DERELICT LAND MONITORING WITH REMOTE SENSING

EDWARD CHARLES HYATT

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SUMMARY

The research assesses the relative merits of multitemporal black and white aerial photography and multispectral orbital satellite imagery for the identification and classification of derelict land. The study area of Dudley occupies the south-west quadrant of the Black Country Boroughs of the West Midlands in Great Britain. The region features extensive post-industrial dereliction due to a lack of directed planning and the decline of traditional industry.

The classification and definition of derelict land are reviewed at length and their effects are considered with regard to derelict land reclamation. An overview of regional and local reclamation policies and derelict land grant and survey procedures is presented.

Panchromatic aerial photographs from two dates are used to estimate and classify derelict land and reclaimed land at a mapping scale of 1:10,000. Accuracy comparisons are made between the aerial photographic survey and more traditional ground surveys. Landsat Thematic Mapper computer compatible tapes are used to estimate the amounts of derelict land in the study area. Analysis of the satellite data is via digital image processing, and accuracy comparisons are made with the aerial photographic survey.

Conclusions of the research indicate that while panchromatic aerial photography is an accurate means of both identifying and classifying derelict land sites, Landsat Thematic Mapper data has neither the spatial resolution or spectral integrity required for derelict land investigations in dense urban environments.

KEY WORDS: Dudley, Derelict land, Reclamation, Remote Sensing

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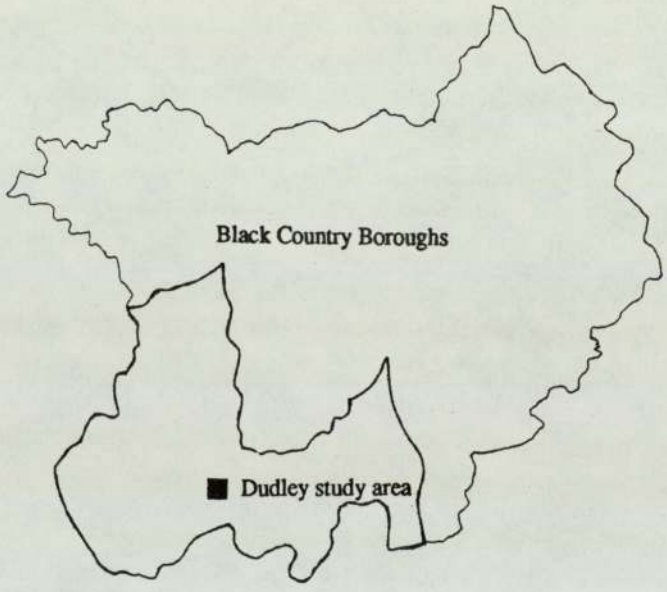
CHAPTER 1: INTRODUCTION

The Dudley study area occupies the south-west quadrant of a region formed by the Black Country Boroughs of Wolverhampton, Walsall and Sandwell, which respectively lie to the north, north-east and east. The Black Country Boroughs together with the City of Birmingham to the east and Solihull and Coventry to the south-east form the West Midlands Region. The specific area of interest, around Lodge Farm, is shown in Figure 1.1 together with the rest of the West Midlands Conurbation. The Black Country Borough's constitute the greater part of the West Midlands Conurbation, an area whose boundaries were defined for the 1951 census. According to Joyce (1977), the established Conurbation boundaries have only a 'quasi - functional relevance' as they are related to an enumeration district which has become obsolete due to the spread of industry and housing.

Figure 1.1 The Dudley study area



The West Midlands Conurbation as defined by Borg (1973), is approximately 19 km in length and 17 in breadth, covering an area of 20,882 hectares (ha) and surrounded by the administrative counties of Staffordshire, Warwickshire, Worcestershire, Shropshire and Herefordshire. On a wider scale, the region is diverse, with an admixture of shire counties and dense industrial networks. The real nucleus of the city is the central business district, around which lie a broadly concentric ring of industry and housing. Commuter satellite towns, such as Sutton Coldfield, Solihull and Telford are peripheral to the main development.

The West Midlands Region is governed on a Borough basis, in some cases, as in the Black Country, amalgamation to meet common aims is preferred. The West Midlands Metropolitan Council, established in 1974, but disbanded in 1986, aimed at the provision of strategic administration for Black Country, Birmingham and Coventry and appears to have had substantial benefits to the West Midlands Region, especially regarding the evolution of a mature planning policy. Its demise presents administrative problems in many areas, however in the Black Country the converse may be more evident. Edmonds et al (1986) states

that; 'The area has suffered extremely rapid economic decline in recent years, moving from a properous, manufacturing area to an assisted area in less than a decade'. It certainly seems that some areas received less assistance than merit dictated when the whole conurbation was considered in terms of strategic planning. The basic concept of a conurbation expressed by Fawcett (1932) as an area occupied by a continous series of dwellings, factories and other buildings, urban parks, playing fields etc; which are not separated from one another by rural land, was interpreted by Joyce (1977) for the West Midlands Region, as including the Black Country and Birmingham, but excluding Coventry and Solihull. The West Midlands Conurbation is influenced by the type of developments that are a legacy of rapid eighteeth century industrialisation. Despite recent progress in strategic planning and the implementation of the resultant policies the West Midlands Conurbation has been obliged to mature within the structure framework of a bygone age, which was founded on heavy industry. In consideration of this, a review of the effects of twentieth century planning policies on the conurbation is presented.

1.1 Planning development in the West Midlands conurbation

In his review of the West Midlands Conurbation's industrial and planning structure, Joyce (1977) states that there is 'no deviation in the tendency for all advanced industrial societies to resort to deliberate and planned action in attempts to control and redirect societal change, and to do so in an organised and institutional fashion'. It may be assumed on the basis of evidence presented later in this chapter that from the 1960's has a structural planning policy been realised in many metropolitan areas. The West Midlands Conurbation is no exception to this rule, and perhaps suffered more than most regions due to unbridled development and lack of planning foresight, as the following planning review demonstrates.

The early planning policies in the West Midlands Conurbation were based upon two studies; 'Conurbation' (1948), by the West Midlands Group and 'The West Midlands Plan' of the same year by Abercrombie and Jackson, which closely followed one of their earlier projects, the 'Plan for London'. The 'Plan for London' (1947) suggested a ceiling population of 2,176,000 (Birmingham) by 1962 and felt that it should be 'contained' physically within a 'Green Belt'. Population overspill was to be accomodated in towns surrounding the conurbation, following the Greater London Plan that proposed new towns at Stevenage, Kilbride and Milton Keynes. 'Conurbation' relied upon the maximal use of existing land, and to quote the West Midlands Group (1948), 'by the preservation of unspoiled land and by the restoration of misused land the conurbation could become a more attractive and efficient place. There is room for present industries to expand naturally; there is room for its inhabitants to be decently housed, there is room for the preservation of those natural amenities so necessary for population closely occupied in industry'. This Plan paid especial attention to waste and derelict land, which is reasonable, as at the time 10% of the Black Country was derelict and would have been ready for what Saunders (1977) described as 'a structure of settlements within a sea of green space'.

The two plans were similar, both endorsing a policy of 'Urban Containment', conurbation via housing needs being met through imaginitive planning, including the utilisation of waste areas. Expansion of areas such as Coventry and Bromsgrove were to account for overspill. The West Midlands Plan reconciled overcrowding by population movement to new towns. Apparent approbation of the Abercrombie and Jackson study was given by the Town Development Act (1952), which represented a favourable change in British goverment policy

towards the establishment of green belt areas. New Town were designated, 110 in all, with the proposal that 500,000 people would be accomodated on 20,000 acres of land in 'satellite' towns. The Town Development Act aimed to ensure the 'development of a balanced community, enjoying a full social, industrial and commerical life'. Birmingham, concerned with its rapid population expansion, capitalised on the new policy by negotiating 10 town overspill schemes, mainly in Staffordshire. However, the city was also rehousing internally, with early 1950's slum clearance and development programmes rehousing over 1,000 families a year.

By the mid-1950's the regional plans were being undermined by unprecedented levels of industrial growth exacerbated by the rapid influx of a supporting labour force. A lack of investment in reclamation programmes, especially in the Black Country, allied with redevelopment and population growth strengthened the City Council's case for new towns.

'Green Girdles' and views on the curtailment of peripheral expansion were first suggested by Meath (1901). Green belt policy was strengthened by the earlier Town and Country Planning Act (1947) that obliged developers to obtain planning permission prior to any development. The introduction of legislation that controlled the establishment of Green Belts around industrial areas in the Ministry of Housing and Local Government Circular 42/55 (1955) seemingly endorsed the Abercrombie and Jackson plans for Birmingham and Greater London. According to Saunders (1977) the success of the green belt policy and its enforcement was ably demonstrated when Birmingham applied for, and was refused, a boundary extension of 2,432 acres into Worcestershire in 1959. Saunders (1977) concludes that; 'The 1950's represent a significant transitional period between the confident assumptions and expectations of what could be acheived through the regional plan and the realisation by the end of the decade (1950-1960) that the New Town overspill component of the strategy had been insufficient and was not made fully operational at a time when the scale of conurbation housing problems was demonstrably increasing'.

The rates of development in the 1960's led to steadily increasing upward revision of overspill calculations. Estimates by the West Midlands Study (1965) suggested that 148,000 houses would be needed between 1963 and 1981, 30,000 was added to this total by the Regional Planning Council (1974) to allow for in-migration. Designated towns such as Dawley, Telford and Redditch were to increase their populations by 1980 from 35,000 to 90.000 and 32,000 to 70,000 respectively. Rosing and Wood (1977) stated that some 86,000 households would be required in order to allay population ingress resulting from in-immigration and household fission. The West Midlands Study (1965) realised that there would be no room left in the conurbation after 1981 and that 170,000 dwellings would have to go to overspill.

The government, long adept at mis-interpreting regional planning strategies apparently realised the value of urban containment and regularisation by the early 1960's. Saunders (1977) states 'the setting up of the Department of Economic Affairs and of Regional Economic Planning Boards and Councils in 1964 can be seen as the turning point in central government's re-engagement in the systematic assessment of regional planning problems'. Increased awareness of industrial strategies is evidenced by the implicit 'social and economic threat' of a large conurbation referred to in the first report of the West Midlands Economic Planning Council, 'The West Midlands: Patterns of Growth (1967)'. The government responded with the re-designation of Dawley, later renamed Telford, and targetted population increase from 90,000 in 1981 to 222,000 by 1991.

A further statement of government's intent to seriously follow these plans was the implementation of studies in and around the conurbation to monitor progress with the regional plan structure. Prior to this, for example the Abercrombie and Jackson plan, no systematic monitoring of the plans success or failure was undertaken.

By 1973 'A New Plan for the City' had been established, following an earlier, 1971, report on 'A Developing Strategy for the West Midlands'. The implementation of structure plans, 'new types of development plans, being decision documents providing broad planning policies for the city', (Borg, 1973) was a major policy step. The prime concerns of these documents were industrial mobility and population decentralisation. The structure plans vary, but all have the common themes of housing, population, industry and communications etc; that all constructive plans should consider. Perhaps the most significant step was the six County Borough Plan that recognised the unique requirements of the Black Country and Birmingham. This was endorsed by the Department of the Environment in 1976 in recognition of 'the force of arguments put by the West Midlands County Council and the Metropolitan Boroughs; above all that if there are insufficient mobile jobs there is no point in moving people a long was away from their current place of employment. We therefore believe that peripheral and close-in development will have an important role in meeting the needs of the area over the next few years'. The Department of Environment go on to argue that 'it should be general policy that priority be given to the development of those areas of land which are suitable for housing and where the necessary infrastructure is already present or can be provided quickly'. The Department of Environment recognised the housing shortfall, some 44 to 63,000 dwellings for the period 1971 to 1986. With regard to industrial migration it is generally recognised that peripheral development may not be the question, rather it is the difficult problem of maintaining the conurbations industrial base.

Since 1950 a rapid growth, not only in industry and housing but also in planning policy has occured. By the early 1970's the central business district was well defined due to Birmingham and the West Midland Conurbation having undergone one of the most rapid and radical changes in structure in the whole of England. However, 'In the Black Country the pace of change was much slower and more incremental utilising in the process at least some of the more readily useable derelict land' (Saunders, 1977).

In conclusion it is evident that the proposals made by Abercrombie and Jackson regarding the need to carefully moniter urban demographic processes have not been realised, nor have they been salvaged by the economic developments of the 1960's and structure plans of the 1970's. The Borough Structure Plans that have evolved since the demise of the West Midlands County Council may provide an answer. They appear to be more pragmatic and 'roll forward' into the 1990's, these, together with their implications for the Black Country's environment are discussed in Chapter 2.

Demographic change and patterns of industrial migration within the West Midlands Region were found to be broadly synonymous. 'The picture for the whole period from 1951 is one of accelerating decentralisation' (Rugman and Green (1977)Rugman and Green, 1977). This observation on population patterns is inversly reflected in terms of industy, with the classic 1950's model of a suburban workforce supporting a central core of industry that promotes development as population levels decline. Post 1961, population growth has been highest in the rapidly expanding satellite towns occupying the peripheral sites of the outer metropolitan area.

The nature of population dispersal, allied with other demographic, economic and social factors provided the impetus for a severe population discrepancy between green belt and inner urban areas. Planning had been

short-sighted, with the Abercrombie and Jackson plan for dispersal and containment of human resources being based upon the unsound platform of population stability. Comparative economics suggest that the industrial labour force, upon attaining a higher standard of living, migrates away from the industrial centre. As Rugman and Green (1977) state; 'More recently, urban population growth has changed to localised population decline'.

1.2 Industrial and employment changes in the conurbation

The changes in industry and employment pre-1950 were far more rapid than the eventual thirty year decline of the industries that once thrived in the conurbation. The loss of major industries such as heavy engineering, metals and vehicles has resulted in an irreversible change in the structure of the conurbation's manufacturing base. Crompton and Penketh (1977) suggest that one of the possible factors supporting the pre-1960's industrial patten was the relative freedom of developers to take industrial decisions within the conurbation. It seems implicit that the planning decisions of the early 1960's, whilst improving housing and working conditions, had a great deal to do with industrial decline, by substantially altering the character of the inner city with regard to population distribution.

It seems reasonable to divide the industrial changes into a stratified time scale on three levels;

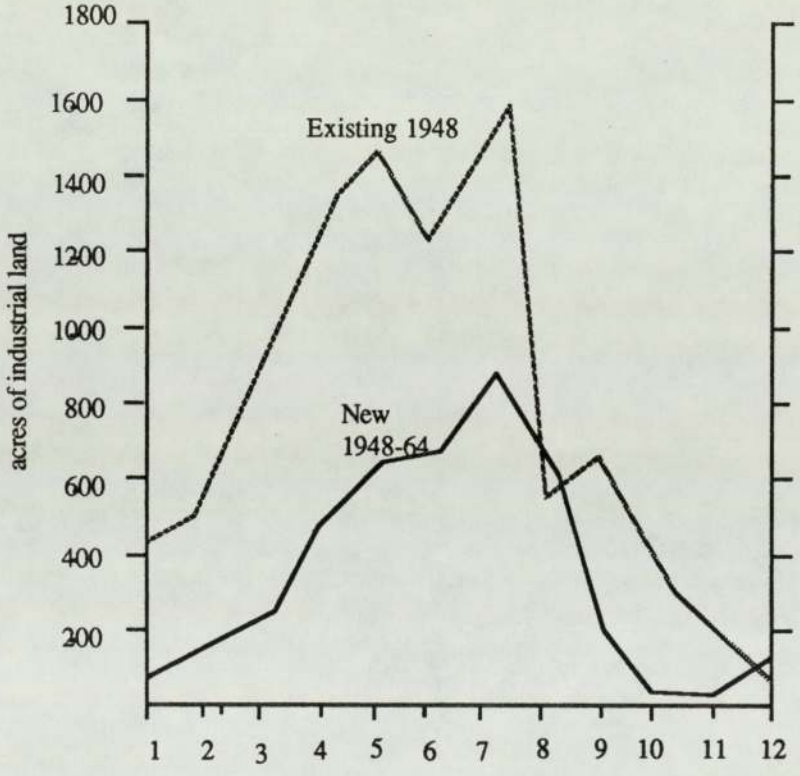
i) 1948 - 1964; rapid growth in employment and relatively uncoordinated planning activity, resulting in a more diverse demographic admixture than was reasonable in the light of how the inner city was developing;
ii) 1964 -1975; a general curtailment of growth followed by active decline, and coordinated atttempts of strategic planning that in real terms did little to alleviate the conurbations problems;
iii) 1975 -1986 ; growth in new areas and investment in industry. However, rates of decline were by now so accelerated as to mask any indications of progress, changes in planning sturcture, or the tendency to aim for redevelopment and the provision of facilities to a population with very high unemployment in an areas of considerable socio-economic stress.

The aim of the Town and Country Planning Act (1947) was to produce development plans that discouraged the mixing of industrial and other land uses. The West Midlands Advisory Plan of 1948 attempted to prevent excessive industrial growth in the outlying districts of the conurbation. Since this was never published there was no regional framework to guide local authorities in the production of their development plans and the high levels of industrial decentralization never materialized, (despite the regulated development encouraged by the Town Development Act of 1952). Instead enclaves of industry, surrounded by housing, had spread across the entire area, with the emphasis on industrial strip development along the dense rail and canal network (Johnson, 1958).

The planning policies had aimed at reducing the amount of industrial development within the conurbation, while simultaneously encouraging decentralisation. According to guidelines specified by Karn (1968) the West Midlands Conurbation might have expected rapid decentralisation as it had a high rate of employment growth in manufacturing, and an equally high proportion of that employment was in manufacturing. In an analysis of the conurbations changing industrial patterns, Carter (1977) showed that in 1964, 46% more industry was present than in 1948, and that its pattern of deployment correlated very highly with existing

industrial sites, particularly around the four Black Country Boroughs as illustrated graphically in Figure 1.2. It can be concluded that little industrial decentralisation was apparent between these dates and that employment in overspill areas was apparently insufficient to significantly alter population distribution patterns. Carter goes on to say that although there was a 46% increase in industrial land use, this percentage was grossly similar to that on Clydeside and was relatively small in relation ot manufacturing employment change, especially since there was a gain in employment of 170,000 in the West Midlands against the loss of 25,000 jobs in Clydeside. The reasons behind this were increasing diversity in Clydeside with an influx of new industries opposed to an expansion of traditional industries in the West Midlands with most of the new workforce being housed in existing premises.

Figure 1.2 The distribution of existing (1948) and new (1948-64) industrial land in relation to distance from the mean centre of distribution



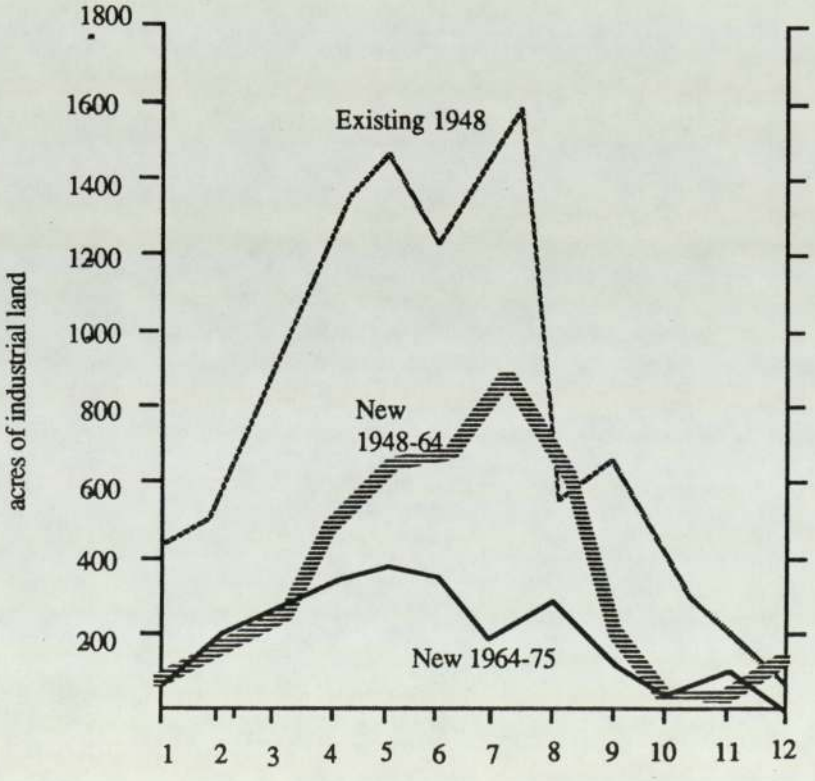
The study area, part of the Black Country, was one of the areas most severely affected, being one of the regions not covered by any developement plans. As the Board of Trade (1966) note between 1948-1964, 83% of new industrial developments in the West Midlands were regarded as extentions of previous ones. Many of the smaller firms also found premises in former central core housing, thereby delaying the development of such areas for larger scale industry. In the Black Country intense central industrialisation was due to derelict

land being available. Derelict land was consumed by industry to the extent that between 1948 and 1964, and 1964 to 1975, 43% and 36% respectively of all land used for development was formerly classed as derelict. In other areas this was not on the same scale as derelict sites were unavailable.

Thus 'central government's "regional policy" not only reduced the amount of land brought into industrial use, but also added to the unwillingness of industry to decentralise by trying to dissuade firms from making short distance moves. Thus particular local characteristics and the failure of local and regional planning, encouraged the development of a pattern of new industrial land very similar to that which already existed, but very different from that which might have been expected' (Carter, 1977).

Thoughout the next decade there was little improvement, and even regression, in the pattern of industrial land use. Figure 1.3, after Carter (1977), reveals that over the 1964 -1975 period industrial development was only half that of the previous decade, adding only 16% to the total stock of industrial land by 1975. Additionally its distribution profile matches that of the 1948 - 1964 period, with a concentration of industry in a 3 mile radius of Birmingham city centre, no new large sites and most of the small developments occuring in the Black Country.

Figure 1.3 The distribution of existing (1948 and 1964) and new (1964-75) industrial land in relation to distance from the mean centre of distribution



Population decentralisation in the 1964 - 1975 period also aided in the reduction of development levels. As Rosing and Wood (1977) state; 'Higher earning power, especially among younger families also prompts a voluntary search for a more pleasant living environment'. As Borg (1972) stated the; 'Better paid choose to live outside conurbation areas, with serious implications for the provision of locally financed services and the populations ability to pay for these'. These more pleasant areas were characterised by the outer metropolitan area and satellite towns. The move of skilled labour away from traditional industrial areas lessened development, the advent of mass unemployment in the last decade established the situation, leading to the curtailment of industrial development. Up to 1970 the emphasis was on industrial decentralisation, however from 1970 - 1975 decline set in. Since the mid-1970's the major influence has been industrial decline and the stated policy of the government indicates a reversal, with the planning of comprehensive redevelopment of industry in the core zone. The government White Paper on 'Industrial and Regional Development' (1972) stressed that; 'The problem of the older industrial areas is deep seated and long term'. As the following section indicates the present planning emphasis is on the development of derelict land, especially in the Black Country, but for housing redevelopment and not industrial land use.

1.3 Dereliction in historical perspective

Derelict land appeared very gradually in the UK, initially as a result of extractive mineral workings, mainly Coal, non-ferrous metal working and more complex areas of disturbance featuring mine and quarry wastes. Wallwork (1974) summaries the historical advent of dereliction up until 1971;

Pre-1800; small-scale mineral working, lowing incidence, few major long-term problems of derelict land.
1800-1920 (i) 1800-70: gradual increase in depth and size of mines; abandonment of some early mining areas; growth of mineral-using industries as source of dereliction. (ii) 1971-1920: increasing use of machinery in mining and quarrying, greater depth of mining with the advent of new techniques; parallel growth of greater damage from subsidence and waste disposal. Abandonment of many non-ferous metal mines; first closures of large ironworks and ancillary plants.
1921-1971: (i) 1921-47: increase in extant dereliction due to further closures of mines, quarries, and related industrial plants. Continued growth of potential dereliction in traditional mining areas, and also in opencast working in new localities. (ii) 1948-onwards: greater importance of legislation designed to minimise dereliction and secure reclamation of land. Accelerated closure of mineral workings, but continued development of the larger, better placed units,with a consequent rise in both extant and potential dereliction.
1971-1985: Since Wallwork's conclusions the situation has changed, with closure of large mineral workings, steel works and railways giving a rise in derelict land levels. Very large numbers of smaller sites have become derelict due to a decline in traditional manufacturing industries and site aggregation becomes an important factor.

Government seemed relatively unaware of the derelict land problem until the pioneer survey of the Black Country by Beaver (1946). This revealed that one out of every 8 acres was 'chronically derelict', however, the situation improved somewhat after this date due to stricter planner controls involving reclamation of badly

affected areas. Oxenham (1948) derived the first quantitative figure of 120,000 acres of derelict land in England and Wales, this was the first attempt at a national survey and the results encouraged the Government to study the problem in depth.

The National Working Party (1954), established by the Ministry of Housing and Local Government (later to become the Department of the Environment), found as the result of government initiative, that 126,000 acres of land lay derelict. This figure, approximating very closely to Oxenhams estimate was divided into three categories;

(i) Spoil heaps, 50,000 acres;
(ii) Excavations and pits, 53,000 acres;
(iii) Other (derelict industrial villages, abandoned woodland), 23,000 acres.

The Government acknowledged in its report on 'new Life for Dead Lands' (1963) that derelict land 'may not only be a symptom of obsolesance, it may be the cause of it'. The report estimated derelict land at 150,000 acres, again close to Oxenham's figures of 15 years before. The distribution of this dereliction was broadly similar to that determined by the national Working Party of 1954;

(i) Spoil heaps, 60,000;
(ii) Excavation and pits, 60,000;
(iii) Other, 30,000 acres.

