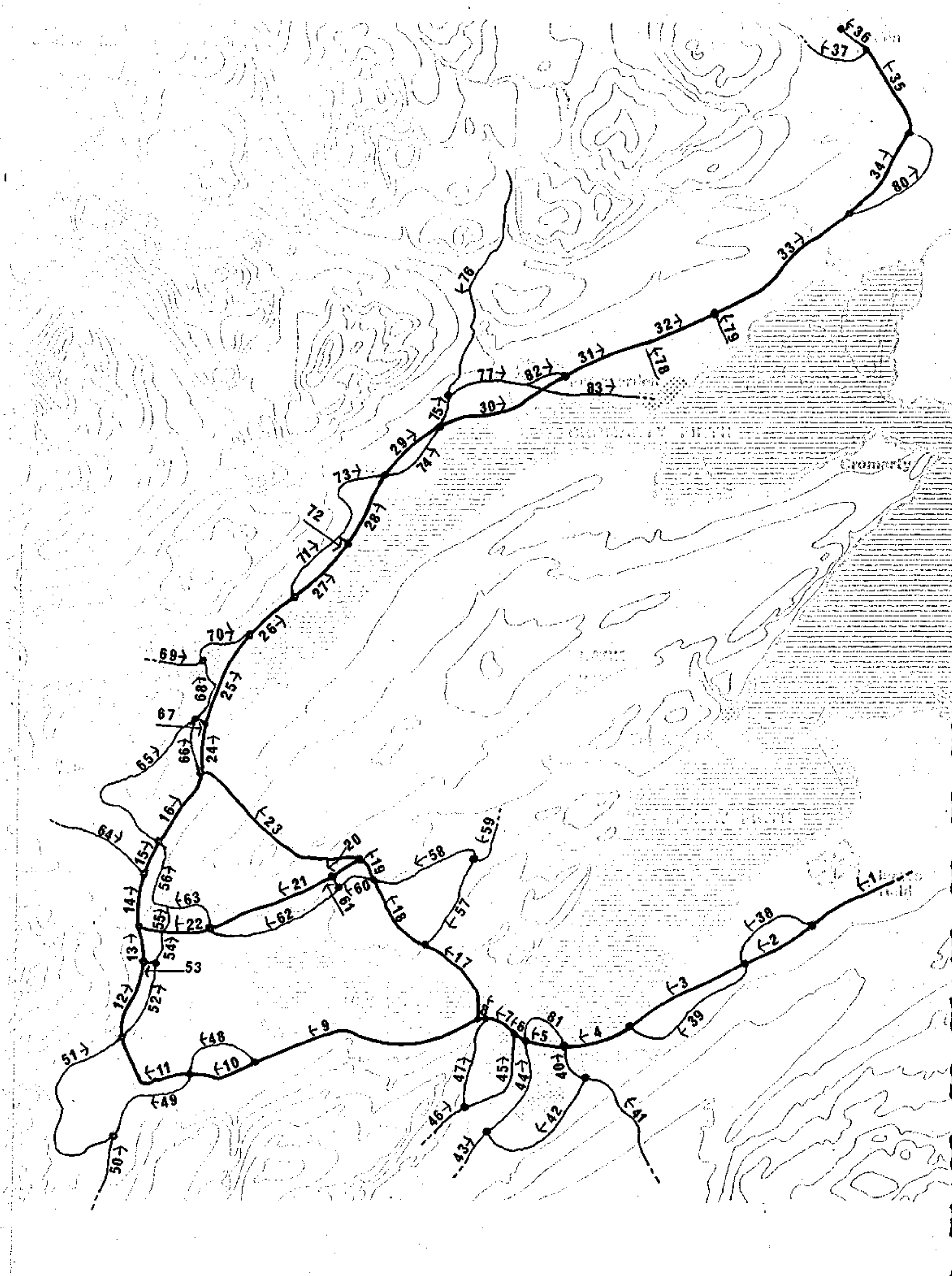
Car Ownership and Usage Characteristics.

Forecasts of the growth of car ownership of private motor vehicles may be conditioned by local restraints such as prospective price mechanisms in metropolitan areas, and the standard of alternative forms of travel. It is a fundamental objective of the strategy for the Moray Firth that people will be able to satisfy their desire to own and use private cars without external restraints. The prediction of ownership for this situation has been made by J. C. Tanner of the Road Research Laboratory.

The latest forecasts made by the Road Research Laboratory indicate that car ownership will treble by the end of the century and total vehicle ownership will increase at a nearly comparable rate. The rise in vehicle ownership is postulated to be a logarithmic curve, based on present values and recent rates of increase, and controlled by a saturation level. The forecast for Great Britain shows that the number of vehicles in the year 2010 may be 41 million compared with 13 million in 1966 and the comparable values for cars may be 35 million and 9.5 million. If this forecast for Great Britain is related to vehicles per head of population then the values obtained and the resultant graph are as shown below:

Year	1966	1971	1981	1991	2010
Vehicles per Head	0.25	0.32	0.44	0.49	0.52
Cars per Head	0.18	0.25	0.37	0.42	0.45





LINK NUMBERS .2

As the completion date of the plan to be tested is not known at this stage, the saturation level of car ownership of 0.45 cars per person was adopted.

Male and female worker car ownership, car availability and car usage factors related to this level of car ownership which have been applied are:

	Cars Owned Per Worker	Cars Useable Per Worker	Car Usage Factor
Male Worker	1.3	1.0	70%
Female Worker	0.51	0.51	50%

Gravity Model Distribution Procedure

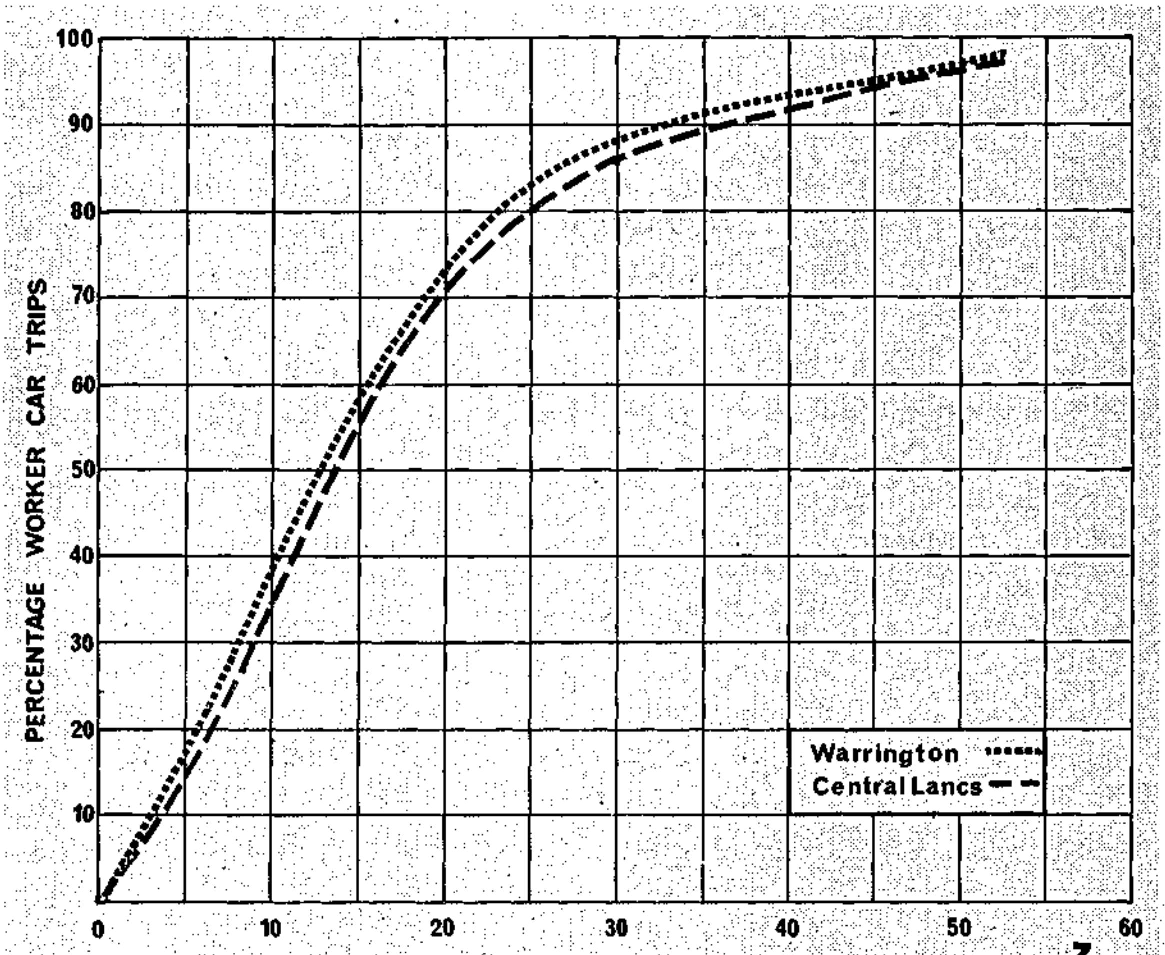
Each link of the network was given a number and an arbitrary positive direction (drg. No.2) which in conjunction with journey time to travel from the centroid of any link to the centroid of any adjacent link enable the network to be described completely and unambiguously with a series of numbers. This was a prerequisite for the network assignment to be done on computer. Each zone was then proportionately related to one or more links within the network. When combined, these factors enabled the quickest routes from each origin zone to each destination zone to be calculated. The quick route table is incorporated in the equation used to distribute the total number of trips entering or leaving each zone.

The 'gravity model' equation used was:

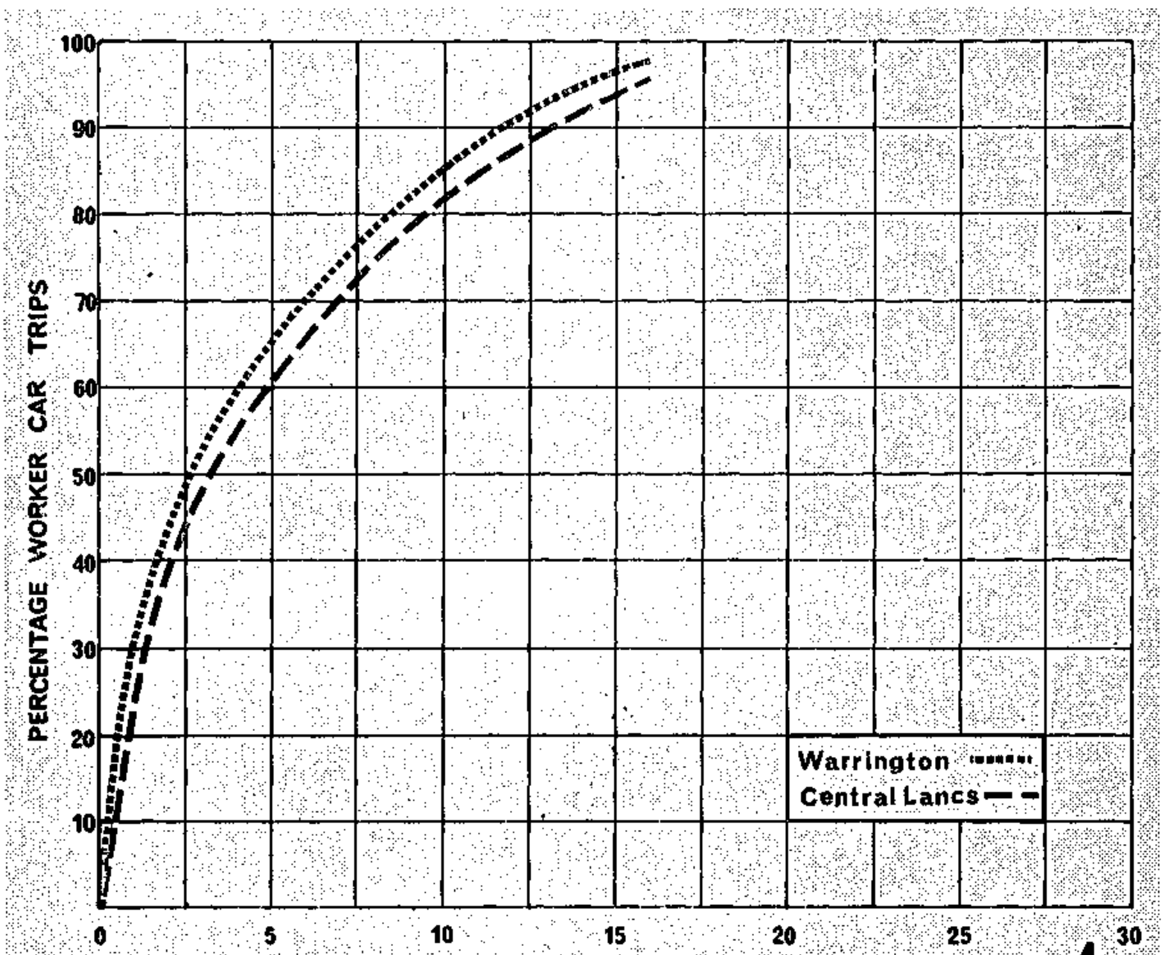
$$Tij = Oi \times \frac{\dfrac{Dj}{dij^{p} \times r^{(q \times dij)}}}{\sum_{j=1}^{n} \dfrac{Dj}{dij^{p} \times r^{(q \times dij)}}}$$

Oi = total trips from zone i
Dj = " " to " j
Tij = trips from Zone i to zone j
dij = quickest journey time between zone i and zone j.
(measured in same time units as used in assignment programme)
p = constant (n)
q = " (λ)
r = napiers e = 2.718

The trip end totals in the Origin by Destination table were balanced by a simple iterative process until the error in any total was less than 3%.


PERCENTAGE WORKER CAR TRIPS
TRIP DURATION — MINUTES
Warrington
Central Lancs
0
10
20
30
40
50
60
70
80
90
100

.3


PERCENTAGE WORKER CAR TRIPS
TRIP DISTANCE — MILES
Warrington
Central Lancs
0
5
10
15
20
25
30

.4

Work Journey.

Analysis of the behaviour of people driving cars to work in sub-regional studies in other areas has shown a remarkable uniformity.

Drg. 3 shows the distribution curve for work journey car driver trips in the Warrington sub-region and in the Central Lancashire sub-region on a base of journey time.

Drg. 4 shows the distribution curve for the same car driver trips on a base of journey distance.

The correlation of these curves has been confirmed in other studies and indicates a universal stability of work journey driver behaviour which is irrespective of location.

In order to calibrate the gravity model to represent distribution curves for the Moray Firth which took into account the characteristics of both the time based and distance based curves from other areas, eight distributions of male workers and four distributions of female workers were done, using differing values of p and q in the mathematical expression of the form of gravity model used in the study and these values were as follows:

DISTRIBUTIONS

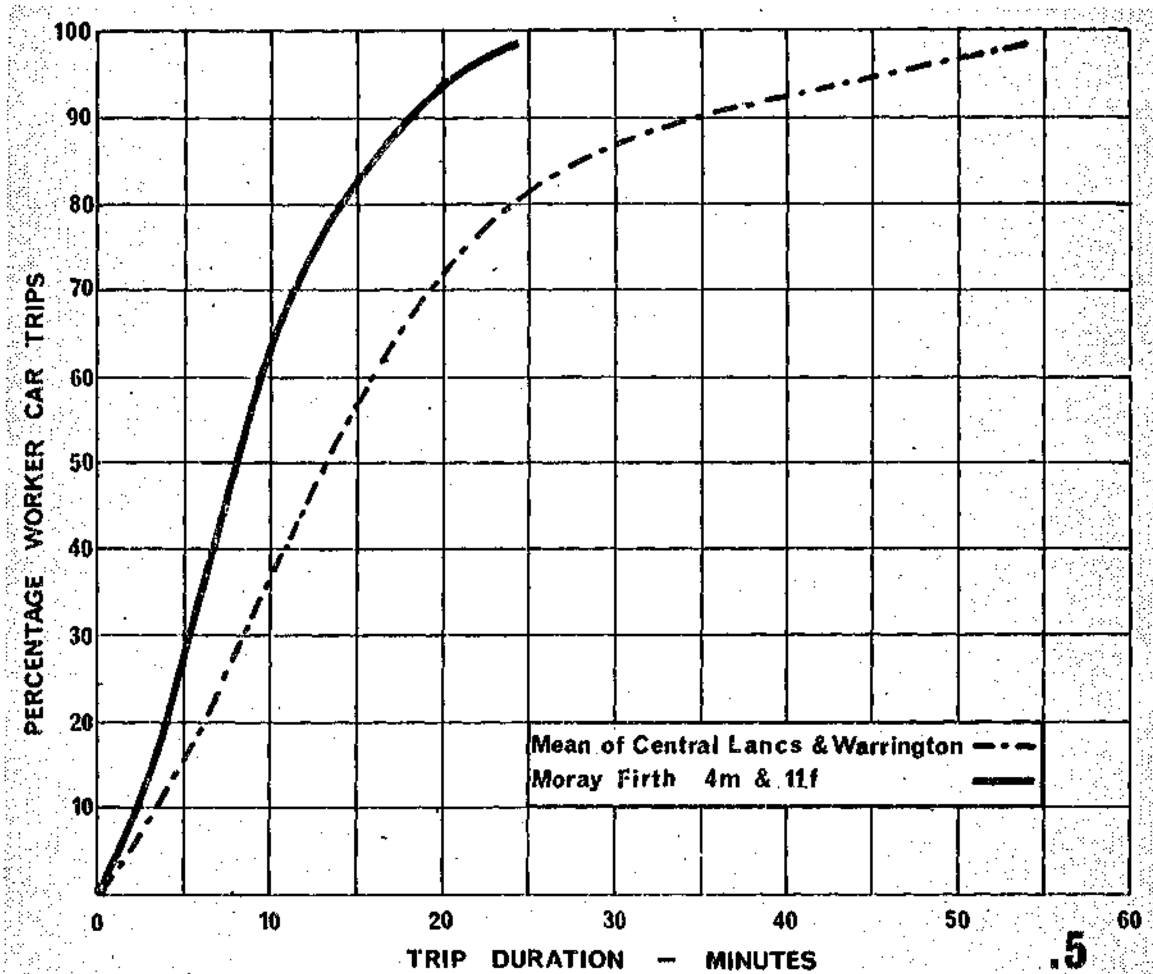
Model	1m	2m	3m	4m	5f	6f	7m	8m	9m	10m	11f	12f
p	0	0	0	0	0	0	0	0	1	1	0	1
q	0.01	0.01	0.02	0.02	0.02	0.03	0.005	0.03	0.01	0.005	0.04	0.03
min	100	10	100	10	10	10	100	100	100	100	10	10

These distributions were done on a KDF9 computer at Glasgow University.

From these distributions the combination of number 5 (female) and number 7 (male) was found to give a good fit to the time-based curves of the other studies and the combination of number 4 (male) and number 11 (female) was found to give a good fit to the distance based curve of the other studies.

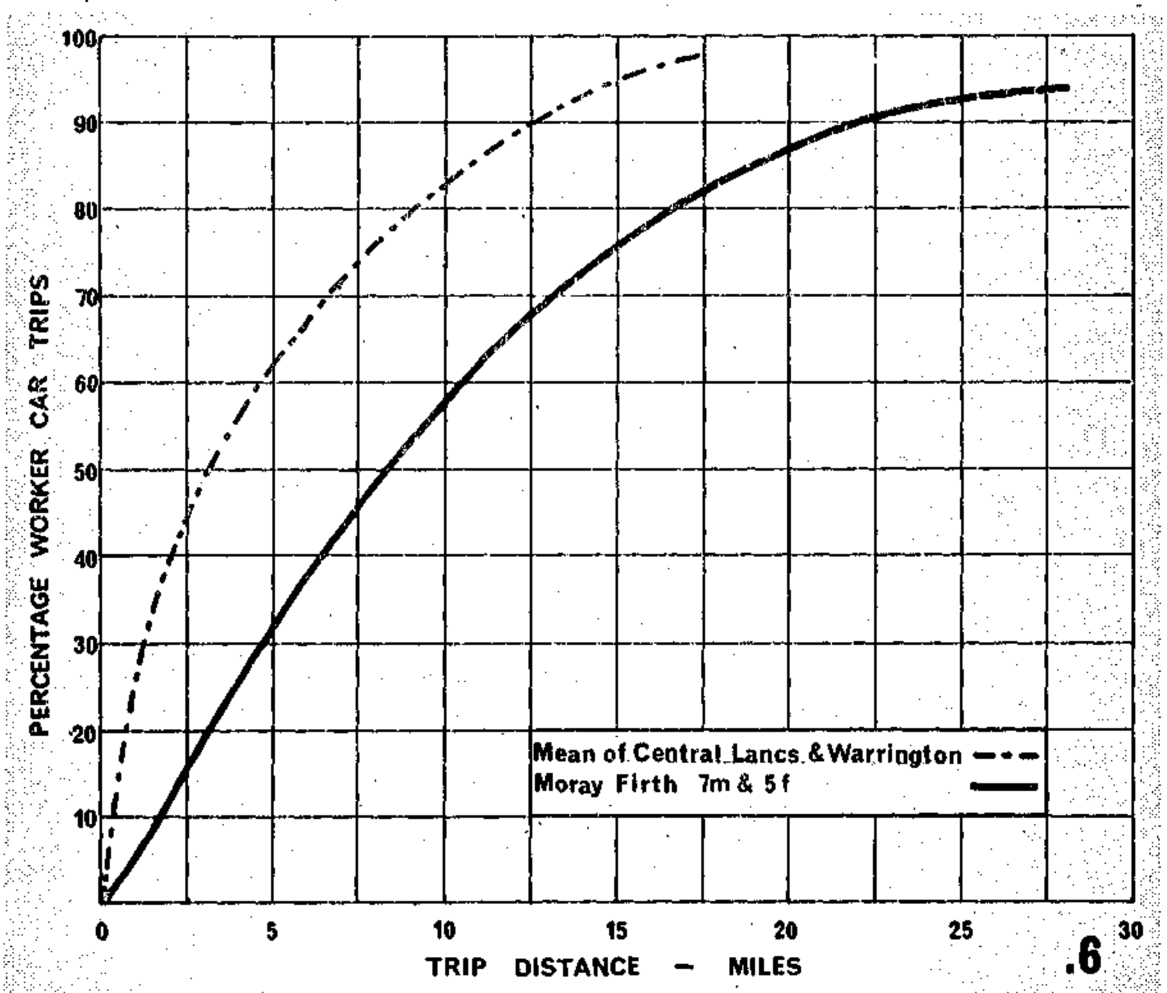
The theoretical research into town form which preceded the formulation of the transportation philosophy for the Moray Firth *confirmed that variations in efficiency of the road network do affect the shape of the distance-based curve for a particular time-based curve. The transport form chosen for the Moray Firth was the most efficient of the various forms examined in the research; hence, it was anticipated that adoption of the time-based curve shown in Drawing 3 for the Moray Firth would result in a distance based curve, flatter than those shown in Drawing 4/

* Ref "Urban Studies" November, 1967.



PERCENTAGE WORKER CAR TRIPS
TRIP DURATION — MINUTES
Mean of Central Lancs & Warrington
Moray Firth 4m & 11f

.5



PERCENTAGE WORKER CAR TRIPS
TRIP DISTANCE — MILES
Mean of Central Lancs & Warrington
Moray Firth 7m & 5f

.6

/Drawing 4 and conversely the adoption of a distance-based curve, such as that shown in Drawing 4 for the Moray Firth would result in a time-based curve steeper than those shown in Drawing 3.

This was confirmed, and Drawing 5 shows the relationship between the time-based curve of the Moray Firth and those of the other areas, when the distance-based curves of the other areas are adopted for the Moray Firth. Drawing 6 shows the relationship between the distance-based curves of the Moray Firth and those at the other areas when the time-based curves of the other areas are adopted for the Moray Firth.

