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Information Paper

# Mesh Blocks

## Australia

## 2003

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## PREFACE

Geographically referenced or 'small area' statistics are increasingly important to informed decision making in Australia. The private sector and all levels of government recognise that there are similarities and differences between and within regions and often need to understand that diversity. Geographic Information Systems (GIS) have greatly improved our ability to analyse and understand this rich spatial diversity. GIS have also created considerable pressure for more and different data and for data at levels of spatial disaggregation which a few years ago would have been unmanageable.

There is no doubt that incompatible geographical units have hindered the exploitation of some otherwise very rich sources of geographically referenced statistics. The problem has been compounded by the expense and difficulty of coding address based location information to standard geographical units. The development by Public Sector Mapping Agencies (PSMA) Australia Ltd. of the Geocoded National Address File (G-NAF) has provided a unique opportunity to alleviate these problems.

This paper proposes a new approach to statistical geography which, if successful, will put geographically referenced statistics on a whole new footing in Australia. That success will require much good will and cooperation between the statistical and spatial communities. I am pleased to say the foundations of that cooperation are already in place.

The proposals in this paper are largely the recommendations of a Panel of Experts convened from within and outside of the Australian Bureau of Statistics (ABS). I wish to thank the members of that committee who have given so generously of their time and contributed so much to the development of the Mesh Block concept.

Comments on this initiative are invited from interested parties. Responses should reach ABS prior to 30 June 2004.

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## ABBREVIATIONS

| | |
|---|---|
| **ABS** | Australian Bureau of Statistics |
| **ASGC** | Australian Standard Geographical Classification |
| **CD** | Collection District |
| **DCDB** | Digital Cadastral Data Base |
| **G-NAF** | Geocoded National Address File |
| **GIS** | geographic information system |
| **LGA** | local government area |
| **MAUP** | Modifiable Areal Unit Problem |
| **PSMA** | Public Sector Mapping Agencies |

# CHAPTER 1 INTRODUCTION

## INTRODUCTION

Geographically classified statistics are statistics with a 'where' dimension. Such statistics are often referred to as 'small area statistics'. In particular the Census of Population and Housing is designed to collect data for small areas and small groups within the population but many other statistics are also collected and published for small areas.

The basic concept of geographically referenced statistics is that data are aggregated for the area in which an activity takes place. When data are aggregated to areas the size, shape and location of those areas greatly influence the usefulness of the statistics. If data are to be compared across collections, across subject matter and across organisations then the areas themselves must be comparable.

Since the early 1980s the ABS has used a common standard for geographical areas across all ABS data collections — the Australian Standard Geographical Classification (ASGC). The ASGC has also been adopted by other organisations for collection and analysis of geographically referenced statistics while many organizations make use of a variety of largely incomparable geographical areas.

In an ideal world all statistics would be aggregated to the same geographical classification and would be readily available at all levels of disaggregation within that classification. This has not happened in Australia because:

- organisations at all levels of government and the private sector have very disparate requirements of unit size, shape and location
- of the difficulty and expense of coding data to ASGC units, particularly the smaller or base units
- of the lack of integration between statistical and administrative geography.

The ABS has in recent years come to the conclusion that the ASGC will never be able to cope with all the disparate needs of its potential users and that what is required is a more flexible approach to statistical geography.

This paper proposes the development of a new micro level geographical unit, the Mesh Block, which it is hoped will become the basic building block of all statistical, political and administrative geography in Australia. While in practice confidentiality will place some limits on flexibility conceptually all statistical data could be collected at the Mesh Block level and then aggregated and disseminated on whatever combination of Mesh Blocks best suited the individual user or individual analysis.

Other developed countries such as the United States of America, Canada, the United Kingdom and New Zealand all make use of micro level units similar to those proposed here. Advances over the last decade in GIS technology and digital topographical data have now made the Mesh Block concept achievable for Australia. In particular the launch on 2 March 2004 of PSMA Australia's G-NAF has enabled both the development of micro level units and the coding of address information to those units.