The report did not fulfil the recommendations of an earlier memorandum, 'Derelict Land and its Reclamation' (1956), that suggested the collation and inclusion of all information in the regional Development Plans of the early 1960's. This idea was not considered to be capable of ensuring an adequate estimate, and an independant survey was subsequently inititated, this ran from 1964 to 1971. During the 7 year period dereliction increased in England from 34,358 ha to 39,292 ha, a 14% rise, or, 32% if the 6,216 ha of land that were reclaimed during this period are discounted.

Wallwork (1974) states that some of the increase is attributable to survey accuracy, but stated that derelict land was increasing at a rate that beats reclamation. Wallwork suggests that between 1200 - 1500 ha are lost to dereliction per annum via mineral working, and that 4600 ha are affected by the disruption this causes; furthermore, on a national scale, land becoming derelict exceeds that being reclaimed by approximately 300 ha a year. This view is endorsed and amplified by the Department of the Environment (1977), who state that dereliction exceeds reclamation by around 1500 ha per year.

The first offically acceptable estimate on the amount of derelict land (in England and Wales) was 85,000 acres. A figure approximating to only half of that determined by Oxenham (1948) and the Ministry of Housing and Local Government (1954). It seems that the Governments definition of derelict land was 'different', this problem is discussed in depth in Chapter 2. Nevertheless, the inference was that the Government was attempting to appease concerned public bodies. Specifically excluded from their 'hard core' of dereliction were ;

Land such as tipping sites on which development has not been complete; Land subject to conditions attached to planning permissions or other arrangements for restoration; Land which may be regarded as derelict from natural causes such as marshland and neglected woodlands, and; War damaged land, 'in-filling' sites awaiting redevelopment and urban sites cleared with a view to redevelopment as part of the programme of urban renewal.

This statistical manipulation was regarded by the Civic Trust's 'Countryside in 1970's Study' as grossly misleading. The study was concerned with 'Reclamation and Clearance of Derelict Land' and the Civic Trust's (1970) stated recommendations were that 'there will still be additions to this 'hard core' which will have to be dealt with in due course, including;

(a) Land now being actively damaged by development which escapes planning controls;
(b) Land now in industrial or other use (eg, a factory) which does not have to be restored when it ceases to be used;
(c) Land which requires or will require further treatment because the planning conditions imposed in the past have been inadequate or incapable of fulfillment.
We recommend that land in these categories be included in any future survey of derelict land as it will sooner or later constitute an addition to the hard core of dereliction.

The recommendations of the Civic Trust were largely ignored, as were those in an earlier report from the Hunt Committee (1969). This study was concerned with Great Britains older industrial areas, the West Midlands and South Wales, and suggested that in these regions reclamation was hindered by sporadic dereliction. The Government also rejected Hunt's conclusions that some local authorities with poor resources were confronted with disproportionate levels of derelict land which they could not afford to reclaim, and the suggestion that a 'Derelict Land Reclamation Agency' should be established.

In 1974, Wallwork suggested that there were 'at a conservative estimate', 110,000 ha of derelict land in England and Wales. This estimate was based upon derlict land returns from local authorities, many of which returned no derelict land, especially in central southern England. Heavy dereliction is a feature of all the traditonal industrial areas, whilst moderate dereliction is very widespread. It has been suggested by Wallwork (1974) that the general country-wide distribution of moderate dereliction masks heavy derelict land in counties with extensive local authority areas. At a county level the former Staffordshire boroughs recorded the greater amounts and densities of dereliction (in proportion to their size), these are summarised in Table 1.1.

Table 1.1. Borough total dereliction (in 1000 ha)

Stoke-on-Trent	66,777
Dudley CB	44,324
Walsall	31,057
West Bromwich	25,053

Bullard (1982) states; 'The amount of total abandoned land is likely to be in excess of that classified as derelict land and may be two to three times the amount, approximately to 250,00 ha for Britain. Since it has been suggested that 1500 ha of land become derelict over that reclaimed annually, then the 1986 total would be around 128,000 ha. Ashworth (1976) considers that 500,000 acres of land lie derelict and suggests that this is enough for 12, 500,000 houses or 2000-250 ha farms. It is evident that housing development of derelict land is favoured at the moment, and this trend in reclamation seems reasonable considering the Countryside Review Committee's (1977) statement that 'the original agricultural quality is hardly every recovered'. It is apparent from the reviews of planning and industrial change and derelict land evaluatation in this Chapter that derelict land needs special consideration. Government, at one time inflexible and conservative in regard to these issues now displays a more positive attitude. The derelict land situation and the planning strategy that has evolved around it for the Black Country's Boroughs are discussed in Chapter 2.

CHAPTER 2: THE CLASSIFICATION AND DEFINITION OF DERELICT LAND

There has been debate as to what constitutes derelict land since the problem was first recognised. Much of the difficulty arises from the requirement to reconcile the social-aesthetic, and economic approaches to the situation. In a social sense the term 'derelict land' is most often used to describe land which is uncared for, or damaged by some use or process and therefore subsequently neglected. In a more legal or official sense the name refers to land that has been relinquished, left vacant, or abandoned by its owners. Thus it is apparent that there may be an infinite variety in the appearance of 'derelict land', a problem which was recognized by Collins et al (1969), who stated 'while they name 'derelict land' may evoke an impression of desolation and ruin, it is an extremely difficult term to define precisely'. From an aesthetic point of view the term is generally applied to land which has become unsightly through human and/or industrial activity.

The common conception of derelict land is one having a neglected appearance which is such as to give offence to the eye. However, it is apparent from the statements above that dereliction appears to be a circumstantial quality, that is open to a wide ranging series of interpretations. The different methods of defining and classifying derelict land are discussed below, and a discussion of how they affect quantitative returns on amounts of derelict land are also presented.

2.1 The definition of derelict land in the Black Country

The classic pioneering study of derelict land by Beaver (1946), revealed how insubstantial was the legal definition of dereliction. Beaver considered that the legal meaning of 'Land left or abandoned by its owners', was so broad and ill-defined that 'if the narrow meaning were adopted ..... there is little land ..... which could be so described'. Beaver found that one in eight acres of land in his study area were derelict according to his definition of derelict 'to the eye". This was an enlightened and unprejudiced qualification of the term 'derelict' as some land that appeared derelict in the study area, such as Beavers oft-quoted example of the Oldbury spoil heaps, were in fact being utilized in an industrial capacity.

The Ministry of Housing and Local Government reflected the gradual government interest in derelict land problems via a Technical Memorandum (M.H.L.G., 1956), which was based on a detailed questionnaire survey by Oxenham in 1954. The M.H.L.G. National Working Party, which was established in 1954, issued a policy statement in its 'New Life for Dead Land's report, (M.H.L.G., 1963). The official definition of dereliction was, 'Land which has been so damaged at some time or other by industry or other development that it is not capable of full use without special treatment'. It was, however, very short-lived, being succeeded less than a year later by a Ministry Circular definitions (M.H.L.G., 1964) of 'Land so damaged by industrial or other development that it is incapable of beneficial use without treatment! This definition was to be used by local planning authorities as a basis for the derelict land return which the Ministry Circular of 1964 required them to submit. The Civic Trust (1964) released a definition of derelict land at the same time as the M.H.L.G.; it stated that derelict land was, 'Land which has been so damaged by extractive and other industrial processes that in default of special action it is unlikely to be used again within a reasonable period and may well be a public nuisance meantime'. A problem with each of the 1964 definition was that there

were types of land that were specifically excluded In the latter case this included 'Land encumbered by diseased service installations, land devastated by enemy action, land cleared for development and land which is being actively used for the tipping of refuse or soil'. The exclusions from the former definitions were broadly similar, although more rigidly laid out:-

1. Land damaged by development, but which is subject to conditions attached to planning or other statuatory arrangements providing for after treatment;
2. Land still in current industrial or other recognized use, such as an active tip which is being continued under the general permission of the Town and Country Planning Development Order, 1963, even though it is not subject to conditions attached to a planning permission or other statutory arrangements required after treatment;
3. Land damaged by development which, though not in current use, is subject to planning permission for further development, such as coal stocking or tipping, in a mineral excavation; or which may be subject to further development under the original planning permission, if in the opinion of the local planning authority, further development will take place under the existing or new permission in the forseeable future;
4. Land damaged by development which has blended into the landscape in the process of time to the extent that it can be reasonably considered as part of the natural surroundings, or has been put to some form of acceptable use, such as a wet mineral excavation used for sailing, fishing, a potential nature reserve, or an area of special scientific interest;
5. War-damaged land, "infilling" sites awaiting development, and urban sites cleared with a view to redevelopment, as part of the programme of urban renewal;
6. 'Land which may be regarded as derelict from natural causes, such as marshland and neglected woodland'.

In 1966 Oxenham reiterated the very early statements on the appearance of derelict land from an aesthetic and social standpoint by stating that in a wide sense, 'the commonest conception of derelict land refers to a neglected appearance which is such as to give offence to the eye'. (Oxenham 1966). This outlook was also apparent in his new definition of derelict land as, 'Land which has been damaged by extractive or other industrial processes, which in its existing state is insightly and incapable of beneficial use and which is likely to remain so unless subjected to special reclamation treatment'. The appearance of the derelict land may be considered as a useful indicator, but not perhaps to the extent used by Thomas (1966), who considered that derelict land was, 'all those areas where the original contours have been disturbed.'

The M.H.L.G. 1964 definition was unchanged until 1972, when the new definition refers to 'derelict and despoiled land', although the term for the derelict component of this remains the same as it originally was in 1964. Up until this time the definition had been heavily criticized by a variety of workers Lowe (1967), Barr (1969), Attenson (1969), Collins and Bush (1969a) and Bush (1970). Most of the criticism was focussed on the exclusions from land officially classified as derelict. The Civic Trust in particular had called for various other land categories to be added to what was termed 'Hard core dereliction' by the D.O.E. The additions, (Civic Trust 1970) which tended to look toward the future of the present industrial and development sites, are outlined in the previous chapter. The early M.H.L.G. definition was, however, useful for them, as it referred

to 'hard-core' dereliction, and more importantly, to that dereliction falling under the grant allowance programme. This view was ably presented by Oxenham (1966), who acknowledged that while it may be desirable to know how much derelict land there is with regard to reclamation, for official and funding purposes it may not be a strict requirement.

The most recently adopted D.O.E. definition has undergone a change, and to some extent conceded that some of the exclusions were perhaps invalid. Despoiled land now includes some of the former exclusions, such as areas that have some after-use landscaping programme. But the major changes focus on types of dereliction such as military and other service installations, and most importantly, active waste tipping and other areas of industrial working.

Further problems have been discussed however, most of these deal with the finer points of what is 'derelict land', 'spoiled land', 'vacant land', 'despoiled land' and so on. Thus it was that the generic concepts of this problem began to surface, MacDonald (1969) introduced the terms 'spoiled' and 'landscape' to replace 'derelict' and 'land', as he considered the word 'derelict' misleading when used in the context of active areas. The generic and aesthetic considerations of this problem are discussed at length by Gibson (1976); resulting in a new definition of derelict land, that presents a stratified approach which reveals a useful appreciation of the vagaries of definition. The definition has been adapted from that of Bush (1980), and takes the following form:-

'The spoiled landscape is that landscape which through the activity and subsequent neglect of man has become on unutilized land resource, or because of the activity of man causes visual intrusion.' Two subdivisions are also defined, which respectively cater for the 'derelict landscape' and the 'activity disfigured landscape. These are, 'that landscape which through the activity and subsequent neglect of man has become an unutilized land resources and 'that landscape which through the activity of man causes visual intrusion.' While this definition and it's qualifying statements adequately satisfy the generic requirements of Gibson's work, they do not aid in defining derelict land as a whole, but simply offer sets of alternatives that appear to have been raised by previous definitions.

What may be required is a more general definition that is free to be interpreted on a broad basis by local authorities making derelict land returns. Such an approach would not require stringent recourse to the D.O.E. definition, but would allow each local authority to have a degree of flexibility which could be tailored to suit the derelict land problems in their administrative area.

The classification devised by the WMC (and upon which the survey work in this thesis is based) is even more simple. The definitions in the WMC surveys of derelict and waste land includes 'any land without a beneficial use.' This definition is discussed in depth later, and the following section details how differences in both definition and classification can influence the amounts of derelict land that are 'recognized' in any one area at a given time.

2.2 The effect of differences in derelict land definition and classification

A large number of different classification schemes have been proposed for derelict land. Use of the various definitions outlined above allowed a very wide interpretation as to what truely constitutes derelict land.

The suggestion that be classified on the method of extraction by Beaver (1950) derelict land should, was primarily concerned with a sites history. As a classification scheme it had little applicability elsewhere, but it should be remembered that Beaver was working in areas where nearby all derelict land was the result of extractive processes. Conversly Stamp (1951) based his classification on the after treatment of land with a five point system:-

1. Industry
2. Housing
3. Recreation
4. Transport
5. Defence

As a classification scheme for derelict land it is very poor, as no reference is made to dereliction, which rather defeats the object of the exercise.

Glover (1957) considered dereliction with specific regard to mineral workings in a similar way to Beaver. However, whereas Beaver's two-fold classification had not really been capable of extrapolation to other areas, Glover's was. The basis for the scheme revolved around the physical expressions of dereliction and included seven categories:-

1. spoil heaps
2. quarries
3. dry pits
4. wet pits
5. hill and dale
6. mounds and hollows
7. areas of subsidence

A further stage in the classification was concerned with how best each of these types may be restored to use, although its application was obviously not suitable to each case. This second tier in the classification included:-

1. removal
2. reduction
3. planting
4. screening
5. clearing, levelling and tidying
6. filling
7. restoration to former use
8. landscaping

This approach realised that it was necessary to think about after-use, and also provided a hierarchical system which would identify which were the worst sites.

An ambitious and adaptable classification was proposed by Smith (1959) working in West Yorkshire. The classification, which is outlined below, was useful for it included illicit dereliction and also made a point that the land should not be in use. The scheme also sub-divides the forms of dereliction resulting from mining and extractive processes, previously these had been considered as one division of a classification scheme. Beaver (1961) also used sub-divisions of, A1 industrial waste; A2 mining spoil; B1 by quarrying; B2 by underground subsidence, in his revised classification. Two forms of dereliction, A, land on which deposits have accumulated; B1 land damaged through the extraction of minerals, were focussed upon, and the resultant definition was much more rigorous and more widely applicable than his 1950 scheme. Thomas (1966) also considered what the causes of dereliction were, and arrived at an expanded version of Beavers A1, A2, B1 and B2 sub-divisions that included:-

1. coal mining
2. open-cast coal mining
3. iron stone mining
4. stone quarrying
5. abandoned industrial sites
6. subsidence.

Perhaps the most useful classification to have emerged from these earlier schemes, is that of Collins and Bush (1969). That previous classifications aided the compilation of this system is obvious, however, is that one of the earliest proposals, that of Beaver (1946), appears to have had the most influence on it's design. Beavers very detailed system, which may be seen in full in Appendix 1, used a four-figure reference number to identify and classify each site. The four main categories were, relief of surface; relation to water; vegetation; and composition of the surface. Various letters and sub-divisions using fractions were included to give fuller information and allow more flexibility in the scheme. An adaption and simplification of the classification by Whythe and Sisam (1949) focussed on Beaver's fourth tier of composition and made the scheme more comprehensible.

The involved, yet very thorough, classification evolved by Collins and Bush uses a series of digits, but in this case combined with letters to grade derelict land into categories. The full classification, which has remained as one of the most useful schemes yet envisaged, is reproduced in Appendix 1. Basically six criteria were defined, with their sub-division, being identified in each case by a different set of digits; upper case letters; Arabic numberals; lower case Roman numerals; lower case letters. Combinations of these descriptors with the main category headings of Topography, Associated Activity, Pictorial Description and Filling Materials, produces unique number-digit sequences that refer to a specific type of derelict land in a particular condition and situation.

An eight point classification system modified from the D.O.E. 1974 Derelict Land Return System by the WMCC has been used to classify derelict land for the 1974 survey, into the following types:-

1. Spoil heaps
2. Excavations and pits
3. Military and other service dereliction
3. Disused rail land
5. Disused sewage works and installations
6. Disused waterways land
7. Neglected waste land
8. Other

Thus it followed on from, and to some extent built upon, the classification originated by the D.O.E. Derelict Land Returns, which is presented in full in Appendix 1.

The WMC adapted a further refinement of their 1974 classification for a 1980 survey. The scheme is reproduced in Appendix 1, and is the same as that for 1974, with the exception that each major category is more rigorously defined; resulting in twenty-three sub-divisions.

Some of the problems that a variety of classification and definitions have caused are discussed in the previous chapter, but they can be more rigorously investigated for the West Midlands region, and in particular, the Black country.

The very first official estimate of the exent of derelict land in Britain was of 85,000 acres (M.H.L.G. 1964). This figure differed very considerably from earlier estimates by Oxenham (1948), the National Working Party (1954) and the Government (1963), of 120,000, 126,000 and 150,000 acres respectiviely. This sort of discrepancy, which was more fully explaned in the previous chapter, illustrates how statistical returns can be so widely different depending upon the requirement of the investigating body.

In one investigation of a small area in the West Riding of Yorkshire, Bush and Collins (1973) concluded that the actual amount of spoiled land was up to four times that considered derelict for offical returns. Earlier surveys had also noted these discrepancies; Study Group 12 (1965), of the 'Countryside in 1970' meeting, suggested that up to twice as much land may be regarded as derelict compared to the 'hard core' areas of dereliction noted by official methods. Further studies by the Welsh Office (1972) and Notts/Derby Sub-Regional Planning Unit (1969) respectively indicated that dereliction was almost one-and-a-half times, and two-times greater than the officially recorded figure.

In the West Midlands more recent surveys have ably demonstrated the problems arising from different definitions and classifications. In reference to sources of statistical information Cave (1983) states 'The essential difference between the two sorts of information is in the definitions used. The DOE uses a relatively strict definition ..... The definition used by the WMCC Surveys of Derelict and Waste Land is much broader ..... Waste Land in wholly rural areas is excluded, but land in active uses such as tipping or excavation is included, as representing degraded land and potential future dereliction'.

The results of these differences are summarized in Table 2.1 and Figures 2.1 and 2.2 where both the DOE and WMCC classifications return figures are given for the amounts of derelict and waste land in the country as a whole, and more specifically, for the Dudly area.

Table 2.1. Effects of differing classification schemes on derelict land returns

Derelict Land Classification (hectares)	1974	1980/82
WMCC Derelict/Waste Land		
DOE classification	3793	4779
WMCC classification	12029	10547
Dudley Derelict/Waste Land		
DOE classification	951	1428
WMCC classification	2841	2445

Figure 2.1. Derelict and waste land classification comparisons 1974-1982 for the West Midlands

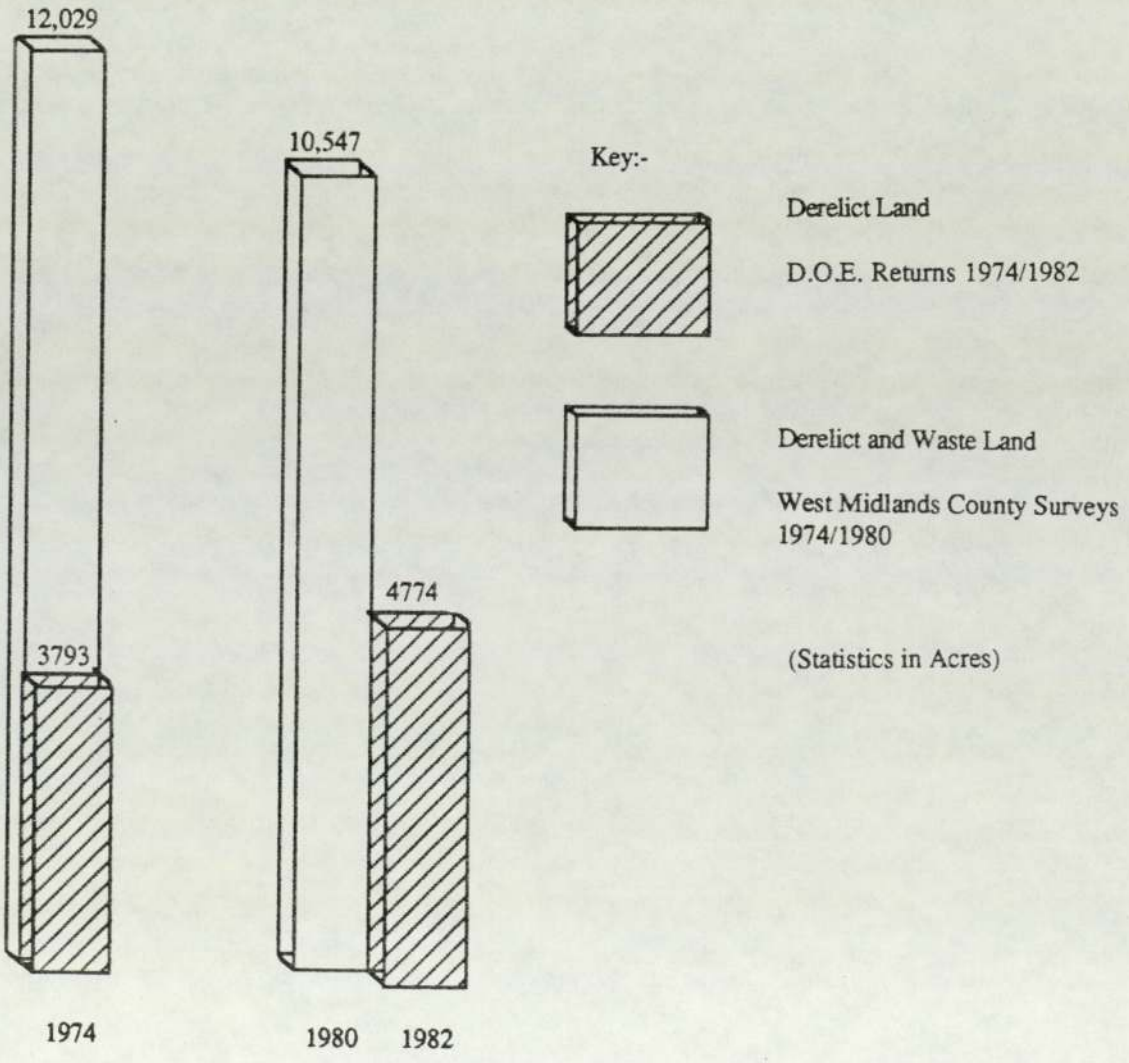
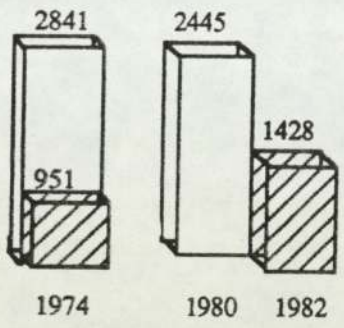


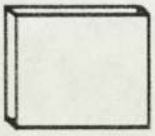
Figure 2.2. Derelict and waste land classification comparisons 1974-1982 for the Dudley Metropolitan Borough



Key:-

Derelict Land

D.O.E. Returns 1974/1982



Derelict and Waste Land

West Midlands County Surveys 1974/1980

(Statistics in Acres)

It is clear from Table 2.1 that the amount of derelict and waste land in the whole county is underestimated by 31% and 43% in 1974 and 1980/82 respectively when compared with the WMCC definition and classification. The problem in Dudley is worse, with the results for 1974 showing a 67% discrepancy, and more alarmingly for 1980/82, a 42% underestimate. Such diversity suggests that both definition and classification are in need of revision or standardization, and in consideration of the WMCC abolition, both the new districts and the DOE should perhaps pay heed to Dueker (1971), who states that 'if however decentralization is necessary due to budget considerations, compatible classification schemes must be utilized'. Perhaps the most apt summary to this whole problem has been provided by Cave (1983), who states 'It is important to note that the compilation of derelict land statistics and hence, their interpretation, depends firstly upon the way in which the derelict land problem is perceived; secondly the quality of information available; and thirdly, upon the definitions used in the classification. Changes in perception of the problem and information sometimes appear to have marked effects on the amount of derelict land recorded in an area, and can seriously affect comparability of data in a time series'.

2.3 Problems associated with derelict land

Many of the problems with derelict land are due to industrial decline, changing patterns of employment and population migration away from inner city areas. As such, most of these may be termed causal factors, and have already been dealt with in Chapter 1. Further difficulties are apparent with derelict land; these are directly concerned with the nature of the land in question, and only look back to the causal factors for their history.

A useful summary of the related events that lead up to inner-city dereliction has been provided by Moss (1981), who provides the following summary:-

changing industrial needs, productivity or methods of operating, requiring less land, or relocation closer to a primary resource, to better communications, to associated activities or to a more reliable employment potential;

decline in the structure and fabric of buildings making renovation or rebuilding in the same location an uneconomic exercise;
land in the process of change from one use to another and where redevelopment is in some way delayed;
land subject to planning policies that have demolished vast areas of buildings and have either changed programme or have become economically unviable;
land that is available for re-use, but is unattractive due to location, price or the uncertain future of surrounding land, buildings and activities;
land held speculatively as a hedge against inflation, or long-term investment; and
land surrounded by a poor quality environment, lacking good communications and essential services.

These points, possibly the most obvious of the causes cited for the increase in urban vacant land, are a testimony to a lengthy period of misguided, and often random, planning and management. It is very hard to eradicate the effects of causal factors such as these, especially when the very nature of all derelict land is in itself so much of a problem.