This postulates a range of distribution behaviour for work travel on the Moray Firth road network. At one end of the range (Drg. 5) workers are assumed to travel the same distance as in other areas, with consequent savings in travel time. At the other end of the range (Drg. 6) workers are assumed to travel for the same times as in other areas, with consequent increase in distances.

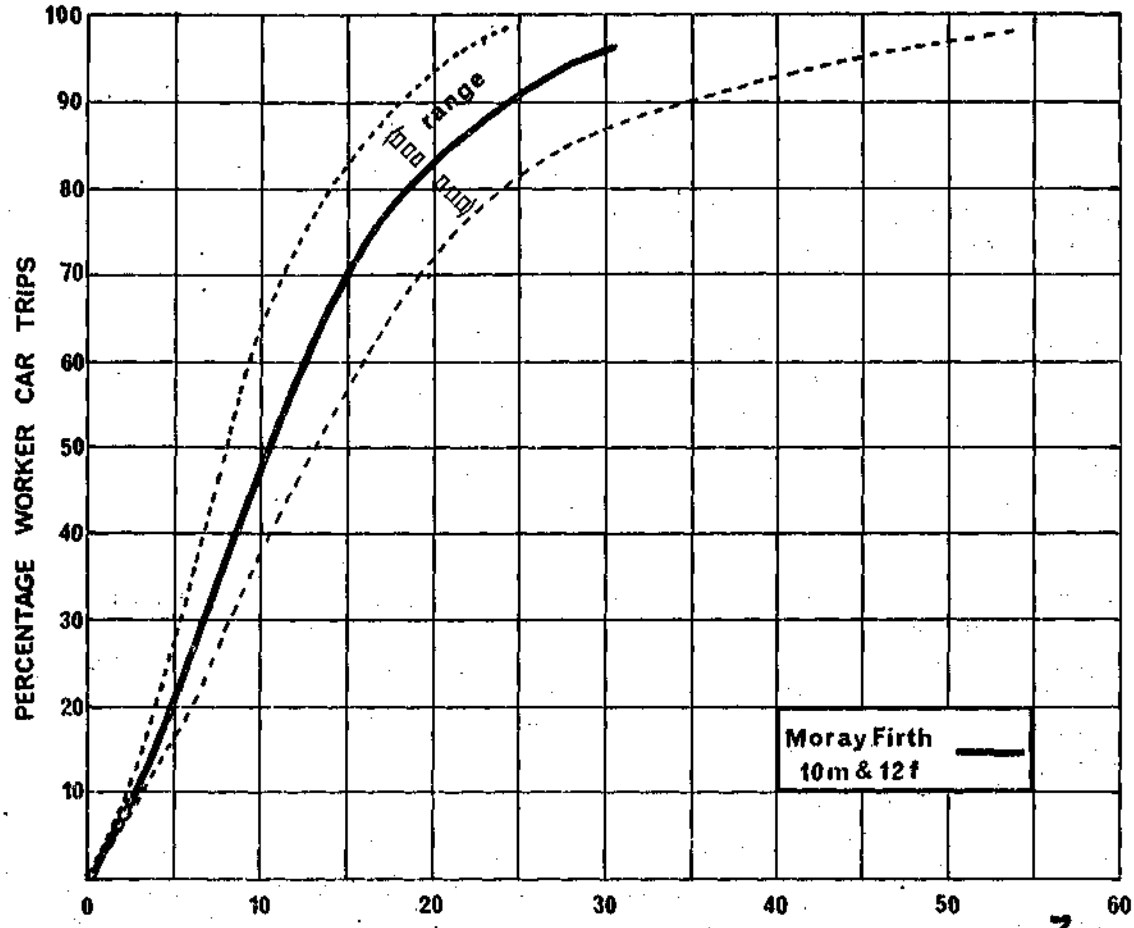
The reduction in travel times (Drg. 5) assumed by adopting the stable distance curves will be modified by the ability to travel further within the demonstrated acceptable journey times, hence taking advantage of the range within which work opportunities are attractive.

Also the increase in distances (Drg. 6) travelled within the stable time curve will result in increased car running costs, and this will have a modifying influence on this assumption.

These modifications suggest that the most probable distribution for the Moray Firth Structure is somewhere between the assumption of Figures 5 and 6. Hence an intermediate time-based curve was also chosen, with its attendant intermediate distance-based curve. (Figures 7 and 8). The intermediate curve was obtained by combining distribution number 10 (male) and number 12 (female). In order to examine the full range of probability, assignments to the network were made, using the distribution at each end of the range as well as the intermediate distribution.

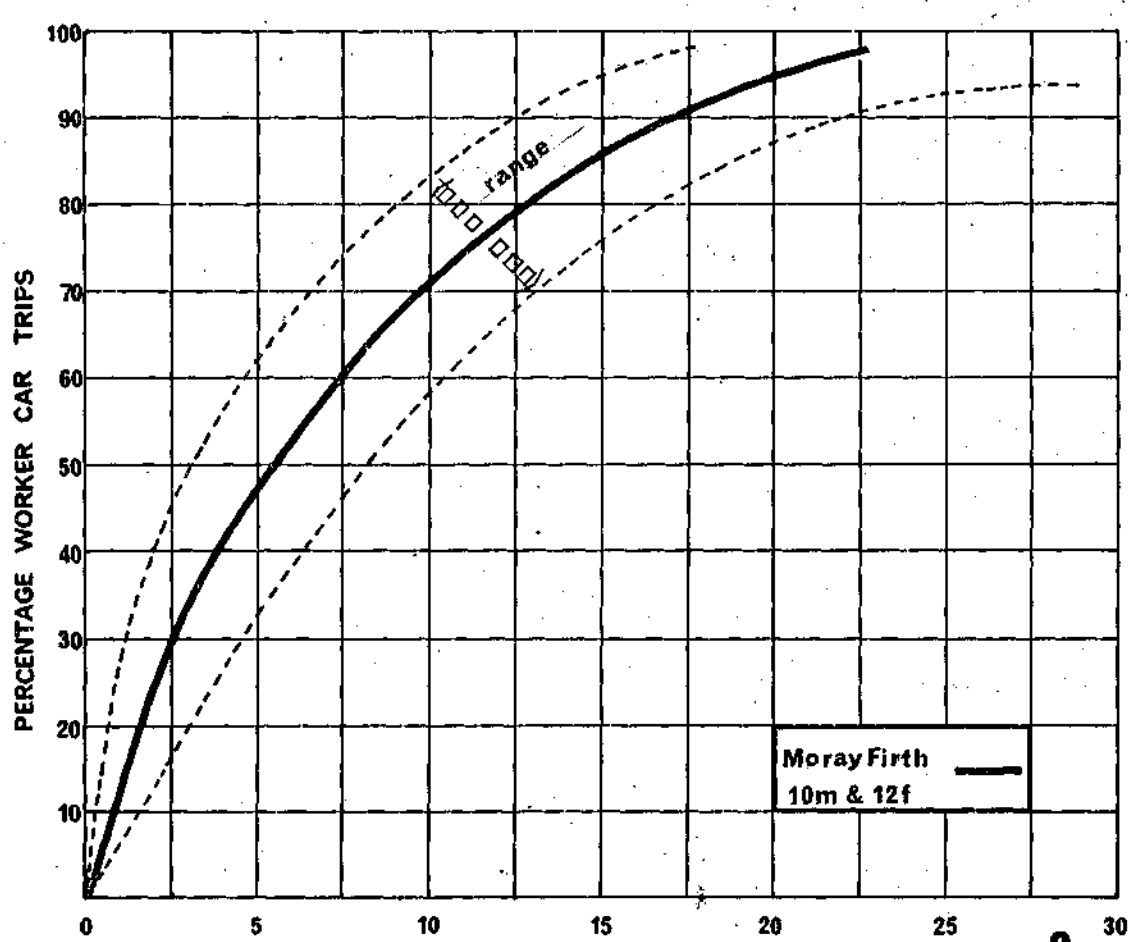
The assignments were made by taking the trips from each origin zone to each destination zone along the links in the network which constituted the quickest route between the two zones.

The pattern of movements derived from the intermediate curve was used as the basis for the assigned car-driver work-journey trips in the next stage which was the determination of peak hour work journey traffic and the addition of allowances for other traffic.



PERCENTAGE WORKER CAR TRIPS
TRIP DURATION — MINUTES
range
Moray Firth
10m & 12f

.7



PERCENTAGE WORKER CAR TRIPS
TRIP DISTANCE — MILES
range
Moray Firth
10m & 12f

.8

Work Journey - Peak Hour Flow Relationship.

The percentage of car driver work trips which occurs in the evening peak hour is, to a large extent, depedent on the employment structure of the area, and values for other areas range from 50% to 60%. In order to test the maximum the figure of 60% was adopted for this study.

From surveys in other areas we know that car driver work trips make up 65% to 73% of total passenger car units in the peak hours. For this study a figure of 70% has been adopted excluding seasonal tourist traffic.

One other factor to be considered is the volume of seasonal tourist traffic on the network during the peak hour. From existing national census point figures which are available, it was possible to elicit present day flows for tourist traffic and these were expanded in relation to the projected increase in national car ownership and added to the work journey loading on the network.

Predicted Traffic Flows on Network.

The assumptions in the above section, when applied to the assigned work journey car driver trips gave the total peak hour flows on the system in passenger car units. Table 9 lists these flows by link numbers and should be read in conjunction with drawing 2 which locates the links.

TABLE 9.

Link No.	Evening Peak Flows In Passenger Car Units				Road Requirements		Percentage Overloading
	Positive Direction IN	Positive Direction OUT	Negative Direction IN	Negative Direction OUT	24' S/C	24' D/C	
1	450	450	450	450	*		
2	450	450	450	450	*		
3	2676	2676	450	450		*	
4	3029	3029	2240	2240		*	1
5	4021	4021	2686	2686		*	
6	6880	6880	2665	2665	INVERNESS		
7	5632	5632	3220	3220	BURGH		
8	5100	5100	3534	3534			
9	1160	1160	897	897	*		12
10	547	547	606	606	*		
11	641	641	1642	1642		*	
12	347	347	1962	1962		*	
13	2087	2087	850	850		*	
14	1476	1476	913	913	*		15
15	1176	1176	613	613	*		12
16	633	633	1245	1245	*		12
17	4135	4135	2831	2831		*	38
18	3425	3425	3333	3333		*	14
19	2940	2940	2670	2670		*	
20	957	957	648	648	*		
21	802	802	648	648	*		
22	603	603	1278	1278	*		13
23	2469	2469	2464	2464		*	
24	2544	2544	3347	3347		*	11
25	1745	1745	3973	3973		*	32
26	1691	1691	4217	4217		*	40
27	1330	1330	4088	4088		*	36
28	926	926	4774	4774		*	59
29	977	977	2950	2950		*	
30	850	850	2525	2525		*	
31	928	928	3610	3610		*	20
32	1880	1880	2004	2004		*	
33	2836	2836	310	310		*	

TABLE 9 (Cond.)

	Evening Peak Flows In Passenger Car Units				Road Requirements		Percentage
Link No.	Positive Direction IN	OUT	Negative Direction IN	OUT	24' S/C	24' D/C	Overloading
34	800	800	150	150	*		
35	930	930	225	225	*		
36	930	100	100	225	*		
37	150	150	150	150	*		
38	0	3086	0	0		*	3
39	873	366	1792	0		*	
40	418	1950	2415	2290		*	
41	450	450	450	450	*		
42	2291	54	512	418		*	
43	150	150	150	150	*		
44	54	1583	636	512		*	
45	28	322	2121	41		*	
46	200	200	200	200	*		
47	41	148	995	28	*		
48	617	438	589	293	*		
49	906	10	12	114	*		
50	100	100	100	100	*		
51	10	70	571	12	*		
52	155	41	354	42	*		
53	3046	3046	193	193		*	2
54	0	432	0	3167		*	6
55	432	432	0	0	*		
56	290	126	822	205	*		
57	37	162	1373	41	*		37
58	41	196	1588	37		*	
59	100	100	100	100	*		
60	672	1378	130	2243		*	
61	332	332	444	444	*		
62	1533	146	654	174		*	
63	406	60	407	86	*		
64	300	300	300	300	*		
65	606	167	1401	127	*		40

TABLE 9 (Cond.)

	Evening Peak Flows In Passenger Car Units				Road Requirements		Percentage
Link No.	Positive Direction IN	Positive Direction OUT	Negative Direction IN	Negative Direction OUT	24' S/C	24' D/C	Overloading
66	227	33	160	30	*		
67	296	296	1721	1721		*	
68	277	48	234	214			
69	100	100	100	100	*		
70	48	161	459	234	*		
71	859	185	417	0	*		
72	125	125	1215	1215	*		20
73	404	51	1155	174	*		15
74	0	1127	0	2779		*	
75	1245	1245	425	425	*		25
76	200	200	200	200	*		
77	1045	157	1067	225	*		7
78	0	2579	0	66		*	
79	0	2645	0	0		*	
80	2052	147	84	167		*	
81	0	1931	3	1012		*	
82	90	90	1126	1126	*		13
83	168	0	66	43	*		

The following capacity standards are taken from Tables 1-4 and 1-5 of "Roads in Urban Areas" - H.M.S.O. 1966.

Note 1. 24' free flow two-way carriageway ... 1,000 p.c.u's in one direction.
Dual 24' free flow carriageways ..... 3,000 p.c.u's in one direction.

The percentages shown in table 9 are related to these capacities.

Note 2. Loading on Primary Distributor roads refer only to the Section of the road adjacent to the Fast road and they will not necessarily be valid over the whole length.

Road Requirements.

Ignoring the "Tore Option" and the direct road link from Inverness to Conon Bridge, our analysis shows that the provision of a free flowing dual two lane carriageway Fast Road from Inverness to north of Invergordon would result in peak hour loadings which would exceed the 3,000 p.c.u.'s recommended by the Ministry of Transport by 59% on one section (Link No.28) and by various amounts under 50% on other sections excluding Inverness Burgh. We know, however, that loadings 50% above the recommended figure can be accommodated reasonably at peak periods.

Including the "Tore Option" and the direct road link from Inverness to Conon Bridge the loadings on the direct link road would be adequately catered for by a free flowing dual two-lane carriageway with up to 37% over-loading. In this case, however, the Fast Road from Inverness to Muir of Ord via Beauly would no longer justify the provision of dual carriageways as so much traffic would be drawn off it and onto the direct road across the Firth to Conon Bridge. The Fast Road from Muir of Ord to north of Invergordon would be dual two lane as before. However, the Tore Option is so speculative at this stage that we do not recommend any change in the current proposal to provide dual carriageways from Inverness to Muir of Ord.

The primary distributor requirements shown in Table 9 refer only to the section of road immediately adjacent to the Fast Road. The detailed requirements along the total length of each distributor will depend on the individual settlement plan and, therefore, as each settlement layout is determined a detailed traffic analysis should be carried out as we have done for the Alness Settlement.

The location studies for the Fast Road and the Primary Distributor roads have been done on 1/25,000 scale with reference to a 1/2500 contoured base at particular locations. (These 1/2500 contoured drawings were prepared specifically for this study and are the first to give all details in the metric scale. All engineering dimensions and design for this study are in metric units with the exception of carriageway widths for which no metric design values have yet been issued.)

TRAFFIC ANALYSIS OF ALNESS STRUCTURE PLAN

Introduction:- Alness (zone 25 in the regional testing tabulations) was broken down into 22 internal zones and three route zones as shown on the plan opposite.

Zone Content:- From the basic population figures for each zone, and applying the service/manufacturing and male/female proportions as used in the regional testing section, tables of the workers and jobs in each zone were prepared (Table 1 & 2). The commuting to and from the route zones was obtained from the regional distribution.

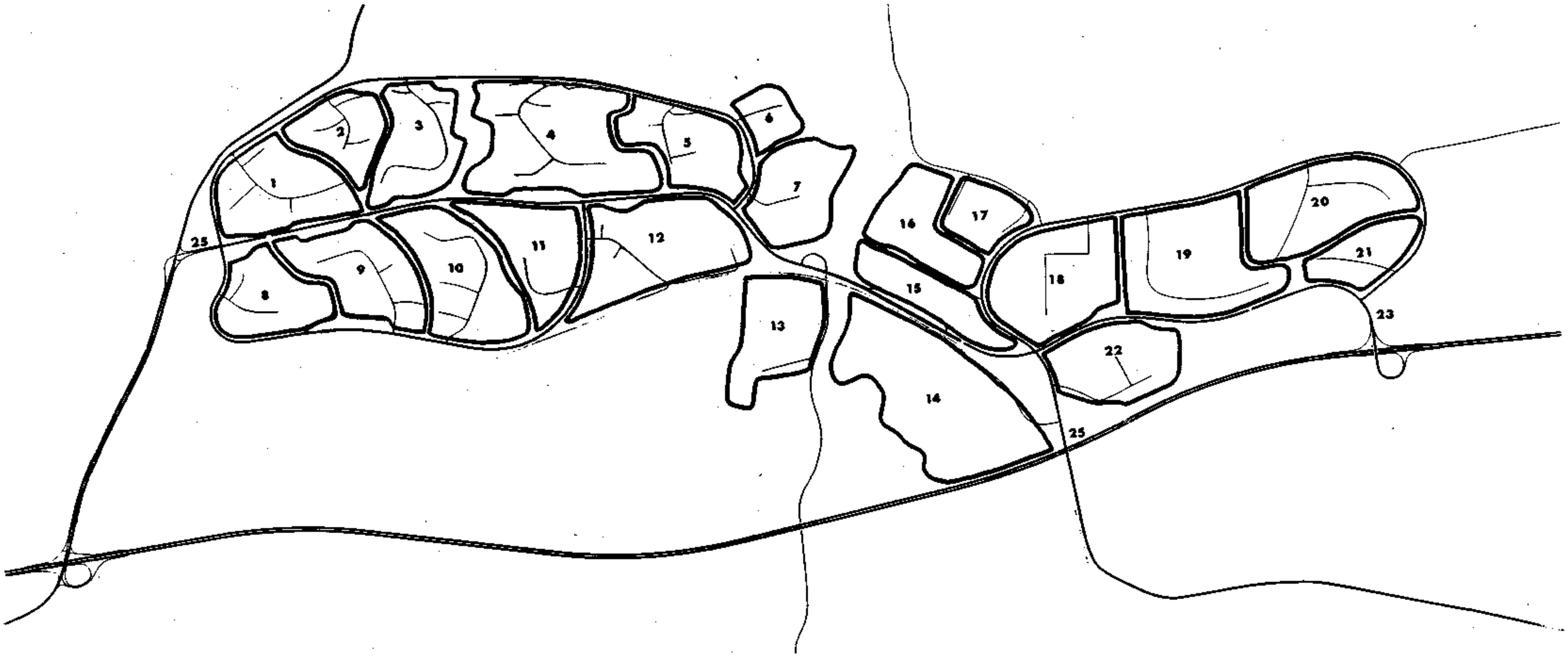
Distribution:- The distribution of workers to jobs within Alness was related solely to the job opportunities as journey times within the town will be small and will not influence workers in their choice of employment.

Assignment:- The distribution of the worker car driver trips was assigned to the network using the quickest route between origin zone and destination zone. The peak hour flows in the network were then calculated using Peak Hour/Worker Car Trips relationships as detailed in the regional section. These peak hour flows are shown in table 3 and should be read in conjunction with the Link Number Drawing.

Road and Junction Requirements.

Primary Distributor:- Within the acceptable degree of overloading (50%) at peak periods the traffic volumes on this road can be accommodated on a single 24 ft. wide carriageway. This width will be increased at junctions with the local distributors and town centre access roads to give additional lanes for channelisation of turning vehicles.

Local Distributor:- Single 24 ft. wide carriageways can accommodate all the forecast traffic volumes on the Local Distributors and no special treatment will be required at junctions with the Housing Feeder Roads.



ZONE NUMBERS

TABLE 1.

1. Male jobs by zone.
2. Male workers by zone.

Sub Zone No.	Male Jobs	Male Workers	Sub Zone No.
1	101	305	1
2	50	189	2
3	56	211	3
4	123	457	4
5	29	109	5
6	60	224	6
7	42	159	7
8	49	185	8
9	79	225	9
10	72	273	10
11	27	-	11
12	84	317	12
13	138	-	13
14	27	-	14
15	703	57	15
16	82	269	16
17	35	131	17
18	92	342	18
19	92	342	19
20	134	423	20
21	31	115	21
22	43	160	22
23	1,368	84	23
24	1,348	290	24
25	12	10	25
Totals	4,877	4,877	Total

TABLE 2.

1. Female Jobs by Zone.
2. Female workers by Zone.

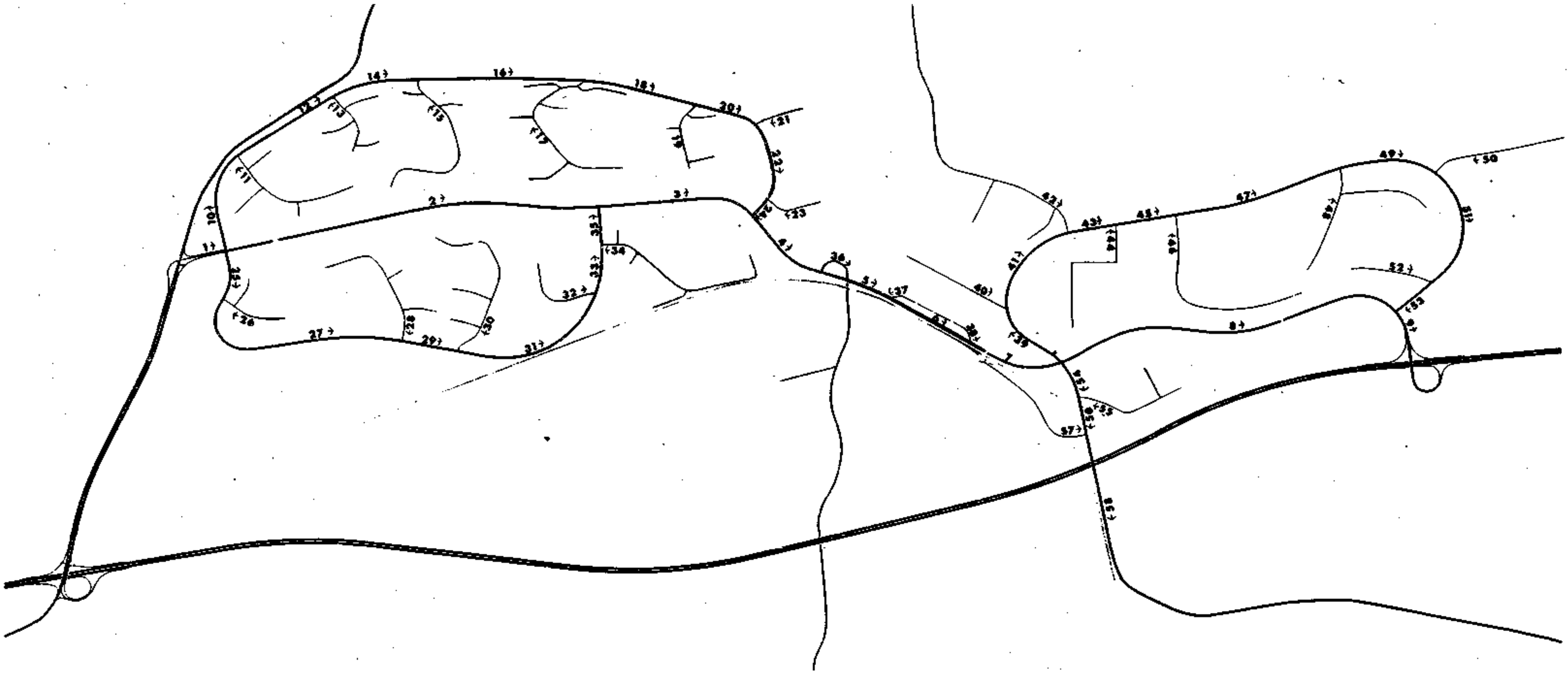
Sub Zone No.	Female Jobs
1	39
2	6
3	6
4	14
5	38
6	7
7	5
8	6
9	37
10	8
11	43
12	9
13	62
14	43
15	1,077
16	8
17	19
18	10
19	10
20	47
21	4
22	5
23	912
24	554
25	30
TOTAL	2,999

Female Workers	Sub Zone No.
185	1
114	2
129	3
279	4
64	5
136	6
94	7
111	8
142	9
168	10
-	11
193	12
-	13
-	14
33	15
163	16
79	17
186	18
210	19
258	20
70	21
95	22
44	23
230	24
16	25
2,999	TOTAL

TRAFFIC FLOWS: TABLE 3.