## INTRODUCTION *continued*

The critical success factor for Mesh Blocks is the extent to which they are embraced not only by users of statistics but also by those responsible for administrative and operational boundaries within their own organisations. While Mesh Blocks will inevitably require some compromises and will not be perfect for all applications, it is important that the design criteria do not include any features which would make them unworkable for a substantial number of potential users. The views of statistical users and stakeholders in geography in general are therefore very important to the successful design and implementation of Mesh Blocks.

## RESPONSES TO THIS PAPER

Comments on the Mesh Block initiative, including the proposed design criteria and ideal size for Mesh Blocks, are welcome and are invited from all interested parties. Responses should be sent to reach the ABS prior to 30 June 2004.

Please address replies to:

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Based on the results of this consultation, the ABS may add or remove criteria or change the relative priority given to some criteria over others. The ABS will also consider the preference of the majority of respondents when considering the most desirable balance between Mesh Block size and publishable data. The automated creation of Mesh Block boundaries will proceed during late 2004 and early 2005.

# CHAPTER 2 AIMS OF THIS PAPER

## AIMS OF THIS PAPER

This paper sets out in some detail the recommendations of a Panel of Experts which was convened over a six-month period to consider the ideal features of a Mesh Block. Panel members were selected from both within the ABS, from other government agencies and from academia. The members are listed in the Appendix.

The aims of the paper are to:

- explain the problem that Mesh Blocks are designed to solve
- describe the criteria developed by the Panel
- seek views on the proposed criteria and other features of Mesh Blocks.

Geographical boundaries can be a very emotive issue and it is very likely that a boundary drawn anywhere or around anything will invoke some degree of dissent. In this case the ABS is not asking for opinions on a particular boundary or boundaries. Mesh Block boundaries have not yet been drawn. Stakeholders are instead being asked to comment on a set of criteria for the creation of Mesh Blocks in the hope that, if consensus can be reached on these, then boundaries drawn to them will be acceptable for most applications.

The specific items on which the ABS seeks views are:

1. the topographic features and administrative boundaries included in the criteria

2. their relative weighting

3. the balance between minimum Mesh Block size and data to be published

4. the demand for flexibility in output geography and customized output areas

5. the acceptability or otherwise of data randomization or perturbation at all levels of geography to facilitate that flexibility.

This paper proposes a fundamental change in statistical geography with the creation of up to 200,000 spatial units. It would not be feasible to consult widely on each and every one of those boundaries. However the ABS appreciates how difficult it is to effectively evaluate a theoretic set of criteria, so some sample Mesh Blocks have been developed over a small part of Brisbane and a section of rural Victoria. These will be available for download from the ABS web site for those who have a GIS available and wish to see what the criteria would produce in practice. It is also anticipated that Mesh Blocks will be built in time to be validated by a small group of key stakeholders in late 2005 and still be ready for the 2006 Census of Population and Housing.

# CHAPTER 3 THE PROBLEM

## THE PROBLEM

Geographically referenced statistics are important to many aspects of policy development, service delivery and decision making in general across all levels of government and the private sector. The increasing use of GIS has enabled the storage, manipulation and analysis of geographical statistics and encouraged the integration of data from often disparate sources.

The basic concept of geographically referenced statistics is that data are aggregated for the geographic area in which the activity takes place. In the case of population statistics the area may equate to where a person is located on Census night or where they usually live or work.

Apart from the need for information about the geographical areas themselves, there are a number of advantages in using geographic areas for the collection and collation of statistics. For example, once suitable geographical units have been established, the statistical collection process can be systematically managed. Summary statistics for geographical areas are also much more efficient to store than data for individuals or 'unit records'. The result is that many organisations are using geographic areas as a base for collating and analysing statistics. For example, many organisations collate or aggregate customer data by the post code of the customer's address in the, sometimes mistaken, assumption that the post code indicates the geographical region in which the person lives.

The different geographic areas being used for aggregation of data are often defined without reference to any other geographical unit or system of units. Most organisations will adopt geographical units of a size which suits their analytical needs. For example a national organisation might divide Australia into only 50 or 60 regions while a local authority might define 60 regions over just their own small area of interest. Once aggregated to the large units the national organisation's data cannot be disaggregated into the local authorities small units.