Some of these fundamental difficulties regarding definition and classification of derelict land have already been discussed in this chapter. The classifications in themselves reveal the major problem with derelict land, which is the amount of various types and forms in which derelict land manifests itself. For the area under examination, which has a considerable history of extractive industries, the problems are perhaps more intense than those of many other areas. Derelict land is present in many forms in Dudley, some of them quite amenable to reclamation procedures, and others, wherein the major problems lie, not so. In order to appreciate this situation, it is necessary to refer to Dudley Metropolitan Borough Council (1986), which states; 'There are documented examples in Dudley of 46 shafts on a 16 hectare site (Cinder Bank) and 59 shafts on 12 hectares (Russells Hall)..... Another aspect of the derelict land problem in Dudley is the variety of past extractive industries. In addition to coal mining - deep, shallow and open cast - there has been sandstone quarrying, basalt quarrying, marl extraction, fireclay workings as well as the abandoned limestone workings. When you add to these, examples of industrial and domestic tips, disused canals, gas works and railways and the more recent phenomena of redundent factories, the variety of dereliction can be imagined'.

It has been further intimated by Cave (1983) and Dudley MBC (1986) that many of these land categories are not used for DOE returns. Indeed the non-representation is very apparent upon the consideration that in 1982 out of 4,800 hectares of derelict land, 2,000 were listed as 'other' dereliction, many forms of which are not recognised under the DOE classification.

One of the most fundamental problems with dereict land is establishing its ownership and subsequently acquiring the site. In the past several acts were in operation to aid site purchase; namely the National Parks and Access to Countryside Act 1949, the Mineral Workings Acts 1951, the Town and Country Planning Act 1962, and the Local Authorities Act 1963.

For Dudley in 1982 the amount of derelict land in private ownership was 63%, or 52 sites totalling 274 hectares, out of a total of 101 sites totalling 439 hectares. A similar situation to that which has developed for the county as a whole since 1975, when Gibson and Collins (1977) published the information shown in Table 2.2.

Table 2.2. Ownership of derelict land

Ownership	% of Derelict Land	% of Waste Land	Average %
Public	47	35	41
Private	51	34	42.5
Unknown	2	31	16.5

Source - Derived from WMCC 1975

The 1984 Derelict Land Survey revealed that 83 sites (314.6 hectares) out of a total of 121 sites (437.8 hectares) were in private ownership, and that many were likely to remain so, judging from the extract below, which is reproduced from the Rolling Programme 1986-1989.

Ownership status of derelict land in Dudley

Site Location	Ownership	Future Use	Comments
Round Oak Steelworks	Private 33.8 ha	Industry	Richardsons uwilling to enter into derelict land scheme

Currently over 56% of the Black Countrys derelict land is privately owned (Dudley MBC 1987, Sandwell etc. MBC's), which means that site acquisition is of prime importance in the success of any reclamation programme. Table 2.3 reveals how the privately owned land is distributed through residential, commercial and industrial land uses. For Dudley alone, this would entail the acquisition of privately owned land in all cases; requiring the MBC to negotiate for, and subsequently purchase, over 90 hectares of derelict land.

Table 2.3. Current ownership of proposal sites (hectares)

	Res	Mixed	Ind	Hard End Use Sites	POS	All Sites
Private	50	125	69	245 (57%)	82	326 (45%)
Local Authority	33	38	25	97 (23%)	146	243 (33%)
Other Public	12	48	2	61 (14%)	29	90 (12%)
Mixed	2	12	14	28 (6%)	42	70 (10%)
Total	97	223	111	431 (100%)	299	730 (100%)

(nb. Figures may not sum, due to rounding)

Source - Black Country Derelict Land Strategy 1986/89

Another source of difficulty stems from the way in which derelict land funding is administered by central government. The rules for derelict land grant qualification are more fully discussed in the next chapter,

however, they are complex and often involved a considerable investment in terms of time and money for local authorities. A similar problem occurs with reclamation schemes; Morgan (1986) has explained how the DOE scrapped a £100,000 derelict land reclamation scheme at its last stage of approval. The problem with the application process, which involves vetting at several stages of the project, are demonstrated by this example for the case in point, three stages had been passed throught before the site was deemed unsuitable, thereby wasting useful local authority resources on a scheme that they considered viable and useful, but which the DOE, which has to adhere to certain policies, did not.

CHAPTER 3: DERELICT LAND RECLAMATION

The previous chapter has outlined the definition, classification, social, aesthetic and natural problems with derelict land; all without offering any indication of how these difficulties may be met, and overcome. It has previously been implied that the rating of derelict land by government has been expressly for the purposes of assessing grant funding (Oxenham 1966), which necessarily alludes to reclamation. This purpose is ably expressed by Gibson (1976) in a statment that, 'Implicit on this view, and indeed explicit in the definition's words of "land ..... incapable of beneficial use without treatment" (DOE 1972), is that the ultimate aim is restoration or reclamation'. However, it is still in the best interests of any local authority to know the total extent of dereliction in their area. Primarily, this knowledge may be used to boost their application for derelict land grant (which is discussed later), so that they are fairly confident of obtaining a significant amount for site, falling under the jurisdiction of the DOE classification. This would leave them able to target their limited funds onto other sites that they, but not the DOE, may consider equally needful of attention.

The recognition of requirements for legislation and statutes to govern and suggest methods and procedures for the reclamation of derelict land have taken a long time to reach fruition in the United Kingdom. Up until the mid-1940's there were only paltry efforts at establishing a reclamation programme, although after this period there was a great deal more, war damaged, derelict land. Thus the industrial decline and accompanying unemployment that characterized the first 30-40 years of the 20th Century were hardly alleviated at all, at a time when there was a great need for work and a great deal of land lying derelict. Indeed, with the lack of government finance, it was apparently left to private individuals to perform any reclamation work, an exercise that apparently few considered worthwhile.

Initial government finacing was only for the sort of reclamation scheme that would benefit industry, such as small projects mounted mainly in the north-east of England, and to some extent the south-west of Wales. Rarely grants were allocated to purely aesthetic reclamation sites, however, it was evident that these were isolated examples that did not constitute a 'policy' on reclamation in any local area.

The most significant acts applicable to reclamation purposes appeared in the mid-to late 1960's, although prior to this the Town and Country Planning Act (1944) had some reclamation policies, which were removed in 1947, as their very nature made them almost impossible to apply. The Local Government Act (1966), Industrial Development Act (1966), and Local Employment Act (1970) were able to offer some hope for reclamation plans. In particular these acts provided a combination of manpower, increased reclamation grant coverage area on a national scale and power for the local authority to acquire derelict land sites. A very large number of specific case studies report on other legislation that have allowed derelict land reclamation, but unfortunately a consolidated national strategy' of land reclamation took a long time to emerge.

3.1 Criteria for land reclamation

Unfortunately one of the most significant appraisals of reclamation criteria came about as a result of the 1966 Aberfan disaster. Government had just begun to tentatively acknowledge the derelict land problem when such a large scale accident, and the questions it raised, rapidly accelerated their plans. Indeed, within one month of

the disaster the Welsh Office Derelict Land Unit was established, and in co-operation with the National Coal Board, it introduced new legislative measures for working coal tips (Waterhouse 1974).

Many areas have no definite policy for reclamation. The choice of site they make, and the reasons they provide for choosing it, remaining unclear. Many schemes are apparently carried out with very little forward planning, allied with a lack appreciation of how the reclamation relates to its surrounds, this reflects quite badly on planning decisions.

There was a clear need for some established guidelines to deal with reclamation. One of the first such lists was prepared by Glamorgan County Council (1970), which established a list of priorities as being:- Danger to life and limb; Threat of economic loss by physical damage; Development potential; Environmental and resource considerations. This positive step indicated the way forward, and was subsequently amended by West Glamorgan County Council (1975). An assessment based rather loosely on these criteria has been made and is presented below:-

Social Criteria - Safety; protection of the environment; aesthetic value; population density and area frequency
Economic Criteria - Development potential; resource development; loss of value; techniques; cost

It will become evident later that the current government emphasises economic criteria, rather than social provision.

Past, and even present, attitudes towards reporting the amounts of reclamation and dereliction are disturbing. Statistical returns can be very misleading, and a subject to a wide range of interpretations. A local authority may, for example, return an overall decrease in land that has become derelict, perhaps meaning that the land has been reclaimed, or quite often that the land has been recategorized and has moved out of the bracket of land requiring treatment. Classification and definition differences, like those existing between the WMCC and DOE, may also mean that a local authority claims it has more derelict land than it is strictly required to in the hope that it will be subject to higher levels of grant aid. The WMCC and other local authorities justified this approach by questioning the definition of derelict land, which has been discussed at length, and yet still remains ambiguous.

The criteria that have been suggested above are quite broad and could easily be sub-divided to take account of local conditions. While this would facilitate more ready interpretation of each category, too many criteria may mean that the main picture may be obscured. However, it is clear that methods of assessing reclamation criteria, and more importantly their working, is required as the problems of dereliction become more apparent.

An important point is the long-term monitoring of reclamation sites. Unfortunately very little of this takes place, although Dudley Metropolitan Borough Council (MBC) monitor deep fill opencast sites for up to ten years in order to establish whether or not settlement has occured (Jennens, 1986). The technical, engineering, ecological and social aspects of derelict land clearance are adequately dealt with by Dalton and Bradshaw (1982), Wallwork (1974) and Oxenham (1966).

In the final analysis and from a socially biased point of view, the actual act of removing derelict land from inner city ares is in itself an end. The Derelict Land Grant currently administered by central government is more inclined toward beneficial 'hard end' use of these areas, although attitudes are also moving toward the

provision of more recreational and open space. Both of these factors can be successfully combined in order to satisfy both central and local government, and as Dudley MBC state, 'it is important to consider reclamation as a contribution to the wider policies of the Council and a valuable method of implementing schemes'.

3.2 Local reclamation programmes

One of the earliest West Midlands derelict land surveys to utilize aerial photography for site identification and classification was carried out by Collins of the Remote Sensing Unit at Aston University. Table 3.1 indicates how much derelict land was returned to use during the 1972-1976 period in the West Midlands. It is evident that restoration did not keep pace with overall expectations. However, for the Black Country Boroughs of Dudley and Sandwell approximately 20 ha each more land was reclaimed than targetted, although for Walsall and Wolverhampton, restoration expectations were over 100 ha down on those envisaged in 1974. In comparison with Table 3.2, however, it becomes obvious that dereliction worsened during the 1972-1974 period, rising from 1535 ha to 1906 ha for the county as a whole. It should be further noted that for the high reclamation areas of Dudley and Sandwell, land becoming derelict exceeded that being reclaimed by approximately 14% and 42% respectively.

Table 3.1. Derelict land restoration in the West Midlands 1972-1976

District	Amount restored 1.1.72-31.3.74 restoration (ha)	Proposed restoration 1974-76 (ha)	Restoration 1.4.74-31.3.75 (ha)	Restoration 1.4.75-31.3.76 (ha)
Birmingham	0	19	5.00	14.0
Coventry	25	0	0	21.0
Dudley	73	29	14.57	34.3
Sandwell	132	27	13.15	32.6
Solihull	0	0	0	0
Walsall	57	176	16.48	56.5
Wolverhampton	8	35	12.00	16.5
West Midlands County Total	295	286	61.20	174.9

Source - DOE 1975, WMCC unpublished data

According to Gibson and Collins (1977), there were a number of reasons for this figure. Apparently the primary difficulty was the financing of restoration projects, as government money was only available for land categorized as derelict under the DOE system, ie. 1535 ha, and not for the extra 2763 ha of waste land denoted

by the WMCC classification. This problem was compounded by the fact that the West Midlands had not then become an assisted area and merely qualified for a 50% grant towards the cost of reclamation.

Table 3.2. Derelict land in the West Midlands 1974

District	Derelict Land (ha)	As % of total area	Increase 31.12.71 - 1.4.74 (ha)	Waste land (ha)	Total Derelict and Waste land (ha)	As % of total area	Waste land as % total vacant land
Birmingham	204	0.8	5	573	777	2.7	73.7
Coventry	78	0.8	37	277	355	3.7	78.0
Dudley	385	3.9	53	680	1065	10.9	63.8
Sandwell	310	3.6	132	348	658	7.7	52.9
Walsall	396	3.7	37	269	665	6.3	40.4
Wolverhampton	149	2.1	105	465	614	8.8	75.7
Solihull	13	0.07	2	151	164	0.9	92.1
West Midlands County Total	1535	1.7	371	2763	4298	4.8	64.3

Source - Gibson and Collins (1977)

Cave's (1983) report on Derelict Land in the West Midlands Country provides a thorough analysis of the amount and types of derelict land reclaimed between 1974 and 1982 by the WMCC and other agencies. This information, which includes totals by district and is based on the DOE classification, is presented below in Table 3.3. The total area reclaimed between 1974 and 1982 equals 982 ha; whilst for the same time period derelict increased from 1535 ha to 1932 ha. This trend is quite worrying for if no reclamation had occured during these periods, 1400 ha of land would have become derelict. These figures are of course removed from the WMC definition used in this thesis, which although revealing much more dereliction, actually reduced its derelict area by around 12%, from 4868 ha to 4268 ha, between the two dates.

The greatest proportion of the 982 ha of land reclaimed between 1974 and 1982 was as a result of DOE grant aided county reclamation schemes, as indicated by Table 3.4. The local authorites also implemented their own schemes, although private reclamation projects as part of redevelopment restored a much greater area, most significantly in Dudley.

In 1985 the four Black Country Boroughs of Dudley, Sandwell, Walsall and Wolverhampton issued a report entitled 'A Joint Strategy for the Reclamation of Derelict Land'. This combined initiative came as a result of ministerial backing and the policy amendments dealing with Rolling Programmes in DOE Circular 28/85 (1985). The major objective of the strategy is 'To aid the regeneration of the inner parts of the Black Country by the elimination and re-utlisation of the area's derelict land'. This prime intention is supported by four further objectives, which are:- 'To apply the maximum possible level of resources to solving the Derelict Land

problem within a a ten-year period and to adopt working procedures that will ensure the most effective use of those resources; To provide adequate stocks of good quality residential land; To provide a balanced portfolio of Commercial and Industrial sites, to enable economic regeneration to take place'; and 'To improve the general environment of the Black Country'.

Table 3.3. Derelict land reclamation 1974-82, by District and Category of derelict land reclaimed (acres)

District	Spoil Heaps	Excavations And Pits	Military Etc. Dereliction	Derelict Railway Land	Other Forms of Dereliction	Total Derelict Land Reclaimed
Birmingham	10	52	0	101	178	341
Coventry	101	5	0	0	32	138
Dudley	353	40	0	49	166	610
Sandwell	178	44	0	69	161	455
Solihull	0	0	0	0	0	0
Walsall	82	161	0	59	213	514
Wolverhampton	289	25	0	49	10	371
WM County Total	1013	329	0	329	756	2427

Totals may not add due to rounding and conversion from hectares

The Strategies objectives are fully reproduced in Appendix 2, although it is useful to draw attention to some of the points here. Based on the governments inner city policies, the prime objective has seen Wolverhampton and Sandwell designated as Programme Area Authorities, and Walsall as a Designated District. A joint approach and administration of DOE funds should ensure that the derelict land problem is treated as an ongoing scheme over ten-years (1985-1995), which would free it from the normal annual funding programme. The requirement for good quality residential land is a direct response to the policy stated in DOE Circular 15/84 (1984), that local authorities should, 'ensure a minimum of 5 years' supply of residential land in their area'. Although DOE Circular 15/84 considers a hard-end use of housing as most important, the Black Country Boroughs emphasize the requirement for industrial land, even though demand for this resource is low. The improvement of environment quality also departs from the provision of housing, but it is considered by the Borough Councils that minor schemes, such as 'Operation Facelift', should be incorporated into the programme in order to develop a balanced area.

The Black Country Boroughs proposed a grant increase from 11.7 m to 16.4 m over the 1986/89 period. This proposal was made in the 1985 financial year when the area's overall allocation was 4.6 m, and so raised the grant (over three years) to 5.4 m each year. As it stood in 1985 the programme was to deal with 730 ha of land, over half of which would have an open space hard end use, a quarter would be for residential use, and the

remainder for mixed end use and general environmental improvement associated with all of these areas. Due to the different reclamation procedures, expenditure on this work is not proportional to the size of area under consideration. More than half of the allocation would be spent on residential and mixed end uses, while a quarter would go to industrial or commercial schemes and a further quarter to the largest single category of open space.

Table 3.4. Derelict land reclamation 1974-82, by Agency of reclamation and Category of derelict land reclaimed (acres)

Agency of reclamation	Spoil heaps	Excavations and pits	Military dereliction	Derelict railway land	Other forms of dereliction	Total reclaimed
Local Authority with DOE Grant	687	237	0	183	576	1680
Local Authority without DOE Grant	89	37	0	54	82	259
Other Agencies, Including Reclamation Incidental to Private Development	240	54	0	94	99	487
All Agencies	1013	329	0	329	756	2427

Totals may not add due to rounding and conversion from hectares

Source - Cave 1984

The objectives of the Strategy are directed toward several major points:-

i) Increasing the rate of derelict land reclamation to enhance the economic, social and environmental regeneration of the Black Country

ii) The removal of derelict land as a major problem over the next decade

iii) Assigning reclamation priorities to sites that provide the maximum impetus for regeneration

iv) Adoption of a scheme of joint working between the four Black Country metropolitian Borough Councils

v) Adoption of a rolling programme of reclamation schemes

vi) A phased build up to the higher proposed rate of reclamation activity

vii) Developing a package of minor works and related expenditure to reinforce the benefits acheived from individual larger projects.

The elements of this Strategy are fairly self-explanatory, however, it may be useful to draw attention to one aspect of the strategy, namely that concerned with minor works and related expenditure.

A concerted effort has been made by the Borough Councils to improve the appearance of priority transport routes through the Black Country as part of it's minor works programme. This scheme has been named 'Black Country Facelift', and has been in operation since November 1984. Although it is intended to emphasize the administrative and policy requirements surrounding the scheme, an explanation of what the plans entail is useful.

Essentially 'Facelift' adopts a high level of 'screening' or landscaping to minimise the social impact resulting from the close proximity of derelict land sites to major transport (road and rail) routes. From 1984 to 1986, £350,000 has been made available for Facelift schemes under the derelict land grant eligibility rules. However the Borough Councils would like to see is a more relaxed approach whereby they are more at liberty to receive greater contributions and administer them as they wish. A lack of large-scale funding limits the size, and therefore choice, of suitable sites. Indeed as the Black Country Derelict Land Strategy 1986/89 (1985) states; 'It is clear that the use of derelict land grants, as currently constituted, is not sufficient, on its own, to acheive the environmental impact required'. To this end the Black Country Boroughs have sought to be treated as a special case subject to more latitude in respect of derelict land grant administration. One of the other major problems in the Facelift programme is that of land ownership; the sites are usually privately owned. It is hoped that the transport corridor improvement may lead to private investment in the area, mainly from the land owners themselves. This is not the case at the moment; this point has been stressed elsewhere in this thesis and in the policy document of the various administrative bodies; the sites that have been reclaimed still have a low value and are not 'attractive' from an investment standpoint.

The programme submission and bid by the Metropolitian Borough Councils in 1985 and for the three year Rolling Programme were as follows: 1986-87: £250,000. 1987-86: £300,000. 1988-89: £350,000. According to Knott (1986) overprogramming in the first instance (1986/87) has ensured that the money has been spent, and it is hoped that some of the flexibility with regard to grant alloaction (discussed earlier) would allow more ambitious and varied approaches to Facelift sites.

The success of Facelift and it's impact on the Black Country environment have been further improved by the qualification of the Black Country Borough Councils in 1986/87 for Urban Programme resources. According to the Black Country Derelict Land Strategy Review 1987-90 (1986), over forty-five sites were improved in 1984-86 at a cost of £300,000, and sixty-five sites were due for improvement in 1986/87. It is apparent that DOE attitudes have improved noticeably with regard to a flexible administration of the funds they allocate. To an extent whereby areas requiring aid can implement their programmes within a framework that is to a large extent unencumbered by strict regulations that cannot realistically be applied 'across the board'.

The major feature of the proposed Rolling Programme for 1987/90, is the substantially increased bid for money, which totals nearly £60 m. This is divided into the following areas:-

i) Mixed uses: £18.8 m

ii) Industrial and Commercial uses: £13.9 m

iii) Residential use: £14.8 m

iv) Open space: 7.6 m. The additional monies are intended for minor schemes, site investigations and the treatment of limestone workings.

This increase is obviously substantial and raises the annual £5.4 m bid in the 1985 Black Country Derelict Land Strategy 1986/89 report, to a level of £18.3 m per year for the 1987/90 period. This increase, of about 350% each year, is due to a number of factors:-

1) The need to reclaim land for hard end uses, especially housing as required by government policy.
2) A need to continue work on committed schemes ie. Those areas that have begun to be reclaimed in the 1986/87 period.
3) The addition of a large number of new sites into the programme area; these are often industrial.
4) Additional resource requirements for environmental and similar schemes, such as Facelift, Greenline etc.
5) The requirement of monies for compulsory purchase of privately owned derelict land sites.

Altogether a total of 876.63 ha are targetted for treatment under this programme, most of these are for mixed end uses, or residential land.

The major way's in which the 1987/90 programme differs from the 1986/89 proposals are in the methods of site programming and a greater understanding of site acquisition procedures. Often considerable delays are encountered during the preliminary stages of site acquisition. It has been found (Black Country Derelict Land Strategy Review 1987-90 (1986) that the best way of dealing with this problem is to over subscribe the number of sites being considered. A flexible priority approach can then be maintained toward those sites presenting few obstacles regarding purchase; necessarily a certain degree of open-mindedness is required from the DOE with this form of programming, but the success the Metropolitan Boroughs has enabled them to obtain DOE support so far. Support from the DOE is also required with regard to site acquisiton, as the Black Country Derelict Land Strategy Review 1987-90 (1986) states; 'The local authorities would welcome discussion with the DOE to explore alternative ways of bringing forward privately owned derelict land for reclamation and re-use'. The major turning point for local authorities would be a policy that does not require land to be in authority ownership before it qualifies for a 100% grant. Currently, the administrative and legal positions that deal with compulsory purchase are quite lengthy, so often delaying the start of reclamation work on sites that the local authority consider a priority.

Perhaps the most welcome aspect of the rolling programme is that it has brought together four Metropolitan Borough Councils and united them in one common aim. The formation of the Black Country Derelict Land Group, with members from all of the Boroughs, has noticeably improved monitoring and joint working with regard to all sites. The main benefits achieved by the Black Country Derelict Land Group are stated in the Black Country Derelict Land Strategy Review 1987-90 (1986), and include:-

i) an improved ability to acheive spending targets because of the larger range of potential schemes
ii) direction of funds across the entire area to meet priorities and agreed regeneration objectives

iii) coordination of the derelict land programme with other programmes to achieve greater impact in regeneration

iv) ability to tackle problems of common concern across Borough boundaries

v) presenting a unified and positive image for the Black Country

vi) a shared and ecomonical use of staff to achieve reclamation within the area

vii) an ability to respond to the local needs of both residents and business.

During a visit to the Dudley Metropolition Borough Council in March 1986 the author met several prospective members of the then unformed Derelict Land Group. During the ensuing discussions several points were emphasised (Withy 1986, Jennens 1989, Morgan 1986, Knott 1986).

i) Although Dudley was working very hard on its derelict land problem, the methods and formalities of grant allocation provided a working problem in that they (the methods) were too restrictive. Particular examples of this were mainly concerned with the fact that only a limited number of sites could be brought forward at any one time, and that over subscription of sites was not realistic.

ii) Many of the sites in Dudley were toxic and the DOE was not prepared to invest the very large sums of money required to re-instate them as they would get little economic return on the area.

iii) Owners of sites often would not accept the low values given to their land by the District Valuers, resulting in the Borough being unable to integrate such areas into their overall derelict land strategy. A particular example of this is Roundoak Steelworks where British Steel were looking for a certain price but probably did not realise that to clear such an area (with extensive reinforced concrete foundations) was a formidable and very expensive operation. Contrastingly, Richardsons, a company owning a great deal of land in the Blackbrook Valley, was willing to engage in land improvement, but could not due to their non-qualification for Derelict Land Grant, although it later received some monies from the Urban Development Grant.

An important step for the Dudley Metropolition Borough Council was the Rolling Programmes put forward by DOE Circular 28/85 (1985). The former West Midlands County Council had worked closely with the DOE, who saw that the County Council had had an important part in operations regarding derelict land in the Black Country, and wisely replaced these with a Rolling Programme. However, at the same time a 'hard-hitting' letter from the DOE reminded the Borough Council that their programme of reclamation must be positive and sucessful, as there was an option to contract out derelict land clearance schemes to the private sector (Morris, 1986).

An outline of the proposed treatment of derelict land in Dudley Metropolitan Borough was given in their policy document 'A Strategy for Derelict Land reclamation in Dudley. Including a Three Year Rolling Programme 1986-1989' (1985). The aims and costs of this three year programme are summarized in Table 3.5. It should be stressed that the independant programmes submitted by the Black Country Boroughs aim to highlight their particular priority clearance areas, but do not favour these above the primary joint rolling programmes that are discussed above.