Link No.	Evening Peak Flows Passenger Car Units	
	Positive Direction	Negative Direction
1	1015	191
2	714	639
3	725	1051
4	648	1500
5	629	1432
6	730	1203
7	773	981
8	261	1034
9	48	1169
10	653	123
11	74	254
12	434	84
13	33	155
14	297	69
15	38	175
16	137	46
17	78	382
18	61	274
19	27	88
20	73	347
21	40	189
22	89	512
23	29	132
24	103	629
25	284	65
26	32	152
27	141	42
28	58	190
29	99	132
30	46	231

Link No.	Evening Peak Flows Passenger Car Units	
	Positive Direction	Negative Direction
31	59	277
32	29	0
33	81	270
34	57	269
35	122	523
36	112	0
37	284	17
38	283	18
39	634	141
40	245	227
41	629	118
42	24	110
43	532	107
44	60	280
45	276	71
46	60	286
47	92	113
48	94	347
49	73	347
50	0	0
51	73	347
52	21	94
53	82	430
54	138	66
55	29	132
56	8	38
57	29	0
58	8	9



LINK NUMBERS

ALNESS ENGINEERING DESIGN

The location studies for the Distributor roads within Alness considered in detail the engineering alignments and profiles.

The design standards adopted for each category of distributor are shown below:-

Primary Distributor

General Geometry:

Design Speed	65 k.p.h.
Minimum horizontal curvature	10° 40'
Maximum gradient	5%
Maximum superelevation	5%
Minimum sight distance = stopping distance	80 m
Passing sight distance	360 m
Normal cross-fall	$2\frac{1}{2}$%
Minimum vertical curvature	
(a) Summit for stopping sight distance	K=15
(b) Valley	K=10
Minimum gradient for drainage channel	0.8%

Super-elevation Treatment;

Up to and including 1° 0' curve - no change

1° 0' to 4° curve - reverse adverse camber over 200 ft. length commencing 100 ft. outside start of curve.

Super-elevation Rates for curves sharper than 4°

3% - 4.65° curve
4% - 6.2° curve
5% - 7.75° curve or over

Super-elevation established by raising outer kerb above inner kerb.

Adverse camber to be taken out before start of transition curve or (if none) before start of circular curve.

Max. rate of change of super-elevation on open road - 1% per 12m.

Local Distributor

Design speed	50 k.p.h.
Minimum horizontal radius	100 m
Maximum gradient	6%
Maximum superelevation	5%

Note: Where maximum gradient and maximum superelevation coincide one or other should be modified so that the resultant gradient obtained does not exceed 6%

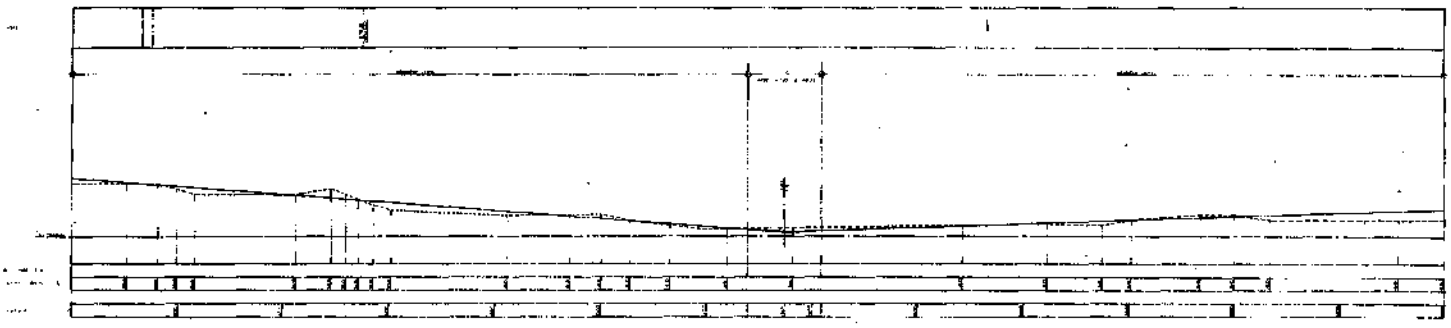
Minimum sight distance - stopping distance	50 m
Normal Cross-fall	3%
Minimum vertical curvature	K=8

Note: Attention should be given to the visual aspect of combinations of vertical and horizontal alignment particularly if minimum standards are being used.

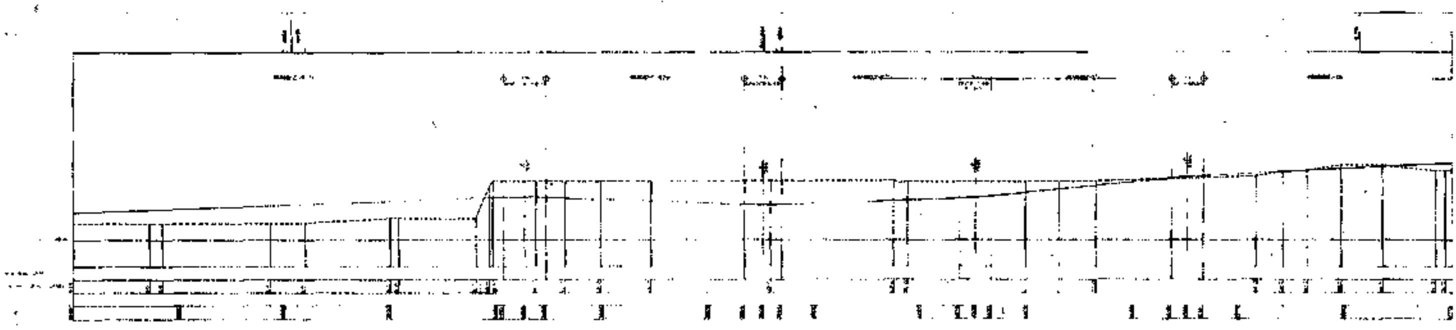
Minimum gradient for drainage channel	0.8%

Junction with Primary Distributor - for 20m back from the edge of the Primary Distributor the gradient of the Housing Feeder should not exceed 3%

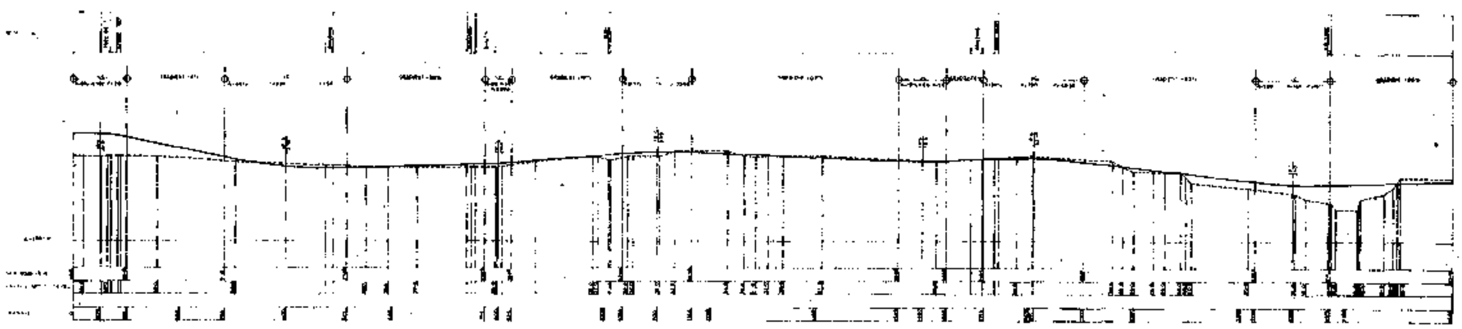
Within these standards but taking into consideration the planning, landscape and architectural influences, a geometric centre line and detailed profiles were designed. Photographic reductions of these designs for the Alness Distributor roads are shown in the three drawings which follow.



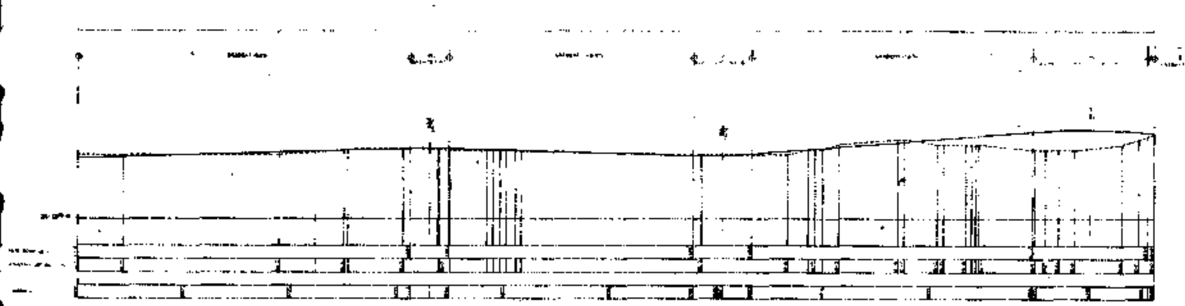
A 9 FAST ROAD SHEET 1



ALNESS FAST ROAD SHEET 2

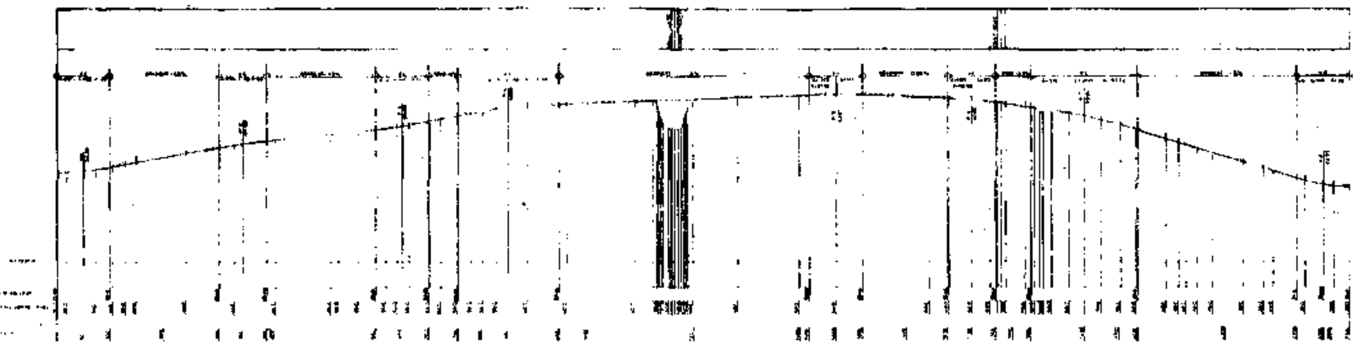


ALNESS PRIMARY DISTRIBUTOR—SHEET 1

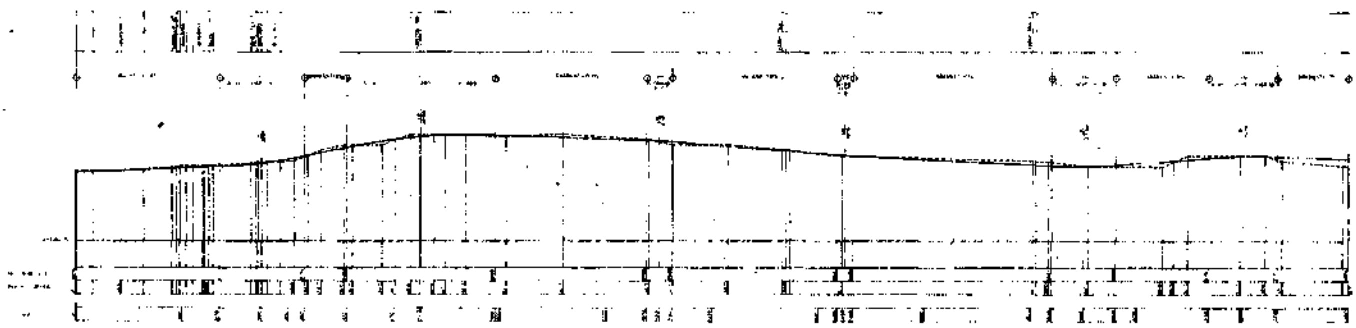


ALNESS PRIMARY DISTRIBUTOR—SHEET 2

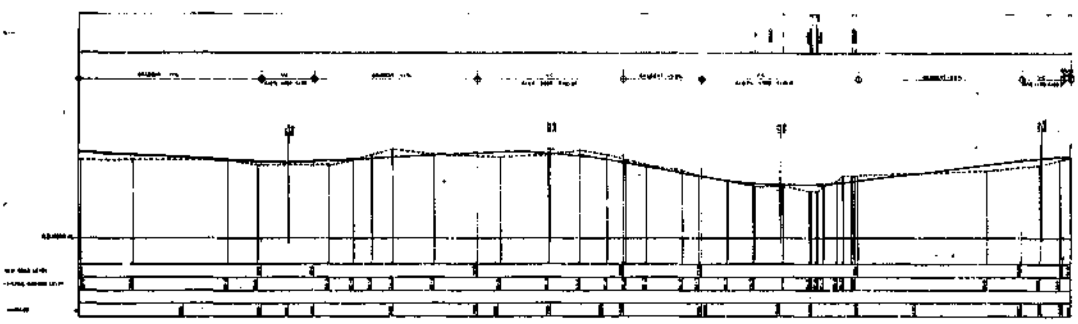
PROFILE DESIGN
sheet one



ALNESS NORTH WEST DISTRIBUTOR

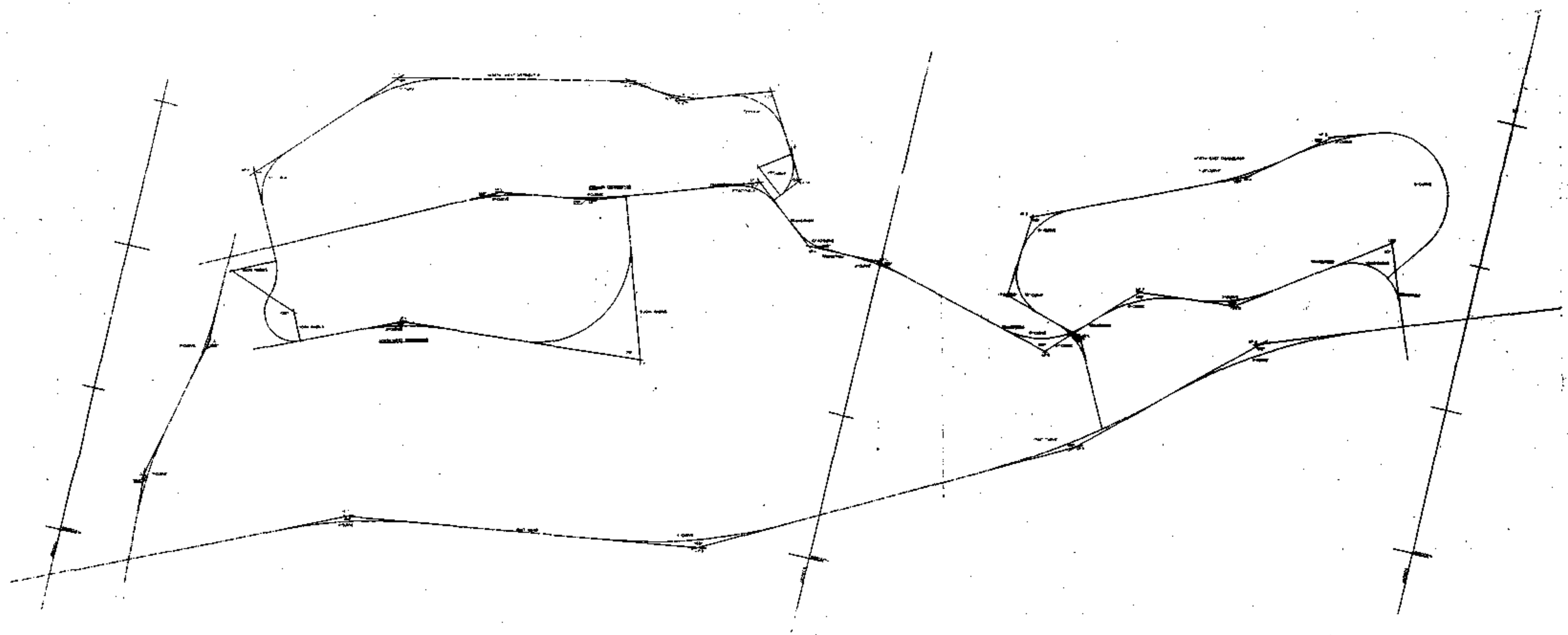


ALNESS NORTH/EAST DISTRIBUTOR



ALNESS SOUTH/WEST DISTRIBUTOR

PROFILE DESIGN
sheet two



GEOMETRIC LAYOUT

FURTHER STUDIES.

FURTHER STUDIES

Throughout the preceding sections of this Report reference has been made to particular places and particular problems which require further study. The following notes detail these:-

Group 1

Inverness) Dingwall) Invergordon)	The importance of preparing detailed planning studies of these towns has already been discussed. Each of these becomes urgent once a final decision to develop industry at Invergordon is made. The study of Dingwall should include Maryburgh and Conon Bridge.

Group 2

We have not been able in the time to make studies of the following villages and hamlets which are listed in a rough order of priority for study; the comments indicate the major reason.

Saltburn) Barbaraville) Balchraggan) Nigg)	effect of major industry nearby.
Cromarty) Rosemarkie) Fortrose) Jemimaville) Culbrokie) Portmahomack) Hilton of) Cadboll) Ballintore) Hill of Fearn)	recreational potential and/or residential sites.
Strathpeffer	Satellite community for Dingwall, Brahan and Muir of Ord.
Ardersier	Effect of airport, and Dalcross industry.
Fort George	because it's there.

Group 3

Structure plans similar to the Alness Study will be required for new and expanded settlements:-

Cromarty Firth	Beauly Firth	Moray Firth	Dornoch Firth
Muir of Ord	Beauly	Balloch	Tain
Evanton	Kirkhill		
Brahan	Aultfearn		
Fearn	Belladrum		

Black Isle

Tore Option (Redcastle
(Munlochy

Such detailed plans will not be required until it is more certain that development will take place.

Group 4

Land analysis. This study would be initiated to ensure that the effects of intensive urban development on the surrounding countryside is understood; for example, disturbance of land ecology and top soil, the effects on agriculture and the changing pattern of recreation; and the possibilities of land reclamation.

Group 5

Implementation. Considerable further detailed work will be required in relation to housing, landscape, service provision and transportation when the size, date, and type of industrial development is firmly known.

PART SEVEN

APPENDICES

CONTENTS.

APPENDIX 1.

HIGHLANDS and ISLANDS DEVELOPMENT BOARD'S REMIT to the GROUP.

REMIT

ALNESS

1. You will produce a Master Plan and Report for the development of a town of about 15,000 inhabitants in the Alness area. The work will consist mainly of testing the planning principles which were used in the intuitive settlement plan for the Alness area in our June Progress Report. The Master Plan will be drawn to a scale of 1/2500 and will show the location of residential and other major land uses and the circulation patterns which will serve them. It is to be supported by other drawings to suitable scales illustrating recommendations for exploiting the characteristics of the area, views, shelter, slopes and landscape potential. This will include pictorial representation of the layout of a typical residential area of about 100 houses to a scale of say 1:500 showing the planning principles, as part of the testing process. It is understood that this support material is part of a planning commission only and that it will not necessarily be capable of immediate translation into working documents for actual construction.

2. The Master Plan and other drawings, together with the written report will contain sufficient material to allow the proposals to be explained and defended at a public inquiry.

3. The material submitted will include:-

(i) Analysis of topography, microclimate and vegetation, to identify areas of containment in terms of shelter, protection, views and aspect; and of

(a) the soil survey and analysis carried out by the Macaulay Institute and called by them "Land Capability Studies" of Alness, Dingwall, Beauly (and possibly the Black Isle) as carried out during 1967, and

(b) the Department of Agriculture Maps showing Agricultural Land Classification - (as revised by them in 1967) - so far as these are available; and

(c) the relationship of these Studies to the infrastructure design.

(ii) Analysis of existing settlements to determine spare capacity of existing schools, shops and other community and social facilities and the implications of these on the proposed development.

(iii) Study of particular land requirements for industry, housing, education, recreation, other social provisions; <u>and their effect on agricultural land use</u>.

(iv) The following traffic studies will be included:-

Prediction of vehicle ownership.
Analysis of vehicle usage for journey to work.
Assignment to selected roads in structure plan.
Testing of route locations on ground contour base.
Draft geometric design.
Draft profiles.
Cost implications of road network.
Phasing.

(v) Traffic in typical housing layout - statement of standards on residtial roads in respect of Housing catchment, geometric plan and profiles, garaging, parking, manoeuvring, visibility, vehicle/pedestrian segregation, protection from noise and nuisance. Application of those standards to typical housing layout.

(vi) Synthesis of the above studies of land, social structures and transportation taking account of economic considerations and leading to the identification of localities or stages in the development of the Town.

4. An approximate estimate of the infra-structure costs at Alness will be given. A broad indication should be included of the costs of using any alternative sites of contrasting agricultural value. The choice of Alness as a site and the choice of 15,000 as a suitable size of population arise from the sub-regional studies.

SUB-REGIONAL PLAN

1. During the same period of six months you will prepare a sub-regional plan which will demonstrate the development potential and population capacity of the Moray Firth Development Area. The work is to consist mainly of testing the planning principles which were adopted in the intuitive draft plan in the June Progress Report. The plan to be submitted is to be drawn to a scale of 1:25000 (or approximately 2½" to one mile) and it will provide a physical framework, a stimulus and a check on future development in the area. Together with its supporting drawings and written Report it will give sufficient material to justify at a public inquiry the choice of sites for major land uses and the settlement hierarchy in the area, and to allow the proposals to be promoted with local and central authorities and industrialists.

2. Your preliminary reports have shown a form of plan which allows flexibility of implementation throughout a development period of twenty to thirty years. The second report is to indicate the kind of constraints that the settlement patterns will have on each other and on the rate of population growth and distribution, and, therefore on the phasing of development.

3. The plan and report will illustrate the areas suitable for development and the circulation pattern which should link them to each other and to the region. The practicability of the choice of sites, of their main social provisions and of the transportation proposals will be tested and statistical and other evidence of this testing will be given either in the body of the Report or in appendices.

4. While the planning principles used at Alness may be typical for most new development in the towns and villages of the area, the towns of Dingwall and Inverness will be exceptional. You will carry out such physical, social and economic analysis of these towns as you consider necessary within the constraints of time and cost, to ensure that they will be capable of fulfilling the role assigned to them in the sub-regional Plan as social and administrative centres and as key points in the transportation pattern.

5. The studies will include:

(a) Land: Testing against air photos and contour maps (as available). Terrain and ground forms
A synthesis of the land surveys carried out by the Department of Agriculture and Fisheries for Scotland and the Macaulay Institute for Soil Research within the determined zones for building.

Profile and aspect in relation to development, local climate and exposure shelter belts, existing and potential, leading to confirmation of areas of containment.

Landscape implication of main route locations.

(b) Population: present structure by age and sex, population projections demographic studies of potential immigrant population.

Social, and demographic consequences of industrial development, viz: income, occupation and social requirements.