Even when organisations adopt units of a similar size they will invariably have a different shape or location to those of another organisation. As a result data cannot be readily integrated and exchanged between organisations. This greatly limits the potential uses for the statistics.

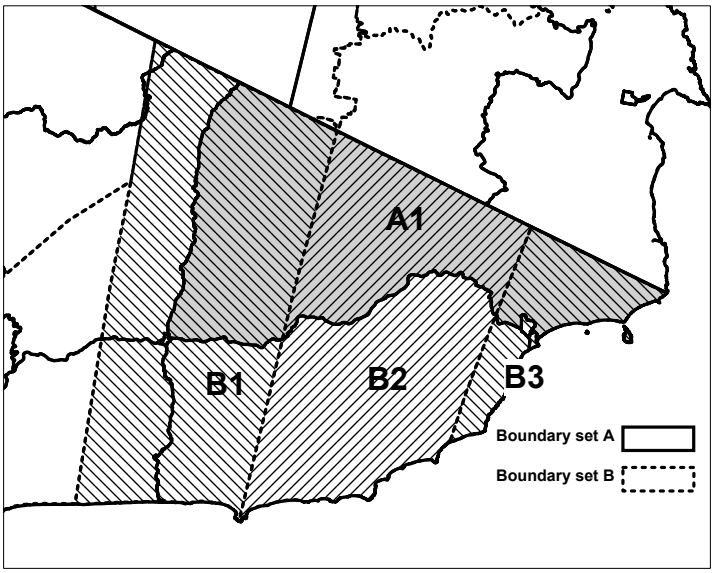
The problem is compounded by the fact that geographical regions are often defined for purposes which, at the time, appear to be totally unrelated to statistics and by organisations which themselves have no need for statistics. Yet it is surprising how often demand for statistics for these areas will eventually arise.

## AN EXAMPLE SITUATION

Figure 1 illustrates the problem where two organisations have referenced statistics to two independently established sets of geographical areas.

AN EXAMPLE SITUATION *continued*

1 INCOMPARABLE AREAS




In this example planners have acquired census data detailing the population characteristics for boundary set A. They are interested in planning a new healthcare facility. To determine the best location for this facility, they need to cross-analyse the census data with health statistics that are reported on boundary set B. Due to the incompatible boundary systems used it is not possible to accurately or efficiently cross-analyse the health and demographic data. As a result, the user must rely on their own judgement and various approximations to compare the datasets and decide the most logical position for the new centre.

This problem has occurred because, historically, organisations hand drafted the majority of geographic areas. With advances in technology these hand-drafted areas have been digitised for incorporation into GIS, a technology for which they have not been adequately designed.

It is important to note that although incompatible boundary units restrict GIS analysis, GIS technology, along with increased computing power, does provide an opportunity to develop new methods of data aggregation and exchange.

SIGNIFICANCE OF THE PROBLEM

The significance of the problem of data integration between incompatible geographical areas has been documented by a number of researchers around the world. For example Martin & Bracken (1991) have developed a raster based model to integrate otherwise incomparable polygon based data. Additionally authors Flowerdew & Green (1994) and Trinidad & Crawford (1996) have each developed interpolation systems to transfer data between different boundary systems. The ABS has also experimented with such techniques (Jenner (2001)). In general these techniques are only applicable to univariate data, (i.e. they may successfully transfer a population count from one region to another but they cannot accurately estimate the detailed characteristics of that population.)

Another commonly used approach to making data for incomparable areas comparable is the weighted concordance. Such concordances are typically population or area weighted. A population weighted concordance for example would tell us that, in figure 1, a certain percentage of the total population of A1 lives in B1, a percentage in B2 and the

## SIGNIFICANCE OF THE PROBLEM *continued*

rest lives in B3. The user of the concordance then assumes that older people or school age children or aboriginal people are distributed in the same proportion as the total population. This assumption can be far from true especially if the subgroup of the population being studied is small or spatially clustered within A1.

The ABS has also investigated the possibilities of re-aggregating point data as a method for transferring data across incompatible areal units. This method would involve geocoding individual households or businesses and using GIS to aggregate unit record data to any given boundary. However recording geocodes for individual households would create at least some risk to confidentiality the protection of which is one of the ABS's highest priorities. Also the transfer of geocoded unit record data between organisations is much more problematic than summary statistics for geographical areas.