Table 3.5. Derelict land reclamation 1986 - 1989

Category	1986/87	£ 000's	1987/88	£ 000's	1988/89	£ 000's
Carry over from 1985/86	Cricketfields (completion)	100				
Development	Russells Hall H5 & H6	570	Tansey Green	240	Holloway Street	335
	Cradley Road	90	Burton Road/ Dibdale Phase I	1085	Burton Road/ Dibdale Phase 2	1112
	Washington St.	80			New Hawne Colliery	300
Acquisition (Development)	Tansey Green	300	Burton Road	50		
	Washington St.	50	Holloway Street	180		
	Cradley Road	25	New Hawne Colliery	200		
Carry over from 1985/86	P.O.S. Schemes	50				
Public Open Space	Pensnett Railway Phase 2	13	Manor Way Railway	22	Burton Road Playing Fields	121
	Russells Hall P.O.S. 1	17	Kingswinford Railway	28	Butchers Lane	17
	Phase 3				Hollyhock Road	9
	Blackbrook Valley	33	Old Bank Colliery	53		
	Blackbrook Valley Phase 1	39	Blackbrook Valley Phase 5(B)	28	North of Fens Pools	128
					Oldnall Road	50
Small clearance schemes		50		50		50
Acquisition (P.O.S.)		50		50		50
Site investigations		50		50		50
TOTAL	£1,517,000		£2,036,000		£2,222,000	

Source - A Strategy for Derelict Land Reclamation in Dudley. Including a 3 year Rolling Programme 1986-89

Dudley is in particular need of reclamation due to its industrial history. Dereliction continues, and during the 1974-1984 period over 315 ha of land became derelict. For the same time-span 325 ha was reclaimed, mostly (75%) by the local authority. It would seem therefore that the problem is being dealt with, but in fact this is not so as the newly derelict sites are mainly vacant industrial property, which require far more time and money for reclamation than open-space areas. In 1974 £10,000 were allocated from central government funds

for reclamation in Dudley, about 0.04% of the national grant for 1974. During 1984 the area received 1.4% of the total grant available nationally, and between 1982-85 over £3 m were spent on reclamation. However, as stressed above the nature of the derelict land is changing and a grant increase does not in the current situation equate with a comparable net reduction in derelict land. For two main reasons this situation does not balance out; primarily, since 1981, the DOE policy has been to concentrate on the expensive end uses of industry and housing, which require substantial land improvement, and secondarily, inflation and economic matters have devalued the level of grant in real monetary terms.

Dudley's planning authority have presented a five point strategy to deal with the derelict land problem in their area:-

i) to prepare rolling programmes which will allow the integration of site investigations, acquisitions and reclamation works
ii) to provide a longer term commitment to the implementation of land use policies throughout the Borough
iii) to allow proper forward planning and enable scheme selection to reflect needs, environmental impact and location
iv) to respond more positively to private sector proposals for local schemes
v) to persuade the DOE that the Council is capable of sustaining a programme of reclamation overtime, with a view to securing grant allocations over a longer period.

The overall aims of the strategy are very similar to those of the joint Black Country Derelict Land Strategy 1986/89 (1985). The Dudley aims differ in the degree of flexibility they exhibit, which is revealed in the stated list of aims and the statement (paragraph 6.2 of the policy document) that accompanies them:- 'Reclamation programmes should also be responsive to other capital programmes of the council and the needs of developers in the Borough. They should also be flexible enough to accomodate opportunities as they arise and so there will be a constant need to monitor and update the strategy'.

It appears that the Council has been restrained by the way in which Derelict Land Grant is administered, especially in the case of encouraging private sector involvement in reclamation projects. As the document 'A Strategy for Derelict Land Reclamation in Dudley. Including a Three Year Rolling Programme 1986/89 (1985)' states 'There seems a general antipathy to private sector grants and there has been disappointment in the complicated and inflexible approach which has to be adopted to 100% grant-aided schemes'.

It should be noted that there has been considerable progress since the publication of these proposed strategy documents. Indeed, such is the success of the joint programme, and the attitude of the DOE towards it, that the Black Country Derelict Land Strategy Review 1987-90 (1986) felt able to claim for more substantial amounts of grant aid. The Rolling Programme appears to be well-established and should be able to continue to function at its present high level within the joint monitoring framework of the four Boroughs, provided that their enthusiasm and impetus for the reclamation programme is maintained.

CHAPTER 4: DERELICT LAND GRANTS AND SURVEYS

4.1 Regional reclamation policies

The current legislation dealing with the derelict land and its renovation has been set out in DOE Circular 28/85. Reclamation and Re-use of Derelict Land (1985). This circular cancelled parts of earlier documents (DOE Circular 17/72) and restated, and in some cases reinforced, statements made in previous circular issues (DOE Circular 6/85, DOE Circular 18/84).

The most important feature of DOE Circular 28/85 is the induction of Rolling Programmes (paragraphs 14,15, 16 and 17). These sections are reproduced fully in Appendix 3, but their main points are summarized below:-

i) In areas that feature extensive dereliction which would normally be subject to annual grants, groups of schemes may be brought-forward in order to aid reclamation procedures

ii) Annual rolling forward will occur with schemes that are put into a pool of projects to be agreed by the local authority and regional DOE office. Guarantees as to post-reclamation land use and land tenure will form part of the package.

iii) Grants must be paid back if an anticipated scheme is not brought-forward within the three year timetable period

iv) Up to half of the grant resources allocated to a local authority may be used in any one year of the rolling programme if the timetabling suggests that this would be beneficial.

The Secretary of State is also concerned with the after use of land and the involvement of the private sector in reclamation schemes. Grant priority was disposed toward Category A schemes, or rather, those in which a private developer is closely linked with the whole reclamation project from the start. However, some rethinking of this approach has resulted in the private developer, who has in many cases been non-commital towards early involvement due to monetary and temporal costs, being able to use the land after reclamation. The burden of responsibility has shifted to the local authority, which is required to state the terms upon which it will dispose of reclaimed land, and the after-use for which the land is most suited. The encouragement of the private sector is a key point in this document, and is clearly expressed by the statement 'The Secretary of State will continue to encourage these projects which engage the resources of the private sector in land reclamation, the looks to local authorities to do all they can to bring about such schemes'! Once again the onus seems to be on the local authority, however, they are advised to use of their compulsory purchase poweres if necessary. These rules come under the Derelict Land Act 1982, which amends the National. Parks and Access to the Countryside Act of 1949, with specific regard to derelict land. The local authority are further advised to sell such land as quickly as possible and are reminded that the 'Chrichel Down Rules' (DOE Circular 18/84 part III (1984)) 'do not require that land which has been compulsory acquired should, on disposal, first be offered back to the original owner'.

Since the DOE Circular 28/85 a great deal of attention has been focussed on the derelict land problem. In a DOE Environment News Release (No. 47, 1987), John Patten, Minister for Housing stated that over 90% of the 1987 derelict land grant would be spent in the North. Mr Patten also stated 'The resources available for derelict land reclamation in 1987/1988 will be about £81.14 m, compared with £78.38 m at the beginning of 1986/87 and about double in real terms the £23.5 m available in 1979/80, of this, £72 m (92%) will be spent in the North, North West, Yorkshire and Humberside, West Midlands and East Midlands.

There does seem to be a bias towards investment by the private sector, at the expense of the local authority. As Patten (1987) states ' I have increased the allocation for grant to the private sector and nationalized industries by over two thirds, to £9.55 m. Resources for local authority schemes are slightly lower than in 1986/87, at £71.3 m. The DOE provides several differnt sorts of grant, the most substantial being the Derelict Land Grant, which is used for the treatment of derelict land under the DOE definition. In the following list each type of grant is briefly outlined; the first four are currently being allocated to Dudley. The very first, Derelict Land Grant, is given a more complete explanation later.

1. Derelict Land Grant

The purpose of this grant is to reclaim land which is derelict by being so damaged by industrial or other uses that it cannot be used without being treated. The grant is allocated as a variable percentage of the net loss sustained by the owner through their reclamation works. Priority is given to projects that lead to an after-use (hard-end-use) of housing, industry or commerce.

2. Urban Programme

This grant supports the Inner Area Programme of local authorities (including Dudley and the other Black Country Boroughs) that are invited to submit proposals for this aid to the DOE. The grant coverage may have a wide range of applications including

a) landscaping and environmental work, building renovation, the provision of minor communication corridors (access roads, parking etc.)

b) monies up to the value of 50% of the total amount for building conversion, extension and modification

c) allocations for site preparation, including clearance (demolition), levelling and the provision of access roads, drains and sewers

d) up to two years rent on the lease of a new building intended for industrial or commercial use

e) 12% grants payable as interest on loans to small firms carrying out reclamation work

f) up to £1000 for the establishment of workers co-operatives and common ownership enterprises

g) staffed workshops and premises for new firms in the area of the Urban Programme.

Over £294 m is available for the 1987/8 period of investment, firms are eligible to about £25 m of this total. Private sector involvement in these schemes is actively encouraged, but the work must increase employment in the area or decrease either derelict land or vacant buildings.

3. Urban Development Grant

According to the DOE the purpose of this grant is 'to promote the economic and physical regeneration of run-down urban areas by encouraging private investment, which would not otherwise take place in such areas, which strengthens the local economy and brings land and buildings back into use'. Applications for this grant require the local authority support, and also that the local authority pays 25% of the grant. All of the Black Country Boroughs are eligible for this grant. The minimum amount of money (in either grant or loan, or a combination of both) required is provided from a £30 m budget for 1987/88. A wide range of projects are eligible for grant, including:-

a) aiding business expansion

b) refurbishing council property or constructing new residences

c) shop, warehouse and workshop building

d) factory, warehouse and other building conversion to houses, flats, offices or shops

e) hotel building and renovation, and the provision of recreational amenities.

4. Urban Regeneration Grant

Using the same budget (ie. £30 m for 1987/88) this aid differs from the Urban Development Grant in that it is directed toward large-scale schemes. It may either be a grant or a loan and is paid directly to the firm or developer by the DOE.

5. Enterprise Zones

Of the four Black Country Boroughs only Dudley has qualified as an Enterprise Zone, possibly reflecting the Metropolitan Borough Council's success in combatting dereliction and encouraging new investment. An Enterprise Zone differs from other industrial parks by being freed from certain of the more common financial and administrative burdens imposed by government. Amongst the exemptions are subject to are:-

a) 100% allowances for capital expenditure on industrial/commercial development with respect to corporation and income tax

b) an exemption from rates

c) simplified planning; an overall planning strategy for the area is agreed and if developments fit into this they do not require individual planning permissions.

6. Urban Development Corporations

Established by the government, an Urban Development Corporation (UDC) is a body designed to regenerate its designated area. Two UDC's (London Docklands Development Corporation and the Merseyside Development Corporation) have operated since 1981. Their primary aims are to :-

a) bring land and buildings into effective use

b) encourage the development of industry and commerce
c) ensure housing and social facilities are available to encourage people to live and work in its area. In 1987 it is proposed that further UDC's will be established, one of these will be in the Black Country and will complement the rolling reclamation programmes already in operation; others are to be set up in Tyne and Wear, Trafford Park and Teeside.

The largest allocation, and seemingly the one that receives most attention is Derelict Land Grant. Although complete copies of the documents relating to Derelict Land Grant (DLG), AOE Derelict Land reclamation Grant: Local Authorities Guidance Note (1986) and DOE Derelict Land Reclamation Grant: Applicants other than Local Authorities. Guidance note (1986), have been prepared by the DOE, however, it may be useful to abstract the more relevant information here:-

Under Section 1 of the Derelict Land Act 1982, and subject to certain conditions, grants are available towards expenditure on acquiring and reclaiming land at the following rates:-

i) 100% in the Assisted Areas (AA's) and Derelict Land Clearance Areas (DLCS's);
ii) 75% in the National Parks and Areas of Outstanding National Beauty (outside the AA's and DLCA's);
iii) 50% elsewhere.

A certain amount of grant may also be given in respect of land which although not derelict is either required for a purpose connected with reclamation works on derelict land, or land liable to become derelict due to mining subsidence (other than coal which has it's own special provisions) which have ceased.
Grant is also available for the removal of vacant industrial buildings which may not be useless, but are sufficiently run-down as to be termed derelict under the DOE definition. With regard to great allocation the definition of obsolete for these buildings is 'incapable of rehabilitation or conversion to enable full beneficial use except at a cost which would exceed the combined cost of demolition and of the construction of a single storey industrial building covering a gross floor area equivalent to the gross ground floor area of the existing building'.

Once of the most important factors in the administration of Derelict Land Grant is the payment of grant and recovery of after value. Usually the grant is paid primarily on the gross costs, which include acquisition, and monies are recovered when the reclaimed, or after value, passes to the local authority. This means that grant is only paid on the true loss incurred by the local authority. Normally the DOE take the time of the value occuring as being when the local authority disposes of the land by sale. This must be before any further developmental work or enhancement has been carried out. If no land acquisition charges are levied then the approporiate amount is the relevant proportion of the difference between the value before reclamation and the after value. If the local authority uses its option of leasing the land then the after value must be paid back as a capital sum calculated from the capitalized value of the land. Amenity or open space land (of which there is a

considerable amount in the Black Country) is treated as having a nil after value as it is retained by the local authority.

Following their introduction in 1981/82 under the Local Government Planning and Land Act 1980, non-local authority schemes have grown steadily more popular, especially with the DOE. Private Sector, nationalized industry and other public bodies are eligible for grants which deal with the essential stages of land reclamation. Within this constraint, grant is payable to the above, together with private individuals, statutory undertakers, other non-local authority public bodies, charitable trusts, parish councils and new town development corporations. The level of grant is up to a maximum of 80% in the Assisted Areas and Derelict Land Clearance Areas, and 50% elsewhere.

The grant assessment process is payable on the net loss incurred to the freeholder or leaseholder after the work has been completed. To ensure 'value for money' for the DOE, it has stressed that at least three tenders for the work must be submitted. The use of competitive tendering means that expenditure targets are not set unrealistically high, so that a greater amount of grant is payable. However, in certain cases though an independent consultant or DOE expert may be able to confirm a tender from the individual or group wishing to reclaim the land.

If the owner sells the land within five years of its reclamation, certain rules apply. A refund will be required if the land is resold at a price in excess of that quoted by the District Valuer during the process of grant allocation.

The DOE tend to give priority to private schemes as they have to be profitable for the developer to benefit, which in turn means that the DOE and local authority will also benefit, as in many cases reclamation influences factors (namely employment and further investment) other than the pure value of land. The DOE ususally implements a fairly comprehensive monitoring scheme, during the development, which has some of the following elements:-

1) an initial site inspection prior to the work being approved
2) examination and approval of tender documents to ensure that only eligible items are included for grant aid and that the costs of work are reasonable
3) agreement on the timetable for completion of reclamation, and phasing of grant payments if eligible for interim payments
4) one or more physical site inspection during progress of the work to ensure that there are no major deviation, from the approved works
5) a final site inspection on completion to certify works have been satisfactorily completed for grant purposes
6) examination of final contract accounts, invoices etc. to substantiated grant claimed
7) monitoring of disposal within the timescales set in the approval letters.

4.2 National derelict land surveys

Although the most fundamental statistics on the amounts of derelict load in the United Kingdom have been stated in Chapter 1, they will be repeated here in order to aid in the appreciation of the national outlook with

regard to derelict land. The various vagaries of classification and the way in which exempt categories of land have been omitted from the calculation is also explained in the earlier chapter.

In 1948 Oxenham (1948) found that an area equivalent to 150 % the size of the Isle of Wight was lying either derelict or damaged in England and Wales. The government response to this 120,000 acres estimate was to commission a survey of their own by the Ministry for Housing and Local Government (MHLG) 1955 The results of this survey supported Oxenhams claim and came out with a slightly higher fiqure of 126,000 acres of derelict on damaged land.

After the failure of the government's first attempt to establish a national derelict land survey, which was supposed to be initiated in 1960 as part of the first Development Plan Review, they published their 'New Life for Dead Lands' (1963) report. This study revealed that 150,000 acres of land derelict, 80 % of which was equally divided between excavations and spoil heaps, while the remainder comprised other forms of dereliction. However, the first official survey in 1964 suggested that there were 85,000 acres of land lying derelict in England, just over half the amount reported in the earlier MHLG Survey.

Since 1964 all local authorities have been required to return the amounts of land lying derelict in their administrative area up to the 31st December in any year that a survey is commissioned by the DOE. Early surveys usually followed a characteristic pattern which began with a circular informing authorities that they should compile land returns for that year. The amount of derelict land was usually divided into:-

i) acreage justifying reclamation
ii) acreage justifying landscaping
iii) acreage not requiring treatment. The amounts of land that had received some treatment under in the current year points
i) and ii) above also had to be reported, that were to be treated in the subsequent year.

Results from the National Survey were usually published in DOE documents (which as well as showing the totals, were often divided into different types of dereliction. Table 4.1 shows the results of surveys between the period 1964-1971 for England and Wales. Up until 1970 the results include Wales, however, that year and in subsequent year the Welsh office did not use the MHLG survey. This decision was based on discrepancies in the categories being returned, together with classification in the widely different interpretations that local authorities could use (Welsh Office 1972).

The complaints from the Welsh Office and many other local authorities who believed the amounts of derelict land in their administrative area were being seriously underestimated led the MHLG (by now the DOE) to rethink the categories and methods employed in the national derelict land survey. Indeed, the DOE went on to document their concern and suggested that a different survey approach was necessary 'to cover additional categories of industrially scarred land and to provide up to date information about land used for surface mineral workings and refuse tips or for which planning permission for such purposes has been given' (DOE 1973).

The new survey of 1974 considerably widened its scope in a number of ways. Previous surveys (those from 1969-1971) were related to certain land use categories i.e. those that were likely to attract government grant

aid for derelict land clearance and not areas of potential dereliction, such as operational mine workings and waste tipping sites.

Table 4.1. Summary of derelict land in England and Wales 1964-71

Year	Extent of derelict land in hectares	Year	Extent of derelict land in hectares
1964	40,101 (34,358*)	1968	45,715
1965	43,511	1969	46,411 (38,738*)
1966	44,957	1970	39,133*
1967	45,499	1971	39,292*

* England only: the totals for England in 1964 and 1969 are shown in brackets for purposes of comparison

Source - Wallwork 1974

It has been mentioned that many local authorities disagreed with the ways in which returns had to be made, and the DOE Circular 1/74 (April 1974) was introduced in order to establish a new precedent for the methods and scope of national derelict land survey. The form of the 1974 survey was particularly interesting as it introduced the following points for the first time:-

i) statistical information on the amounts of land used for surface mineral working and waste tipping
ii) areas permitted for these purposes but not yet under active use as such
iii) land use for other waste tipping
iv) abandoned railway land and military and other service dereliction were also considered separately from other forms of dereliction.

The results from the 1974 survey were published in a number of formats:- summary tables; derelict land and waste (refuse) tipping; mineral working. The complete results of the 1974 survey are published as Results of the 1974 survey of Derelict and Despoiled Land in England. Summary Tables. (DOE, 1975). A brief precis of the more relevant statistics presented in the 1975 DOE report is provided by Table 4.2, and gives totals for England as a whole and not merely on a county-by-county basis.

The next national derelict land of any particular merit was carried out by the Civic Trust in 1976 in the absence of a major government initiative. This survey was interesting in that although not a quantitative survey as such, it did focus on particular sites and the problems local authorities faced with them. Analysis of 279 questionnaires completed by various local groups for the Civic Trust tended toward the quantitative. In most cases the appearance of the site was a major factor, and although only one site was chosen per country

area, it was often reported that the area contained 'about 2 or 8 similar sites' (Civil Trust, 1977). Although the report cannot be regarded as a rigorous overview of the amounts of derelict land in England, it is useful in that it ably expresses the deep concern of the communities in which derelict land was commonplace.

Table 4.2. Derelict land restored between 1 April 1974 and 31 March 1982

Standard regions	1 April 1974 - 31 March 1978				1 April 1978 - 31 March 1982				Total - 1 April 1974 - 31 March 1982			
	LA with grant	LA without grant	Other agencies	Total	LA with grant	LA without grant	Other agencies	Total	LA with grant	LA without grant	Other agencies	Total
England	4653	951	2373	7977	5642	758	2575	8975	10295	1709	4948	16952

Source - DOE 1982

The next major national derelict land survey took place in 1982, although it had been intended for 1976. The returns to the DOE for this survey relate to the derelict land situation as at 1 April 1982. In contrast to the 1974 survey the 1982 results also contained information relating to the extent of urban dereliction and the ownership of derelict land. The most significant results of this survey are presented in Table 4.3.

Table 4.3. Total amount of derelict land as at 1 April 1982 (hectares)

Standard regions	Spoil heaps		Excavation and pits		Military etc dereliction		Derelict railway land		Other forms of dereliction		Derelict land	
	Total area	Area justifying reclamation	Total area	Area justifying reclamation	Total area	Area justifying reclamation	Total area	Area justifying reclamation	Total area	Area justifying reclamation	Total area	Area justifying reclamation
North	1872	1711	1043	719	168	147	1375	760	2849	2278	7307	5615
North West	2012	1679	1381	1072	398	373	1648	1569	4603	4299	10042	8992
Yorkshire and Humberside	1070	869	1433	869	385	216	1428	1111	1115	1010	5431	4075
West Midlands	2174	2112	917	726	330	318	875	562	1491	1459	5787	5177
East Midlands	1225	1197	1258	1094	644	577	1339	1178	732	706	5198	4752
East Anglia	15	14	305	209	251	192	170	115	63	61	804	591
South West	4870	616	420	162	208	160	820	265	317	206	6635	1409
South East (Ex. GL)	57	57	1439	1233	268	105	374	299	387	334	2525	2028
Greater London	45	45	382	318	364	364	181	156	982	756	1954	1639
England	13340	8300	8578	6402	3016	2452	8210	6015	12539	11109	45683	34278

Source - DOE 1982

The total amount of derelict land reclaimed between 1974 and 1982 was approximately 17,000 ha, with 45,683 ha of derelict land remaining in total, 34,278 ha of which is regarded by the DOE as justifying reclamation. Despite the fact that 17,000 ha of land have been reclaimed in the 1974-82 period, dereliction has increased by 2,410 ha. It is also evident that the rate of reclamation envisaged in 1974 for the 1974-1976 period of 5,275 ha, if extrapolated to 1982, would approximate a total of nearly 37,000 ha of land that should have been reclaimed if the initial 1974-76 impetus was maintained. Although it is unlikely that such a rate be maintained, due to factors such as the ease in reclamation of larger sites, which would be tackled first instead of the more difficult to reclaim small sites, the amount of land that has been reclaimed is half that expected. Nearly half of the derelict land reported was in urban areas, thus the decision to establish how much inner city land was derelict was apparently justified and reveals the scope of the problem. Of this land 50% was in private ownership, while 41% was the property of the local authority.

It is probable that any further national surveys of derelict land will continue to adopt the procedures and structure of the 1982 survey. The next complete survey of derelict land in England has been timetabled for 1988 by the DOE, with returns being submitted on the financial year basis as at the 1 April of the survey year.

4.3 The regional picture of dereliction

The Town and Country Planning Act of 1947 was aimed at producing development plans that discouraged the mixing of industrial and other land uses. The West Midlands Advisory Plan of 1948 attempted to prevent excessive industrial growth in the districts, since this was never published, there was no regional framework for local authorities to produce their development plans. The high levels of industrial decentralization never materialized, despite the regulated development encouraged by the Town Development Act of 1952. Instead as Johnson (1958) noted, enclaves of industry, surrounded by housing, had spread across the entire area, with the emphasis on industrial strip development along the dense rail and canal network. Derelict land was consumed by industry to the extent that between 1948 and 1964, 43%, and 1964 to 1975, 36% of all land used for development was formerly classed derelict.

The economic slump has taken its toll of the traditional manufacturing industries. Coupled with the formation of the West Midlands Metropolitan County Council (WMCC) in 1972 which ensured the differentral decentralization of people and firms through comprehensive redevelopment and planning policies, the relative locational advantages of the Black Country were lost, assisting the closure of many firms and increasing the number of redundant industrial properties. Cave's (1984) survey for the WMCC reveals that 765 vacant properties in the Black Country accounted for an area 1689 ha large, and that 28 of the largest properties comprised over 50% of the total site area vacant, which will probably encourage aggregation.

The Black Country has a history of extractive and heavy industries, making it inevitably an area of acute dereliction. However the legacy of despoiled land left from over 500 ninteeth century collieries was substantially reduced from 5,760 ha in 1903 to 3933 ha in 1946 and to 1554 ha in 1965, a net decrease of over 60%. Beaver (1945) suggests that this reclamation was for housing and industrial development during the inter and post war periods, however little attention was paid to planning.

Dudley seems to have the least flexibility with regard to reallocation of its industrial land and premises. Cave's (1984) Planning Survey reveals that only 4% of existing industrial premises are less than 5 minutes drive time away from the motorway network, 26% are more than 15 minutes away. Nearly 75% of Dudleys industrial sites are subject to this marketability of vacant property proportionally affected by accessibility. In as much as current market conditions dictate the need for an alternative use for vacant industrial land, over 50% of the properties surveyed in the Black Country appear to be unsuitable for residential development.

Birmingham was revealed to be the third worst area in the UK for dereliction, as a percentage of total County area, by the Department of the Environment's (DOE) 1974 Survey. This amounts to 1.7% under the DOE (1975) classification, but nearer 4.4% using the West Midlands County Council (WMCC) classification, the difference has been explained in an earlier chapter. The WMC's 1980/82 survey revealed that by the end of 1980 nearly 5%, 4800 hectares (ha) out of the 86,664 ha that comprise the WMCC area, could be classed derelict. Representing an increase of nearly 1000 ha, or 26%, on the 1974 figures, 75% of that increase being within the Black Country District of Dudley, Walsall, Sandwell and Wolverhampton. In contrast, the total amount of derelict and waste land recorded in County Council surveyssuprisingly underwent a net decrease of about 12 %, representing a decline fron 12,000 acres in 1974 to 10,500 acres in 1982. Cave (1984) suggests several reasons why this may be so:-

1) As new developments encroach onto the reserves of derelict and waste land it is the derelict land that is more easily reclaimed which is first used, while the hard core dereliction remains undeveloped.
2) Some waste land sites are re-classified as derelict as knowledge of their true condition improves.

According to Cave (1983), the amount of land becoming derelict in the County exceeds that being reclaimed by 29%, while the DOE (1977) state that nationally land becoming derelict exceeds that being reclaimed by 1500 ha/year. The derelict land figures for 1982 do reveal a slight decline in derelict land, so with respect to these figures the West Midlands seems to have suffered against the national trend from 1974-1982. In fact the West Midlands was still the fourth most derelict area nationally, with 5,787 ha derelict compared with 10,042 ha in the north-west, 6,635 ha in the south-west and 5,431 ha in Yorkshire and South Humberside. Table 4.4 reveals the distribution of derelict land in 1974 in comparison with the 1982 survey results. However, if dereliction within urban areas is considered then the West Midlands County still ranks third after Greater Manchester and West Yorkshire, and according to Cave (1984) still appears to have the highest rate of increase amongst Metroploitan Counties where comparisons may be drawn. It seems ironic that this should be the case, with Birminghams potential considered by virtue of its location at the centre of the national road and rail networks.