Physical settlement hierarchy as influenced by shopping and recreational movement patterns and locations, community facilities and industrial locations.

(c) Determination of land requirements including the testing of the allocation of land for the principal land uses, i.e. residential, industrial, commercial and major recreational open spaces, to indicate the approximate density capacity, the effect on agricultural land, and the requirements for major social and community facilities in the new development, as well as the amount of spare capacity which is available in existing services and facilities, and the impact of the new development on the existing communities.

(d) Traffic Studies:

Prediction of vehicle ownership.
Analysis of vehicle usage for journey to work.
Prediction of regional tourist traffic.
Assignment to trunk roads and primary distributors.
Testing of intuitive locations of main routes on ground contour base with draft geometric plans and profiles to suitable scales where necessary.
Definition of junction locations and types.
Definition of lane requirements.
Cost implications of transportation pattern.
Phasing of transportation system development.

(e) Approximate estimates of infra-structure costs at various phases of the plan (based on known figures for comparable projects).

6. You are not in a position to report fully on the specific 300 acres industrial site at Inverbreakie, but you will deal with the general suitability of this and other localities for various scales and types of industrial development.

APPENDIX 2.

PROPOSED "HOUSE BUILDING" PROGRAMME

A Report to the Jack Holmes Planning Group

by

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CONTENTS

OBJECT.

1. This report considers the implementations of a housebuilding programme of 22,000 units over 15 years. While the construction of these houses is regarded as the paramount objective, we have borne in mind also the importance of:

   (a) carrying out the programme with the most efficient use of resources to minimise costs;

   (b) employing the local resources of labour, management, materials; and

   (c) the houses being to such standards and conditions of tenure as to make them attractive to the potential employees of the industrial companies developing in the area. It is assumed that the majority of these employees will be Scots currently resident in other parts of Scotland - particularly the Central Belt - or South of the Border.

INTRODUCTION.

2. We first examine the proposed programme in the light of the housebuilding achievements within the area concerned over the past twenty years. We then proceed to an analysis of the estimated resource requirements of this programme and the possibilities of achieving economies which the adoption of industrialised building techniques would allow. The selection of one or more industrialised systems is then considered and the subsequent section discusses the client organisation and its possible relations with local authorities in the area. A final section offers conclusions.

PREVIOUS LEVEL OF OUTPUT

3. The starting point of this survey is an examination of the past performance of the housebuilding industry in the area likely to be affected by the proposed building programme in the Moray Firth Area. The chief objective of this is to put the suggested annual programme of 1,000 for five years rising to 1,700 houses for the remaining 10 years in the perspective of past achievements.

It is recognised that the effects of the proposed development will not be confined to the immediate Invergordon area. They will affect the pressure on the building industry throughout the country though such effects may be expected to vary inversely with the distance from the scene of development.

4. In order to give a better picture of the dimensions of the problem of the proposed building programme, the past performance of the building industry in the North has been examined in five 'areas'. The five areas represent broadly speaking all building done within an ever increasing radius of the Moray Firth Area. It will be noted that the geographical and political boundaries of the areas are sometimes not entirely appropriate to this analysis but this is in the nature of the statistical material as supplied by the Scottish Housing Returns.

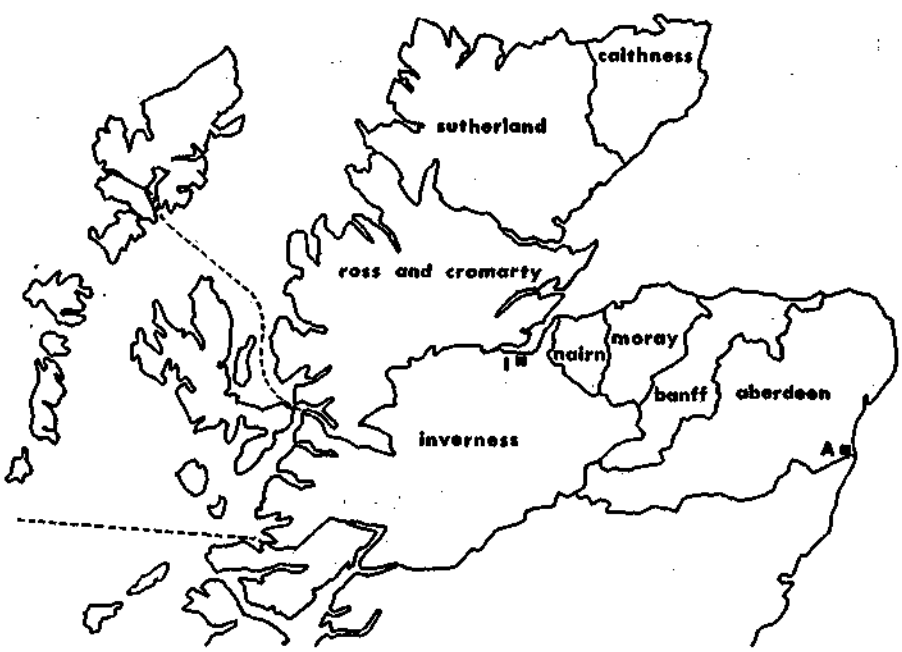
AREA I includes only those authorities for whom information is published and who are actually within the area of proposed new development. This is somewhat unsatisfactory because Beauly, Evanton and Alness are not included as they are not of burgh status. However, one may reasonably assume that the amount of building overlooked is very small. The same applies to some, at present, rural areas.

AREA II makes up the deficiencies in Area I by including the whole of the area of proposed development. This is done by the (only possible) expedient of including the whole of the counties of Ross and Cromarty and Inverness. This again has rough edges, for example Nairn is nearer geographically and probably economically to the proposed development than Fort William and yet is excluded.

AREA III comprises Area II, Moray and Nairn, the more westerly burghs of Banffshire and Dornoch.

AREA IV comprises Area III, the rest of Banffshire and Sutherland.

AREA V comprises Area IV plus Aberdeen, Aberdeenshire and Caithness.



A – City of Aberdeen, I – Burgh of Inverness

HOUSE BUILDING PERFORMANCE 1945-66.

Date	L.A.	S.S.H.A.	Owner-Occupier	Others	Annual Total	Cumulative Total 1945-66
AREA I.						
1945	0	2	-	-	2	
1950	270	84	6	-	360	
1955	152	50	4	-	206	
1960	51	0	395	0	446	
1964	277	0	185	0	462	
1965	287	0	225	0	512	
1966	126	0	158	0	284	4886
AREA II.						
1945	4	2	-	-	6	
1950	973	84	58	-	1115	
1955	276	50	124	62	512	
1960	94	0	520	12	626	
1964	545	0	363	16	924	
1965	585	82	382	6	1055	
1966	486	82	316	26	910	12435
AREA III.						
1945	16	2	-	-	18	
1950	1215	84	77	-	1376	
1955	564	150	148	138	1000	
1960	174	0	566	96	836	
1964	758	0	400	98	1256	
1965	844	82	457	215	1598	
1966	844	82	380	113	1419	19779
AREA IV.						
1945	16	2	-	-	18	
1950	1324	84	83	-	1491	
1955	741	150	175	150	1216	
1960	190	17	577	128	912	
1964	856	0	436	98	1390	
1965	965	82	506	215	1768	
1966	933	82	413	114	1542	22500
AREA V.						
1945	152	2	-	-	154	
1950	2614	114	192	-	2920	
1955	2156	323	427	131	3037	
1960	1263	145	1225	541	3174	
1964	1883	0	1022	132	3037	
1965	2189	82	816	215	3302	
1966	2422	82	1021	115	3640	36288

5. The proposed building programme, it is assumed, will be superimposed upon current trends in the Moray Firth area - that is to say it must be regarded as additional building. In this case, taking Area I, an immediate trebling and subsequent quadrupling of previous peak output is envisaged. Even considering Area II we are still faced with a 90% increase over the previous peak output rising to an increase of 100%. As there is only one builder in Area II who is big enough for this scale of operation, if no resources were available from outside the programme would certainly not be feasible.

However, although the visible impact will all be in Area II there is no doubt that the proposed development will have effects reaching much further south. Area V includes the great population concentration of Aberdeen and Aberdeenshire, and seen in their perspective the problem becomes more manageable. Here we are considering an immediate increase over previous peak output of 30% rising to 47%.

RESOURCE REQUIREMENTS

Implications of the Programme

6. The previous section suggests that to attempt to implement the proposed housebuilding programme given current trends in this field is to load the construction capacity in the area with orders considerably in excess of its previous maximum housing output. Of course, if other kinds of construction work were at levels below capacity, then resources would be available to cope with the increase in housing demands. However, we must assume that while this housebuilding programme is proceeding, other new construction work - roads, industrial and commercial building, schools, hospitals, etc. - will also be proceeding in the area at higher levels than hitherto.

7. The precise extent to which all new construction in the Moray Firth area would employ resources in any one year cannot be determined at this stage by calculation. However, as a basis on which to draw out the implications of the programme, we proceed on the following assumptions:

(a) that all construction work in the Moray Firth Development will be carried out by Building and Civil Engineering contractors;

(b) that the proportions of housebuilding to other new construction work to be carried out in the Moray Firth area are the same as those for contractors' outputs in Scotland in 1966, i.e. 2 of housing to 3 of other new work. * (i)

(c) that the proportions of contractors' output of repair and maintenance work to new construction (1:6 in Scotland in 1966) will be 1:30. * (ii)

On these bases, the value of construction output (at 1966 prices) for an average year might be as follows:-

* (iii)

New Housing..............................	£6,000,000
Other New Work...........................	£9,000,000
Repair & Maintenance.....................	500,000
	£15,500,000

Because of the bunching of investment in new infrastructure at the beginning of the development, the above estimate for other new work may be an understatement. However, bearing in mind this reservation, we now consider what volume of labour employment is implied by this construction output.

* (i) In 1966, Contractors' output in Scotland was valued at £353 million, made up as follows:-

	£m.
Housing................	121
Other New Work.........	181
Repair & Maintenance...	51

Source: Digest of Scottish Statistics, April, 1967.

* (ii) As footnote (i) shows Contractors' repair and maintenance is about one sixth of contractors' annual output. However, a new development will entail a smaller proportion of repair and maintenance work and the diversion of labour to new work will probably mean that some maintenance work is not undertaken. In the circumstances, a very much lower proportion than that for the national output is probably appropriate.

* (iii) The value of housing output in 1966 (£121m.) was associated with completions in that year of 36,029. Probably 10% of these were built by agencies other than contractors - mainly the direct labour organisations of local authorities. Thus the value of contractors' output per completion was £3,670 approximately. However, account must be taken of the fact that the houses to be built will be largely for young households and the families of industrial workers. There will thus be a lower proportion of small houses - appropriate for the aged - and this will tend to raise the value of output per completion ratio. Given the orders of magnitude it is considered reasonable to adopt for the purposes of this exercise a figure of £4,000.

Labour.

8. In 1966, 194,000 were employed in Scotland on construction. Of these approximately 44,000 would be with Local Authorities, Public Utilities and Government departments, so that approximately 150,000 were employed by Building and Civil Engineering Contractors. As contractors' output in 1966 was £416,000,000, output per head/year was approximately £2,770. An output of £15,500,000 given this level of production, thus implies labour employment of 5,600. However, output per head for the industry is undoubtedly reduced because of the low productivity of the Repair and Maintenance sector - where over one third of the industry's operatives are employed but less than one quarter of the industry's output is produced.

In considering the proposed Moray Firth Development it is clear that repair and maintenance work will be of negligible proportions in the construction programme initially though it will come to assume increasing importance as the programme proceeds. In these circumstances it is reasonable to consider that output per head would be of the order of £3,000 per annum, and an annual programme of the dimensions specified in para. 8 would involve a labour force of approximately 5,000.

9. 5,000 construction workers represent of course, only some $2\frac{1}{2}$% of the existing Scottish labour force, and unemployment in construction is generally above this level - even in June at times it has been double this level. However, unemployment does tend to be concentrated in certain areas e.g. Glasgow, and in certain occupations, e.g. labourers, bricklayers. Furthermore the pressure of demand on the industry is continually increasing. The White Paper on the Scottish Economy (Cmd. 2864) showed the output target for 1970, 41% above output in 1964. At the same time the Ministry of Labour forecast that throughout this period manpower could only be expected to increase at 1.6% per annum (compound) i.e. 3,000 a year - and up to the present this rate of increase has applied.

10. All this suggests that to recruit 5,000 construction workers, embracing all the skills employed in building and civil engineering, for work away from the large centres of population, at any time during the next three years will prove very difficult

The table below puts the labour requirement in the context of employment and unemployment figures for the five areas defined on page No. 2A2. Only males are considered for obvious reasons.

Employment & Unemployment in Scotland - Areas 1 - 5

	ALL OCCUPATIONS				CONSTRUCTION			
Area	Date	Unemployed	Date	Employed	Date	Unemployed	Date	Employed
Area 1	Feb. 1967 Aug. 1967	1492 1140	June	18,925	Feb. 1967 Aug. 1967	487 319	June	3,926
Area 2	Feb. 1967 Aug. 1967	1667 1284	"	23,881	Feb. 1967 Aug. 1967	560 368	"	5,793
Area 3	Feb. 1967 Aug. 1967	1702 1304	"	36,483	Feb. 1967 Aug. 1967	597 389	"	7,101
Area 4	Feb. 1967 Aug. 1967	2606 2013	"	39,202	Feb. 1967 Aug. 1967	800 554	"	7,540
Area 5	Feb. 1967 Aug. 1967	5975 4894	"	120,653	Feb. 1967 Aug. 1967	1289 915	"	19,923

Figures supplied by Ministry of Labour

Outer Hebrides and Orkney & Shetland not included.

11. In the area of the proposed development, there are several important building and civil engineering contractors. Notable among these are Alex. Hall & Sons Ltd., G. W. Bruce & Co. Ltd., Wm. Tawse & Co. Ltd., all of Aberdeen. Duncan Logan Ltd., Muir of Ord, and A. Morrison & Son, Tain. It has been estimated for us that between them these contractors employ 1,500 men in Area II. Clearly these could represent an important part of the construction effort though it would seem equally clear that not all of these resources will be available for employment on the Moray Firth. If half of this manpower were committed to the project, the recruitment problem would remain formidable.

12. It should be remembered that unemployment figures tend to exaggerate labour availability because a large proportion (some ½%) of the insured population are unemployable and swell the rank of the unemployed without forming part of a potential labour force. Others appear only temporarily in the unemployment figures and are in fact only changing jobs. In thinking in terms of potential labour force therefore, the unemployment figures should be deflated by perhaps 20%. It must be borne in mind that even when there are plenty of unemployed these may not be suitable for

construction work and that bottle-necks will occur (for example joiners) even where the bare statistics suggest that enough construction workers are available.

It can be seen that in Area II (Ross & Cromarty & Inverness-shire) there are 1284 unemployed and 23,881 working. Only 368 construction workers were out of work, whereas 5,793 people were actively engaged in construction. The proposed development would thus require an increase of 21% in the total workforce of the area; of 86% in those engaged in construction work, and a net inflow of labour of an absolute minimum of 3716.

Taking the perhaps more helpful Area V (everything north of Aberdeen) there are 915 male construction workers unemployed and a total of 4,894 men unemployed in all forms of work. Thus even if all the unemployment in Area V could be absorbed into construction, immigration into the area would still be necessary. The unemployed construction workers form only 26% of the labour requirement.

13. Fortunately, there is scope for considerable saving in the use of site labour through industrialised methods of housebuilding. Before moving to discuss these labour-saving methods we consider first some of the major materials involved in housebuilding.

Materials.

14. In this section we refer to some building materials which have been in short supply in the past.

15. Bricks. Material requirements for house construction obviously vary with design. For example the cladding material selected for the building will have effects on the demand for bricks. Therefore, until a design has been approved, material usage estimates must necessarily be drawn up on the basis of national usage, and we proceed in this way.

16. Of the three classes of output Housing,Other New Work and repairs and maintenance - the first is the largest user of brick while the requirements of the last are negligible. If we assume that a given expenditure in Housing involves three times the usage of bricks as the same expenditure in Other New Work, then approximately 67% of brick deliveries in Scotland would be for house building. We can derive brick usage per house as follows:

	1963	1964	1965	1966
Annual production of Building Bricks (millions)	705	802	755	744
Estimated use in house-building (millions)	472	537	506	498
Houses completed	28,217	37,171	35,116	36,029
Estimated brick usage per house	16,700	14,450	14,400	13,850

Bearing in mind the above reservations with regard to design, it would seem, in the light of the above, that a housebuilding programme of 1,500 units annually could give rise to a demand for bricks of the order of 20 millions per year.

It would seem likely that such a demand would be met with locally produced cement bricks or cement/lime bricks or building blocks. The production process is relatively capital intensive involving mixing units, feeders and the brick-making plant. Manufacture is already established in N.E. Scotland and in the event of new demands of the above dimensions, could be readily expanded. Increased production would of course depend on the continuing availability of cement.

17. Cement. In cement usage housing uses less cement than Other New Work - roads, bridges, dams, docks etc. being particularly heavy users. The adequacy of supplies for housing therefore depends to a certain extent on the growth of demand in the non-housing construction sector.

However, another feature overshadows the continuity of supplies for Scotland. Although Scotland has cement works based on indigenuous clinker at Dunbar these are inadequate for the needs of its construction industry and supplies continue to be drawn from England. In this situation there is obviously the possibility that Growth in demand South of the Border will lead to supply difficulties in Scotland. While there were difficulties over supplies in 1965 these were not limited to Scotland and generally work was kept going. When eventually restrictive measures were taken by the Government, they appear to have affected the construction industry in England rather more severely than the industry in Scotland. This reflects a change in strategy on the part of the authorities in attempting to shelter the development areas as much as possible in their measures to regulate the economy.

There are two points to be made on this development. First, the change gives encouragement to industries to establish themselves in development areas to serve these markets since they appear to offer some degree of insulation against "stop-go". In fact, new cement manufacturing capacity is to be installed in Scotland which will use imported clinker. This will reduce Scotland's dependence on English imports and also the risk of local shortages, given a resurgence of demand in England. Second, the resurgence of construction demand in England seems likely to be delayed beyond the point of expansion of demand generally. This is because of the time lag in building between the client's decision to order a unit of construction output and the impact on the contracting and building materials industries. For the short term, therefore, it would seem reasonable to believe that Scotland's reliance on imported cement will not jeopardise any part of its building programme.

18. Plasterboard. Acute shortages of this material were experienced during 1965. However, the supply has now been increased with the commissioning by B.P.B. Industries of a large new plant in the North of England.

19. Copper Tubes & Copper Fittings. Some shortage of these materials has occurred over recent years but capacity, including capacity at Scottish works, has been expanded. It is likely that supplies will be adequate for the next three years. Prices have fluctuated particularly as a consequence of the disturbance to supplies following the U.D.I. in Rhodesia. Manufacturers have developed "thin wall" tube using less copper and this reduces, to some extent, the effect on users of changes in the world price of copper.

20. Other Materials. The above materials have been in short supply from time to time in the recent past. Other materials such as sand and gravel, damp-proof courses, roofing felt, timber and glass are reported as being readily available.

INDUSTRIALISED HOUSING

21. Industrialised methods of house building do not lend themselves to precise definition. It is more appropriate to consider this area of activity as part of a spectrum of different approaches to house building. At one end of the spectrum the approach is haphazard; materials are ordered as required, work is often held up because certain sub-contractors cannot be obtained or supplies of materials are not forthcoming. At the other end there has been close attention to every detail of the building process, perhaps involving network analysis with the object of ensuring that the order is fulfilled at the lowest cost, that resources are available as and when required and that delivery is given on time.

This range of activity is often divided into three parts: "traditional", "rationalised traditional" and "industrialised". In the first sector, methods and materials are well tried and proved and have the advantage of familiarity to the consumer, the labour force, the contractor and the materials supplier. In the second, there has been an attempt to save resources through changing some aspects of the traditional building process, e.g. some walls instead of being built by brick may be of concrete which has been poured into shuttering on site, or a planning technique may have been applied to the building operation. The third sector is characterised by pre-planning, the widespread use of pre-fabricated components and minimum on-site activity.

22. During the past ten years there has been a significant development effort directed towards industrialised methods. These generally involve the establishment of a factory to produce the components (walls, floors, etc.) to be assembled on site. However, the result of this development effort has been that the number of industrialised methods is now greater than the market can sustain. The danger in such a situation is that the market becomes unduly fragmented and many component manufacturers do not achieve the economies of scale which can make the final produce competitive on price.

23. This situation has led to the establishment of the National Building Agency who, to meet the above situation, provide two services. First, they have attempted to develop consortia of local authorities so that these could place orders for houses in sufficient volume to give a satisfactory level of employment to component factories. Second, they provide an appraisal service of industrialised building systems so that clients - generally local authorities - can be made aware of what contractors have to offer.

24. In Scotland, the N.B.A. have given appraisal certificate to 21 systems. (A full list of these is given on p. 2A22). These include systems for both high-rise and low-rise buildings and embrace rationalised-traditional as well as industrialised systems. As the N.B.A. define an industrialised building system as any approach to the building process which is systematic, a certificate does not necessarily imply great savings of site labour.

There is thus ample potential in Scotland for the exploitation of industrialised methods. However, to date few systems are in use and the scale of output of some of these cannot be considered satisfactory.

HOUSES BUILT IN SCOTLAND BY INDUSTRIALISED SYSTEMS FOR LOCAL AUTHORITIES AND NEW TOWNS.

System	Tenders Approved	
	1965	1966
Bison High Wall Frame	1965	938
Dorran	209	291
Hawthorn Leslie (Buildings) Ltd.	33	-
Kincorth	286	2
Laidlaw-Bison	90	-
Jas. Miller & Partners	-	49
Reema	200	680
S.S.H.A. No Fines	1094	811
Skarne (Crudens)	-	1644
Weir (Timber)	90	267
Wimpey No Fines	3504	5141
12 M Jespersen (Laing)	264	216
Others	9	2
All Systems	7744	10041
Total Housing Starts in Scotland	42,228	36,049

25. However, the outlook for the industrialised approach in Scotland may be rather better than is brought out by the above table. In the first place not all systems require large orders; though clearly these are always desirable, they are not in every case critical. For example, some of the systems are lightweight timber frame systems which do not require adjacent factory facilities. Second, not all of the systems rely on their own resources for all components. Some component manufacturers may be supplying parts for other contractors' systems and for buildings other than houses as well as systems of their own. In this way, economies of scale at some important levels of the production process can be achieved. Third, with increasing experience of the industrialised approach an improved product is emerging which can be adapted to local requirements.

26. The industrialised approach is, of course of tremendous significance in considering the Moray Firth Development bearing in mind the possibilities of shortages in construction manpower.

Some idea of the savings in operative labour that industrialised house-building allows were provided by building contractors during the course of our enquiries. Alex. Hall & Sons, Aberdeen, indicated that 1,400 man hours would on average be required to build a house by traditional methods. Weir Housing Corporation, Coatbridge, estimate that a programme of house-building at a rate of 1,000 units annually need involve only 400 man hours per house - given previous planning of the whole programme and continuity of employment.

27. Taking this last figure, 1,000 houses per year would employ 200 men, while 1,700 would require 340. In contrast, building these houses by the traditional methods would require 700 and 1190 men respectively. It seems likely, however, that given continuity of work and the planning that this would allow, taken together with possible overtime working, that the latter figures could be significantly reduced.

28. The calculations above reflect high rates of housing output per head in the light of national averages. For Great Britain in the sixties, completions per operative have been increasing from just below 1 in 1961 to 1.2 in 1966. For Scotland, given the higher standards of housing, more difficult sites and more severe winters, performance is probably below the national one. However, the above operative inputs per house suggest completions per operative of 1.4 for the traditional methods and 5.0 for the industrialised system.