The ABS does not believe that any of the above methods of data integration adequately solve the problem for the majority of statistical data users.

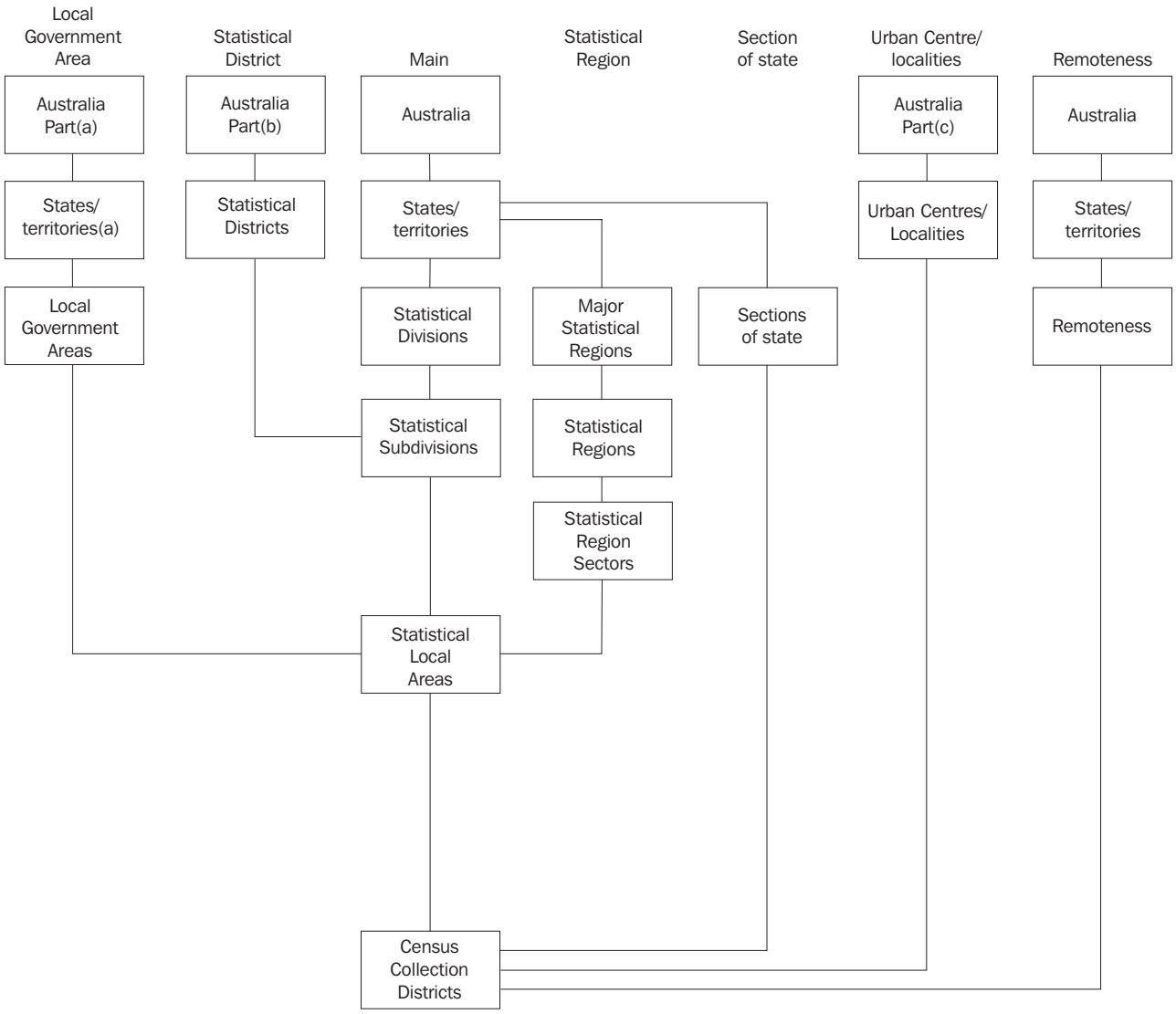
## THE SOLUTION

If data are to be compared across collections, across subject matter and across organisations then the areas, to which the data is attached, must be comparable. The ABS's approach to the problem has been to create a classification of geographical areas in which the smaller areas are designed to be aggregated in various ways to meet various needs and to encourage other organisations to use this classification for their own statistical and administrative geography.