A 1985 survey of the four Black Country Boroughs by a joint survey team revealed that the area had 1668 ha of derelict land, which represented an increase of over 34% since 1974, and an increase of just over 7% since the 1982 DOE survey. The fact that new dereliction is replacing (and exceeding) older derelict areas may be attributed to the closure of industrial sites, such as Bilston, Round Oak and Patent Shaft steel works, the Rubery Owen complex and very many smaller foundry premises (Black Country Derelict Land Strategy 1986/89 (1985)).

Table 4.4. Derelict land restored between 1 April 1974 and 31 March 1982

Standard regions	1 April 1974 - 31 March 1978				1 April 1978 - 31 March 1982				Total - 1 April 1974 - 31 March 1982			
	LA with grant	LA without grant	Other agencies	Total	LA with grant	LA without grant	Other agencies	Total	LA with grant	LA without grant	Other agencies	Total
Spoil heaps	260	86	132	478	502	20	385	907	762	106	57	1385
Excavation and pits	147	71	160	378	142	13	159	314	289	84	319	692
Military etc dereliction	25	0	20	45	150	10	8	168	175	10	28	213
Derelict railway land	42	8	11	61	126	106	42	274	168	114	53	335
Other forms of dereliction	192	119	50	361	371	14	74	459	563	133	124	820
WEST MIDLANDS	666	284	373	1323	1291	163	668	2122	1957	447	1041	3445

Source - DOE 1982

In 1984 the Dudley Metropolitan Borough Council carried out it's own derelict land survey, as part of the preparation for a joint rolling programme submission with the other Black Country Borough Councils. The survey found 102 sites that were derelict when regarded in the light of the DOE definition. Altogether 4389 ha of land were so identified, a figure that equates to 4.5% of the total area within the Dudley M.B.C.

CHAPTER 5: AERIAL PHOTOGRAPHIC ANALYSIS OF DERELICT LAND

Satellite remote sensing, which is discussed more fully in the following chapter, has developed within, and in addition to, aerial photographic survey. For this reason the brief explanation given below attempts to put remote sensing into a historical context, concentrating in the first instance on the early sensors and methods used for the interpretation of the information they provided.

5.1 The early history of remote sensing

The term 'remote sensing', as applied in the present-day context, first came into existence during the development of spaceborne remote sensing systems in the early 1960's. The systems were exemplified by the excellent photographic results obtained from the Mercury and Gemini missions, which in themselves paved the way for the non-photographic sensors of the 1970's. The rapid changes that led to the birth of this new terminology were characterized by Colwell (1979), who divided the development of remote sensing into two areas of interest: pre-1960 and post-1960. Prior to 1960, aerial photography was the only operational imaging system, and itself developed in tandem with the advances made in photographic film, camera and platform technology.

This parallel development can therefore be strictly traced back 2,300 years to Aristotle's experiment with a 'camera obscura'. However, within the bounds of photographic images from the air, it is recorded that the first aerial photograph was taken in 1859 by Gaspard Felix Tournachon. This unique image was taken from a balloon over the village of Petit Bicetre near Paris (ostensibly for mapping purposes). Tournachon, who later known became known as Nadar, had no choice but to develop the film whilst still airborne, although by 1871 Maddox had developed a gelatin emulsion of silver halide grains so that an image could be developed at a later time.

During the late 19th and early 20th century much of the original work was undertaken which provided the basis for the development of non-photographic sensors and colour films, as well as the platforms themselves. Notable examples of this type include De Hauron's work on three colour separations using red, yellow and blue pigments (1895) and Heinrich Hertz's discovery in 1889 that solid objects reflect radio waves. Of direct relevance to remote sensing at the time however, were the first aerial images to be taken from an aircraft. These motion picture images were obtained by Wilbur Wright on 24 April 1909 whilst flying over Centonelli in Italy. Prior to the refinement of the aeroplane, a variety of platforms had been used, ranging from balloons and kites to a 70 gm camera strapped to a pigeon's chest. However, once established, the combination of aeroplane and camera developed rapidly, especially during the First World War. It did not take long before both sides in this conflict discovered the advantages of photo-reconnaissance; thus in 1915 the first practical aerial camera was introduced by J.T.C. Moore-Brabazon of the R.A.F.

The value of aerial photography was amply demonstrated during the war, although few training procedures had been established and few aircraft and aerial cameras were available for training purposes. During the inter-war years, though, development did continue, especially in the science of photogrammetry. The mapping

aspect of aerial photography characterized by photogrammetry was pursued during this period by survey and planning bodies, especially in the U.S.A., where the U.S. Geological Survey (USGS) and Tennessee Valley Authority became chief exponents of aerial survey techniques.

The next strides to be taken in remote sensing technology were a direct result of the Second World War, the main advance being observation in wavelengths beyond the visible regions of the spectrum. It was the development of colour-infrared film and radar that provided the main impetus to remote sensing as it is considered today. The effect of the advances made in Germany with rocket and turbojet technology cannot be ignored or overstated, but of more immediate interest to the remote sensing community as such was the refinement of colour-infrared film.

The ability to monitor the Earth's surface in a variety of wavelengths, although invaluable, could only be applied to relatively small areas of the Earth at one time. Before the first manned orbital space missions, the maximum altitude that a manned aircraft could achieve was approximately 23,000m, this honour belonging to the Lockheed U-2 military reconnaisance aircraft of the type piloted by Francis Gary Powers and shot down over the U.S.S.R. in 1960. The possibilities of using rocket-borne cameras for earth observation had been recognized over fifty years earlier when Alfred Maul patented a gyroscopically stabilised camera for mounting in a rocket that was rather similar in appearance to a large firework! Although Maul's rocket attained a maximum altitude of only 865m, the idea had at least been tested. Thus it was that the possibilities offered by the National Aeronautics and Space Administration (NASA) space programme for remote sensing were eventually acknowledged. The first orbital photographs (167 frames) were taken from an unmanned Mercury-Redstone 2 orbiter on 31 January 1961. The photographs of North Africa amply demonstrated the synoptic capabilities of this type of photography, the images even being used to produce a series of geological maps of the Sahara desert. During the subsequent manned Mercury missions further high-quality 35mm and 70mm colour photographs were obtained by each astronaut. The response to these images was highly encouraging, so two experiments were designed for the second-generation Gemini programme.

Experiments S005 (Synoptic Terrain) and S006 (Synoptic Weather) produced more than 1,100 high-quality colour photographs during a total of ten missions. As part of the Gemini IV mission (3-7 June 1965), thirty-nine exposures with six-second intervals provided the first stereoscopic coverage from space, which extended from California to Texas. The two crew members of Gemini IX (3-6 June 1966), photographing Peru simultaneously, managed to attain coverage for almost three-quarters of the country in three minutes. These particular results were appreciated, since only one-quarter of Peru had been photographed from the air during the previous fifty years.

This increasing interest shown in orbital imagery by terrestrial and marine scientists prompted the next step in space remote sensing. A combination of multispectral remote sensing systems and high-altitude space vehicles was an obvious progression. Therefore, the S065 Multispectral Terrain Photography Experiment was carried on Apollo 9 in March 1969. The system consisted of four Hasselblad cameras mounted together, each having a different film/filter combination allowing coverage in the yellow, green, red and infrared (the spectral bands planned for the ERTS-A/Landsat-1 Multispectral Scanner). The images obtained proved very promising for earth observation, but since the Apollo missions were directed towards a Moon landing, a different platform had to be considered. The obvious choice was NASA's Skylab programme, although some poor-quality 35

mm and 70 mm photography was acquired in 1975 during the joint U.S.-U.S.S.R. Apollo-Soyuz Test Project. The U.S.A.'s first space station was launched on 14 May 1973 into a near-circular orbit (435 km) carrying the Earth Resources Experiment Package (EREP). Two cameras were carried, the S190A multi-spectral camera system and the S190B Earth Terrain Camera. S190A consisted of six Hasselblads which covered the same ground area with six different film/filter combinations over the 0.41-0.9 μm region. S190B was a single camera of focal length 127 mm covering the 0.4-0.88 μm range. However, more important to the future of remote sensing were the infrared spectrometer (S161) and thirteen-channel multispectral scanner (S192) also carried. These systems, although not perfect, signalled the end of conventional orbital photography, until the Shuttle Large Format Camera (LFC) and Metric Camera, but acknowledged an era of synoptic coverage with scanner data which had already 'taken off' on 23 July 1972 with the launch of the first orbital remote sensing satellite, ERTS-1, which was later renamed Landsat-1.

5.2 Remote sensing use in derelict land survey and planning

One of the most useful surveys of aerial photography for planning purposes by local authorities was performal by Denton (1973). The results of the study revealed that out of the sample authorities questioned nearly 90% had used aerial photography to some degree in planning or related situations. Approximately 50% of these authorities had made quite regular use of aerial photography in the last five years up to the survey, although the others only rarely used aerial photography. Perhaps more interesting, however, is the fact that 45% of the authorities questioned had used aerial photography for derelict land studies, and that when listed this application came eigth out of a total of nineteen applications.

Denton's 1973 survey followed similar earlier survey's by White (1970,1971). White's 1970 study revealed that only 15% of planners had not used aerial photographs, but the other 85% did not regard them as a worthwhile source of planning information. It is probable that the conclusions of White (1970) and Denton (1973) are so different because White used individual questioning of planners, while Denton surveyed use of aerial photography on a broad based departmental level.

Many individuals have published material highlighting the advantages of aerial photography in planning Mott (1957), Joseph (1957) Belling (1966) and Collins (1969). Much of the important developmental work on the use of aerial photography in planning has stemmed from academic research in photogrammetry, and little if any has resulted from work by planners.

Most of the works mentioned above have presented the photograph as a tool which could be useful for planning purposes, but have done little to qualify their statements. However, a significant amount of work has been done on the use of aerial photography in spoiled land and derelict land studies and again most of it by academics Eyre (1969), James (1970) Collins and Bush (1969, (a), 1969 (b), 1971), Ballam and Collins (1975), Gibson and Collins (1977), Collins and Gibson (1980) and Bullard (1982, 1983). The work of Collins, Bush and Gibson in particular revealed that it was possible to accurately map (if not necessarily classify) derelict and degraded land in urban areas. The classification and air-photo key devised by Bush and Collins (1969) for their studies was however very complicated, probably too much so, a fact which is attested to by Bush (1970). Another survey, that of James (1970) went much further towards aiding the planner. Whereas others (Bush (1976) in particular) had proved that aerial photographs could be sucessfully used to

accurately identify urban derelict land, James study applied certain criteria relating to the site and situation of that land and the purpose for which it may be best reclaimed. More recently attention has been given by Bullard (1982, 1983) to the long term monitoring of reclaimed sites using a variety of remote sensing techniques, concentrating principally on the Airborne Thematic Mapper (ATM). Although no applied methods are offered by these studies, they are useful as an indication that remote sensing may have other benefits besides those put forward by the established literature relating to the use of aerial photographs for the identification and quantification of derelict and spoiled land areas.

The literature reveals how aerial photography may be used to produce quality survey results in a planning environment, however, to what extent that capability has been realised by planning authorities is in some question. Gibson (1976), looking at the use of aerial photography for spoiled and derelict land studies in Glamorgan, presented a methodology for aerial survey that was particularly applicable to planning requirements. The practicality of this approach was subsequently demonstrated by the use of a similar system in private contract surveys in the West Midlands, Glamorgan and Merseyside for the 1974 DOE derelict land survey of England and Scotland by the Remote Sensing Unit of Aston University. The conclusions of the West Midlands survey, which have been documented by Gibson and Collins (1977), were that the increased demands for data on derelict and spoiled lands could be provided quickly and accurately by aerial survey. This paper went on to challenge the DOE classification of derelict land, as over 50 % of the land classified as derelict in the survey was not eligible for grant aid under DOE definitions.

Since these mid-1970 surveys there appears to have been very few (if any) analyses of derelict land by aerial photographs. Indeed, local authorities have apparently reverted to the use of more traditional ground survey methods, even though appreciable savings in terms of both money and time have been demonstrated using aerial photography (Collins and Gibson, 1987). In the West Midlands none of the Metroplolitan Borough Councils use aerial photography for their derelict land surveys. However, Birmingham City Council is interested in remote sensing technology, although this interest appears to be confined towards the use of satellite sensors, which unlike aerial photography, have no proven sucessful track record in survey use.

5.3 Principles of air photo interpretation

There are seven aids for identifying an object on an aerial photograph, these being:-

1) Tone
2) Shape
3) Size
4) Texture
5) Pattern
6) Shadow
7) Location

It should be realized, however, that intuitive decisions begin to be made after considerable experience with the interpretation of aerial photographs. This results in instantaneous interpretation and often the skilled

operator will not run through the characteristics described below, but will 'know' what a feature, or class, of ground cover is. It is very hard to qualify experience of this kind, but it should be realised that the combination of eye and brain are the fastest classifiers currently available, despite the rapid advances in computerized image processing technology.

1. Tone

Tone is widely regarded as the single most important characteristic of the aerial photograph. It represents a record of the radiation that has been reflected from the Earth's surface and preserved on the photographic emulsion. Light tone represents areas with a high radiance and dark tone represents areas with a low radiance. Surface texture may alter the tone of an object, although this is dependent on the smoothness and reflectance of that surface, so that roads which normally tend to be black on monochromatic emulsions can appear white, and water can appear as any shade ranging from black to white.

For the reasons stated above the tone of objects viewed under the stereoscope must be treated very carefully, and often their interpretation is solely a matter of experience.

2. Shape

Shape relates to general form; the configuration of outline of an individual object. The shape of an object viewed from the vertical plane is that of a plan view, this appears different to the oblique views that are normal for the human eye, therefore it is often necessary to reorientate one's thinking.

Shape limits the class of objects to which the unknown item can belong, and it if does not allow conclusive identification, it aids in understanding the significance and function of the object.

3. Size

Size relates to the surface or volume dimensions of an object and can be obtained in two ways:-

a) By comparison with other recognisable features eg. houses.

b) By photogrammetric measurements, provided the scale of the photograph is accurately known.

Being familiar with the size of an object enables whole groups of possible identities suggested by considerations of shape to be eliminated, e.g. differences between houses and garages, or the difference between clumps of grass and trees.

4. Texture

Texture on photographic images may be defined as the frequency of tone changes within the image, produced by groups of individual features which are too small to be seen themselves on the image. As the scale of the photograph decreases, so the texture of the photograph becomes finer and more subtle. However, within a given range of scales, texture can often be distinctive enough to serve as a reliable clue to objects, or types of ground cover.

5. Pattern

Pattern refers to the spatial arrangements of objects on a photograph, a repetetive arrangement produces a pattern which is a clue to the objects under observation. Pattern can help in the distinction between natural and man made features. The latter are conspicious for their use of straight lines and regular configurations, while the former features have far less regular patterns; most patterns depend on an interaction between the two.

Although it may be difficult to understand man made features, their configuration seen from the air is often a sufficient clue to their function. For instance, motorways and railways may look alike, but rail networks generally have fewer intersections and wider curves in their tracks.

6. Shadow

Shadow is important if the objects being viewed are small or lack tonal contrast with their surroundings. Shadows not only indicate the height, but also the elevational shape of the object. However, the object onto which shadows fall can only be seen dimly, if at all, although this problem is not as great as in radar images in which shadow contains no information whatsoever.

7. Location

Once the basic features of an object have been recognised, several choices as to what the object may be would suggest themselves, however, by considering the object in relation to other features or objects, the interpreter will often positively identify it. eg. chimneys are often near a factory and filter beds are usually associated with sewage works.

These are the basic features which enable the recognition of objects on aerial photographs, certain of which are more useful than others. Patterns or arrangements of objects may be of more use than the individual objects themselves.

5.4 Mirror stereoscopes

Mirror stereoscope are used chiefly in the interpretation of aerial and terrestrial photographs and as auxiliary instruments in all phases of surveying and mapping. Stereoscopic vision is obtained by looking at an object with both eyes. The left eye sees a slightly different picture from that seen by the right eye; both pictures are fused by the visual centre of the brain into a three-dimensional impression of the object.

Instead of looking directly at the object under examination, it can be photographed from two points analogous to the location of the two eyes. If these pictures are then viewed, left picture with left eye, right picture with right eye, the object appears again in three true dimensions, although if the photographs are reversed the topography becomes inverted, which can be an aid to the skilled interpreter when dealing with certain features.

For direct viewing, the stereoscopic field of view is 18cm x 23cm; with 3x oculars the field of view diameter is 70mm. Almost any stereopair can be viewed in the mirror stereoscope. Stereoscopy will be obtained if the scale of both pictures differs by not more than 10 - 15% and the base (distance between exposure stations in

the air) is not excessively long in relation to camera-to-object distance and object depth. Local parallax differences must not exceed 10 to 15mm. The spatial model obtained in the stereoscope is not normally similar in the strict mathematical sense to the object; it usually shows a certain amount of deformation. Due to the generally quite large ratio between length of base and object distance ('base-height ratio' in aerial photogrammetry), vertical relief often appears strongly exaggerated, especially in small scale photography

Photographic flights are usually planned so that the resultant prints will overlap by 60% in the line of flight and about 30% between strips. For effective stereo viewing the prints are trimmed down to 9 x 9 inch size, preserving the four fiducial marks at the midpoint of the four edges that aid in the determination of the principal point (centre of individual prints) and the conjugate principal points (corresponding to the centres of adjacent photographs.

5.5 Additional data sources

In this and earlier studies the uses of aerial photography have been demonstrated to be effective for the mapping of derelict and spoiled land in dense urban environments. In this work a preliminary classification by aerial photography is used to gauge the accuracy of a subsequent satellite analysis of derelict land. This section reveals how a reliable air photo base was constructed; but despite this, it was felt that further accuracy checks were worthwhile.

At the time that the study was undertaken there were two additional sources of data. These consisted of accurate dyeline copy ground survey maps for the whole of the WMCC at a scale of 1:10,000. These maps are the results of two surveys:-

1. June 1980. Derelict land in the WMCC. County Planning Department: Cave, A. A. (1983).
2. December 1984. Vacant industrial property in the Black Country. County Planning Department: Cave, A. A. (1984).

The sites, having been identified on field survey maps at a scale of 1:2,500, were transfered to 1:10,000 scale clear film maps, together with site reference numbers. Corresponding files on site data were maintained on the WMCC mainframe (now transfered to Solihull) with analysis being provided by the FILETAB, GIMMS and SPSS packages, more recently data manipulation has been performed on the LAMIS system. These data sources were occasionally used for comparison with, or to supplement data arising from the air photo classification.

5.6 The interpretation of derelict land

The study area, part of the Dudley Metropolitan District Council in the south west of the West Midlands Black Country Conurbation was chosen for a variety of reasons. Ground survey, aerial photography and satellite data were all available. The area has changed dramatically in a short time and features extractive and heavy industries, extensive rail and canal networks and has seen attempts at reclamation. It is relatively close to Aston University which facilitates field-study and communication with the local council.

An eight point classification modified from the DOE 1974 Derelict Land Return System by the WMCC is used for the aerial photographic survey. Land without any beneficial use is divided into:-

1. Spoil heaps
2. Excavations and pits
3. Military and other Service Dereliction
4. Disused Rail Land
5. Disused Sewage Works and Installations
6. Disused Waterways Land
7. Neglected Waste Land
8. Other

The 8 basic characteristics were further divided by the WMCC for their ground survey to give 23 sub-divisions. As many of these are not apparent from aerial imagery they will not be exhaustively listed here.

More important are the criteria relating to the site, a list of which is provided by Appendix 1. Most of these elements were considered during the air photo survey, their influence on each site is tabulated on forms such as the one reproduced in Appendix 4. Identification of most of these types is usually quite straightforward from aerial photographs, although discrepancies can exist.

1) Neglected Wasteland

This land may or may not be vegetated and the following criteria should apply:-

i) land cleared of buildings - historical records and foundation relics (not actual foundations) should aid in identification;

ii) waste land incapable of natural development in its present state i.e. due to marsh land, toxicity, steep slopes etc.

iii) waste land not otherwise classified in its natural state, i.e. no evidence of alteration of the ground surface contours;

iv) waste land with altered contours i.e.due to tipping, earth moving or landfill, but excluding sites under construction. This category contains all land that does not fit other categories within the 'theme' of derelict land.

2) Spoil Heaps

These are positive land features, often very easily idnetifiable on aerial photographs, that result coal mining and extraction, quarrying of minerals other than coal and other activities. Spoil heaps that have been revegetated are included if the presence of spoil is apparent.

3) Excavations and Pits

Negative land features that are classed as derelict if they are being either infilled or neglected.

4) Disused Rail Land

Only land which has no tracks is included in this category, as unless there is substantial vegetation overgrowth it is diffficult to tell whether or not rail land is in use.

5) Disused Waterways Land

These were mainly canals and when deciding if they wrer or were not derelict, various ancillary data, mainly from maps were used.

6) Disused Sewage Works and Installations

Sewage works and associated installations and land adjacent to the sewage treatment installation for the disposal of slurry.

7) Military and Other Service Dereliction - not sub divided

8) Other

Disused gas works and installations, disused electricity generating stations and other installations and other derelict land not elsewhere classified. This class is merely used as a residual one when the derelict land will fit no other category.

5.7 Methodology of derelict land survey

The aerial survey utilized 2 sets of low and medium altitude panchromatic aerial photography, totalling 78 prints, flown in October 1971 and July 1980 at scales of 1:12000 and 1:6000 respectively. Both sets are of good quality, being flown in late morning/midday to minimise shadow effects of buildings. However the 1980 set initially suffered from 16 missing prints which covered the North-West quadrant of the area, therefore figures for this area come from the WMCC ground survey in the paper by Hyatt et al (1986). The missing prints were later obtained from Dudley Metropolitan Bourough Council and classified, the resultant data being incorporated into the overall statistical analysis.

A photo mosaic was compiled using the panchromatic aerial photography. These were stereoscopically examined and areas of dereliction were plotted on acetate overlays placed on alternate photographs within the flight strips. The vertical strips overlapped by approximately 60% and adjacent photographs had a 25% overlap.

Each site was traced onto acetate overlays, attatched to the aerial photographs to prevent them being marked, and a classification number was appended to each polygon. The site information was then transferred to 1:10,000 scale clear film maps of the area. Initially that was done by using the Bausch and Lomb Zoom Transferscope, a device that allows one medium to be projected onto another at the same scale so that vector data may be exchanged between the two. However, it was felt that the machine was inaccurate due to its service history, particularly with regard to edge matching on adjacent acetate overlays. For this reason relating the acetate overlays to the 1:10,000 scale clear film maps was done by eye, with extensive use of the topographic map as a boundary guide. Although this induced some error into the transference process, it was

considered upon inspection of sample area, that such error was less than that incurred with the use of the Zoom Transferscope.

Using the technique above 1:10,000 scale clear film map were prepared from the 1971 and 1980 photography. In order to appreciate the different classes resulting from the air photo interpretation the sites were than infilled in a variety of colours with Letraset. In all four maps were produced in this way to respectively illustrate derelict land 1970; derelict land 1980; land lost to dereliction and land reclaimed in the 1971-1980 period; derelict land, 1980 (not coloured, a trace map for comparison with 1971 derelict land). The fact that the maps were on acetate sheets allowed them to be used in combination and also as overlays on the 1:10,00 topographic map of the study area. Some of the maps, and these various combinations are shown by Plates 5.1, 5.2 and 5.3.

5.8 Comparison of results with those of the WMCC surveys of 1980 and 1984

A direct comparison of the air photo survey results for 1980 was made with the 1980 Derelict Land in the WMCC and 1984 Vacant Industrial Property in the Black Country Studies. A visual comparison could be accurately performed as the 1:10,000 coloured air photo survey maps could be overlayed directly onto dyeline maps of the same scale from the county survey.

5.9 Compilation of Statistics - Digitization

All of the area information regarding derelict land featured in the tables in this section was measured using a digitizer programme. The DIGITIZE programme (Bellavia, 1985) allows the tracing of area polygons on a digitizing table, with the automatic calculation of area and boundary length of each polygon. In addition the frequency of signal from the mouse is variable so that corners and irregular shapes may be accurately recorded using a more rapid frequency signal. The programme may also accept a wide range of scales and expresses all results in kilometres or divisions thereof.

A minimum site mapping unit of 0.25 hectares was specified, this corresponds to an area of 2.7 TM pixels (TM resolution being approximately 0.1 ha). It was considered that this would give sufficient accuracy for the later TM classification, as according to Wilson and Thompson (1982), MSS data, 0.5 ha resolution, can be used for map scales down to 1:25000.

The digitization was performed on the 1:10,000 scale clear film map after the area polygons had been added. The original intention was to digitize directly from the transparent air-photo acetates in order to obtain a higher degree of accuracy (errors probably being incurred when data were transferred from the acetates to the 1:10,000 scale clear film maps) however, this proved difficult. The major difficulty was the physical size of the digitizing table, which meant that the acetates (9 x 9 inch) could not be secured with the conventional means of magnets. This problem was overcome by scotch-taping the acetates to the digitizing tablet, this was satisfactory, but unfortunately the acetate proved too soft and flexible for the mouse. Flexing was caused in the acetate by the mouse, which adheres to the material it is digitizing by means of a vacuum, and it was decided to abandon digitization of the acetates for the more reliable 1:10,000 scale clear film maps.