29. Undoubtedly actual performance is affected by interruptions to work not only because of inclement weather but because the industry's demand is not organised in a way that ensures continuity of employment. In the Moray Firth Development a programme of 1,000 to 1,700 houses annually would allow continuity of activities in a way too infrequently experienced by the industry and thus permit high productivity.

30. So far as inclement weather is concerned, many devices exist for preventing this from interfering with site work. However, should winter weather be severe enough to stop work, say, for one month a year, this would imply an increase of 8% in the labour force in order to attain the target output in the remaining months. Obviously a labour force of 200/300 is more readily expansible by 8% than one of 700/1,000.

31. In the light of these considerations it seems desirable that the house-building programme should be considered on the basis of its implementation through an industrialised method which involves relatively low labour inputs. We turn now to consider the selections of such a system.

THE SELECTION OF AN INDUSTRIALISED SYSTEM

32. In considering which of the many systems available to Scottish clients would be appropriate for the Moray Firth Development one of the most important criteria will be the Labour requirements of the system. Faced with the prospect of shortage of construction manpower it is clearly desirable to exploit a system which minimises - so far as is consistent with other objectives - the use of construction manpower.

33. In considering manpower savings it is not only the savings in site operatives that must be borne in mind. Systems, generally heavy systems, that rely on components produced from factories in the area may require some building craftsmen, e.g. plasterers and joiners. Some other systems may rely on components which are produced in the Central Belt of Scotland thus utilising skills outwith the area of the development.

34. Another major consideration will be the flexibility of the system. Bearing in mind the importance of producing homes that will prove attractive to industrial workers in all parts of the country, it is necessary that the system chosen should be capable of adaptation to designs that meet this requirement and are appropriate to the environment of the Moray Firth.

35. If the development of an industrial complex along the Moray Firth is to proceed smoothly, it is clearly desirable that manpower should be attracted as the job opportunities materialise and as the homes become available. It would clearly be inimical to such development if the new houses attracted a bad reputation at the outset. We would therefore set a high priority on choosing from systems which have already been proven satisfactory in delivery and in performance in Scotland.

36. All of these criteria must be used in choosing a system and a balance struck having regard to the cost at which the programme would be carried out.

37. In considering the cost at which the programme would be carried out, it is recognised that the development provides an excellent opportunity for a system builder to minimise costs. Through economies of large-scale production and purchasing, particularly the spreading of capital overheads over the proposed output, close attention to the programming of all aspects of the building process, continuous employment of operatives, so that through time they become increasingly adept at the work, the builder will be able to price his product on terms significantly below those generally prevailing. The greater the length of time a client is prepared to allow one builder to undertake his housing requirements (always provided the builder has been able to take the period into account in his planning) the

greater will be the economies achieved. It is thus in the best interest of the client with a substantial housing programme extending over 15 years to adopt a serial form of contract. It may be appropriate to contract initially for three years - subject to certain conditions - and to extend for a further three year periods if quality and progress have proved satisfactory. *

38. We move now to the number of houses per year for which a builder should be asked to contract. A common level of capacity for factories producing concrete components is a maximum annual output sufficient for 2,000 houses on the basis of three-shift working. The capital costs involved are in some cases written off over three years in fixing prices. One programme envisaged could be undertaken by involving such a factory and, given the prospect of employment for considerably longer than three years, it would seem reasonable that prices should include a smaller allowance in respect of capital costs.

39. However, attractive though this course appears, there seem to us to be strong arguments for accepting an alternative course.
These counter arguments are:

(i) The employment of one contractor exclusively on the house-building programme would remove any element of competition and exclude such inter-firm comparisons as could be made if more than one contractor were employed.

(ii) The adoption of one system with a view to achieving substantial economies of scale may involve uniformity in design. There is scope in many systems for variety of appearance but, of course, the more variations specified the shorter the production run and hence greater cost.

(iii) A building programme employing a system which involves the use of concrete components may not provide houses at lowest cost. This, of course, can only be determined by negotiating with several system builders.

(iv) A heavy system may not show the greatest saving in labour, or if it does, the saving may be outweighed by other factors, e.g. cost, aesthetics, reputation, etc.

* Scottish Development Department consider serial contracting, coupled with negotiated contracts, offers particular advantages when construction is by industrialised methods involving factory production of components for which continuous runs are essential (vide S.D.D. No. 25/1967).

40. The proposed programme is, by the standards of the Scottish house-building industry, a large one. At the level of site operations a development of 200/250 houses is usually large enough for a general foreman to exercise effective control. Beyond this level, management is obviously more thinly spread and supervision weakens. Two or three such sites would present a contracting team with adequate opportunities for the exploitation of planning techniques and the attainment of scale economies.

41. In the light of the above, we consider that rather than commit the entire house-building programme to one contractor it would be in the best interests of the development for the client to choose about six contractors who can offer industrialised house-building systems. The next stage would be to brief contractors with a view to selecting two of them to implement the programme. Since two contractors are to be chosen the client may decide to frame two different briefs, though in these circumstances he would give one brief* to one set of three contractors and the other brief to the remainder.

42. In selecting six contractors from the current N.B.A. list of appraised systems it cannot be too strongly emphasised that this list is by no means definitive. Clearly further appraisals will be made between now and the time the client has to make a choice. However, at the time of writing we can confirm that the following eight contractors would be interested in an invitation to a briefing associated with this development:

1. Concrete (Scotland) Ltd., Falkirk.
2. John Laing Construction Ltd., Glasgow.
3. Weir Housing Corporation Ltd., Coatbridge.
4. Reema (Scotland) Ltd., Bellshill.
5. Crudens Ltd., Musselburgh.
6. Geo. Wimpey & Co. Ltd., Barnton, Edinburgh.
7. Alexander Hall & Son (Builders) Ltd., Aberdeen.
8. Mitchell-Camus Ltd., Newmains.

* The main points to be included in a design brief up are given on p. 2A21.

43. In selecting one or more contractor for the house-building programme, it may be considered that more regard should be paid to the contracting teams which are already well established in this area, namely, Alex. Hall & Sons, Aberdeen; A. Morrison & Son, Tain and Duncan Logan at Muir of Ord. Undoubtedly the considerable resources at the disposal of these companies will play an important part in the development. However, the question arises will it be the house-building programme for which their fund of technological experience makes them best suited? Until the client briefs the interested contractors and receives, in response, their proposals regarding the development and prices, this question remains unresolved. It may be considered that contractors with more experience of industrialised methods of house-building and of large scale housing programmes should deal with this part of the construction programme. This would allow the local builders, with their wide experience of other types of construction, to deploy their resources in the other building work which is not amenable to industrialised methods.

44. It may be argued that to place all the construction business with local contractors and negotiate prices, would allow these contractors - acting in concert - to maintain agreed wage rates and, generally, pursue common man-power policies. The danger in the extreme alternative course lies in many employers, each faced with labour shortages, poaching manpower with the inducement of higher wages, with consequential increases in price to the client. The client could, of course, guard against such an eventuality by negotiating a fixed price for the contract.

In considering this argument we must recognise that either there will be a labour shortage in the development or there will not. If there is no shortage of labour then there is no need for local contractors to have all the business and then to proceed to act in concert in their industrial relations. If there is a labour shortage, then the more agressive contractors make more progress on their contracts than those employers who suffer losses from poaching, or all the contractors fail to attain their targets.

Clearly a labour shortage will have adverse consequences for the development whatever the arrangements over the award of contracts. It is because industrialised methods of house-building can make the most significant contribution to the saving of operative labour that we consider the selection of the contractor (or contractors) should not be limited to local employers. Rather should this selection consider all the industrialised systems available in Scotland.

THE CLIENT AUTHORITY.

45. At present there is no single organisation which stands ready to take upon itself the organisation, finance and implementation of this considerable programme of construction work.

There are, of course, already several housing authorities, i.e. local authorities, in the area of the proposed development and it might be considered that these are the appropriate bodies to implement this housing programme. Any other course might put the goodwill of the local authorities towards the development at risk.

46. The development of the programme in harmony with the development of industrial activity clearly makes it important that there should be an agreed strategy over housing starts and completions throughout the area. This end may be achieved by the formation of a consortium of the local authorities. A consortium might also allow the best use to be made of authorities' professional staff and ensure that this is not too thinly spread.

47. It is also important to ensure that orders for houses are in large enough numbers and of such a degree of continuity as to allow an industrialised builder to achieve the economies which the industrialised approach offers. Here again, however, this difficulty could be overcome by the authorities acting in a consortium.

48. However, against this suggestion of a consortium, we have weighed the views of the N.B.A., Edinburgh.

In Scotland, the N.B.A. have had a great deal of experience in the promotion of and subsequently in advising consortia. The view of the N.B.A. now is that if it is possible to establish an effective client organisation which can speak with one voice, then this is preferable to a consortium. It is, of course, natural that the members of a consortium should pay heed to the interests of their own areas but this means that there are difficulties over which area is to have its building programme implemented first. The existence of many views also means that agreement over design aspects is more difficult.

49. In the light of the above we conclude that while it remains vitally important to foster and retain local goodwill, it would be inappropriate to commit the housebuilding programme to the local authorities in the development area.

50. We take the view that a single authority should be established armed with powers similar to those of a local authority; e.g. power to provide water supplies, power to treat with the gas and electricity supply undertakings, power to place orders for houses and other kinds of construction output, etc.

51. Given these powers it would obviously be necessary for the authority to have professional staff in order to ensure that the policy of authority was implemented. This staff should include an architect, a quantity surveyor, an engineer and a Building Manager (a General Manager or Town Manager) and land agent (for land acquisition). The importance of effective staff in this authority cannot be too strongly emphasised. All members of such a team are important but we would single out as occupying a key role in the construction programme the manager referred to above. This man will for many aspects of the building programme, so far as the contractors are concerned, be the embodiment of the client. He must, therefore, be associated with the development at the design stage, involved in subsequent negotiations with contractors and be available throughout the construction process for consultation on any aspects which are outwith the terms of reference of his professional colleagues. The successes or failures of this development will be associated with this man and he will accordingly have appropriate powers.

52. Once the authority has been established, one of its first and continuing tasks will be the establishment of harmonious relations with the local authorities. It is also desirable that the members of the Dean of Guilds Courts should be made aware of the aims and strategy of the client authority at each stage of the development. In the area of the development it is likely that there are several such courts and it would be desirable that the authority should deal with one only. This would avoid the danger of one court interpreting regulations in a different way from another in the area with the necessity for consequential changes in a house design or which the authority wished to standardise.

53. Some parallels may be drawn for the kind of approach we have in mind with that of the development by the U.K. Atomic Energy Authority in Thurso, Caithness.

In Thurso, the A.E.A. have built houses for letting to their employees. The local authorities provide services, power, lighting, water, sewage, refuse collection etc. and levy rates. The A.E.A. is the landlord, having acquired the land from the local authority and contracted with Halls of Aberdeen for the major part of its housebuilding programme.

The A.E.A. commissioned house designs and these were displayed to the local authorities. While the A.E.A. was, of course, legally required to submit plans to the local authority (as the planning authority) the impression remains of a client organisation inspired by a genuine desire to keep the local populace fully aware of its plans as and when these were formulated. In pursuing this end the client organisation's actions and disclosures would normally be in excess of rather than limited to the legal requirements.

54. The development at Thurso can be judged to have been successful. The trebling of the population within a decade might have occasioned resentment, or friction or outright opposition to the development. That these features did not assume significant proportions may be due, in part, to the attention paid by the A.E.A. to local feeling. The scale of the proposed Moray Firth

Development is greater than that at Thurso but we would feel the same attitude applies. The local population will be naturally uncertain of the changes which will occur in its environment and this uncertainty should be dispelled as early as possible. Once the client organisation has been accepted in the area as reasonable and sensitive to local attitudes it must continue to preserve this status and maintain public confidence.

55. Given the importance of general public confidence it may be appropriate that the Highlands and Islands Development Board itself should assume the role of client organisation. The Board already has a large fund of goodwill in the area, and it would be entirely appropriate that the body which originally sponsored the imaginative proposals for the industrial development of the area should proceed with their implementation.

CONCLUSIONS

56. The proposed housebuilding programme is substantially greater in size than any housing development previously undertaken in the area of the Moray Firth.

57. Since the proposed housing programme will be implemented at the same time as an even larger programme of other building work there will be manpower problems in the area. Major difficulties over the supply of building materials are not however anticipated.

58. Industrialised methods of housebuilding allow substantial savings in construction labour and these methods would therefore be appropriate in the development.

59. In selecting an industrialised housebuilding system for the development, regard should be paid to:

(a) Price

(b) Savings in manpower

(c) Choice over design

(d) Previous satisfactory performance of the system.

60. We recommend that rather than place the contract for the housing programme in the hands of one builder, two groups of three builders should be briefed and, in the light of their proposals, two contractors employed.

61. The client organisation should not be the local authorities or a consortium of these but be independent of them having its own professional staff. The Highlands and Islands Development Board seems well suited to assume the role of client authority.

62. The client authority should take every care to retain the goodwill of local authorities and the public in general by making known its intentions and programmes as soon as these have been worked out.

DESIGN BRIEFS FOR INDUSTRIALISED BUILDERS

The main points to be included in a design brief are detailed in Scottish Development Department Memorandum No. 25/1967 as follows:

(a) The total number of dwellings, and the proportion of dwellings of different sizes;

(b) the form of development, i.e. whether in flats, maisonettes, houses or a mixture in certain proportions;

(c) the standard of space, fittings, equipment, heating and finish in the dwellings;

(d) any special requirements for multi-storey buildings with regard to lifts, refuse chutes, plumbing, drying areas and similar matters;

(e) the way in which the layout will fit in with the general road pattern and development form of the area; and the methods of providing for segregation of vehicles and pedestrians;

(f) the standard and provision of children's play space;

(g) the standard of provision for car storage and for parking of visitor's vehicles;

(h) the details of site conditions, including levels, nature of subsoil and liability of subsidence, site investigation report (in the case of multi-storey buildings, this may need to be more detailed than for other buildings), trees to be retained, services required and details of services available, and preferably a schedule of approximate quantities;

(i) the constructional standards and widths of roads;

(j) building regulations, local water bye-laws, relevant British Standards and codes of practice to be complied with, etc.

List of Industrialised House Building Systems Appraised by the National Building Agency, Edinburgh

System Name	Name & Address of Sponsor or Licensee	Storey Heights covered by appraisal certificates	Date of Issue of Certificate
Anchor 12 M	Anchor Construction Co. Ltd., Bo'ness, West Lothian.	2 storey	31.5.'67
Belfry	Belfry Houses (Scotland) Ltd., Polmont, by Falkirk.	2-5 storeys	31.7.'66
Bison Wall Frame	Concrete (Scotland) Ltd. Falkirk.	2 storey	31.5.'67
Bison Wall Frame	Concrete (Scotland) Ltd. Falkirk.	Walk up and multi-storey	31.3.'66
Camus	Mitchell-Camus Ltd., Newmains, Lanarks.	Multi-storey	31.7.'66
Jespersen 12 M	John Laing Construction Ltd., 145 North Street, Glasgow, C.3.	1-5 storeys	31.3.'66
Jespersen 12 M	John Laing Construction Ltd., 175 Elderslie Street, Glasgow, C.3.	Multi-storey	31.1.'67
Kincorth	Alex. Hall & Son (Builders) Ltd., Aberdeen	1-5 storeys	30.4.'66
Mactrab	Charles Gray (Builders) Ltd., Dundee	8 storey	30.6.'67
Mark	Maxwell Holdings Ltd., Coseley, nr. Bilston, Staffs.	2 storey	31.5.'67
Miller	James Miller & Partners Ltd., Edinburgh	1+2 storeys	30.4.'66
Multicon	Weir Housing Corp'n.Ltd. Coatbridge.	1 & 2 storey	31.5.'66
Multigrid	Weir Housing Corp'n.Ltd. Coatbridge	1 & 2 storey	30.4.'66

List of Industrialised House Building Systems Appraised by the National Building Agency, Edinburgh. (contd.)

System Name	Name & Address of Sponsor or Licensee	Storey Heights covered by appraisal certificates	Date of Issue of Certificate
Reema	Reema (Scotland) Ltd., Bellshill.	2 storey	31.1.'67
Reema	Reema (Scotland) Ltd., Bellshill.	Multi-storey	31.3.'66
Skarne	Crudens Ltd., Musselburgh	1-5 storey	30.4.'66
Skarne	Crudens Ltd., Musselburgh	Multi-storey	31.1.'67
Sisicon	A.M.McDougall, Glasgow.	Walk up	31.1.'67
Laidlaw-Thornton	James Laidlaw & Sons Ltd. Rutherglen.	Multi-storey	31.1.'67
Wimpey W6M	George Wimpey & Co. Ltd., Edinburgh.	1-5 storeys	31.3.'66
Wimpey 1001S	George Wimpey & Co. Ltd., Edinburgh.	Multi-storey	31.3.'66

APPENDIX 3.

AN ASSESSMENT OF CLIMATE IN THE MORAY FIRTH

by

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CONTENTS

1. Introduction

2. General Climate Studies

(i) Cold air drainage and liability to frost; study of local topography leads to identification of areas at risk.

(ii) Local channelling of winds; wind direction is liable to be changeable in certain areas.

(iii) Variations in sunshine, radiation and cloud cover; the annual mean of sunshine per day is 3.5 hours. There is a good record of visibility throughout the year.

(iv) Precipitation snow and evaporation; the annual rainfall around the coastal zone is about 30", the number of days with snow lying should be between 10 and 20 in the coastal area.

(v) Humidity; relative humidity values between 80 - 85% in winter months and 60 - 65% in summer months can be expected.

(vi) Oceanography, river flows, land drainage and flood control.

(vii) Length of growing season and variations in temperature due to elevation. There is a reduction in length of growing season as altitude and distance from the sea increases.

3. Atmospheric Pollution

A study of the dispersal of atmospheric pollution has been undertaken with special reference to industry at Invergordon.

4. Profile of Housing in relation to Topography, Cold Air Drainage etc.

Research into the effects of climate, aspect and topography on housing profile has been initiated. In view of the northerly latitude shadow length of buildings is of particular importance in planning.

Maps on the scale 1:25000 have been completed to illustrate the broad Climatological Pattern.

1. INTRODUCTION

The general climate of the Moray Firth area is mild and oceanic, enjoying very favourable regimes of temperature, rainfall and sunshine which are commonly associated with lower latitudes of the British Isles. The mild conditions and relatively low rainfall are attributable to the effect of the mountain massif to the west and south, which moderates the influence of the prevailing westerly and south-westerly winds.

Although there is considerable local variation in climate over the area, due to elevation and nearness to the sea, extreme conditions of temperature, wind and precipitation are rarely encountered as also are other weather hazards such as fog and lightning. From the point of view of agricultural production, the factors limiting output are those of soil, elevation and aspect rather than those pertaining to climate.

The average duration of sunshine in the area is equivalent to that of Coventry but with a longer day-length in summer and a shorter day-length in winter. In order to take full advantage of this feature, plans for development should bear in mind the longer shadow lengths experienced in northerly latitudes. The most important consideration, however, should be given to the natural drainage pattern of the area since rapid run-off of the higher rainfall in the more elevated parts of the area, to the west and south, may influence development in the river valleys. Apart from these two considerations, the climate is likely to impose few limitations on planning and has, on the other hand, many advantages to contribute to development.

2. GENERAL CLIMATE STUDIES

(i) Cold Air Drainage and Liability to Frost:

Maps showing average dates of first and last screen frosts should be accepted with caution, since local changes in topography will have a considerable effect on these figures. Consequently, it seems preferable to indicate only the main routes of cold air drainage and areas with increased liability to frost.

However, it must be borne in mind that the incidence and severity of frosts will be relative to the overall climate of the locality, so that some of the indicated areas although cold air drainage basins, may not be climatically unfavourable for development if near the sea. More serious attention must be paid to those areas less influenced by the sea and the temperatures experienced in the inland frost pockets will depend upon the area and the elevation of the land mass draining its cold air into the valley site and on any obstructions to the free drainage of the cold air down the valley.

The general picture of low temperatures is shown by the following data for the years 1961-65:-

	Fortrose	Tarbatness	Inverness	Nairn	Cannich
Days per annum of Air Frost	33	31	58	60	119
Ground frost (grass minimum below 0°C)	-	-	113	146	196
Snow lying at 9h	15	10	21	29	53

(Although Nairn has a slightly higher mean January temperature than Inverness, the range of temperature at Nairn is greater; hence, the greater incidence of frost and snow lying, both of which will be intensified when easterly weather prevails.)

Comparing these figures with short-term observations for Alness and Invergordon:

	Alness (presumably the air-field)		Invergordon (26ft. above M.S.L.)
	1944	1945	1942
Ground Frost	133	113	86
Snow lying at 7h	27	33	20
Mean of lowest minimum temps. at screen height	29.08°F	30.41°F	32.33°F
Mean of lowest minimum temps. on grass	21.17°F	24.92°F	26.5°F

These figures, although too brief to be of much significance, indicate the order of differences between Invergordon and the low-lying area of Alness. Temperatures in Alness village itself will be less severe and should be about mid-way between the above figures.

In the Beauly Firth area the main cold air drainage will take place along the valleys of the rivers Conon and Beauly. The most serious problems will arise where drainage is impeded by the topography, e.g. on the A.831 road near Erchless Castle. Beyond this, the cold air flow can fan out and the whole of the valley from Beaufort Castle through Beauly to the Beauly Firth will be subjected to relatively low temperatures when still, radiation nights occur. However, the degree of ventilation on the plain and the fact that there should be an exchange of air between the warmer surface of the waters of the Firth and the cold ground of the hinterland will reduce the low temperature incidence at Beauly itself.

Similarly, the Muir of Ord area will be exposed to the unimpeded flow of cold air from the high-lying ground to the W. and WSW. and, to a lesser extent, to cold air from the southern projection of the Black Isle ridge. Again, the ventilation here should serve to reduce the stagnation of cold air and the development of really low temperatures on all but the calmest of nights. In this area, there is little that can be done either intentionally or accidentally, to affect the cold air situation. Gradients being small, the chances of damming up the air are small. Any attempt to maintain the ventilation, which could alleviate the frost situation, should be considered in relation to other times of the year when some form of shelter may be beneficial. It is unlikely, however, that low temperatures experienced here will present any problem.

Maryburgh is in a rather different situation and any further development to the east of the existing village would appear to be in the path of the natural drainage route for cold air. There is little one can do to divert this but it may prove advisable to avoid damming up the cold air on the NE side of any housing development on the lower ground. Because of the extensive area of mud flats, where relatively low temperatures will tend to develop during cold weather, it is doubtful whether any benefit could be derived from damming up the cold air on the SW side, i.e. before it reached the houses.

The Strathpeffer valley forms a natural collecting area for cold air from the steep slopes to N. and S. However, the fall in the ground is such that there will be little movement due to gravity in the direction of Dingwall, which would appear to be well sited from this point of view. The constriction of the valley at its eastern end will hold back the cold air, as well as the gradient, and it is suggested that any development on the Kinnairdy-Blinkbonny side to the N. of the Academy should allow for free drainage of the air as far as possible.

There will also be a local development of a cold air pocket on the low ground between Munlochy and Munlochy Bay, which would tend to restrict its potential for housing but not for recreational or other purposes. Temperatures will, in any case, be higher here due to nearness to the sea.

In the case of any development for housing at Beaufort Castle and Kirkhill, it would be an advantage if this could be restricted to ground above the 50ft. contour at the former site and above the 25ft. contour at the latter. No real cold air problem arises at Charlestown where some development is likely to take place.

In the case of the Dornoch Firth, cold air will tend to lie in the narrow valley to the South of Morangie Forest and, where unimpeded, to flow out on to the Tain area, where its effect will be much diluted. The area to the east of Tain is low-lying and has a complicated topography and some frost-pockets here are inevitable. On the whole, the incidence of severe radiation frosts here will be low and in the majority of instances, there should be plenty of ventilation from the sea and land breezes to prevent the development of low temperatures. Tarbatness, because of its situation, has a very low incidence of frosts. It may be noted too that Geanies House further down the coast, is reputed to have a very mild local climate favourable for the cultivation of various exotic shrubs.