The resulting classification is the ASGC.

Figure 2 shows how the smallest unit of the ASGC, the Census Collection District (CD), is aggregated in seven different ways to form higher level units each designed to meet a particular geographical or statistical need.

2 AUSTRALIAN STANDARD GEOGRAPHICAL CLASSIFICATION




(a) Incorporated areas only.
(b) Areas covered by S Dist only.
(c) Areas covered by UC/L only.

THE SOLUTION

*continued*

The ASGC includes the important administrative regions of Local Government and also represents important geographical concepts such as the urban/rural dichotomy and remoteness. It also caters for various small, medium and large communities of interest. The ABS, however, recognises that although the ASGC is a well-developed hierarchical system for the collection and collation of statistical data there is a growing need to define still more different sets of geographical areas for different purposes.

It is not possible to continue to expand the multiple hierarchies of the ASGC to cater for all the important geographical units which are not currently represented and still maintain a coherent and practical classification. It is possible, however, for different geographies to share a common building block and thereby achieve a level of comparability and compatibility beyond what we have today. The following chapter proposes the design of this common building block — referred to as a Mesh Block.

# CHAPTER 4 THE MESH BLOCK

## WHAT IS A MESH BLOCK?

Mesh Blocks will be a new micro level of geographic unit, about four or fives times smaller than a CD. The minimum number of dwellings in each Mesh Block will be between 20 and 50 except where a Mesh Block is deliberately designed to have zero population. However, Mesh Blocks will not just be used for population statistics and the census. Where economic activity is closely linked to location, such as agricultural production, economic data can also be coded to Mesh Blocks.

Mesh Blocks will be small so that they can aggregate reasonably accurately to many different geographical regions, administrative, management and political boundaries. Thus, by coding statistics to Mesh Blocks, it will be possible to produce summary statistics for a whole range of geographical regions not currently represented in statistical geography.

## HOW WILL MESH BLOCK BOUNDARIES BE DRAWN

The ABS recognises that, to solve the present conundrum of incomparable boundaries, Mesh Blocks must be used and shared by a wide variety of people and organisations. To represent the needs of the broadest possible cross section of statistical and non-statistical stake holders, a Panel of Experts was invited to advise the ABS on the ideal design criteria for Mesh Blocks. The Panel includes spatial scientists, expert users of census and other statistical data and administrative boundary experts. (Refer to the Appendix for further details of the Panel of Experts.)

By drawing on the collective experience and wisdom of the Panel of Experts the ABS has developed a proposed set of criteria for the design of Mesh Blocks which strike a balance between the increasingly complex demands of statistical and spatial analysts and preserving the privacy of individuals.

To ensure they are comprehensive and achievable the ABS selected two test regions, one in Brisbane and one in rural Victoria, to test the design criteria. The criteria and test results are explained in detail in Chapter 5. If the majority of stakeholders agree that these design criteria will result in Mesh Blocks which will meet their particular needs then the criteria will be programmed into an automated system to create digital boundaries for Mesh Blocks, similar to the boundary files currently available for CDs and other ASGC areal units.

As with the development of any generic unit or classification some compromise will be required but Mesh Blocks will be designed to meet the needs of most stakeholders, most of the time. Importantly there must be no feature in the design or implementation which would preclude their use by any group which is defining geographical regions for what ever purpose,statistical or otherwise.

## MESH BLOCKS AND NON-STANDARD GEOGRAPHY

Historically, geographic areas have evolved in Australia to facilitate political, economic and administrative functions. Since Australia is a Federation of six states and two territories — each having a different political, economic and administrative system — there are often large differences between the types, completeness and consistency of geographic areas being used across the country. Table 3 lists just some of the key geographic regionalisations in Australia. It is clear from this table that geographic areas can be the result of political arbitration, service delivery routing, topography or aggregation from existing geographic areas. Table 1 also shows how, in some cases, organisations have defined administrative or statistical geography, which is not an official part of the ASGC but which is based on ASGC units.