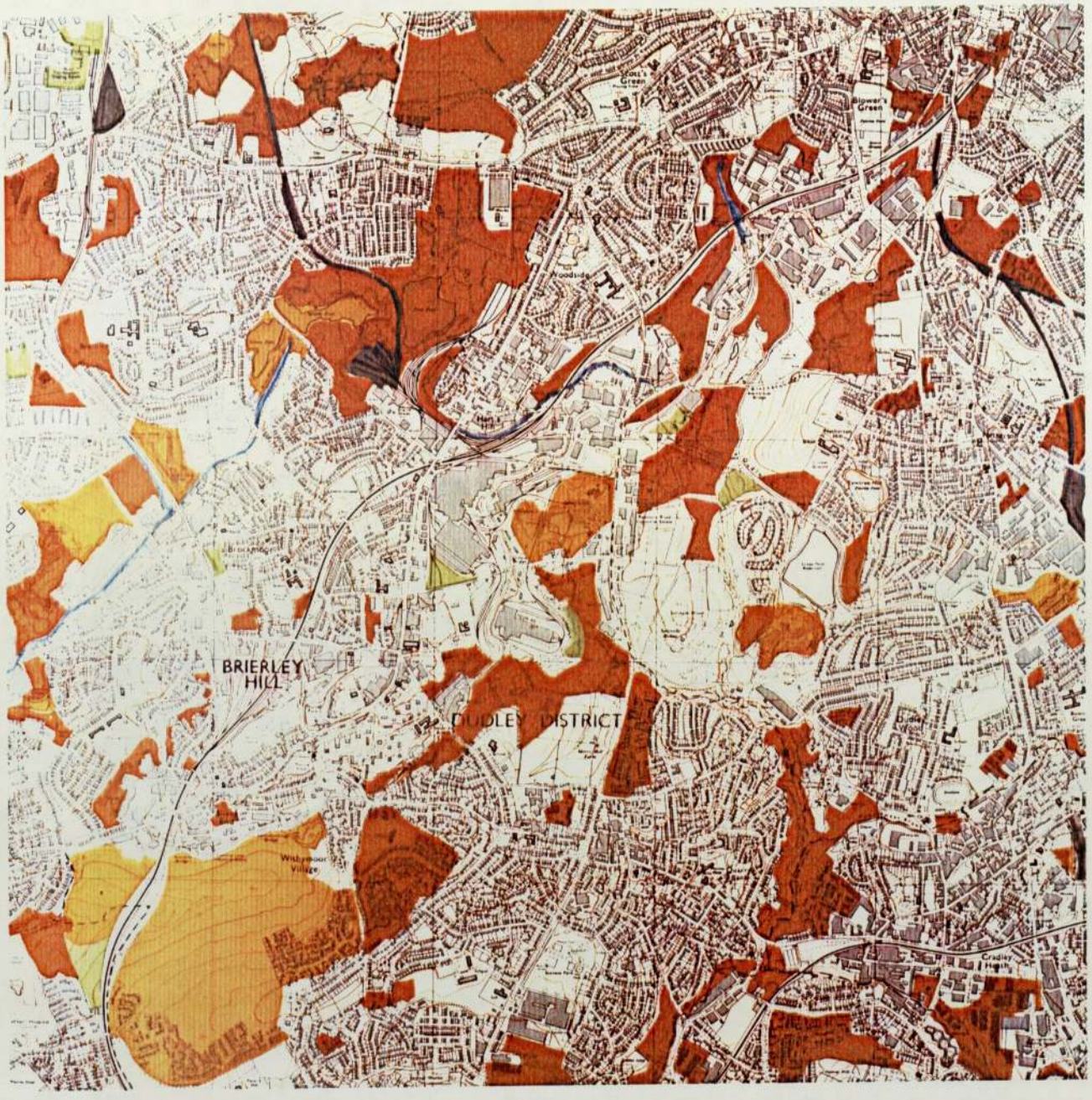


Plate 5.1 Distribution of derelict land 1970

KEY:
Grey - Disused railway land
Yellow - Excavations and pits
Orange - Neglected wasteland
Green - Spoil heaps
Blue - Disused canal land
Violet - Sewage works and installations

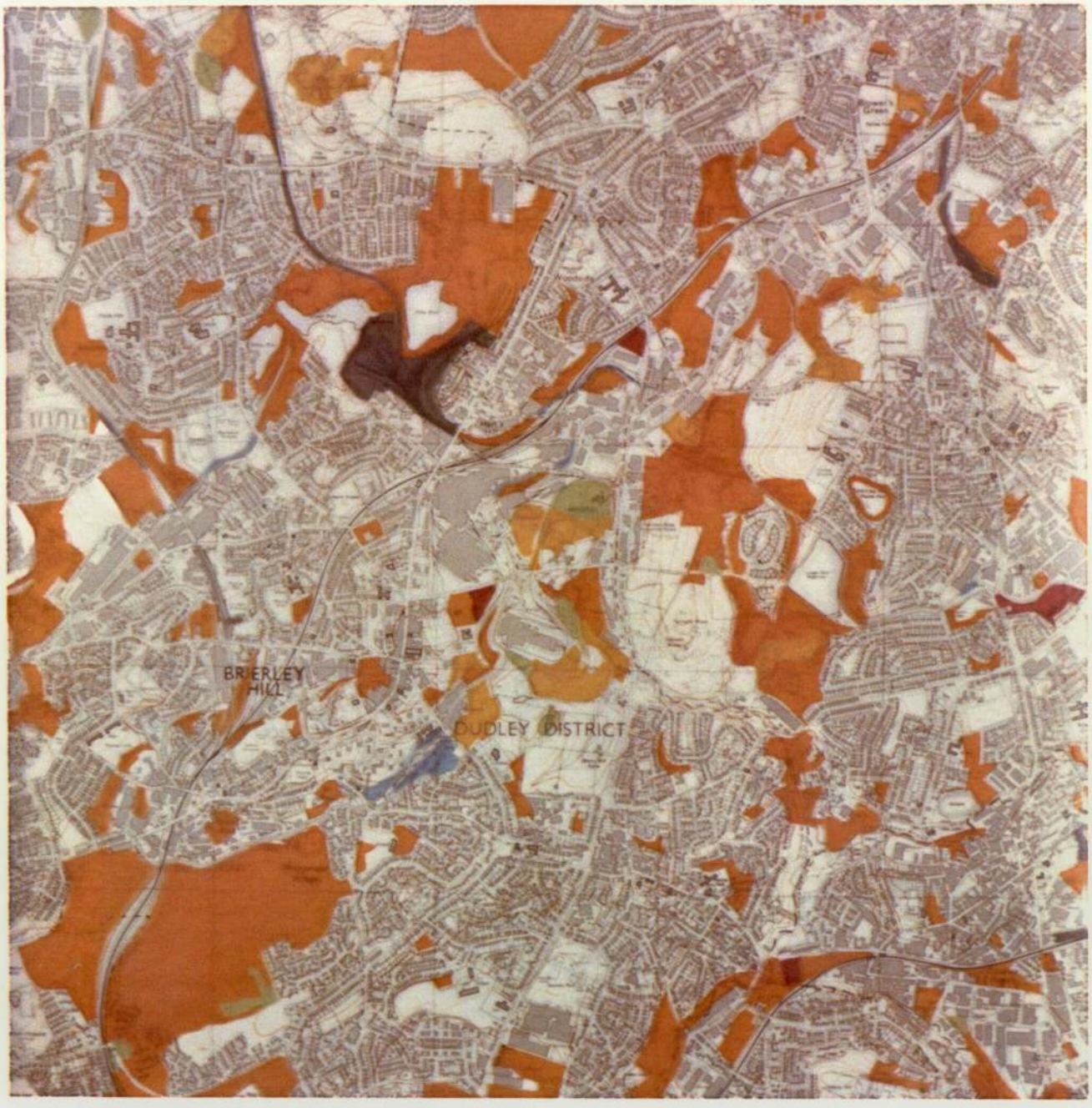


Plate 5.2 Distribution of derelict land 1980

KEY:
Grey - Disused railway land
Yellow - Excavations and pits
Orange - Neglected wasteland
Green - Spoil heaps
Blue - Disused canal land
Violet - Sewage works and installations

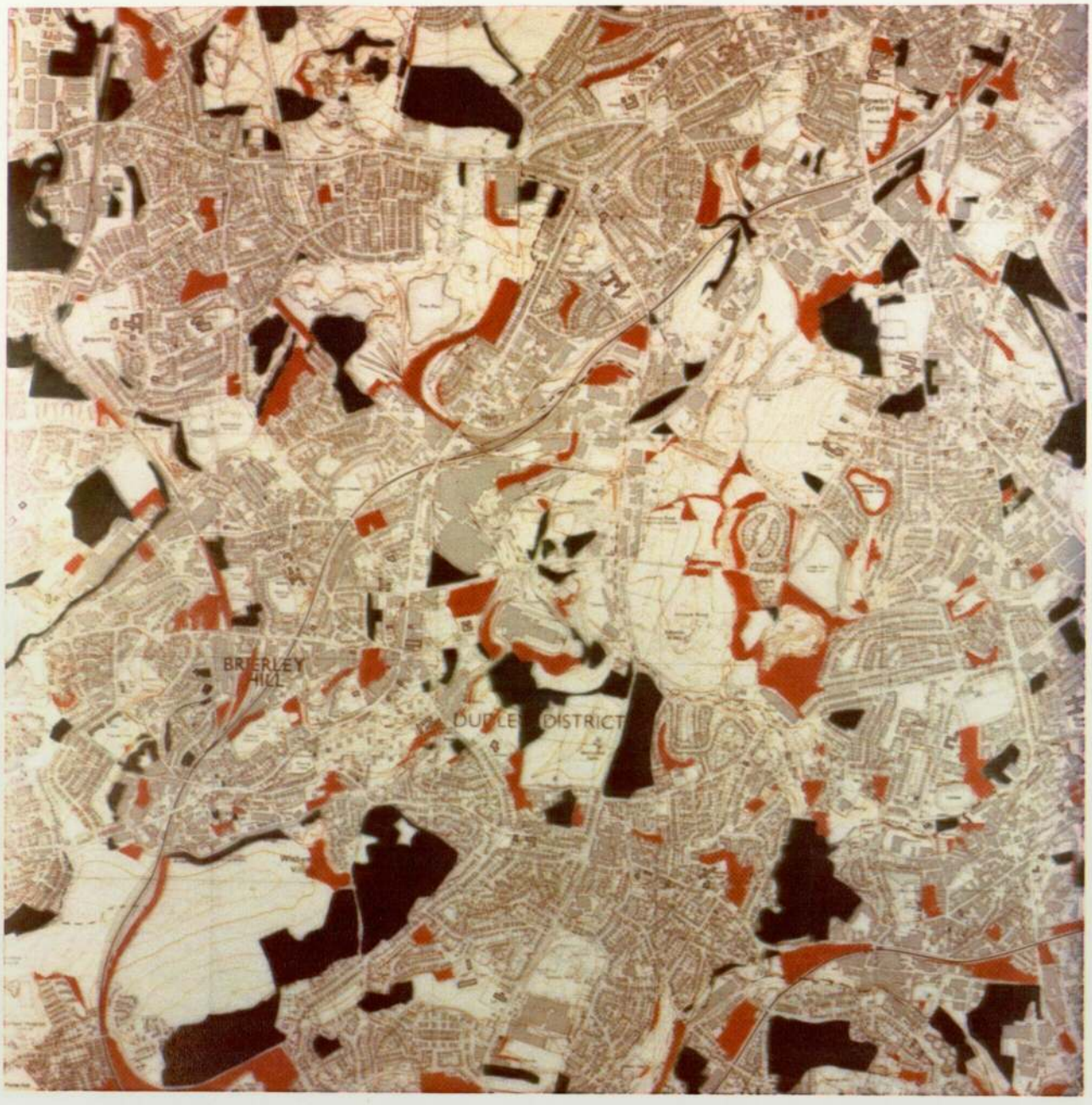


Plate 5.3 Land becoming derelict and land being reclaimed 1970-1980

KEY:
Red (hatched) - land becoming derelict 1970-1980
Green (hatched) - land being reclaimed 1970-1980

5.10 Analysis of aerial photography classification

The results of the aerial photographic survey of derelict and waste land are presented in Tables 5.1, 5.2, 5.3 and 5.4. The most meaningful results with respect to how the WMCC coped with the Black Country derelict land problem are those expressed by Tables 5.3 and 5.4, dealing with the number and size of derelict sites in the mapped area.

Table 5.1. 1971 Classification scheme

1971 Dudley Derelict Land

	sites	hectares	%	mean
spoil heaps	11	29.4	5.1	2.7
excavations and pits	14	137.4	24	9.8
military	0	0	0	0
disused railway land	6	14.7	2.6	2.5
disused sewage works	0	0	0	0
disused waterways	4	8	1.4	2
neglected land	82	382.1	66.9	4.7
other	0	0	0	0
total	117	571.6	100	

Table 5.2. 1980 Classification scheme

1980 Dudley Derelict Land

	sites	hectares	%	mean
spoil heaps	11	13.1	2.9	1.2
excavations and pits	15	39.3	8.7	2.6
military	0	0	0	0
disused railway land	7	23.5	5.2	3.4
disused sewage works	1	0.8	0.2	0.8
disused waterways	7	7.4	1.6	1.1
neglected land	141	363.4	80.3	1.6
other	0	0	0	0
total	185	425.3	100	

In 1971, 571 out of 2500 ha, ie 23% of the map area, were derelict. This figure had reduced in 1980 by 119 ha, or 5%, to 18% of the map area, 453 ha. The reduction in size of the total derelict area is very encouraging, and reflects the WMCC success with reclamation. However, a more worrying trend is the number of sites that are derelict in the Dudley area. The increase in site number by 59% from 117 in 1971 to 185 in 1980 suggests that derelict land sites were widely scattered. The number of sites in the 0-0.5 ha and 0.5-1 ha range

has increased by 6% between the two dates and 48% of all the sites considered in the 1980 analysis are present in this category.

The major reason behind the rise in the number of sites appears to be an acceleration in the decline of traditional manufacturing industries, which reached very high proportions in the early 1980s. Cave (1984) shows that the amount of vacant industrial floorspace in the Black Country increased by over 400% from 60 ha in April 1979 to 258 ha in April 1982, 16 ha of this is in Dudley. For the same period unemployment rose 290% from 77,000 to 225,000. It seems reasonable in the light of this evidence to conclude that the closure of factories and other premises accounts for the disproportionate rise in small derelict sites.

Table 5.3. Number and size of sites in the Dudley area (1971)

1971 Dudley Derelict

hectares	no. sites
0-0.5	2
0.51-1	18
1.01-1.5	19
1.51-2	14
2.01-3	17
3.01-4	9
4.01-5	6
5 +	32
total	117

Table 5.4. Number and size of sites in the Dudley area (1980)

1980 Dudley Derelict

hectares	no. sites
0-0.5	42
0.51-1	47
1.01-1.5	27
1.51-2	11
2.01-3	21
3.01-4	12
4.01-5	5
5 +	20
total	185

The number of sites in the 1-5 ha range seems to have remained reasonably stable, with a reduction of 11 sites over the period. However, over 5 ha a significant reduction in site numbers has occurred from 32 to 20 sites. The larger sites generally belonged to the neglected waste land category, a type of land that is relatively easy to reclaim. It appears that much of the land has been returned to private development and recreational use.

The move towards these uses seems reasonable considering the Countryside Review Committee (1976) statement concerning reclaimed land that 'the original agricultural quality is hardly ever recovered'.

Tables 5.1 and 5.2 reveal the classification results for 1971 and 1980. The true numbers of sites in the study area in all of the classes, apart from neglected wasteland, do not vary very much. Most of the increase from 117 sites in 1971 to 185 sites in 1980 comes from an additional 59 neglected land sites recorded in 1980.

The hectarage covered by the sites has also been reduced with an overall reduction of 146.3 ha. The most significant reduction appears to be that associated with excavations and pits, whose percentage area has dropped over the nine-year period from 24% to 8.7% of the total derelict area, with over 98 ha (or 52%) having been reclaimed. This trend reflects the relative ease by which excavations and pits may be refilled and landscaped. Although the hectarage of neglected wasteland has been reduced from 382.1 ha to 363.4 ha, the percentage cover of these sites has risen from 66.9% of the total area, to 80.3% of the total area.

It has been mentioned earlier that sites are apparently becoming smaller and more disseminated in their distribution. The statistical analysis of the 1971 and 1980 survey bears out this point; of the eight site classes, two, Military and other service dereliction and Other are unchanged having a zero presence in both years, of the rest only two have increased in their mean size and in each case the change has little affect on overall trends as with Disused rail land and Disused sewage works the mean area has increased from only 2.5 to 3.4 and 0 to 0.8 respectively. The two most significant contributions to this pattern are the Excavations and pits and Neglected land categories. The former cover class has had its mean size reduced from 9.8 to 2.6 ha, while the latter site category not only has far more sites, but has had their mean area reduced from 4.7 to 2.6 ha.

It is apparent that the air survey methods outlined in this section are efficient and accurate, with the study results reflecting county and district changes. It has been demonstrated by Collins and Gibson (1980) that aerial surveys have substantial advantages over traditional ground based surveys, which take up to 12 times as long, cost 4.5-8.5 times as much and do not locate as many sites.

CHAPTER 6: SATELLITE DATA ANALYSIS OF DERELICT LAND

The previous chapter outlined the developmental history of remote sensing, with particular emphasis on aerial photography. What follows is a brief introduction to satellite remote sensing, concentrating on the well established Landsat system, which provided the satellite data used in this study.

6.1 The Landsat series of remote sensing satellites

The first Earth Resources Technology satellite (ERTS-1) was launched by NASA in July 1972 and renamed Landsat-1 upon the launch of Landsat-2 in January 1975. The satellite was designed to collect data about the Earth's surface and carried a payload that consisted of two sensors: the Return Beam Vidicon (RBV) Camera and a four-band Multispectral Scanner (MSS). A fifth band in the thermal infrared region was added in Landsat-3, together with an updated RBV system with twice the resolution of the previous system and a different imaging configuration.

Landsat 4, which was launched in July 1982, heralded the advent of a second-generation Landsat series, as it carried a seven-band Thematic Mapper (TM) with increased spectral sensitivity and spatial resolution in addition to the MSS payload carried on Landsats 1 and 2. Unfortunately the improved TM sensor was partially closed down after only 213 days owing to a power failure. However, the launch of a modified Landsat-5 in March 1984 re-established a fully functioning TM sensor.

The TM sensor is a modification of the MSS which records reflected radiation over seven bands of the spectrum. The technical parameters of the band widths recorded by the sensors are given below:-

The inclusion of the additional bands in the TM allows enhanced detection of spectral diversity, thus providing increased tonal separation for different classes of land cover. The TM sensor scans the earth in two directions and the signals it receives are less degraded than those of MSS as incoming radiation is reflected directly onto the detectors rather than via the fiber optics of the MSS.

The prime focal plane assembly of the TM consists of four sets of sixteen detectors for four visible and near infrared portions of the spectrum, whilst two sets of sixteen cooled medium antimonide photodiodes record two middle infrared bands. Four separate mercury cadmium telluride detectors record the thermal band. The high 30m spatial resolution of the TM detector is due to the instantaneous-field-of-view (IFOV), 30 x 30m, of the six detectors for bands 1,2,3,4,5 and 7, band 6, the thermal band, has an IFOV of 120 x 120m. In addition each spectral band has four times the sensitivity of MSS bands as TM data are quantisized to eight bits, against the six bit quantisization of MSS data.

A further generation of Landsat satellites has been proposed by EOSAT following its commercial takeover of the Landsat programme. EOSAT proposes to use an Advanced TIROS-N/Defense Meteorological Satellite Programme spacecraft for Landsat-6. The spacecraft, which will probably be launched by a U.S. Titan II Expendable Launch Vehicle (ELV) early in 1989, will include an Enhanced Thematic Mapper (ETM) that duplicates the current TM bands and features an additional 15 m panchromatic channel in the 0.5-0.9 μm wavelength region. It is further proposed that the same bands as the earlier MSS of Landsats 1, 2, 4 and 5 will be provided at 60 m resolution by the Emulated Multispectral Scanner (EMSS). EOSAT had previously

favoured employing OMNISTAR, a modular long-life spacecraft which can carry a variety of payloads, together with fuel supplies that would allow it to change to a low orbit for equipment servicing by the Shuttle for Landsat-6. The OMNISTAR concept will most probably be employed for Landsat-7, ensuring data continuity by its twenty-year life, and providing a flexible system that can respond to developments in commercial remote sensing sensors and applications. A further stage is envisaged that will take the Landsat series into the next century and its fourth generation. It is proposed that the Landsat-H satellite will carry a payload that includes Multispectral Linear Array (MLA) 'Smart Sensors', a 5 m High Resolution Pointable Imager (HRPI), L, C and X Band SAR and an active optical sensor for night imaging and atmospheric calibration.

Landsat's - 4 and 5 are in rear polar sun synchronous orbits which create a sixteen day repeat cycle for each satellite. This means that the satellite covers the same ground track once every sixteen days, although the current satellites have been placed in out of phase orbits, meaning there is an eight day gap between their respective repeat cycles. This means that any ground area may be covered every seven days.

The TM and MSS sensors scan a 185 km wide geographical area directly beneath the satellites orbital path. Each swath overlaps the one from the adjacent orbit by a minimum of 7.3% at the equator, increasing to 84% at 80° N/S. The data received by the satellite is divided into scenes which are 185 x 189 km square, each scene being recorded during a 25.87 second increment of the satellites orbital motion.

A great deal of analysis of TM data quality has been carried out on both Landsat - 4 and 5 by Townshend and Harrison (1984), Benny (1984), Welch et al (1985), Tilton et al (1985), Desachy et al (1985), Fusco et al (1985), Metzler and Malila (1985), Murphy et al (1985), Malaretet et al (1985) and Malila (1985).

6.2 Satellite remote sensing data in the urban environment

Chapter 5 demonstrated the accuracy and benefits of using aerial photography in the assessment of specific urban land covers. One of the main problems with such surveys is that councils obtain coverage on an aperiodic basis only. In considering reclamation Bullard (1983), explains the philosophy behind this, 'The cost of monitoring may be a small percentage of the total cost of reclamation but like any 'service' they are only fully appreciated when they can show significant changes taking place in one or more of the conditions'. It is unlikely that the mentality of local authorities will be changed and therefore another source of monitoring data needs to be utilized. Satellite imagery is readily available and being multitemporal is suited to the needs of local authorities. The use of such data is well documented for agricultural and other land uses, however interest is increasing in using high spatial and spectral resolution systems, such as SPOT 1 and Landsat 5 TM in urban studies.

In investigations of abandoned coal mine features at Dugger, Indiana, Mausel et al (1981) used Principal Components Analysis (PCA) of single data Landsat data. The first two PC's and two rotations (each of 45°) of these were considered together with vegetation index (ratio) and soil index (ratio) images. Following a supervised classification of these sets in various combination it was found from scatterplots that the rotated PC 1 and two ratio data sets best differentiated between over five different abandoned mine features. Classification of various combinations of these data resulted in useful separations between cover classes and

suggested that band ratio and PC data effectively extended the amount of information that could be extracted from Landsat MSS data.

Urban monitoring studies by Forster (1982) revealed that broad land use classes could be determined with 80% accuracy. Difficulty was, however, encountered when the sub-division of broad urban classes was attempted, particularly with residential sub-classes. Forster suggested that the (then) new generation of remote sensing satellites, such as the TM and SPOT, would help to rectify these difficulties. This would be achieved by, respectively, increased spectral characteristics and better spatial resolution. The increase in these factors was then postulated to be useful in forward planning, by the prediction and monitoring of detailed urban land use classes.

With regard to intra-class discrimination. Witt et al (1983) found that canonical analysis led to the best results when mapping surface mining. The study of surface mines also concluded that using data reduction and signal extension techniques produced a wide classification discrepancy between MSS and TM data. Classification using the TM data were consistently 9% (85% vs 76%) better than those determined by using MSS data. In respect of the canonical analysis it was stated that data reduction methods such as these are more accurate and cost effective means of delineating subtle land cover categories.

Niedzuriedz (198x) discusses the use of remote sensing technology at local, country and regional planning levels. The most off-quoted reasons for the non-utilization of remote sensing techniques by planners were given as no need, budgetary constraints, lack of remote sensing education and skills among staff and no confidence in remote sensing techniques. The lack of remote sensing education came second in the list of responses and indicates that this factor may adversly predjudice the other stated reasons for non use of the technology.

A combination of aerial photography and satellite imagery are considered by Duggan (198x). The work focusses on the occasional use of aerial photography and its augmentation by satillite (MSS) data. Aerial photograph was used to determine cover classes in an urban environment and these were then simulated spectrally using ground based measurements. Similarities between these characteristics and those actually observed in the MSS data revealed sufficient similarity for the MSS to be used to determine gross urban cover classes on a periodic basis.

6.3 Digital images from satellites

A digital image is composed of ground or picture elements (pixels) which correspond in size on the image to the satellite sensors IFOV, e.g. each pixel in a TM image is 30 x 30m square. The radiation reflected from the ground to the satellite is separated into discrete wavelengths via a diffraction grating, each radiation component then being passed into a photomultiplier tube. The electrical pulse generated by this operation is proportional to the reflected radiation. The pulse passes into an analogue to digital converter thereby producing a digital signal which is numerically equivalent to the pulse voltage. In most satellite systems the number will be between 0 and 255 (256 levels), and each of the resultant pixels has eight binary digits (bits) which means they can exhibit a possible 256 grey shades. It is varying combinations of these grey shades that produce an image from the digital data. The digital data may be stored onboard the satellite in high density magnet media for later transmission to the ground when in range of a data receiving station, or may be

transmitted instantaneously via satellite tracking and data relay systems. The transmitted digital data are stored in various formats on computer compatible tape (CCT), along with header data which provides a record of the technical parameters (sun elevation, time of imaging) of image acquisition. The CCT is read onto a computer display system to enable analysis and interpretation of the data it holds.