(ii) Local Channelling of Winds etc:

The wind distribution has been estimated from Kinloss data (1961-65) and from the short-term observations during the war at Invergordon and, subsequently, Alness (see wind-rose diagrams on p.3A14).

Comparison of the records from the three stations would seem to suggest that the Kinloss data over-estimate the frequency of SW. winds and, in spite of the shorter-term observations of the Alness and Invergordon figures, these would seem to be preferable, at least for the Dornoch and Cromarty Firths.

An estimate of the wind-rose for the Dornoch area is shown on the appropriate map. This shows the dominance of the W. and WSW. directions.

Estimates of local variations in wind direction are also shown on the maps. In general, no serious problem affecting land use can be anticipated from local channelling of the wind. Wind direction is likely to be very changeable on the Muir of Ord plain and in the valley of the River Conon. Again, in Munlochy Bay, rather turbulent wind conditions can be expected during strong, SW. winds and the sea breeze (as also the prevailing wind) will tend to be accentuated at the mouth of the bay due to the high promontories to the N. and S.

There is a discrepancy between the wind speed values recorded at Alness during 1945 and the previous estimates based on Kinloss data. Whereas the calculated wind speed for the Invergordon area was given as 8.8 m.p.h. at 10 m. (33ft.) above ground, the Alness average for the one year is 11.5 m.p.h. There is some doubt about the actual site of the anemometer but this was presumably on the airfield and exposed at the correct height. Monthly figures are as follows:-

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
12.1	14.5	13.6	15.4	12.2	12.8	12.5	9.1	9.8	8.3	8.0	10.6

Unfortunately the wind records at Invergordon did not include wind speed, so there is no independent check on the Alness figures.

(iii) Variations in Sunshine, Radiation and Cloud Cover:

The annual mean hours of sunshine per day is 3.5 for the area as a whole, with mean hours per day in June of 5.25. The area receives 28-30% of the maximum possible, with cloud cover during daylight hours of about 72%, although some reduction must be expected in the sunshine hours as one moves westward. As mentioned earlier, the western part of the Beauly area will receive about 25% of possible sunshine, due to the greater incidence of cloud (about 75%).

The mean cloud cover from 33 months of observations at Alness is 73% which is in line with the above estimates.

Allowance must be made for the differences in cloud cover due to elevation but these will affect only those areas above 1,000 ft. or so.

The annual receipts of total solar radiation (direct + diffuse) are estimated to average 192 langleys (or calories per sq. cm.) per day, with the following distribution:-

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
37	90	150	274	360	403	344	278	195	104	45	25	192

Of these figures, approximately one-third is direct radiation (direct sunlight) and two-third diffuse radiation (scattered by the atmosphere and clouds).

The above figures refer to a horizontal surface. For slopes the following adjustments should be made to the totals:-

	North facing slopes		South facing slopes	
	20°	10°	20°	10°
Mar -	15%	- 7%	+ 10%	+ 5%
Jun -	5%	- 2%	+ 1%	+ 1%
Sept -	13%	- 6%	+ 9%	+ 5%
Dec -	nil	- 20%	+ 32%	+ 17%
Year -	10%	- 5%	+ 7%	+ 5%

NOTE: There are no 20° gradients apparent on the maps but there are some 10° slopes.

In making these adjustments, no allowance can be made for differences in cloud cover at different elevations, owing to the lack of any known information on this for stations other than Fortrose. For practical purposes it can be assumed that differences in cloud cover and sunshine can be ignored for coastal stations below 1,000 ft. There will be a slight decrease in hours of sunshine as one goes inland (but it is doubtful if the change is as great as 5% at the western limit of the Cromarty Firth). As far as land use in the inland area is concerned, this order of change should make little difference.

Mention might be made of visibility; at Invergordon in 1942, there were only two observations of fog at 7 a.m. and at Alness in 1944 and 1945 there were again only two instances per year. As shown in the Climatological Atlas of the British Isles (1952) the Moray Firth has a very good record of visibility throughout the year in comparison with any coastal area further south.

Considering local differences in sunshine hours, the eastern half of Nigg and the eastern side of the Black Isle enjoys the best sunshine climate in the area, receiving rather more than 30% of the possible. Fortrose has an annual mean of 3.54 hours per day, Nairn 3.52 and Inverness 3.39. The annual average for Nairn is only slightly behind that for Fortrose. Nairn experiences slightly more winter sunshine than Fortrose but Fortrose figures are consistently higher between April and August (5.86 hours per day in June as against 5.68 in Nairn).

Taking averages for the whole area, there will be 70-80 days in the year with no bright sunshine and 30-40 days with more than 9 hours. Because of the northerly latitude, only 1-1½ hours of sunshine per day can be expected between the third week in November and the beginning of February.

(iv) Precipitation, Snow and Evaporation:

The general precipitation distribution is shown on the map.

No data are available of the amount of snow fall (depth) but some observations of the number of days with snow lying in the mornings have been mentioned on p.2. For the eastern (coastal) part of the area, the number of days with snow falling on low ground (0 - 200ft), should be as follows, on average:-

Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2-3	4-5	5-6	4-5	5-6	3-4

The usual correction for elevation applied to the annual totals is to add 1 day for each 50 ft. rise in elevation up to 1,000ft. For higher elevations, the correction to the "low ground" values is + 20 for ground above 1,000ft. and + 35 for ground above 1,500 ft.

The number of days with snow lying during the day should be less than 10 for the northern tip of Nigg, 10-20 for the rest of the coastal area and 20-50 for the low ground elsewhere.

In the absence of further information on snow depths, the following observations are a guide:-

	Max. Recorded depth of snow 1956-63
Fortrose	7 inches
Inverness	21 inches
Kinloss	12 inches

In Britain and western Europe the maximum depth of undrifted snow on level ground rarely exceeds 24 inches, which is equivalent to a loading of approximately 13 lbs. per sq.ft.

In the absence too of measured records of evaporation, various techniques are now in use for estimating the evaporation in order to illustrate the availability of water for cropping, etc. which, if through-drainage is neglected, is represented by the difference between precipitation and the combined demands of evaporation and transpiration. None of these techniques has proved entirely satisfactory. Nevertheless, if growing season rainfall is superimposed on Penman's (1950) map of evaporation over the British Isles, it will be seen that the Dornoch Firth and the eastern parts of the Cromarty and Beauly Firths has a deficiency of water (less than 4 ins.) during the growing season by this method. The western part of the Cromarty Firth and the western and south-eastern portions of the Beauly Firth have, on the other hand, a surplus of water equivalent to less than 8 ins.

A more recent method, due to Green (1964) would serve to show that the eastern half of Nigg and the NE tip of the Black Isle around Cromarty has a potential water deficit of 3 ins. during the year, whilst the rest of the area has a potential deficit of 2 ins. except for the western section of the Beauly Firth where the deficit is only 1 in. Actual deficits are not the same as potential deficits: the difference depends upon the amount and availability of stored water in the soil.

What this information amounts to is that in the coastal area, a potential deficiency of water exists but this may be compensated for by a reasonably high water table (i.e. ground storage of water). However, where drainage is sharp, as on the sandy dunes of the Black Isle, grass and other crops would tend to suffer a shortage of water during part at least of the growing season. Vegetation on slopes could expect to show drought effects when valley farmland, with the advantage of more stored water, would not be similarly affected.

(v) Humidity:

Few figures are available for humidity in the area. Relative humidity values can be expected to be of the order of 80-85% during the winter months, falling to 70-75% in the spring and autumn and to 60-65% in midsummer. Inevitably, there will also be a diurnal change, the lowest values being recorded at mid-day during the summer but it is unlikely that a minimum below 60% will be observed at any point in the area.

(vi) Oceanography, River Flows, Land Drainage and Flood Control:

Although no data on these aspects have been assembled, contact has been established with the Marine Laboratory, Department of Agriculture and Fisheries for Scotland, P.O. Box No. 101, Victoria Road, Torry, Aberdeen in connection with inshore oceanography. According to Dr. J. H. Steele, a considerable part of the work of the Marine Laboratory is devoted to inshore and estuarine problems. Mr. R. E. Craig of the Laboratory's staff is concerned with problems relating to waste disposal and pollution in estuaries and is recognised as an authority in this field. Further information may be obtained from him.

It would appear that a survey of the Cromarty Firth has been completed. A report on the hydrographic aspects has been written and a fuller version to include detailed plankton survey results is in preparation. A survey of the Inverness and Beauly Firths is in progress and will be completed this year. The Laboratory has no observations on the Dornoch Firth, which at low water is practically riverine, and this area is not on any immediate list for survey.

It was anticipated that the information on precipitation would be followed in due course by a hydrological analysis, in order to assess liability to flooding and drainage capacity. As a first stage, the frequency and intensity of unusually heavy rainstorms would need to be assessed from an examination of the long-term records of rainfall at the existing measurement stations in the area. These are:-

		Elevation ft.	Natl. Grid Ref.
	Geanies House	200	NH (28) 895793
	Fortrose	15	NH (28) 749557
	Ospisdale House	100	NH (28) 346194
	Tarbatness	60	NH (28) 947875
	Ardross School	495	NH (28) 644736
*	Aultdearg	725	NH (28) 288652
*	Loch Luichart Manse	310	NH (28) 317625
*	Loch Luichart East	165	NH (28) 390575
*	Bridgend, Strathconon	400	NH (28) 323551
*	Strathvaich Lodge	790	NH (28) 349743
*	Dubh Choille	1150	NH (28) 399683
	Fairburn House	500	NH (28) 455528
	Muir of Ord	150	NH (28) 527500
	Blackstand, Millbuie	520	NH (28) 716612
	Culduthel Reservoir	242	NH (28) 665412
	Achareidh, Nairn	59	NH (28) 868565
	Cawdor Castle	225	NH (28) 847498
	Balblair, near Nairn	94	NH (28) 873553
	Dalcross	35	NH (28) 766520
	Auchindoune	425	NH (28) 838479

* These stations provide an indication of rainfall to be expected in the elevated western parts of the area.

Hydrological Memoranda Nos. 29 and 30 (Meteorological Office) already provide information for most of these stations on the monthly distribution of rainfall, the accumulated mean daily rainfall for the years 1916-50 (for a few selected stations only) and the frequency of daily rainfalls of particular amounts (again, for a few stations only).

As a second stage, it would be necessary to examine the statistical information available on precipitation and storm frequency in relation to the particular watersheds involved. This would apply especially to the watersheds of the Rivers Beauly and Conon, for which some data on river flow should be available. Although no attempt to secure river flow data for the area has yet been made, it is understood that information may be obtained from:-

Mr. P. L. Aitken,
North of Scotland Hydro Electric Board, 16 Rothesay Terrace,
Edinburgh, 3.

Mr. J. K. C. Wilson,
21 Lansdowne Crescent, Edinburgh, 12.

(vii) Length of Growing Season and Variations in Temperature due to Elevation:

The computed length of the growing season, taking 45°F as the baseline, is 193 days at sea level. This figure can be taken as the standard growing season for the whole area, adjustments being made for elevation and distance from the sea.

The effect of altitude is to reduce this period by approximately 10 days for each 250 ft. rise in elevation above mean sea level. On the maps growing seasons have been expressed in terms of the departure from the standard value, e.g. "G.S. - 10" indicates a growing season duration of 183 days etc.

Theoretically the mean figure for the 250 to 500ft. elevations would seem to be "-15" rather than "-10", since the growing season length should decrease gradully by 10 days at the 250 ft. contour and by 20 days at the 500 ft. contour. Similarly a mean figure of "-25" for the 500 to 750 ft. elevations would seem more appropriate than "-20". However, allowance must be made for proximity to the sea, the effect of which is to moderate the annual and diurnal range of temperatures. Thus, for the Cromarty and Dornoch Firths and for the eastern section of the Inverness area a deduction of 10 days has been adopted as the average for each 250 ft. elevation band.

However, the section west of Beauly is dominated by the high-lying land mass of part of the N.W. Highlands rather than by the sea to the east. It can be anticipated that a transition in the climate - from a maritime type to one somewhat more continental in character - will occur between the eastern and western sections of this area. The approximate course of the boundary runs northwards from Cannich to Beauly, Muir of Ord, Contin and Loch Garve. A sharply defined line will not be traceable on the ground and vegetation; the line itself indicates that the transition in climate will take place in the valley or on the plain through which the line passes. The difference in climate should be apparent on the higher ground to the east and west of this line.

Accordingly, the adjustment for elevation in the growing season values for the area west of this line becomes "-15" for the 250-500 ft. band, "-25" for the 500-750 ft. band, "-35" for 750-1,000 ft., etc., in order to show this distinction.

The order of difference between the two climatic "zones" is likely to be as follows:-

	Mean Range of Temp.	Mean Min Temp.	Days of Frost	Sunshine % of possible	Cloud
Eastern Area	30°F	35°F	50	28%	72%
Western Area	32°F	32°F	100	25%	75%

These are average values but the overall picture for the western area, in comparison with the eastern part, will be of higher rainfall, more cloud and therefore less sunshine, a slightly increased range of temperature and more days of frost.

Allowance must still be made for aspect and although not shown on the map the mean figures for each elevation band should be weighted by adding 5 days for slopes between E and W through S and deducting 5 days for slopes between W and E through N. Above 1,250 ft. these adjustments are of little practical relevance.

For variation in mean temperature due to elevation, it is usual to deduct 1°F for every 300 ft. rise in elevation above mean sea level.

No attempt has been made to show mean temperatures on the maps but the following are of interest:-

	Fortrose 69 ft. o.d.	Inverness 68 ft. o.d.	Nairn 20 ft. o.d.
Mean Annual Temp.	47.66°F	46.94°F	47.30°F
Monthly Mean, Jan.	37.94	37.40	37.58
Monthly Mean, July	58.28	57.56	57.92

Although small, these differences show the maritime influence at Fortrose and Nairn and the smaller effect of this at Inverness. Inland stations to the west of Beauly will experience slightly lower mean temperatures than Inverness but differences will be particularly apparent in the winter-time temperatures, monthly mean temperatures in January frequently being of the order of 30-31°F in valley situations.

3. ATMOSPHERIC POLLUTION

1. Nature of pollutants and, hence, injurious effects will depend on the type of industries sited in the complex at Invergordon.

Dispersal of pollutant material will depend on:-

industrial factors, e.g. strength of source or rate of emission from stacks; dilution of wastes in chimney; temperature of effluent or terminal velocity of large particles of ash, etc.; height of stacks and orifice diameter; surrounding complex of buildings;

site factors, e.g. topography; location of nearby buildings and their effects on air flow and local climate;

weather factors, e.g. prevailing wind direction; horizontal wind speed; wind structure (turbulence pattern) dependent upon stability of relevant layers (temperature change with height)

2. Bearing in mind that detailed information on all the above would be necessary for a full prediction of the potential problem, nevertheless certain general conclusions can be drawn at this stage. Information on atmospheric stability is in any case rarely obtainable for any site in the U.K. and since plume behaviour and, hence, the distribution of smoke and other material are largely governed by the stability pattern it would be necessary to have data on the incidence of different weather situations before a complete analysis could be made.

However, accepting Sutton's generalised diffusion coefficients for an "average" stability index ($n = 0.25$), a plan of ground concentrations for a given wind direction has been produced. This can be orientated on the 1:25,000 map for the wind direction under consideration. In this case, allowance has been made in the Sutton formula for a mean wind velocity of 4 metres/sec. Note that the effect of an increase in wind speed is to dilute the concentration at ground level rather than to change the distribution pattern (i.e. the distance at which maximum concentrations are found). (See p. 3A16).

3. In the absence of wind records for Invergordon, the wind rose shown on p.3A14 is based on 1961-65 records for Kinloss taken 4 times daily. These show the following percentage distribution:-

Calm	N	NE	E	SE	S	SW	W	NW	Total
2.39	8.05	5.41	13.04	5.28	13.24	28.54	16.75	7.30	100

It is possible that these figures underestimate the importance of the sea breeze at Invergordon. Local observation, particularly of how this varies between NE and SE, would help to improve on the above figures. But, bearing in mind the fact that there is a considerable yearly variation in wind distribution, it would be unreasonable to expect too high a degree of accuracy from mean percentages of this kind. In the case of Invergordon, one could reasonably allow for E winds prevailing for up to 18 or 20% of the time in any one year.

The average computed wind speed for Invergordon is 8.8 m.p.h. at 10 m. above ground (33 ft.). The average wind at 7 ft. will be 78% of this, i.e. 6.9 m.p.h. and 124% or 10.9 m.p.h. at 100 ft. With higher stack heights, proportionately higher winds at the orifice must be expected, thus reducing the upward development of the smoke plume.

4. Considering atmospheric conditions, Invergordon should have about 3½ hours of sunshine per day as an annual average (the same as Coventry). The cloudiness pattern is as follows:-

	Spring		Summer		Autumn		Winter		Year	
	1 am.	1 pm.	1 am.	1 pm.	1 am.	1 pm.	1 am.	1 pm.	1 am.	1 pm.
Occasions with cloud below 1,000 ft.	5	3	9	4	3	2	2	1	19	10
Occasions with cloud between 1,000 and 8,000 ft.	72	81	79	86	82	88	78	82	311	337
Occasions with no cloud below 8,000 ft.	14	7	3	1	7	2	11	8	35	18

Thus, the dominant pattern is for cloud between 1,000 and 8,000 ft. with no great difference between night and early afternoon. Little relevant information can therefore be derived from these figures, except as mentioned below.

5. Since plume behaviour depends on stability, it can be anticipated that at Invergordon, with a high proportion of cloudy and windy weather and mechanical turbulence generated by mountainous country to the SW and W (as opposed to local, thermally induced turbulence), and also a moist climate, the dominant pattern will be "coning", typical of neutral or weak temperature lapse rates. Ground level concentrations downwind of the source and the distance to the point where the maximum concentration occurs will therefore depend very much upon stack height. As an example, the following shows the relation between stack height and distance to the point of maximum concentration:-

Height of stack in metres	Distance downwind in metres
10	158
25	439
50	1,224
75	2,350
100	4,070

This situation will not, of course, prevail all the time (hence, the difference in the 4 km figure above and the 2-4 km range shown in the diagram for a 100 metre chimney stack). Under very stable conditions, i.e. an inversion, surface concentrations would be negligible with 50 times the height of the stack when "fanning" occurs. The height of stack would have its greatest effect at this time. However, these conditions are not likely to be very frequent at Invergordon.

Unstable conditions, with strong temperature lapse rates, which produce the characteristic "looping" type of smoke plume, should not be as frequent at Invergordon as at inland sites, owing to the maritime influence. Under these conditions, maximum concentrations of pollution can be found fairly near the stack source and stack heights have little effect, at least at distances of more than 10 heights. "Looping" is liable to occur only in daytime when skies are clear and there is little wind; mixing and turbulence combat excessive concentrations.

One type of plume pattern which may prove troublesome on occasions - although it is difficult to make any quantitative estimate of frequency - is that known as "fumigation", when an unstable or near neutral surface layer is capped by an inversion above the stack. This is associated with air flow from cool water to warm land during the day in spring and summer and from cool land (snow covered, for example) to warmer water during the night in autumn and winter. Frequently this condition disappears by early morning. It is expected that Invergordon will have about 140 occasions with fog at 9 a.m. in the winter and about 6 in the summer, many of these dispersing early in the day. It is felt, therefore, that the frequency of these conditions in spring and summer (which produce the "haar") is not likely to be very great. The autumn and winter type, since the winds will in this case be off-shore, can be disregarded.

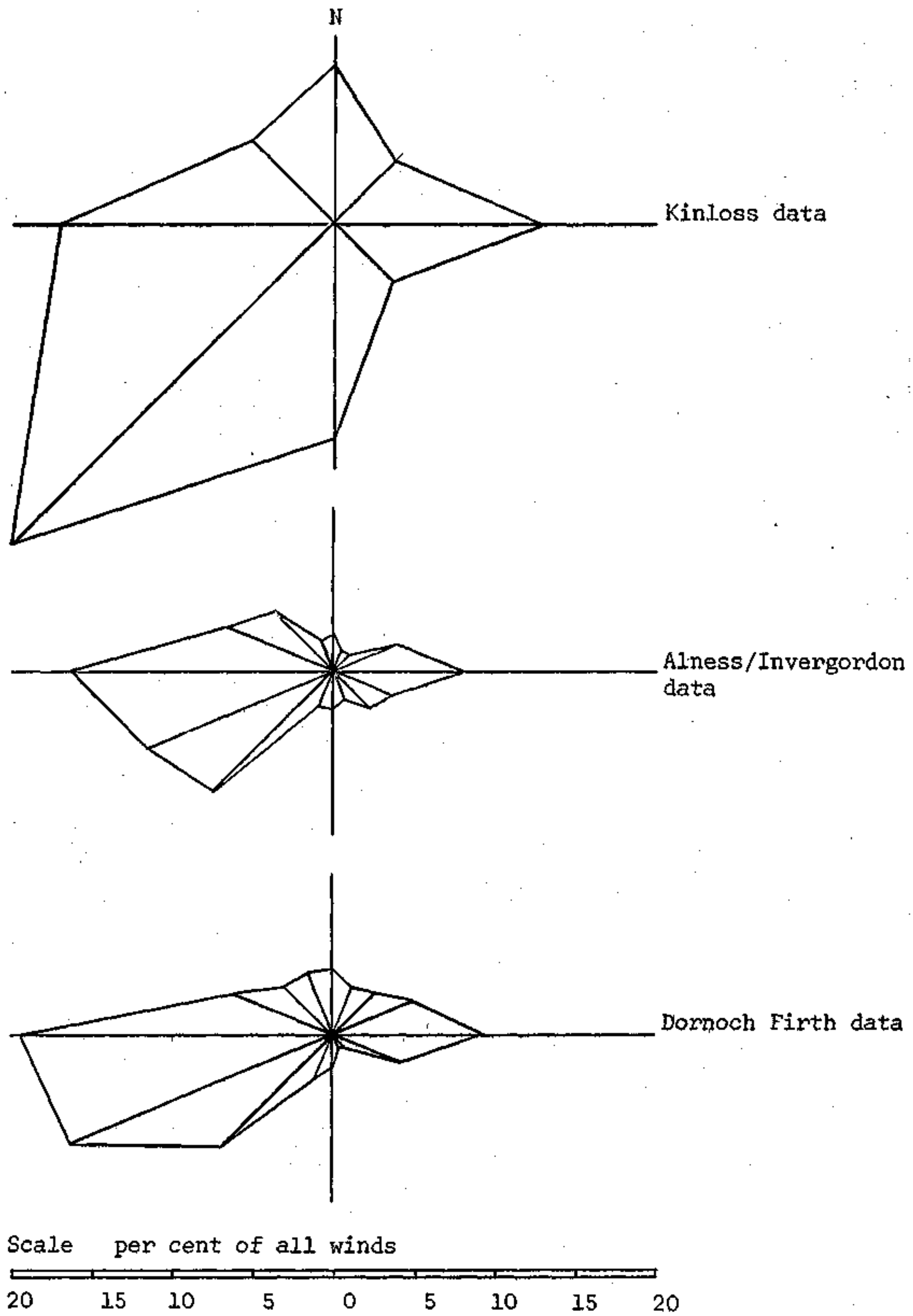
"Trapping" which is in some respects similar to "fumigation" but due to an inversion caused by subsidence in anticyclonic weather (the type which produces the serious London and Midland "smog") should be less frequent than in inland areas.

In conclusion, the majority of inversion conditions which occur will be relatively shallow and these are not unfavourable, provided that they do not extend above the stack. Stacks should be kept as high as is feasible.

6. The site at Invergordon is topographically very suitable for dispersal of pollutants and for achieving the maximum abatement of the nuisance. It should be borne in mind, however, that downwash of stack gases can be caused by other tall buildings in the vicinity of stacks. This should not occur when the stack is at least $2\frac{1}{2}$ times the height of any other structure within 20 "heights" of the stack. Thus, for a stack of 300 ft., no building should be taller than 120 ft. if within 2,000 yards of the stack.