By building boundaries using ASGC units, organisations can develop spatial units which best suit their particular needs but at the same time maintain comparability with ABS statistics. Examples of special purpose units derived from ASGC units are Tourism Regions, Agro-ecologic Regions and some Commonwealth and State Government planning and management areas.

3 COMMONLY USED ADMINISTRATIVE BOUNDARIES, COVERAGE AND DELINEATION CRITERIA

| Geographic Area | Custodian | General method of delineation |
|---|---|---|
| Cadastral parcel | State government | Land survey |
| Postcodes | Australia Post | Service delivery area |
| Commonwealth Electoral Boundaries | Australian Electoral Commission | Political arbitration |
| Suburb/Locality boundaries | Geographic Names Boards | Community consultation |
| ASGC | ABS | The CDs have traditionally been designed for collection management. Whilst the higher units are different aggregations for different purposes. |
| Fire Districts | State fire authorities | Sometimes ASGC aggregations |
| Police Districts | State police authorities | Sometimes ASGC aggregations |
| Health Districts | State/Federal Government | Sometimes Postcode aggregations |
| River catchments | State Government | Topographic boundaries |
| Agro-ecologic Regions | Australian Government | ASGC aggregations |
| Interim Biogeographical Regions | All of government | Ecological boundaries |
| National Action Plan Priority Regions | All of government | Political arbitration |
| Tourism Regions | State Government | Mostly ASGC aggregations |

Despite the ability to derive special purpose units and the seven parallel structures already included in the ASGC there are still a number of existing or emerging geographical areas which are not provided for. Some important geographical units not directly incorporated in the ASGC are State and Commonwealth Electoral boundaries, post codes, river catchments, and official (Geographic Names Board) suburbs and localities.

These alternative geographies conflict with the existing ASGC hierarchies and with each other, to an extent that makes it impossible to incorporate them directly into the classification. Currently, the best the ABS can do is to approximate them using a 'best fit' of CDs. Currently CD derived approximations, and consequently a full range of Census data, are available for electoral boundaries, postal areas and suburbs. Commonwealth Electoral boundaries are approximated fairly well because the Australian Electoral Commission (AEC), where possible, makes Electoral Divisions aggregates of whole CDs. Conversely, for the 2001 Census, CDs were made to fit suburbs where possible and so

## MESH BLOCKS AND NON-STANDARD GEOGRAPHY *continued*

CD derived suburbs are a close approximation of official suburbs. However there are very significant differences between CD derived postal areas and official Australia Post postcodes, mostly to do with the nature of postcodes which make them problematic as a spatial unit.

Additionally, because of the constraints placed on CDs for census collection purposes, CD boundaries do not align well to river catchments, Geographic Names Board localities, small rural communities and temporal regions such as the National Action Plan Priority Regions. This lack of alignment is largely due to the fact that CDs must have a physical boundary visible to a census collector in the field, such as the middle of a road or a river, while many natural and administrative boundaries are aligned to less obvious features in the landscape or property (cadastral) boundaries.

Mesh Blocks will be designed to fit exactly or almost exactly to many of these non-standard geographical units. In some cases, however, the higher level boundary or larger unit may have to change to align with the underlying Mesh Blocks rather than the other way around. This is entirely appropriate where the higher level boundary is subject to frequent change such as electoral geography.