6.4 Digital image processing systems

In order to extract the required information from an image, the DIPS facilitates the manipulation of digital data in a varied number of ways. One of the main elements of the system is a raster display for the image, used in combination width a host computer and image processing workstation and various peripheral equipment. In addition to the main computer several subsystems are used:-

A text character generator used to display instructions and information on a colour monitor.
A floppy disk drive card controlling the floppy disk unit and also interfacing that unit to the complete system. Standard 5.25 inch, soft sectored disk are used to store and input additional software. There was also a 400 megabyte 2 sided laser disk storage system, on temporary loan from an external company (Magstore of Kent), which allowed data to be accessed more rapidly.
A standard serial line interface (via Kermit). For communication with the University computer (Vax 8650), upon which large processing jobs are undertaken.
Three 0.5 Megabyte image planes (frame stores) each capable of storing a 1024 x 512 x 8 bit image. Each image plane is attached separately to the Red, Green, Blue inputs of a high resolution display monitor, providing 256 shades of each colour, combining to give a palette of 16.8 million colours.
The framestore on each image plane is configured as two pages of 512 x 512 pixels, 8 bits deep. This means 6 images or bands can be held in the framestore simultaneously, although only 3 bands can be displayed on the monitor at any one time.
A panchromatic video camera, whose output can be digitised via a frame grab module to provide a 512 x 512 x 8 bit image. A colour wheel enables images to be digitised via red, green and blue filters.
An integrex colourjet 132 ink-jet plotter, to provide hard copy of images displayed on the monitor.

The IBM DIPS is an inhouse system based around an IBM PC AT which can be controlled by commands from a keyboard and mouse drive. A suite of software for DIP has been written for the system and is used in combination with a variety of commercial subroutine packages.

It is possible to combine the bands from satellite imagery in a number of ways in order to enhance or hide certain features. If for example bands 1, 2 and 3 of TM data are used they will simulate the 'true colours' of an image when viewed from space, however, 'false colour' images may be generated if any of the infrared or thermal channels are used. These wavelengths are displayed through the colour monitor in wavelengths visible to the human eye and can considerably alter the appearance, interpretation and information conveyed by an image.

6.5 Imagery used

Cloud free, 30m resolution satellite imagery from Landsat 5 TM is used for the second classification stage of this study. The image was obtained on 26 April 1984, Path 205/Row 25. Only 6 channel data was requested. Band 6, the thermal channel, was not required for this study. The image was obtained form the National Remote Sensing Centre archive at Farnborough, UK.

6.6 Image processing

An unprocessed or 'raw' satellite image needs to be manipulated by various operations in order to be restored to a semblance of the original scene imaged by the satellite sensor. A variety of image processing techniques were performed on the STA channel data:-

6.6.1 Geometric correction

One of the major distortions produced in satellite images is panoramic, caused by the Earths' rotation during the period of satellite imaging and resulting in rotational distortion. The error is easily rectified by shifting each row (horizontal line) of pixels by an amount deduced from the Earths rotational velocity. The image used in this study was a whole Landsat 5 TM scene, however, the area of interest within this scene (167 x 167 pixels) is far smaller than the whole scene. For this reason an area smaller than that of the whole scene, yet still containing enough information to enable geometric correction, was determined.

An extract of 1789 x 1396 pixels was made from the scene and within this area, control points (the exact locations of easily recognizable landmarks), were determined. About forty control points give acceptable results for a whole scene, yet to obtain high levels of accuracy, twenty one control points were selected for the extract. The same points were identified on a combination of 1:50,000 and 1:60,000 scale topographic maps. Both the map co-ordinate, and corresponding GCP in row and column format were then entered into the computer (an I2S DIPS based at NERC, Swindon). A transformation was then run which warped the image onto the UTM map coordinate, an operation that would facilitate the later classification and comparison stages of data analysis.

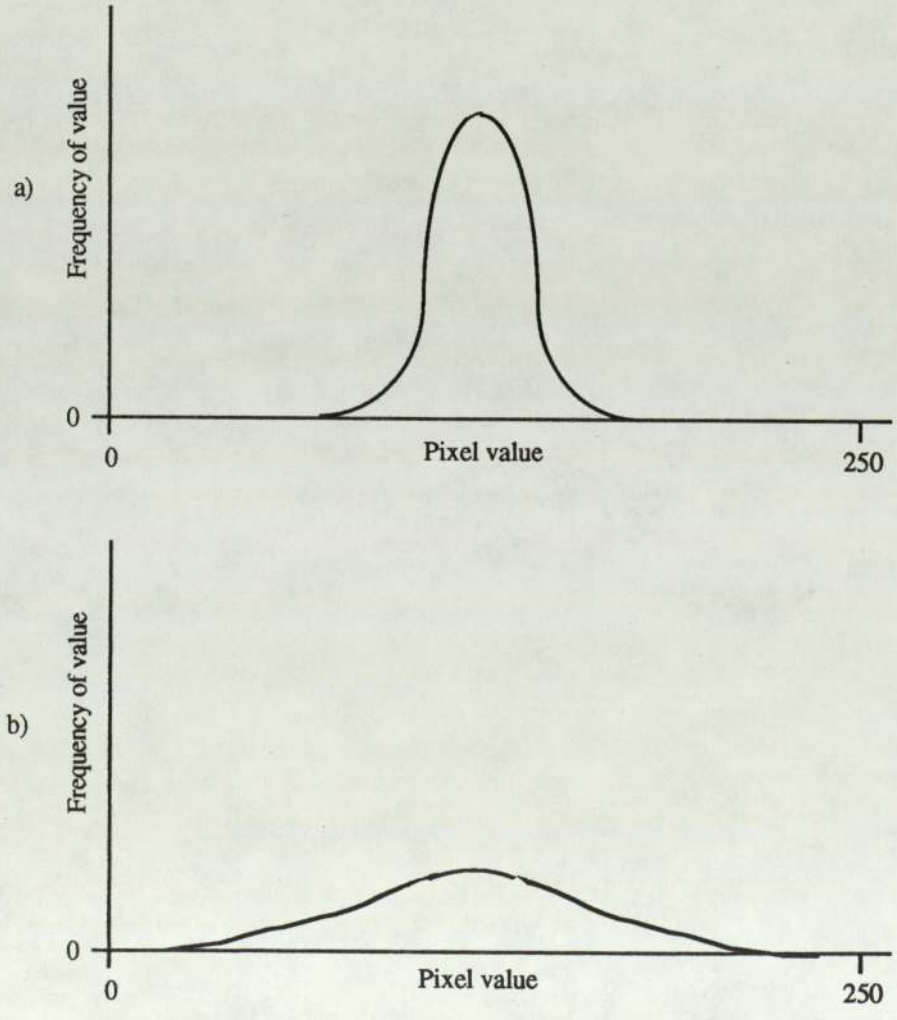
6.6.2 Image enhancement

Each band of the corrected image was read onto the IBM DIP from the floppy disk. A combination of these bands (1, 4 and 5) was used to define the extract of 167 x 167 pixels which relates to the area covered by OS 98 NW (see Plate 6.1). Histograms which revealed the spread of information in each band were then generated, and study of these revealed that bands 3, 4 and 5 exhibited the most variance, and a false colour composite was produced from this combination:- Red-4 Green-5 Blue-3.

6.6.3 Contrast stretching

In order to facilitate the location of suitable training areas for the later classification stage the image was contrast stretched. This technique, which is illustrated in Figure 6.1, improves the image contrast over the whole range of 256 grey scales and is best explained in terms of histogram changes. A histogram for a standard image, such as a) in Figure 6.1, will usually exhibit a normal distribution over a small range of the available digital numbers (DN). The contrast stretch effectively widens the range of DN's covered by image data so that darker pixels are found at the end of the scale, whilst the brightest pixels are at the 255 end. A range of contrast stretches are available on the IBM DIPS, however, it was felt that the autolinear stretch, which employs a linear transfer function, was successful. A more subtle stretch, the piecewise linear, using the sections listed below, did result in a slight improvement in the clarity of band 4 when compared with the autolinear stretch. The stretch works on each of the three separate images that constitute a colour image in an identical manner in the autolinear stretch, but uses different stretch parameters for each band for the piece-wise linear stretch. The results of the piece-wise linear stretch may be seen in Plate 6.2.

Figure 6.1. Contrast stretching of an image. Histogram a) displays a normal distribution, which is spread over a wider range when a contrast stretch is applied (b))



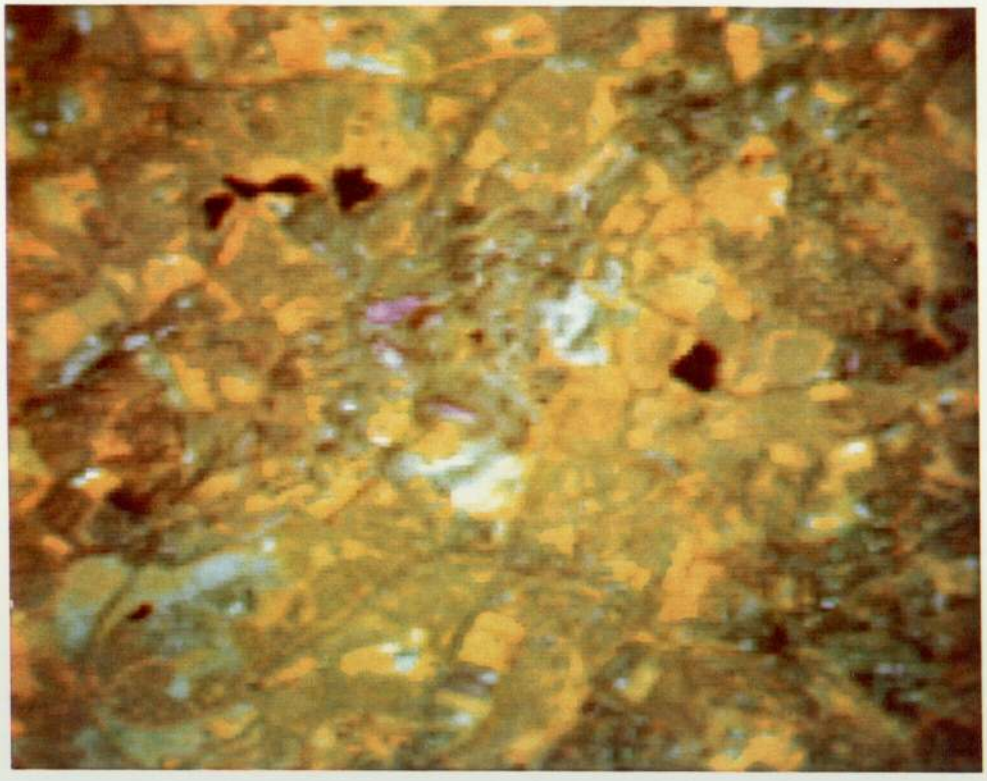


Plate 6.1 The Dudley study area

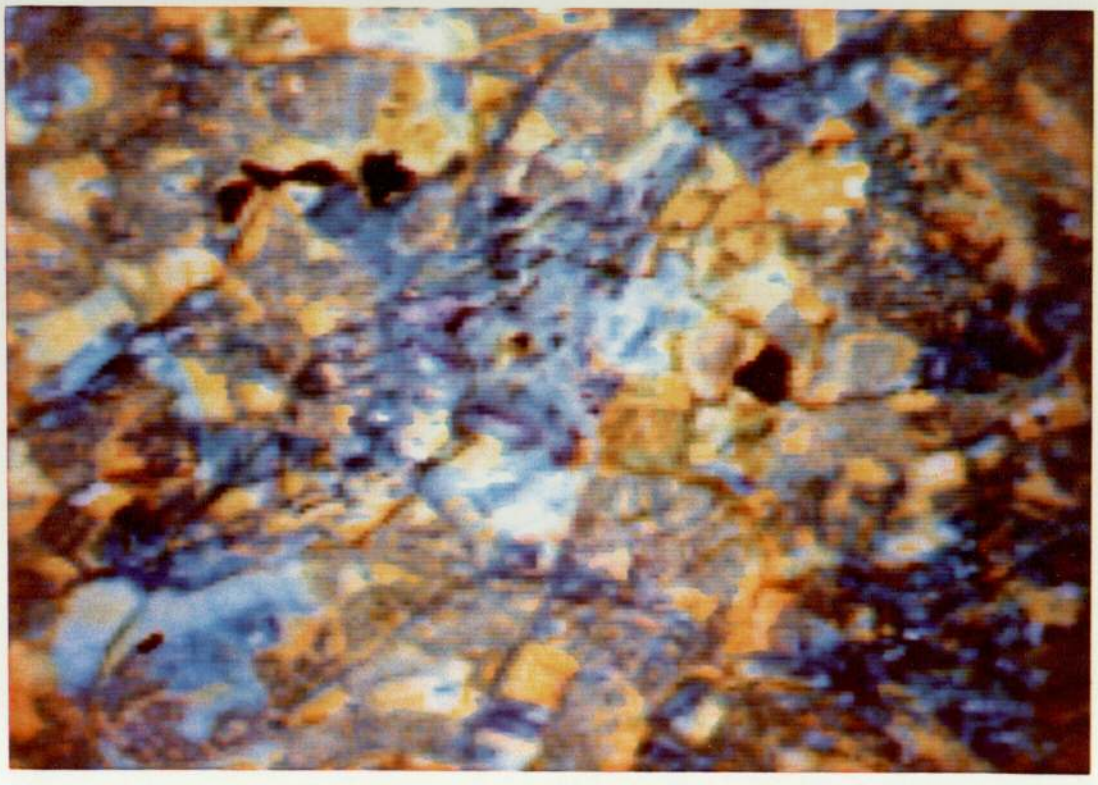


Plate 6.2 Piecewise linear stretch of bands 4, 5 and 3

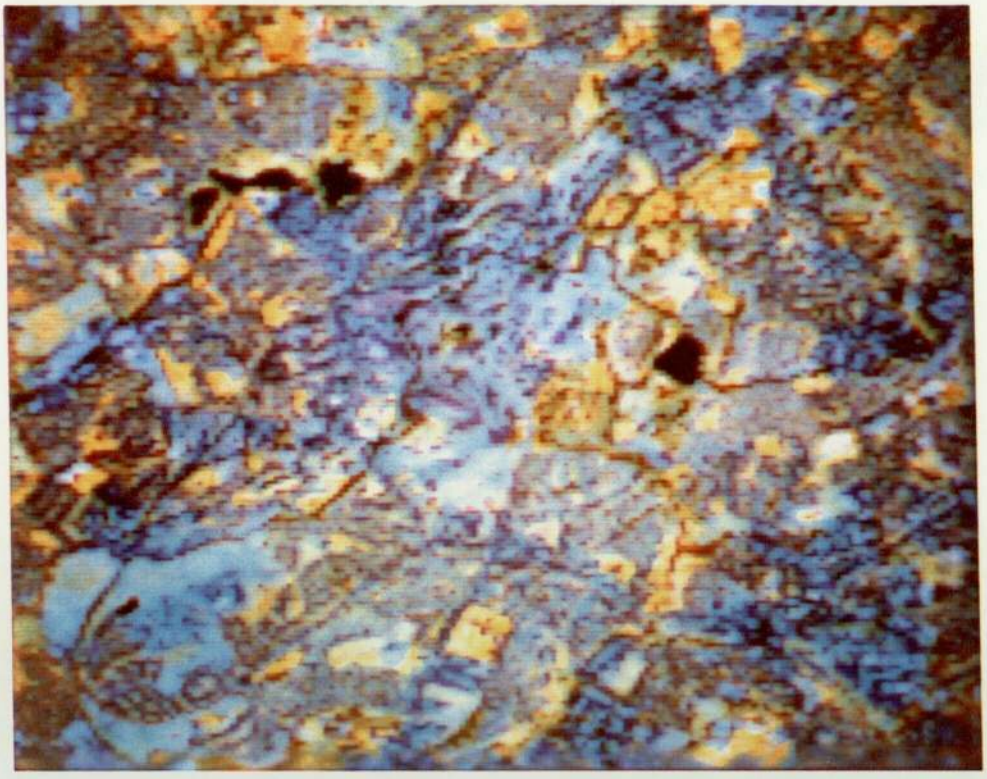


Plate 6.3 Edge enhancement of bands 4
and 5 of a Landsat band 4, 5 and 3 combination

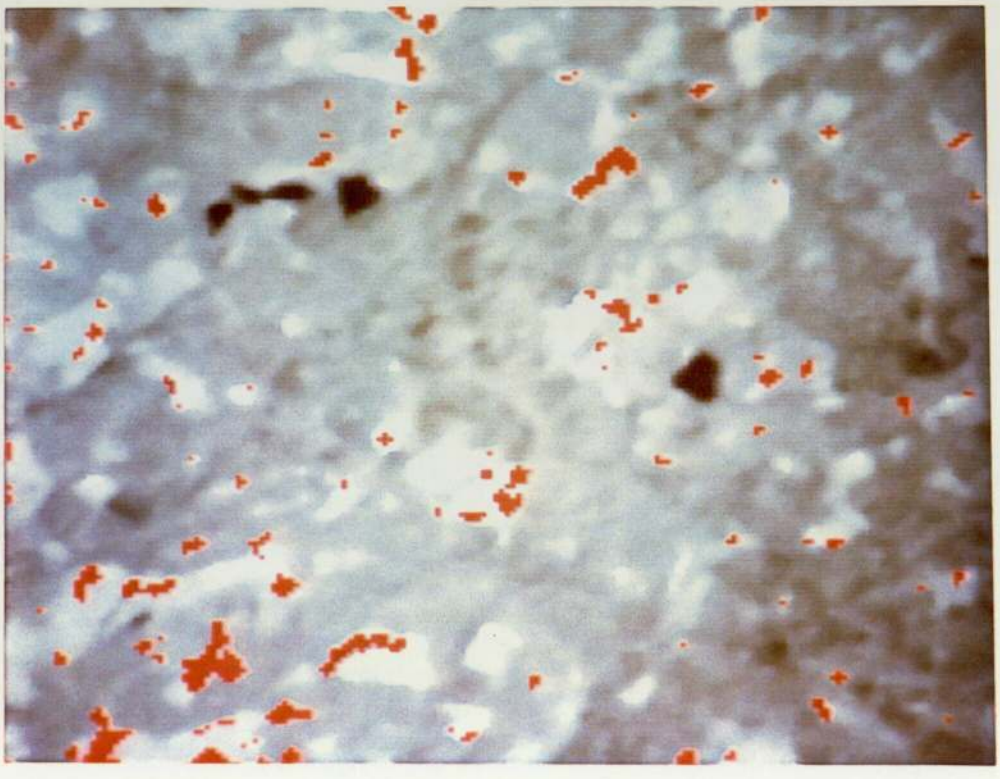


Plate 6.4 Minimum distance classification
of principal components 1, 2 and 3 (smoothed post-classifier)

6.6.4 Digital filtering

These operations may be performed collectively or on individual channels, their main purpose being the enhancement or suppression of various spatial frequencies within an image to alter its information content. Since the study area features a wide range of cover types, notably housing blocks and communication networks of a generally linear nature, a high pass filter was chosen. The filter has the effect of highlighting boundaries between grey shades on an image, a process which tends to accentuate linear features, making them more discernible to the eye.

A standard Laplacian filter was used in the first instance operating over a 3 x 3 pixel environment, however, use of this filter, even on one band, resulted in the production of artefacts, or clutter, within the image. For this reason a general convolution filter of the mask design shown in Figure 6.2 was created. Plate 6.3 shows the results of using this filter on band's 4 and 5 (red and green framestores), which appeared to carry the highest amounts of linear information.

Figure 6.2. Edge enhancement mask

0	-1	0
-1	5	-1
0	-1	0

Almost opposite to the edge-enhancement technique is that of smoothing, in which the boundaries between varying pixel values are decreased, resulting in an overall loss of definition in the image. This technique is very useful for post-classification operations, as it effectively removes random classification error from an image.

6.6.5 Principal components analysis

This technique is principally one of data reduction and uses multichannel images as its input data. The principal component (PC) algorithm produces new channels in which the data sets are uncorrelated, or in simple terms, do not contain any similar information. The processes maximises the important information and effectively removes any spectral data that are not required for easier visualization. If three channel data are used the mean and correlation of these data in feature space are calculated, the PC algorithm assesses how these data may be best uncorrelated and rotates the axes of the pixel values in feature space. The shifted areas then represent the PC's, with the first PC lying along the axis which exhibits the most variance, the second PC is perpendicular to the first and includes a lot of the remaining variance, and the third PC is at right angles to all these.

6.6.6 Image classification

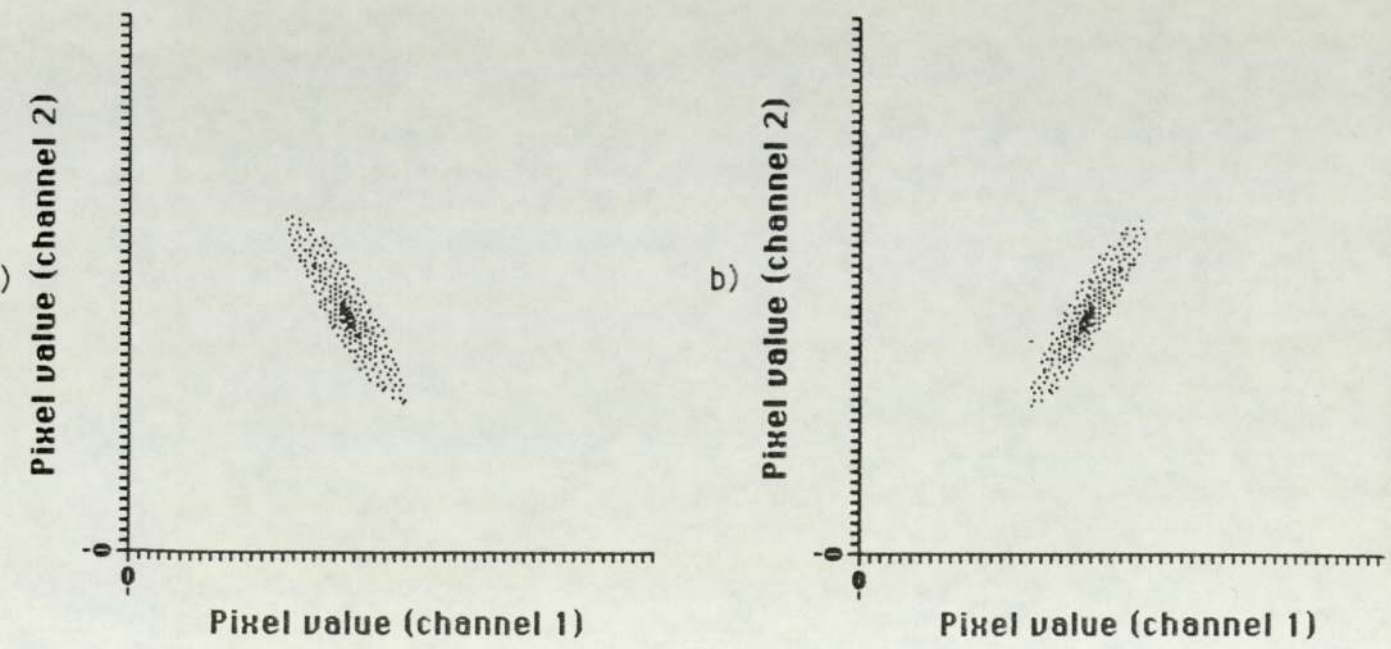
Image classification attempts to group certain areas with similar spectral properties into discrete areas within the whole image. This theory works on the premis that a certain type of ground cover will always exhibit the same values with regard to spectial reflectance, and that this value would alter between individual channels.

Unfortunately in practice such is not the case, and ground cover types exhibit a range of spectral values, even if imaged upon successive days. The cause of this variance may be attributed to a wide range of environmental factors, but what is evident is that land cover classes cannot be considered to exhibit unique spectral properties that will identify them time after time.

In effect the above means that when those values are placed in three dimensional feature space, they form a cluster. This is used as the basic means of classifying multichannel images. The classification process divides the feature space into areas based around the clusters of like values and partitions the feature space into discrete groups or classes.

The classification depends on the degree of correlation between multichannel image data. This is illustrated for two dimensional data in Figure 6.3. The channels in b) have similar pixel values and are therefore highly correlated, while those in a) are uncorrelated and display dissimilar pixel values in the feature space. In essence this means that for b) one of the channels does not contribute a substantial amount of information to the image and should be replaced by one of a lower correlation but a higher dissimilar information content. In order to facilitate the accurate classification of an image it is common to use training area data. These are areas defined from a homogenous section of a known class of ground cover, in the case of this analysis, derelict land sites identified from the aerial photographic survey were used. The areas are defined interactively on the DIPS screen using a mouse. By using this a priori information the DIPS can partition the feature space into known classes based on the user defined training classes. Using training data in this manner is termed supervised classification.

Figure 6.3. Correlation differences in two dimensional feature space

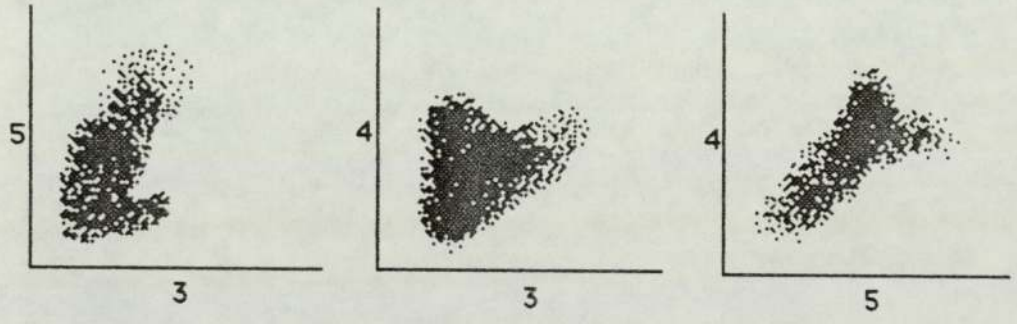


A number of classification algorithms are available on the IBM DIPS, however, it was felt that the minimum distance to mean method would provide the most accurate results. This classification algorithm determines the centre of each training data cluster and is one of the simplest methods available.