There should be no objection to a tower building to the south of the industrial site at Invergordon, provided the above conditions are satisfied. Since winds from the NE are not frequent, it would be an advantage if the building could be sited a little to the SW of the pollution source. If within 1,000 yards or so, it should escape most of the pollution.

7. Large particles, e.g. of ash, will fall out near the stack, depending on terminal velocities. This is a problem to be examined by those concerned with the industrial processes.



WIND ROSE DIAGRAMS

4. POTENTIAL PROFILE OF HOUSING IN RELATION TO TOPOGRAPHY, COLD AIR DRAINAGE ETC.

In view of the northerly latitude of the Moray Firth, it is advisable that shadow length is taken into account when planning decisions are made. This will be particularly important during the winter months when the sun's altitude is very low. Examples of shadow lengths at noon and at 0900/1500 hrs, in the middle of each month for the latitude of Inverness (57°30'N.) have already been given. These range from a little over half the height of the object casting the shadow in mid-June at 12 noon to 32 times the height of the object at 0900 or 1500 hrs. in mid-December.

One objective has been to produce a series of diagrams and/or tables from which it is possible to determine at a glance the shadow pattern at any time of day and any season of the year created by a line of building, windbreak or similar obstruction of different orientations, e.g. N-S., NW-SE, E-W and NE-SW.

The length of shadow, L, cast by an object of height H, can be determined as follows:- $L = H \cot. a$, where a = solar altitude.

The latitude of Inverness is 57°30'N. and that of Golspie 58°N. Taking the Inverness latitude, the following table shows the shadow length at noon (with the noon shadow length for 50° N., Lands' End-Dieppe for comparison) and also at 9 a.m. and 3 p.m. GMT.

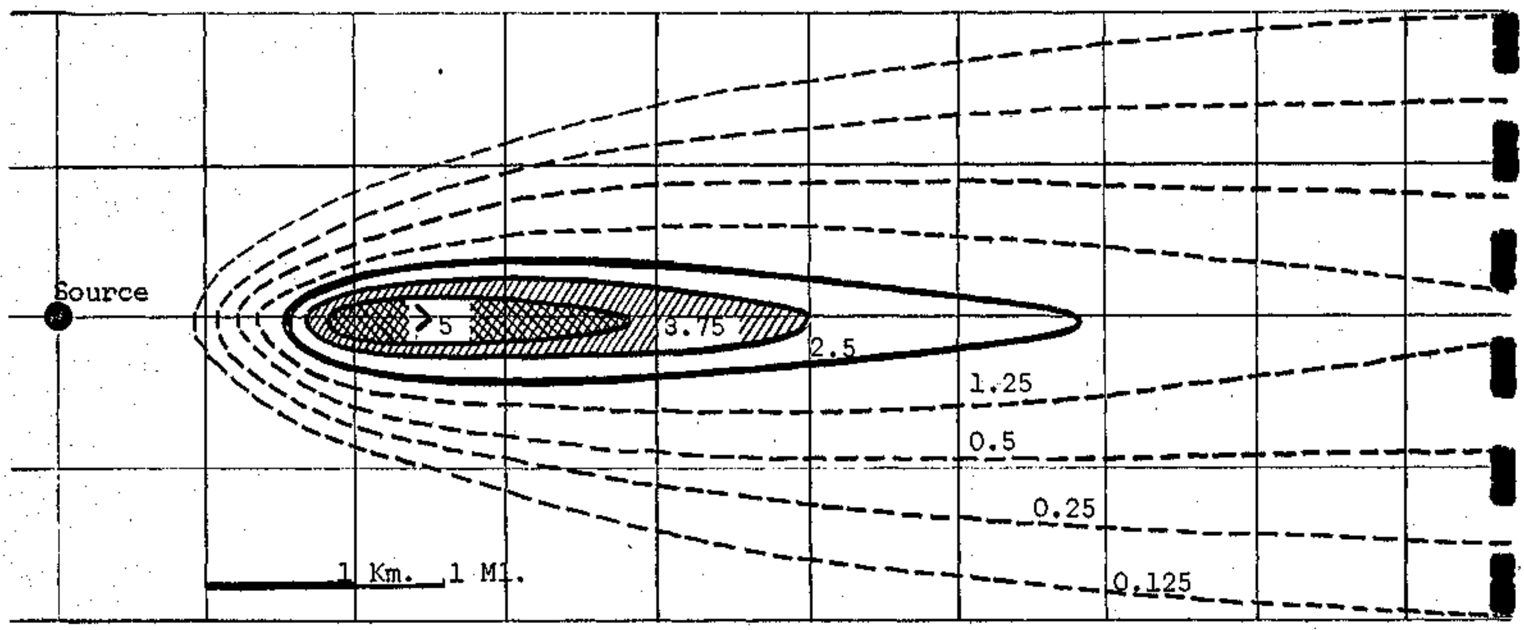
Date	Noon Solar Altitude, Inverness, 57°30'N.	Shadow length x H	cf. Shadow length for 50°N. x H	Solar Altitude at 9 a.m./3 p.m. Inverness, 57°30'N.	Shadow length x H
Jan 15	11°	5.14	2.9	3°	19.08
Feb 14	19°30'	2.82	1.96	10°30'	5.40
Mar 15	27°30'	1.92	1.28	20°	2.75
Apr 15	42°	1.11	0.87	31°	1.66
May 15	51°	0.81	0.6	39°	1.23
Jun 15	56°	0.67	0.51	42°45'	1.08
Jul 15	54°30'	0.71	0.53	41°45'	1.12
Aug 15	46°	0.97	0.73	35°	1.43
Sep 15	35°	1.43	1.07	25°	2.14
Oct 15	24°30'	2.19	1.6	15°	3.73
Nov 15	14°	4.87	2.48	5°45'	10
Dec 15	9°30'	5.98	3.27	1°45'	32

These calculations can be extended to determine the shadow length of a wall, row of buildings or a shelterbelt, of known orientation, using the formula:-

$$L = H \sin (180 - b + c).\ \cot.\ a,$$

where a = altitude of the sun;
b = azimuth of the sun) measured clock-
c = direction of wall, windbreak, etc.) wise from N.

Since hourly values of azimuth and solar altitude are not easily available to most people, a start has been made in devising a suitable computer programme in which this information can be calculated for any latitude, time of day and time of year.



ATMOSPHERIC POLLUTION

General pattern of ground concentrations of Pollutant material for a stack height of 100 metres (based on Sutton's equations where $n = 0.25$ and $Cy=Cz=0.1m^{\frac{1}{8}}$; $U = 4$ m. sec.$^{-1}$). Ground concentrations expressed in 10^{-6} Q, where Q = output from the source per unit time. Hence the figure 5 on the diagram represents a concentration of 0.0005% of the output.

APPENDIX 4.

MORAY FIRTH WILD LIFE SURVEY

By

THE NATURAL ENVIRONMENT RESEARCH COUNCIL - NATURE CONSERVANCY.

CONTENTS.

INTRODUCTION

1. The area of survey is the tidal waters and flats of the Cromarty and Beauly Firths together with hinterland up to the 500 feet (150-metre) contour from Tain to Nairn. Although the actual survey is thus limited, the Moray Firth catchment area as a whole comprises a wide range of natural and semi-natural habitats from bare mountain tops to tidal flats and estuaries. The Ben Wyvis massif forms one of the most scientifically interesting areas of mountain vegetation in the northern Highlands; it is an important link between the distinctly different plant communities of the north-west mountains and those of the Grampians. The spacious tidal waters and flats provide wintering grounds for a large and diverse community of wildfowl and waders and is a staging post for migrants. The intervening ground is in agriculture or commercial forest, and the few semi-natural habitats which remain in riverine localities, gorges, disused quarries, firth shores and scrubland now have a value to local wildlife conservation which is commensurate with their rarity.

Shortage of time has necessitated a superficial study of the whole area, with more particular attention to the seaward parts. The landward parts most closely associated with the major developments planned for the Cromarty Firth have been studied in greatest detail. This rapid treatment has been in accord with the needs of the Planning Group in preparing a capacity study for development in the Moray Firth, on behalf of the Highlands and Islands Development Board. The survey did not commence until 10th November and therefore some areas of botanical (flowering plants) and ornithological (breeding and summer migrant birds) study have not been included. This disadvantage has been off-set by including in the survey as wide a range of semi-natural habitats as possible, and by the fact that this is the most suitable time for studying the wildfowl which are one of the most important wildlife resources in the area.

The proposed developments and increase in population should be possible without any disastrous effects on the existing wildlife and plant habitats provided that these are fully recognised in planning. Opportunities should be found for the improvement of existing habitats and the creation of new ones.

This survey was done by Dr. I. D. Pennie, Warden Naturalist for the Northern Highlands in co-operation with the Jack Holmes Planning Group. The aim is to provide a sketch overlay of wildlife interests within the Moray Firth.

2. Tidal Areas

The Cromarty and Beauly Firths are winter feeding grounds for many species of duck and one of the main Scottish wintering grounds for Wigeon. The Firths have been partially covered in the National Wildfowl Counts and the figures indicate that the total number of Wigeon in the Cromarty Firth is about 25,000 and in the Beauly Firth about 10,000.

Other ducks are present in smaller numbers, the most numerous being Mallard, Teal and Pintail. These species are of sporting value and numerous other species occur regularly such as Shelduck, Red-breasted Merganser, Goosander, Common Scoter, Long-tailed Duck and Goldeneye. Numbers of geese and swans vary, but there are possibly about 3,000 Grey Lag Geese, 1,000 Pinkfeet all told and 500 Whooper Swans. At Lentran on the Beauly Firth there is a moulting ground for about 170 Canada Geese in late summer and a small number of Greenland Whitefronted Geese winter on Loch Eye.

The most important wildfowl areas are Nigg Bay, Alness Bay, Dingwall Bay, Udale Bay, Munlochy Bay and Longman Bay. All these should be given special consideration in planning, and the pattern of disturbance caused by the development on these areas would require to be collectively assessed by the Nature Conservancy in co-operation with the local wildfowlers' association in advance of any reclamation scheme or shore development. It is accepted, however, that some disturbance is inevitable and it is possible that it may therefore be necessary to include within the wildlife plan, the Dornoch Firth as a wildfowl area of some importance.

The mudflats of the Cromarty and Beauly Firths have an abundance of two species of Eelgrass, *Zostera nana* and *Z. angustifolia*, upon which wildfowl feed. A possible danger to wildfowl, therefore, is chemical and thermal pollution which could have an adverse effect on the *Zostera*. Pollution could also greatly reduce the standing crop of animal food such as crustaceans, molluscs and worms. Wading birds and other species of duck feed on these invertebrates and all the places named are feeding areas for vast numbers of wading birds in addition to ducks. Pollution is particularly important in regard to the industrial development and shipping in the Cromarty Firth.

Industrial development and increased human population in the Inverness district could have an adverse effect on the birds using the Longman Bay, by pollution, general disturbance and uncontrolled shooting; irregular shooting already takes place and will no doubt increase. This tends to keep the birds off the feeding area and drives them to the open waters of the outer firth where they are unable to feed. Longman Bay is readily accessible from Inverness and the birds are easily observed from the public road; it therefore has considerable amenity and educational value to the people of Inverness and consideration will be given to creating a Regional Wildfowl Refuge at Longman Bay.

Reedbeds are not generally extensive in the north of Scotland but there are several beds of *Phragmites communis* in the development area which are an important habitat both for wildfowl and other birds. These reedbeds are also places of beauty and scientific interest which are already threatened by the dumping of refuse. The five main reedbeds are: Dingwall Bay, the Conon River at 552575 opposite Pitglassie Farm (in danger of being destroyed by dumping domestic refuse), south side of Munlochy Bay, the mouth of the Beauly River and Lentran shore (extensive).

The following are four important tidal and estuarine habitats which lie close to the main proposed centres of development:

(i) Dingwall Bay. This has a very attractive saltmarsh with beds of sedge (Scirpus maritimus) and reed (Phragmites communis); the latter extend northwards as far as 563574 just beyond the railway bridge. This has considerable botanical interest and provides shelter for ducks and other birds. Its situation between the railway and the mudflats has rendered it immune so far from dumping except at the north end where much refuse has been dumped over the wall from the main road. New road construction should avoid damage to this site.

(ii) Conon Estuary. The islands in the Conon Estuary form an interesting group of habitats: these are mainly saltmarsh and mud at the lower end, but upstream the large island becomes dry grassland, then open savannah-like scrub, and finally has an almost closed cover of Alder, Willow and Birch.

(iii) The Beauly Firth. A bridge, viaduct or open causeway would have virtually no effect on existing habitats upstream. A dam or barrage, on the other hand, would result in the creation of a large freshwater impoundment upstream from the barrier, and presumably some of the existing mudflats would be reclaimed as agricultural land, and this could be advantageous as a wildlife habitat for few areas of shallow, fertile freshwater now remain undrained in the north of Scotland. The creation of such areas would require to be carefully planned in consultation with the Nature Conservancy, the local wildfowlers' association, river boards and angling interests. Strict control would require to be invoked in the use of motor boats.

(iv) Nigg Bay. Reclamation of Nigg Bay from the sea would create similar shallow, freshwater areas for angling and wildfowl. This may possibly alter tidal currents in the Cromarty Firth with scouring or sand deposition on the beds of Zostera.

(v) Alness Bay. Alness Bay is not only one of the most important feeding areas for duck and waders on the Cromarty Firth but is likely to be particularly vulnerable at an early stage in the development. The mud here is highly organic with profusions of Zostera, Salicornia and Enteromorpha. Wildfowl counts record maxima of 3,000 Wigeon and 200 each of Mallard and Teal, but an estimate on 14th November, 1967, suggested that these figures may be greatly exceeded. There were also on that date very large flocks of Dunlin, Redshanks, Knots, Bar-tailed Godwits and Curlews, 4 Common Snipe, 1 Jack Snipe, 40 Whooper and 20 Mute Swans. In view of the close association of Alness Bay with the proposed human population increase at Alness, this area merits further study and consultation with the Wildfowlers' Association on the question of designation as a Regional Wildfowl Refuge.

3. Freshwater Areas.

Almost all the landward area to the 500 ft. (150 metre) contour is under either arable farming or forestry, and many former wetland areas of high ornithological, entomological and botanical interest have now been drained. Development plans should include the provision of freshwater areas for all kinds of recreational use, including biological interests, and barrages on the Beauly Firth and Nigg Bay could provide for this. Pitmaduthy Moss, between Calrossie and King's Causeway, in Easter Ross, is another area suitable for flooding by freshwater. It has not been possible to identify and report on every existing piece of freshwater, but the following are considered to be of importance:-

(i) Loch Eye. As a wildfowl roost and feeding place this is now the most important piece of freshwater in the area. It is one of the main roosts for Grey Lag Geese and the Greenland White-fronted Geese already noted. It also holds large numbers of Mallard, Teal, Wigeon, Tufted Ducks, Goldeneye and Coots. Part of Loch Eye is kept as a private bird sanctuary but otherwise it is much disturbed by irregular and uncontrolled shooting. It is a good trout loch. The local Wildfowlers' Association would like to see Loch Eye designated a Regional Wildfowl Refuge, when no new developments or sports other than angling should be permitted.

(ii) Black Loch 777758 (behind Shandwick Inn). A very attractive small boggy loch which is at present being destroydd by dumping spoil from the adjacent gravel pit.

(iii) Lochan nan Tunnag 766762. This is a small eutrophic loch in a fine woodland setting with private fishing.

(iv) Loch Achnacloich 664733 Ardross. This is an excellent eutrophic loch surrounded by reedbeds in a setting of Alder wood.

(v) Loch Ussie. This is a particularly fine eutrophic loch (water supply for Dingwall) in a setting partly of coniferous plantations and partly of Alder mixed with naturally regenerating Pine. The particular attraction, however, lies in the series of islands, thickly wooded with deciduous trees; one island has a heronry and there are many wintering duck, mainly Pochard.

(vi) Ord Loch 526505 Muir of Ord. This has little open water left and is being partly filled in for building on one side; the wet scrub is worth saving.

(vii) Lily Loch 535696 Blair of Tarradale, Muir of Ord. This is a eutrophic glacial loch with very little open water, but probably attempts have been made to drain it. It has a thick vegetation cover of *Scirpus/Juncus/Menyanthes* with *Salix* scrub. There is a young Scots Pine plantation on the west side and a rubbish tip with old cars at the east end. This is an interesting and ornithologically valuable piece of wetland habitat of a type of which very little remains in the district. It is recommended that rubbish dumping be stopped forthwith and that this loch should be retained, with a slightly raised water level.

(viii) Culbokie Loch, Black Isle. This loch is situated in Culbokie Wood Forestry Commission plantation of Scots Pine and some Norway Spruce round the loch. It is over a mile long and partly drained, but has some open water and is still an interesting piece of Carex/Juncus/Equisetum marsh, probably supporting many interesting birds and insects in spring and summer.

(ix) Monadh Mor, Ferintosh, Black Isle. This area consists of about a square mile of bog with many partially drained small lochs and pools, much overgrown with self-seeded scrub Pine. It does not give the impression of drying out rapidly and is a near approach to boreal muskeg or Lapland forest bog. In spite of what is said in "Wildfowl in Great Britain" (p.222) this is one of the most interesting pieces of semi-wetland in the district. This place should be preserved for further study without drainage as it is probably of little value for forestry.

(x) Flemington Loch. A eutrophic loch near Nairn with little tree cover and mixed wildfowl: tufted duck, pochard, wigeon, coot, swans, moorhens.

4. River Valleys

Throughout the whole of the survey area, river and stream valleys are of paramount importance for wildlife and as places of natural beauty. Many of these contain the only uncultivated or unplanted land for miles around; most contain strips of natural or semi-natural woodland and have the nearest approach to a natural ground flora. Furthermore, the exposed rock in many stream gorges forms plant habitats not found elsewhere under present conditions and consequently the flora is greatly enriched. Few of these valleys are suitable for agriculture or forestry and all should be retained as places of biological interest and beauty.

The most notable of these are:- Balnagown River from Scotsburn Bridge to Balnagown Castle; Alness River; Contullich Burn, Alness; River Glass, including the Black Rock Gorge and Allt Graad; River Skiach above Glenskiach Distillery; the Newhall Burn in the Black Isle; the Beauly River, particularly from Kiltarlity to Eilean Aigas; the Moniack Burn above Easter Moniack, including the Glen of Reelick which is a limestone area of high amenity and botanical importance; Rosemarkie Burn, including The Dens which is a scheduled Site of Special Scientific Interest.

Some of these are threatened only by rubbish dumping, but others are in the near proximity of centres of proposed development and in these cases development plans must include plans for their management. This applies especially to the Alness River valley and the Contullich Burn which are very close to the proposed Alness urban development. Consideration should be given to provision of a management plan for the Alness River valley as one unit from Alness to Dalneich Bridge. This provides a unique opportunity for the incorporation of an area of very high amenity, scientific and educational value in the plans for the new town. A vast quantity of refuse is being dumped into the valley at a point opposite the junction of the golf course road and the Millcraig road. This should be stopped immediately.

In the area of Rosemarkie Burn there is a great deal of naturally regenerating Ash and the whole valley could be made into a most attractive woodland walk. Evidently some attempt has been made to do this in the past, but the path is much neglected, the bridges broken and rubbish dumped in it from the road. Fulmars are occupying sites on ledges in the Earth Pillars in the S.S.S.I. section of The Dens. There is also a lot of naturally regenerating Ash in the Den of Raddery nearby.

5. Other Landward Sites of Particular Interest

In an area where practically all the land is devoted to arable farming and forestry, it is desirable to maintain as diverse a series of semi-natural habitats as possible including deciduous and coniferous woodland and scrubland of various kinds. These may be quite small; for example, disused stone quarries such as Findon Quarry in the Black Isle often develop into extremely interesting botanical and ornithological sites and may be well worth preserving.

This survey shows thirteen outstanding sites:

(i) Talich, Fearn. This is an Alder wood of varied age on the site of a drained loch.

(ii) Balchraggan Wood - Logie Wood. These form roughly a square bounded on the north by Logie Hill road, on the west by the Balnagown River, on the south by the main north road, and on the east by the Pitmaduthy road. This is an area of birch scrub, heather and broom with some planted Pine and some semi-natural self-seeded pine. It includes the two lochs noted above in 3, Black Loch (spoiled by gravel workings) and Lochan nan Tunnag.

(iii) White Hills, Alness. An area of Birch, Pine and Poplar woodland and scrub on shingle, presumably the 100 foot raised beach. The whole of the White Hills area should be managed as one unit, possibly with the Alness River valley (see 4).

(iv) Black Rock Gorge and Evanton Wood. An area of high amenity and scientific interest in the immediate vicinity of Evanton development area.

(v) Dalroy Gorge. A gorge east of Inverness in the Lower Old Red Sandstone with a diverse woodland containing birch (dominant), pine, gean, larch, hazel, aspen, ash, rowan, juniper, broom, bell heather and blaeberry.

(vi) Drummondreach Oakwood, near Alcaig, Black Isle. This is a fine piece of semi-natural oakwood in which there is a deep ravine with a burn. It contains also some Hazel, Beech and young Aspen; it appears to have been ungrazed for some years.

(vii) Findon Wood, Black Isle. An ungrazed oakwood different in character from the last, containing more Birch and with a ground vegetation partly of heather.

(viii) Kilravock Wood. A birchwood with juniper and fine stands of beech close to conifer plantations.

(ix) Findon Quarry, the Black Isle 595602. A disused sandstone quarry fringed with broom and now overgrown with Ash, Willow, Wild Rose and a profusion of Gean (Wild Cherry) of all ages. An adjacent smaller quarry is similar but has no Gean. No refuse has been dumped in these quarries but refuse is still apparently being dumped on the beach between them in spite of a Local Authority "No Dumping" notice.

(x) All the deciduous woodland between Redcastle and North Kessock, and between North Kessock and Munlochy Bay. The whole of this stretch is of high amenity value, which is no doubt already being considered in the development plan, but it also provides a good diversity of wildlife and botanical habitats, including what may be a fragment of natural Ashwood at Kilmuir. On the slopes above Craigton Light is the only known site of the Maiden Pink (*Dianthus deltoides*) in the north. This area is particularly rich in raptorial birds.

(xi) Sand dunes on the shore about one mile north of Rosemarkie. This is an interesting botanical site with a number of plants which are only locally abundant, including the vetches *Astragalus danicus* and *glycyphyllos* and *Vicia sylvatica*.

(xii) Balintore sand dunes. This is a small attractive dune and grassland which could be developed for recreational purposes; these dunes have three interesting local plants: *Oxytropis halleri*, *Carlina vulgaris* and *Mertensia maritima*. None is rare at the national level, but all are very localised in distribution and should be conserved as part of the local interest and amenity.

(xiii) Whiteness Head. A narrow shingle spit to the east of Inverness covered with whin and marram grass; between The Spit and the Carse of Ardersier there is an extensive salt marsh.

There are few opportunities for cliff-nesting seabirds to colonise these firth areas, but there is a small colony of Kittiwakes, Razorbills, Guillemots, Shags and Cormorants at Castlecraig, Nigg and on the South Sutor, Cromarty. These, especially the former could become of local educational and general interest if large centres of population were located near them.

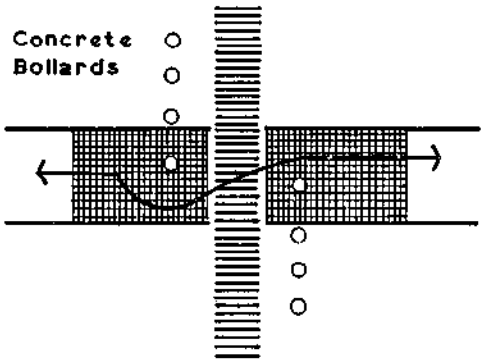
APPENDIX 5

HOUSING AND TRAFFIC STANDARDS and BUILDING CONSTRUCTION POLICY.