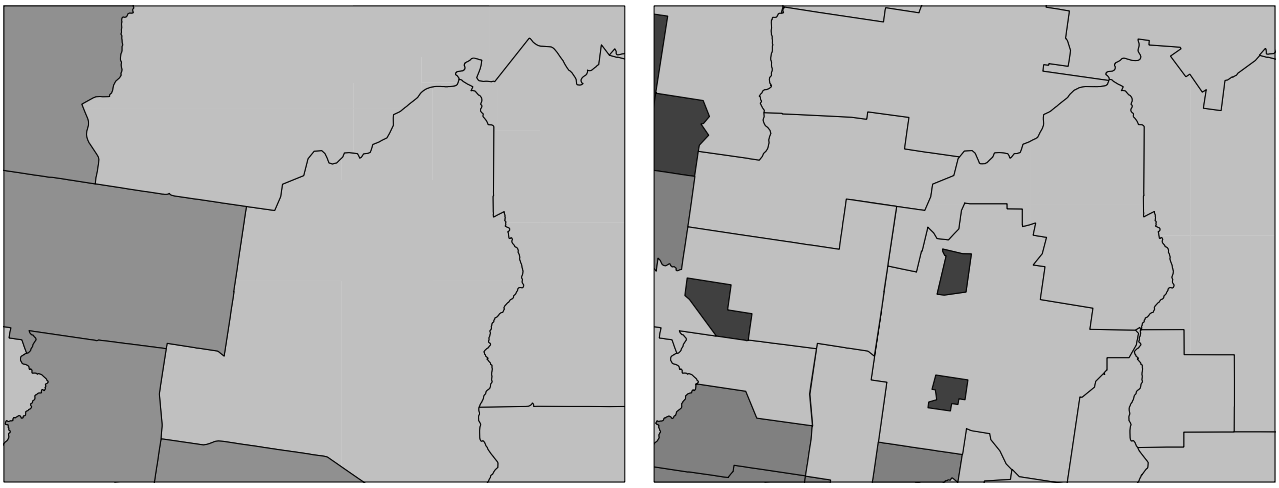
## BENEFITS OF MESH BLOCKS FOR DATA ANALYSIS

The development of Mesh Blocks is intended to facilitate accurate data exchange, integration and analysis. The following section outlines a number of the characteristics inherent within the Mesh Blocks that make them beneficial for statistical analysis.

## SMALLER GEOGRAPHIC UNIT

Initial tests demonstrate that due to their small size (20–50 dwellings) Mesh Blocks will provide analysts improved insight into the location and distribution of population clusters. Figure 4 shows the population density for the same region using CDs and simulated Mesh Blocks. The Mesh Block map shows additional smaller population clusters (dark) which could not be identified if data were only aggregated to the larger units.

4 POPULATION DISTRIBUTION BY COLLECTION DISTRICT AND MESH BLOCK



## MESH BLOCK CLASSIFICATION

The Panel of Experts has recommended that a system of codes be developed to classify Mesh Blocks based on broad land use.

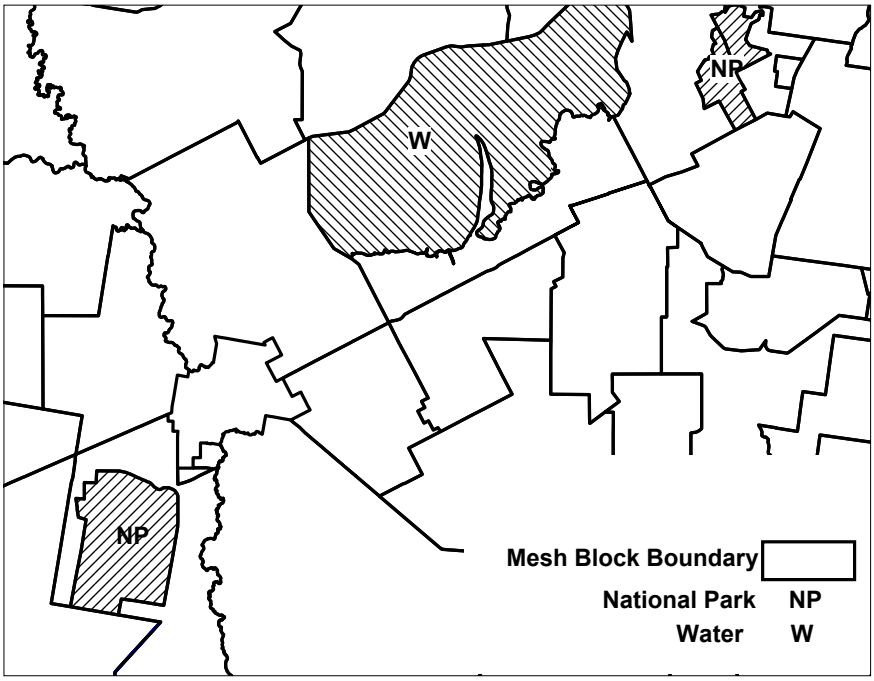
For example:

Type (A) Mesh Blocks are predominantly residential
Type (B) Mesh Blocks are predominantly commercial
Type (C) Zero population Mesh Blocks
Type (D) ….etc.