6.7 Results of the minimum distance classification

The scatterplots of the combinations of bands 4, 5 and 3 are revealed in Figure 6.4. Correlation between the bands is low, with perhaps the exception of a degree of similarity between bands 4 and 5. In the first instance only one training class was determined, that of neglected wasteland, however, upon running the classification programme this selection produced no meaningful results at all. Following this, several different combinations of class and training area were tried, again with very negative results. As a final attempt neglected wasteland and excavations and pits were combined as one cover class category and classified after defining training areas for that class. Once again this was largely unsuccessful, despite the fact that the three training areas corresponded to the major concentrations of derelict land derived from the aerial photograph classification.

Figure 6.4. Scatterplots of bands 3, 4 and 5



Since classification of the false colour image produced such poor results it was decided to concentrate on the PC image. The six band PC analysis performed on the data resulted in a good separation of information within the image. The eigenvectors and eigen values from the PCA are shown in Table 6.1. Only the first three PC's were used as they respectively contained 61%, 30% and 7% of the image information. The scatterplots of PC's 1, 2 and 3 are revealed in Figure 6.5 as an indication of the high degree of inter-band variation.

Figure 6.5. Scatterplots of principal components 1, 2 and 3

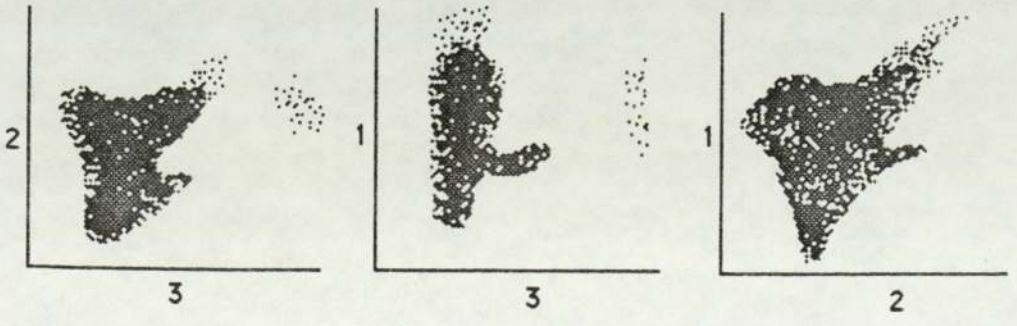


Table 6.1. Eigen values and eigen vectors generated by a six-band principal component analysis

Eigen Values

354.174	0.000	0.000	0.000	0.000	0.000
0.000	173.096	0.000	0.000	0.000	0.000
0.000	0.000	37.318	0.000	0.000	0.000
0.000	0.000	0.000	7.699	0.000	0.000
0.000	0.000	0.000	0.000	3.510	0.000
0.000	0.000	0.000	0.000	0.000	0.756

Eigen Vectors

0.2567	-0.3571	-0.3327	0.7883	0.2792	-0.0052
0.6963	-0.1061	-0.5220	-0.4779	-0.0493	0.0262
0.6395	0.4979	0.5337	0.2321	0.0289	-0.0601
0.1305	-0.4736	0.2371	0.0851	-0.7077	-0.4410
0.1077	-0.1942	0.2646	0.0271	-0.2475	0.8827
0.1080	-0.5500	0.4638	-0.2973	0.6002	-0.1486

Preliminary classification of the image using several cover types proved unsuccessful, however, when the final stage used for classification of the false colour image was used, limited success was obtained. The results of this classificaiton, which have undergone post-classification smoothing, are revealed in Plate 6.4. It is apparent that the classification was partly successful, although most of the classified area corresponds to training area data and should therefore be included anyway. A direct comparison of Plate 6.4 and Plate 5.2 shows that although the classification worked in some areas it completely disregarded large concentrations of derelict land and could not detect more subtle variations in derelict land distribution.

CHAPTER 7: CONCLUSION

From the results of the air-photo analysis presented in Chapter 5 it is evident that this method of derelict land survey is excellent for both occasional and multitemporal studies. Despite being proven as an operational system for this kind of work by others, local authorities and central governement continue to regard these methods with some scepticism. Very few local authorities use aerial photography for derelict land studies, or even obtain them for any planning purpose. It can only be suggested that thay are not aware of the advantages of using aerial photographs, or are perhaps unwilling to use them in the light of the skills that are required for their interpretation. However, with the emergence of country-wide database information systems, such as the Birmingham LAMIS database, an increased awareness of these kinds of data input may be realised. One of the major factors affecting the decisions not to use aerial photography is the cost of the initial aerial photography. It has been demonstrated (Gibson and Collins 1980) that aerial photography is significantly cheaper than using equivalent ground survey methods, but it still requires a considerable capital investment (£10,000 for the Birmingham City Council Area (Silson 1987)) in the initial stages. It is for this reason that attention was focussed towards the use of satellite data in the seond stage of derelict survey in this thesis.

Landsat MSS imagery has been used in the urban environment, but only with limited success. Wang (1984) notes that studies in the urban environment concentrate on those areas needing less resolution, such as boundary changes, and that few have realised the harder task of identifying urban land use categories.

The TM appears to have advantages over MSS data in terms of data quality that may figure significantly in urban area analysis. Anuta (1984) reveals that using the same clustering and merging sequencesfor classification, TM data exhibits 42 classes as opposed to 21 from MSS. Additional evidence of the increased dimensionality in TM opposed to MSS is recognised when Principal Component (PC) images are examined. Quattrochi (1982 and 1985) has recognised that using PC images in band ratio and photographic forms facilitates detailed examination of urban structures. Additional dimensionality over MSS and the ability of the third PC of 4 band data for detection/discrimination of built up areas/bare soil has been noted by Sadowski (1983).

Increased spatial and spectral resolution do not necessarily mean that this data provides an uncomplicated answer to urban monitoring problems. The nature of urban cover must be considered, Owe et al (1984) state that heterogenous urban features often cause classification error. The reflectance from mature trees, which are often higher than residential units, has been found by Baumann (1979) to influence classification accuracy. Other investigators, Bryant (1971) and Forster (1981 and 1982) have highlighted the problem in abrupt changes of urban land use over short distances, in the form of considerable inter and intra pixel differences, which seriously alter the reflection from one cover class that is surrounded by classes giving dissimilar readings. The difficulties associated with such conditions are summarised by Clark (1979), 'Physical or spectral conditions of a land use do not always divide as sharply as the cultural definitions of the land use.'

Boundary definition is very important in the urban area, however sharp contrasts are infrequently seen. Instead pixels lie along boundary lines and introduce cover mixing effects. Merickel et al (1984) consider that up to 60% of the pixels in some Landsat scenes are mixed, Owe et al (1984) says that with the TM,

more pixels per unit area do not lessen the chance of boundary features being crossed. A programme, 'CASCADE', introduced by Merickel et al (1984), specifically to combat the mixed pixel effect, assigns pixels to homogenous regions in a neighbourhood after judging that region responsible for the mixing effect.

A further influence on category discrimination, particularly in heterogenous regions, is the sensor Point Spread Function (PSF). Acting over a 3x3 pixel area, this seriously affects the signature from cover classes with dissimilar neighbours. According to Forshaw (1985) a better representation of resolution would be a deconvolved PSF rather than a pixel only estimate. Forshaw considers that as a term 'spatial resolution', is 'poorly defined and improperly used' and is artificially high in order to compensate for the rapid data sampling rates of modern satellite systems. The views on the increased spatial resolution of sensors are as mixed as those on the improved spectral range. Irons (1984) suggests that a 'stalemate' is evident, where increasing resolution does not affect accuracy because; a) category spectral variability increase hinders classification; and b) a decrease in mixed pixels (by up to 24%) enhances classification. A 'Point of diminishing return is reached and 30m IFOV should be the best for multispectral classification' is the stated view of Clark (1979) in an analysis of multi resolution TM Simulation data in an urban environment. Forshaw (1983) considers that 'resolutions rather better than 10m will be necessary for consistently high recognition accuracies', and Jackson et al (1984), in recognition of the dense nature of English development states 20m as a minimum resolution requirement. Forster's (1982) theory is that TM should be used to determine surface types, while SPOT panchromatic data, 10m resolution, could provide high resolution cartographic and contextual information. Clark also recognised that as resolution decreased, classification accuracy actually increased, probably due to the heterogenous nature of urban sites being 'smoothed' out.

To summarize Forster (1982), higher resolutions will, in urban areas;

1.Reduce mixed pixels
2.Aid contextual identification
3.Aid in registration
4.Reduce the PSF effect
5.Higher data redundancy will allow more accurate judgement of surface percentages
6.Higher pixel homogenity will aid in clustering procedures
7.Texture studies may be implemented

The increase in information content of TM data has proved problematic, not least in terms of data handling, but also regarding classification techniques. PC and canonical analysis have been used as data reduction and feature extraction techniques by a number of workers, Brumfield (1981), Jackson (1984) and Sadawski (1983), non traditional methods such as canonical analysis can result in up to 20% improvement in classification accuracy. The need for new classification algorithms for TM imagery has been recognised by Irons (1984), and classification schemes currently being developed at the Natural Environment Research Council by Jackson et al (1984) exploit per-pixel, textural and contextual algorithms. Such techniques need careful development as Wang (1984) considers that the 'Averaging process smooths out a certain amount of the data's unique qualities', while Forshaw (1985) implies that resampling may limit resolution to 2 times the pixel

size. It is evident that although significant classification accuracy can be obtained with TM data, better results can be expected and a hiatus exists with current methods unable to realise the full potential of TM data.

Although cartographic fidelity does not appear to be a problem with TM data (Welch et al 1984), data transformation does alter pixel values, damaging their essential qualities. Yet the geometric correction performed on the study area was necessary in order to accurately determine training areas for the classification and to allow visual comparison for the aerial photographs and satellite classifications.

Much of the work being done on TM imagery and urban environments originated from the USA, which features a different urban make-up to the UK. Jackson et al (1984) define the problem with a statement on the quality of the first TM images, 'in rural areas, there is a very significant improvement over the MSS, whereas in urban areas the improvement is much less marked, probably as a result of the high density of English urban development.'

It is probable that this is the largest single factor affecting the accuracy of this study. It was revealed in the previous chapter that satellite data have been used in the US to good effect in some cases. The nature of the urban environment is, however, very different, usually based on a grid system of blocks of houses and roads. This square arrangement of ground cover does seem to have been an important factor in the overall success of satellite data in these areas.

It is evident from the discussions above that workers in this urban area (Clark 1979, Jackson et al 1984 and Forshaw1983) disagree as to which resolution constitutes an optimum for satellite data. Further discussions focus on the spectral sensitivity of satellite sensors and their influence on category discrimination. With these factors in mind the future implications for satellite remote sensing within urban areas are discussed below.

Perhaps the most significant recent advance in satellite remote sensing is the launch of the SPOT (full) system. The satellite, SPOT-1, was placed in orbit on 22 February 1986 at 01.44.35 a.m. by the Ariane-1 launcher. Spatial resolutions of 10 m and 20 m respectively in one panchromatic and three multispectral modes, allied with a revisit capability that can provide stereoscopic imagery and which will allow an area to be imaged every five days, provide SPOT-1 with unique imaging capabilities. The current SPOT programme has been defined into the 1990's. SPOT-1 and its successor SPOT-2 have two-year design lives and are essentially the same, although the High Resolution Visible scanners on SPOT-2 will have Thompson-CSF linear arrays instead of the current Fairchild CCD. The French government gave the go-ahead for the continuation of the SPOT programme in 1985. SPOT-3 is expected to have a four-year life and should replace SPOT-2 towards the end of 1990. SPOT-4 will be available for launch in 1991 as a back-up to SPOT-3; however, launch will be in 1994 if no problems occur with SPOT-3. The sensors on these latter-generation series will be modifications and improvements of the former payload. A 20 m mid-infrared vegetation channel (1.5 μm-1.7 μm) will be introduced, thus providing four MS bands. The second MS band will relay both 10 m panchromctic and 20 m MS data, which will considerably aid geometric registration between the different channels.

The increased resolution of this system, allied with a greater range of spectral bands in SPOT 3 and 4 may aid urban discrimation. Similarly, the ETM and HRPI proposed for Landsat M could be useful additions to sensor capability.

Although some of the early results with SPOT data have proved satisfactory, it may not be an ideal system for urban monitoring, especially in dense urban areas. The major reason for this is its relatively restricted range of spectral bands. In this respect the TM is superior, and it may be that Landsat-6 with its 15m panchromatic channel and seven spectral bands will produce better results. The optimum system would probably be as TM sensor with 10-20 in resolution multispectral channels as well as a 10-20m panchromatic band.

One further problem is the status of satellite remote sensing; it is now considered to be operational with two companies, EOSAT and SPOT Image, operating commercial system. Realistically, however, the system is only operational in a small category of application areas, notably geology and large area inventory. Most of the studies of satellite remote sensing are still performed as unique research projects, which often tend to promote very advanced uses of satellites imagery at the expense of operational and cost effective methods. Until this approach has been modified and adapted for higher precision systems the use of satellite remote sensing for studying discrete cover classes in urban environments remains, at best, limited.

APPENDIX 1

Classification schemes for derelict land

A. Classification model (Beaver, 1946).

First digit: relief of surface

1 more or less level
2 gently sloping (i.e. gradient not more than 1 in 20)
3 steeply sloping (i.e. gradient over 1 in 20)
4 level, but pot-holed by subsidence
5 irregular mounds and hollows (old spoilbands) - amplitude under 10 feet
6 as 5 amplitude over 20 feet
7 large spoilbands, projecting from level surface - conical
8 as 7 - other shapes
9 marl holes, quarries

Second digit: relation to water

1 permanently waterlogged
2 liable to floods
3 with waterlogged hollows
4 generally free from surface water

Third digit: vegetation

1 bare: little or no vegetation
2 mainly weeds
3 weeds with sufficient grass to provide a scanty grazing
4 grass, weeds and bramble, or other small bushes
5 mainly bushes
6 trees

Fourth digit: compositon of the surface

1 shale
2 burnt shale
3 shale mixed with stones and other debris
4 stones or quarry waste
5 blast furnace or other slag
6 rubble, bricks, concrete, etc.
7 chemical waste
8 ashes, cinders
9 town's refuse or other domestic refuse

N.B. if the 3rd digit is 3, 4, 5 or 6, a soil is almost certain to exist.

B. Classification model (Collins and Bush, 1969).

I Topography

The form of ground is a very important factor in the classification of land, and it was decided to divide the derelict land into four major categories:

A dereliction above the natural ground level - 'heaps';
B dereliction below the natural ground level - 'holes';
C dereliction at ground level;
D installations.

The inclusion of D is justified in that a category is provided for those derelict items that may be considered as being either above ground level or at ground level, namely the installations associated with the industry or other activity leading to the dereliction. As their immediate landscape expression divorces them from actual ground level, they contribute to the topography of an area, while at the same time, they cannot readily be included in the 'heaps' category.

II Associated activity - general

The second order of the classification refers to the 'extractive or other industrial processes' that contribute to the dereliction.

1 mineral working
2 refuse
3 industrial workings
4 transportation
5 other activities

III Associated activity - specific

This third order of the classification describes in greater detail the activity associated with the dereliction.

1 i coal
1 ii brick clay
1 iii lead
1 iv ironstone
1 v limestone
1 vi chalk
1 vii sand and gravel
1 viii china clay
1 ix tin
1 x slate
1 xi others

2 i household waste
2 ii scrap
2 iii cars

2 iv others

3 i brick works
3 ii chemical works
3 iii gas works
3 iv iron and steel works
3 v power stations
3 vi sewage works
3 vii others

4 i airfields
4 ii canals
4 iii railways
4 iv roads
4 v others

5 i others

This section has been prepared so that other categories can be readily added without disturbing the overall form of the classification. The 'other' categories can either be used in the original general form (i.e. as 'others'), or they can be translated into other separate categories, with the 'other' category taking a new lower placing in the list.

IV Pictorial description

The terms used in this fourth order are selected so that a more pictorial idea of the derelict site can be envisaged:

a tip
b dump
c dry pit
d wet pit
e cleared land, but still 'spoiled' or 'degraded'
f degraded land associated with the site
g degraded land peripheral to the site
h open cast workings not yet 'pits'
j sludge

A tip differs from a dump in that while the former consists of waste material, the latter consists of material being stored awaiting transport. 'h' differs from 'c' since it describes land from which the top soil has been removed, but which has not yet been subjected to intensive excavations - the pit has not yet been formed. Categories 'e', 'f' and 'g' might at first appear difficult to distinguish, but in fact are easily differentiated. 'g' has not necessarily been ruined, but has an unkempt appearance due to the proximity of a major derelict site; 'e'and 'f' are both located within the area of a derelict site (the region between a colliery and a nearby tip, for

example), but 'e' has evidence of some form of improvement (perhaps in the form of the partial removal of a tip).

C. Classification model (Department of the Environment, 1974).

The DoE uses the following definition of derelict land, viz, "land so damaged by industrial or other development that it is incapable of beneficial use without treatment".

The DoE Guidance Notes indicate that this should include:

i) disused spoil heaps;

ii) worked out excavations not subject to effective arrangements for restoration;

iii) abandoned military installations;

iv) abandoned railway land;

v) abandoned industrial installations, disused gas works, power stations, docks etc;

vi) land affected or likely to be affected by surface collapse resulting from disused underground mining operations (excluding coal).

The DoE definition specifically excludes:

i) land which is derelict through neglect or from natural factors, such as neglected farm land, marshes, sand dunes etc;

ii) damaged land subject to effective restoration arrangements;

iii) land in active use, even though there may be no provision for its restoration;

iv) damaged land which has become part of the natural environment, e.g. through re-vegetation;

v) infilling sites awaiting development, and sites cleared as part of an urban renewal scheme; abandoned buildings awaiting demolition as part of a redevelopment scheme.

D. i) Classification model (West Midlands County Council, 1980)

The definition used in the WMC surveys of Derelict and Waste Land includes "any land without a beneficial use".

The broad categories included in this definition are:

i) spoil heaps;

ii) excavation and pits;

iii) military dereliction;

iv) disused railway land;

v) disused sewage works/installations;

vi) disused canals;

vii) neglected waste land, including

a) land cleared of buildings;

b) naturally derelict land;

c) other disturbed land;

viii) disused gas works and power stations;

ix) other types of dereliction.

D. ii) West Midlands Derelict Land Classification Sub-divisions

1. Site number sites numbered consecutively per map

2. Geo-code 8 figure grid reference; road name or local feature

3. Area acre and hectares

4. Type of dereliction
   a Spoil heaps (Section 8)
   b Excavations and pits

c Military and other service dereliction
d Disused rail land
e Disused sewage works and installations
f Disused waterways land
g Neglected waste land
h Other

5. Tipping Y - Yes; N - No

6. Area of demolition Y - Yes; N - No

7. Used or disused U - site in use; D - site in disuse

8. Wet or dry W - water present on site
(excluding stream, drain river D - water not present on site
or canal)

9. Buildings on site Y - Yes; N - No

10. Vegetation type and cover Extent of cover
a - 0-10%; b - 10%-50%; c - 50%-100%
Dominant vegetation type
t - trees; s - shrubs; g - grass

11. Surrounding land use I - industrial; R - residential; O - Other Multiple use given where necessary

12. Geology
3 clay, shale and marl
4 coal
6 igneous rock
8 limestone
9 sand and gravel
10 sandstone

13. Access points
Number of access points over 4m in width (Holes only)

Waste land in wholly rural areas is excluded. Additionally, the 1974 survey produced data on active sites, i.e. mineral excavations and tipping sites, so to ensure comparability between surveys carried out at 1974 and 1980, the definition is extended to include these categories.

APPENDIX 2

Rolling Programme Strategy Objectives

The prime objective of the Strategy is:

To aid the regeneration of the inner parts of the Black Country, by the eliminations and re-utilisation of the area's derelict land.

This objective accords with the aim of a variety of programmes instituted by the four Black Country Metropolitan Borough Councils and by the West Midlands County Council. These include Structure and Local Plans, infrastructural proposals, economic development, environmental improvements, educational and social programmes. The objective is also in accordance with the Government's policy on Inner Cities, which has resulted in the designation of Wolverhampton and Sandwell as Programme Area Authorities and Walsall as a Designated District.

In achieving the primary objective, the Strategy will also aim to achieve the following supporting objectives:

To apply the maximum possible level of resources to solving the Derelict Land problem within a 10 year period and to adopt working procedures that will ensure the most effective use of those resources.

The four authorities believe that a level of resources capable of treating the overall problem within the next 10 years should be allocated to the area by the Department of the Environment. These should be allocated on a Black Country basis, and administered by the four authorities through a joint programme. The scale and continuity of such a programme dictates that Derelict Land Grant should be allocated on the basis of a rolling programme, and not on the present annual basis.

To provide adequate stocks of good quality residential land.

The Department of the Environment's Circular 15/84 (Residential Land Availability) stresses the need for Local Authorities to ensure a minimum of 5 years' supply of residential land in their area. Of the four authorities, Sandwell and Walsall are dependent upon derelict land to help provide the requisite 5 year supply, whilst Dudley and Wolverhampton will look to this source for their requirements beyond this timescale. The Strategy therefore aims to bring forward adequate residential land to maintain an appropriate land supply, within each local authority area. In so doing, the strategy will aid regeneration by providing a stock of new dwellings on those sites most accessible to job opportunities, and will be reducing pressure on surrounding areas of Green Belt.

To provide a balanced portfolio of Commercial and Industrial sites, to enable economic regeneration to take place.

The Black Country has suffered major economic decline of a structural nature during the past 5 years. A report by Colin Buchanan & Partners and the Economists Advisory Group considered that this decline could only be reserved by a co-ordinated package of measures, to develop and to attract new industries. The provision of readily available, serviced, attractive sites is a key element in this process, and derelict land reclamation must be directed towards providing these sites. Whilst it is recognised that the emphasis of the Draft Circular is towards provision of housing sites, and that demand for industrial land remains low, the four authorities consider that the Strategy must contain a commitment towards industrial end uses. This will facilitate a more balanced regeneration of the area, by reducing the development costs of potential employment locations, many of which are well located with reference to the national transport network.

To improve the general environment of the Black Country.

The improvement of the environment is important in regenerating both the economic and social life of the area. It improves the physical appearance and the "image" of the area, thus helping attract new industry, and it also improves living conditions, which have long been poor, as a result of the intermix of housing and heavy industry, and a lack of open space. Environmental improvement needs to be developed in two ways within the area:

i) Large sites should be reclaimed where ther is a shortage of open space, where they complement reclamation for other end uses, or where a large, otherwise undevelopable area is blighting the general environment. Such schemes will need to be incorporated into the programme as specific shcemes, normally undertaken by the public sector, and at a lower average cost than hard end use schemes. These sites will provide a visual improvement and enhance the area as one in which to live and work.

ii) There is considerable scope for programmes of minor environmental improvements, to complement other schemes, such as industrial promotion. The Black Country Facelift and small clearance site programmes are examples of these, where individual sites are insufficiently large to be specified in the strategy, and are included under a broad "minor schemes" heading.

APPENDIX 3

Rolling Programmes

A number of local authorities and the Associations have argued that the year by year allocation of DLG resources inhibits the sensible forward planning of reclamation. The Secretary of State accepts that longer term reclamation programmes are sensible in a limited number of cases. Most schemes will continue to be approved on an annual basis. Once approved, funding for that scheme will continue, if necessary beyond the financial year, until the approved work is completed. However, in areas of extensive dereliction the Department is prepared to consider rolling programmes in selected areas whereby groups of schemes will be agreed up to three years ahead. Although no absolute guarnatee can be given as to the provision of resources in future years a rolling programme will provide greater continuity and enable authorities to tackle the area as a whole.

Those authorities seeking rolling programmes will be expected to prepare, in consultation with the Department's Regional Office, a detailed reclamation plan for the area to be treated. This should include a committment as to after-uses and land tenure and a timetable for the various schemes within the rolling programme. If variations in later years are necessary they should be agreed with the Department. Resources will be allocated to later schemes provided that the Department is satisfied with the performance of the programme to date. With this proviso, advance scheme approval will be given to those projects in the plan scheduled to start within three years and the programme can be rolled forward annually.

To avoid unnecessary land-banking, grant for land acquisition will be considered only on an undertaking by the local authority that the grant will be repaid if a scheme, in accordance with the approved reclamation plan, is not submitted within the three year period of the programme.

In order to preserve flexibility within the derelict land programme as a whole a regional office will be able to allocate up to a maximum of 50 percent of its resources in any one year to rolling programmes.

APPENDIX 4

Derelict land register sheet

Map No. SO 98 NW	Dudley 1980									
Site No.	Geo.Code	Area (hectares)	Class	Tipping	Demln. Area	Used-Disused	Wet-Dry	Bldgs on Site	Veg Type & Cover	Surrounding Land Use
23	941 894	0.5866	g	N	N	D	D	N	a/t	10
24	941 895	1.3561	b	Y	N	D	D	Y	a/t	10
25	943 895	0.7114	g	N	Y	D	D	N	c/g	1
26	944 896	0.7692	g	N	N	D	D	N	b/s	10
27	944 895	08708	g	N	N	D	D	N	c/g	0
28	944 894	0.3592	g	N	N	D	D	N	b/t	R
29	945 896	0.5330	g	N	N	D	D	N	b/s	10
30	946 896	0.9459	g	N	Y	D	D	N	a/s	10
31	946 898	0.5133	g	N	N	D	D	N	c/g	10
32	949 889	0.8781	g	N	N	D	D	N	a/s	R
33	947 891	0.9368	g	N	N	U	D	Y	b/t	R

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