CONTENTS

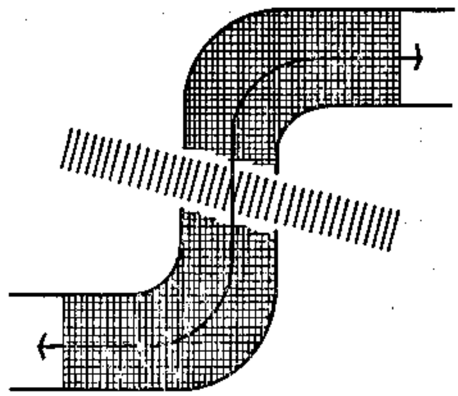
ILLUSTRATIONS

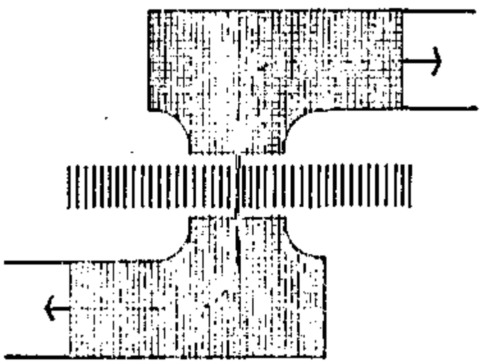
THE USE OF CHICANES TO REDUCE PEDESTRIAN / VEHICLE CONFLICT



1. Vehicle speed is reduced on a long straight stretch of road.

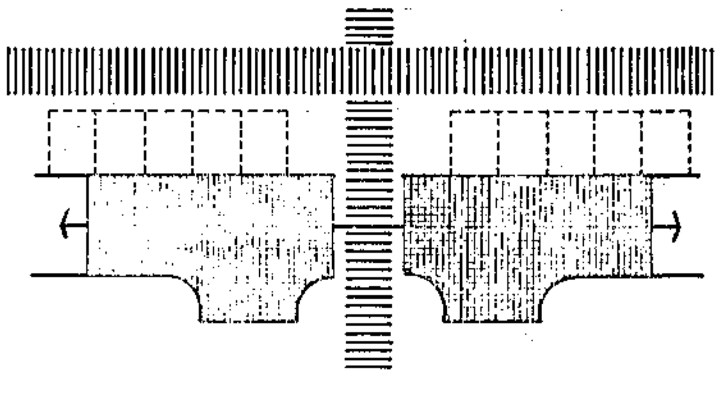
2. Vehicle speed is considerably reduced. Good intervisibility requires to be achieved in this design.





3. Vehicular linking of cul-de-sacs allowing access to servicing vehicles and thus avoiding double journeys on each cul-de-sac.

4. Vehicular linking of cul-de-sacs. Parking bays with direct access to pedestrian ways also incorporated.



NOTES ON HOUSING STANDARDS

The sketch house types used to construct specimen layouts in the body of the report were based on the standards set out in "Building Standards (Scotland) Regulations 1963", and the "Scottish Housing Handbook". Some of the layouts however are for owner-occupied houses with somewhat higher standards in a number of respects, such as living space, window area, heating and insulation.

We should add the following observations which are of both a general and particular nature relating to the Moray Firth situation.

The rate at which the national population is said to be increasing, the general shortage of housing, and the simple requirements of national economics indicate that it is unlikely that the life span of any new house should be less than 60 years. For this reason alone building materials should be chosen for their permanence and low maintenance cost. Calculations of relative capital and maintenance costs will generally reveal the long term savings to be made by employing more expensive but more permanent materials, and such a policy reduces the danger of spoiling the general environment in later years with decaying buildings.

Within the fabric of permanent structures it will be possible to allow for amenability to the changing needs of the family as children are born, grow up and leave home. Adaptable forms of partitioning and fitments within the living space particularly will help to cope not only with the normal growth of a generation but with the changing requirements in the use of space for storage and recreation as society progresses towards even greater variety of leisure pursuits.

To avoid the likelihood of a house becoming obsolete or even sub-standard over the investment period it should be capable of being reconditioned, in the sense that the working parts such as bathrooms, kitchens and heating units could be entirely replaced without awkward modifications to the main fabric. Thus the house could keep pace with technical advance if the service parts are regarded by the designers as the dynamic elements, as opposed to the static elements, of the main living spaces and the fabric which shapes them.

While the more massive materials of which a house is constructed are the primary defence against intrusive noise, further steps can be taken to preserve privacy in the siting and landscape treatment. The relationship to main roads, the use of planting and earth moulding can all be manipulated to this end.

Two routes of access to houses are shown in the specimen layouts. One is purely pedestrian and the other is from the service/delivery/car park areas which we have called "court-yards" in revival of an old term which as nearly describes its function as any other we can devise. (See also Housing Study, Part Five). One function of the design of these courtyards is to keep down the pace of the vehicle. This can be effectively achieved by the use of "chicanes" or obstructions to speed some of which are illustrated opposite.

ROADS AND LANDSCAPE

The appearance and design of roads in the landscape context is a matter for great concern if they are not to disrupt the harmony between scenery and land use which is a central principle to the plan. Whereas the traffic speed for which the road is intended governs the carriageway design there are other factors to be considered.

The total design of the road should be in harmony with the scale and pattern of adjacent scenery and land use. This is necessary to achieve visual continuity in the landscape (or townscape) and to bring the scenery of the road itself into a scale appropriate to its design speed - an important factor influencing driver reaction and, therefore, safety.

The alignment of the carriageways should take account of natural features and, wherever possible, should follow natural land form. Where cuttings and embankments are necessary, however, much land could be returned to agriculture or given some other useful function by the careful manipulation of cut and fill and by the grading off of the side slopes themselves.

The design problem is often most critical at road junctions and particularly where these are of the grade separated type. Attention to the design of the total environment of these junctions is as necessary as it is anywhere else in the built environment.

Our experience in these matters is that additional costs for the proper landscape treatment of roads is minimal in comparison to the benefits to be obtained and can, with fairly generous provision, be contained within a sum amounting to about 2-3% of the total construction costs.

ROAD STANDARDS AND PARKING PROVISION WITHIN THE LOCALITY

A. Design Elements of Roads:

1. Housing feeder Road having no frontage, no parking, no turning vehicles.

* Width	18ft-24ft
Design speed	40.0 kilometres per hour
Min. Hor. Radius	40 m
Max. gradient	6%
Camber	3%
Max. super-elevation	5%
Minimum sight distance	40 m
Minimum vertical curvature	K=5 R=450 m
Minimum channel gradient	0.8%
Minimum spacing of junctions with district distributor	125 m

Note: For a distance of 10m into the housing feeder road from its connection with the district distributor the gradient should not exceed 3%.

2. Service Road having frontage, garaging, manoeuvring etc.

Width	18ft
Design speed	30 kilometres per hour
Min. Hor. Radius	15 m

Note: Use should be made of this radius in order to control running speeds.

Max. gradient	8%
Camber	3%
Max. super-elevation	3%
Minimum sight distance	30 m
Minimum vertical curvature	K=2.5 R=250 m
Minimum channel gradient	0.8%
Junction with housing feeder	Tee junction
Minimum kerb radius	5 m
Sight lines back up service road	6 m
along feeder road	30 m

Note: For a distance of 6m into the service road from its junction with the feeder road the gradient should not exceed 3%.

* All engineering dimensions and design for this study are in metric units, with the exception of carriageway widths for which no metric design values have yet been issued.

B. Parking and Garaging:

1. Provision

Private Development:

Car ownership	=	1.5/family	150%
Resident Parking	=	1.5/family	150%
Visitor Parking	=	0.5/family	50%
		3.5 car spaces/family	350% provision

The above is the average provision for this type of development. Various factors such as type of family structure, income structure, distance from centre, will vary the provision from 290% to 450%.

Local Authority Development:

Car Ownership	=	1.2/family	120%
Resident parking	=	1.2/family	120%
Visitor parking	=	0.5/family	50%
		2.9 car spaces/family	290% provision

Again this is the average provision and it is possible to envisage a variation from say 200% to 350%.

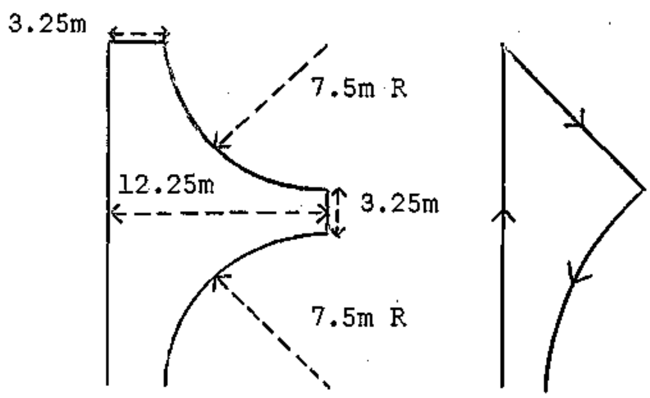
2. Dimensions

Garage sizes	5.25m x 2.75m
Parking Bay size	5.25m x 2.25m

C. Vehicular Turning Places:

1. Should not be located at points of shortest transfer distance to dwellings (otherwise they will be used for parking).

2. Must contain an area adequate in dimensions for service vehicles to turn - the minimum area for a 4 wheel medium commercial vehicle is shown below:



3. Garage Entrances:

(a) At right angles to road - 9.0 m from the face of garage to far side of road.
(b) Garages face to face - 8.0 m between garages.

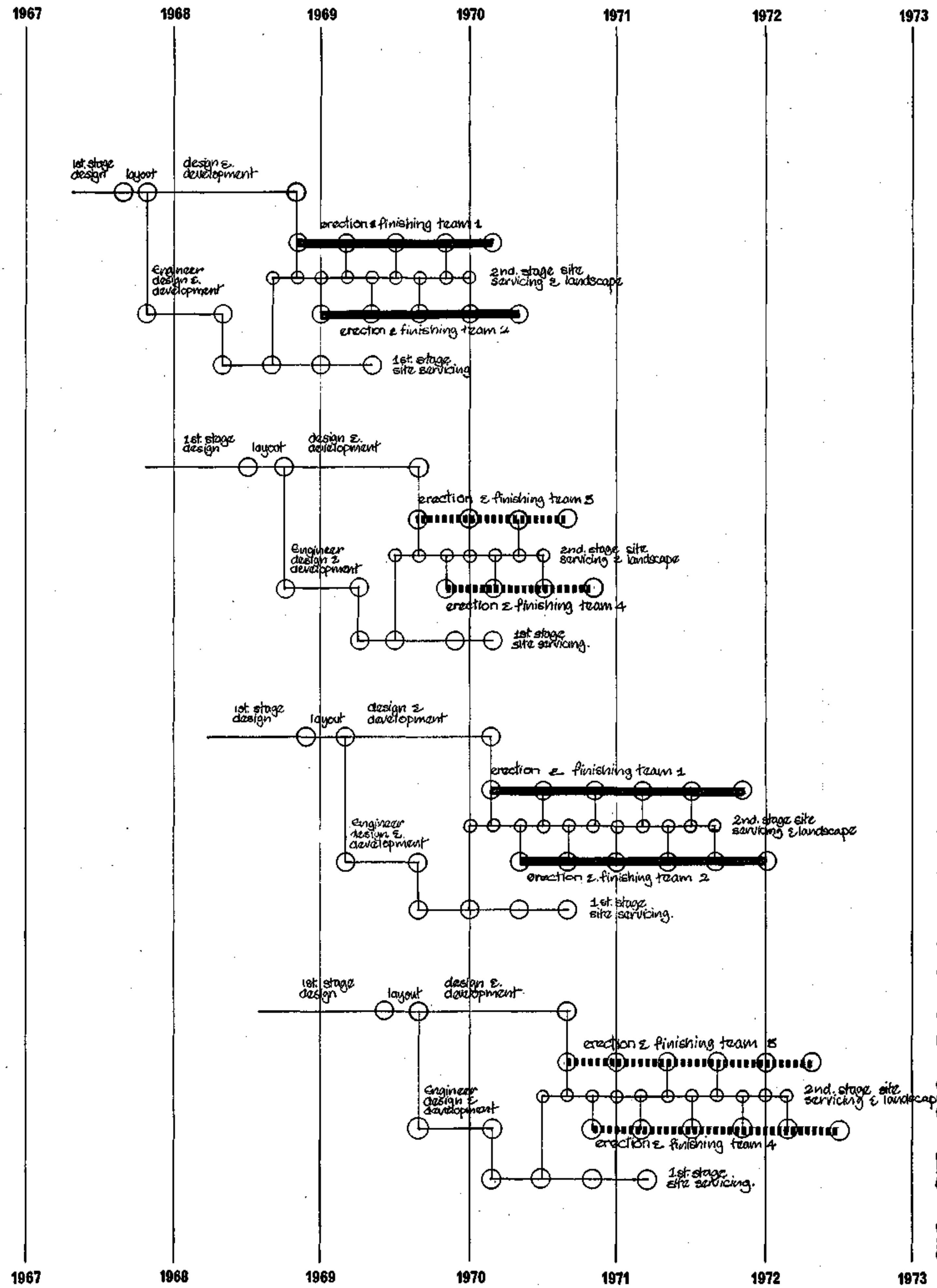
METHODS OF HOUSE BUILDING

Assuming rates of house building greater than 800 p.a., the following is a brief outline of a method by which the building programme could be met, and which would allow the greatest advantage to be taken of industrial techniques and modern management principles.

While houses are being manufactured in units or components in a central factory, the site would be made ready. For construction planning the housing layout would be divided into Crane Reaches. A Reach would be cleared and the top soil taken to improve poorer land nearby. All services will be laid, including drains, water, gas, electricity, telephone, piped T.V. and then a thin concrete sub-floor could be laid on the solum of the houses with service connections upstanding above its surface ready for flexible connections. All house foundations, roads, pavings, car parks, play spaces and all hard and soft landscaping (the last according to the season) would then be finished and the site would be complete except for the buildings. The site servicing team would then move on to the next Crane Reach well ahead of the next arrival on the site, which would be the mobile crane. The crane would take up a pre-arranged position on the service road or other suitable area of hard standing without damage to work already done. The first lorries containing house components would arrive on the car park and the crane would then erect, with the help of the Erection Team, all the houses within its Reach. The houses would then be wind- and water-tight.

After the first day's work by the crane the Finishing Team would arrive and connect with flexible connections all the services to and within the houses. They would fit all fixtures not already built-in to the major elements, clean the houses and move on the second day's work by the crane. On the completion of its work in the Reach the crane would move on to the next Reach while the Finishing Team dealt with the previous day's work by the crane.

The serial nature of the contract would allow the site works to be further broken down into two operations. Mains servicing would be carried out by teams dealing with a larger area ahead of Branch Servicing teams who would deal with sections of these areas, and take all services up to the point where they would eventually be connected to houses. Perhaps four branch servicing teams would follow behind one Mains servicing team. Their work would have to be completed on each Crane Reach before the arrival of the crane. The rate at which the crane could build would determine the optimum size of the site servicing teams, the finishing teams, the work rate of the earth-moving equipment, and the stock of building components to be held at the factory. Much therefore depends on the choice of crane. It would probably be more economical to have an expensive long-span mobile crane than a cheap fixed crane whose removal to the next site would take several days. It seems theoretically possible to build 5,000 houses by 1974 using only four such cranes. (See diagram on next page).



a possible construction programme

APPENDIX 6.

CLASSIFICATION OF AGRICULTURAL LAND.

CLASSIFICATION OF AGRICULTURAL LAND

1. Introduction.

The methods used by the Department of Agriculture and Fisheries for Scotland and the Macaulay Institute for Soil Research in classifying agricultural land are described in paras. 2 and 3.

The best land according to each classification has been abstracted for use in the present study, and the total area has been looked on as a constraint where alternative land uses were being considered. The aim has been to evolve a land use pattern which would minimise the effect on the best agricultural land, whilst achieving a coherent, flexible and economic strategy for other forms of development.

2. Department of Agriculture Classification.

The Department of Agriculture and Fisheries for Scotland use for their own purposes a system of Classification of agricultural land with lettered grades A+, A, B+, B, B-, C and D, representing Very Good, Good, Medium Plus, Medium, Medium Minus, Poor and Non Arable Land respectively. This evaluation is based on a field to field visual survey with an underlying knowledge of productive results of farm units, and reflects the standard of husbandry at the time of the survey. The classification made available for the Moray Firth area incorporates amendments in the Ross-shire section to take account of areas brought into or excluded from production up to Autumn 1966.

3. Macaulay Institute Classification (Soil Survey of Great Britain).

The Soil Survey of Great Britain has now produced a unified agricultural land capability classification to assist government planners, the National Agricultural Advisory Service, the Department of Agriculture and Fisheries in Scotland, the Agricultural Land Service and other land users. This classification is a modification of that developed by the Soil Conservation Service of the United States Department of Agriculture, and the object of the classification is to present results of soil surveys in a form which may be of use to advisers, farm planners and other land users. The grading into seven classes is based on interpretation of the influence of soil, site and climate on management and crop performance.

A survey and classification on this system for the Moray Firth, concentrated on the area of this study, has been carried out by the Macaulay Institute for Soil Research, Aberdeen, under the supervision of Dr. R. Glentworth, Head of the Department for Soil Survey. During this survey close contact has been maintained with the local advisory staff of the North of Scotland College of Agriculture.

Assumptions and Explanations *

1. The classification is primarily for agricultural purposes.

2. Land is assessed on its capability under a moderately high level of management and not necessarily on its present use.

3. Flexibility of cropping, whether actual or potential, is given considerable weight but does not outweigh the ability to produce consistently high yields of a somewhat narrower range of crops.

4. Land which suffers from limitations which can be removed or reduced at acceptable cost is graded on the severity of any remaining limitations.

5. The capability classification may be changed by major reclamation projects (e.g. pump schemes) which permanently change the limitations in use. Minor changes, e.g. mole drainage liable to regress in time, will not change the classification.

6. Within capability classes soils may differ in management, fertiliser requirements, and detailed cropping, and are only grouped because they have similar degrees of limitation affecting adaptability. The classification however is not necessarily a grouping of soils according to the most profitable use to be made of the land.

7. Within specific subclasses are soils which suffer from the same degree and kind of limitation but which may differ in management requirements; for example in subclass 3w the wetness may result from slow infiltration or from the effects of rising ground-water; conditions which would each require separate treatment.

8. The system is based not on chemical, but on physical limitations, for in general these are more permanent and difficult to rectify; severely limiting chemical properties however, can be recognised as a soil limitation.

9. Distance to markets, kinds of roads and pattern of land ownership do not influence the grading although these factors will affect decisions about land use.

10. The interpretations try to express current knowledge, and as new experience is acquired new interpretations will be necessary.

11. The system is not a soil suitability classification for specific crops or use, e.g. for potatoes or forestry. Interpretations of soil maps for such purposes may require different groupings of the soil mapping units to express the concept of land capability used in the system.

Classes.

Class 1. Land with very minor or no physical limitations to use.
Class 2. Land with some limitations that reduce the choice of crops and interfere with cultivations.
Class 3. Land with moderately severe limitations that restrict the choice of crops and/or demand careful management.
Class 4. Land with severe limitations that restrict the choice of crops and/or require very careful management practices.
Class 5. Land with very severe limitations that restrict its use to pasture, forestry and recreation.
Class 6. Land with very severe limitations that restrict use to rough grazing, forestry and recreation.
Class 7. Land with extremely severe limitations that cannot be rectified.

Within the above classes there are subclasses based on the kinds of limitations affecting land use. These are:-

w. Wetness.
s. Soil limitations.
g. Gradient and soil pattern limitations.
e. Liability to erosion.
c. Climatic limitations.

* Extracted from a paper by D. Mackney and J. S. Bibby.

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The 2 multi-coloured maps and covers by Outrams, Perth.

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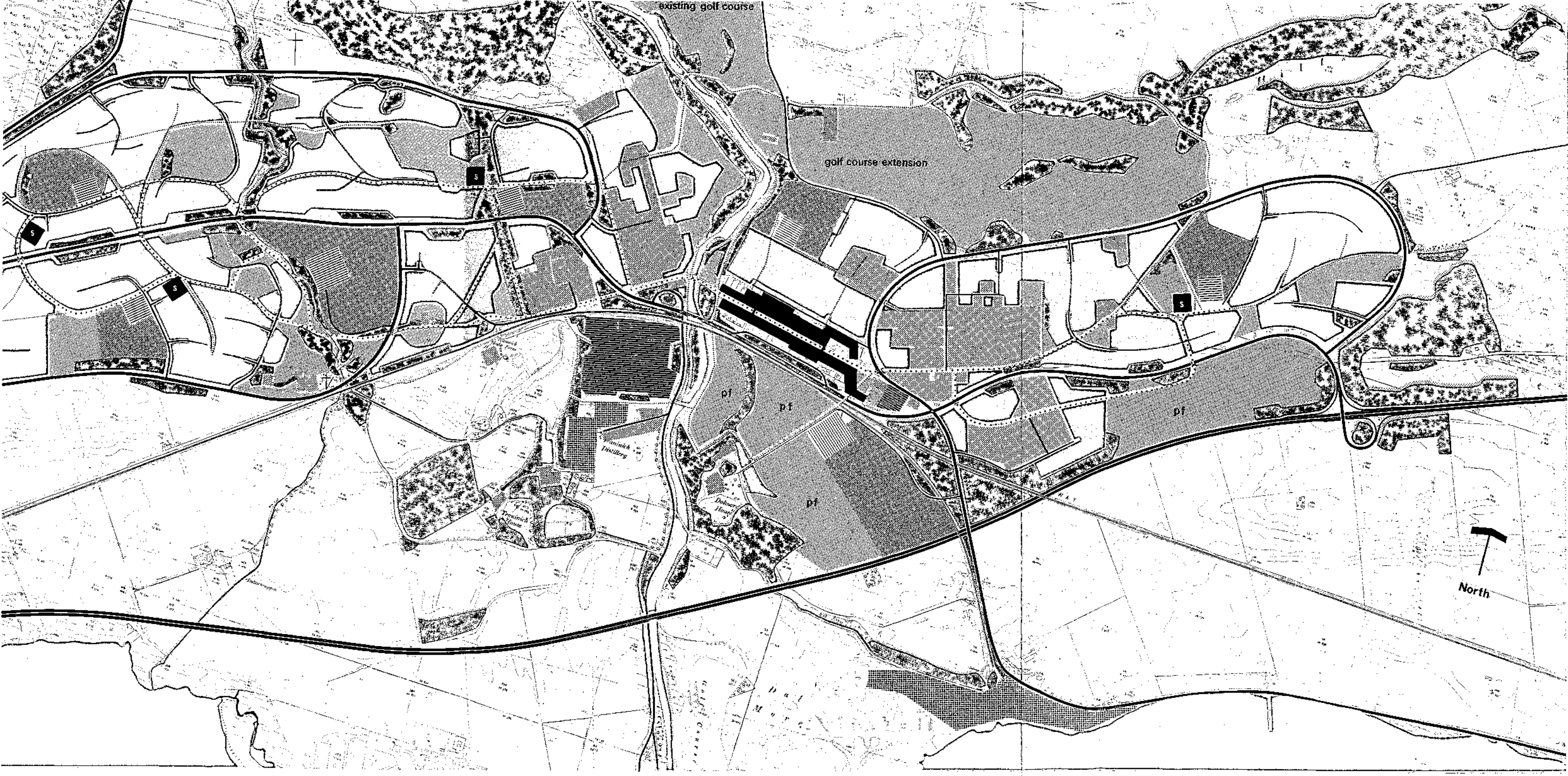

open space
pf playing fields
woodland
water
railway
footpaths

secondary school
primary school
cemetery

1Km
1MI

ALNESS STRUCTURE PLAN