The number and type of classes will be restricted by the available data but such a classification system has the potential to facilitate land use mapping, journey to work analysis and more meaningful population/dwelling density counts.

Figure 5 shows part of the test area in Victoria. In this example water areas and National Parks can be easily identified and, if appropriate, eliminated from the analysis.

5 EXAMPLE OF THE ZERO POPULATION MESH BLOCKS



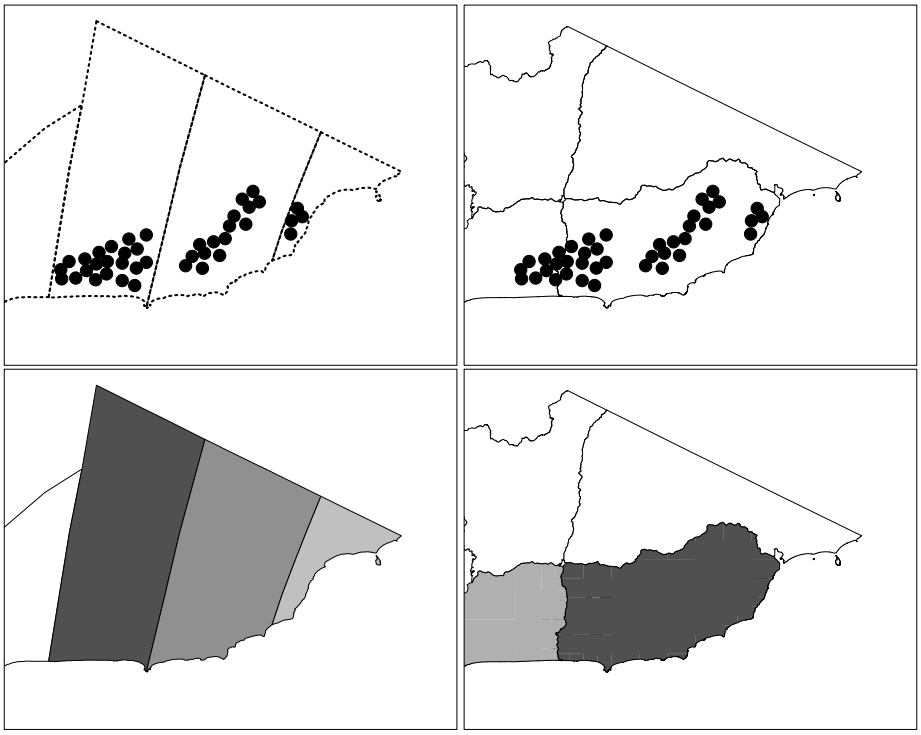

## MODIFIABLE AREAL UNIT PROBLEM (MAUP)

The Modifiable Areal Unit Problem (MAUP) is the term used to describe problems associated with the aggregation of point data into geographic areas or small areas into larger areas. The MAUP is endemic to all geographically referenced data and consists of two interrelated parts, the scale effect and the zoning effect.

The scale effect is used to describe the different statistical results obtained from the same set of data when the information is grouped at different levels of spatial resolution.

The zoning or aggregation effect is the variability in statistical results obtained from a set of modifiable units as a function of the various ways these units can be grouped (see figure 6).

6 ILLUSTRATION OF DIFFERENT RESULTS WHEN POINT DATA ARE AGGREGATED INTO TWO DISTINCTLY DIFFERENT BOUNDARY SYSTEMS



MODIFIABLE AREAL UNIT PROBLEM (MAUP) *continued*

The first two maps in figure 6 show two different boundary systems overlayed on the same distribution of points, (e.g. households.) The second two maps show population density within each area and illustrate how the apparent population distribution can be dramatically shifted by a change of boundaries.

Census data is very susceptible to the MAUP. It is collected from each household but published only as summary statistics for geographic areas (CDs). When the values are averaged through the process of aggregation, variability in the dataset is lost, and the values of statistics computed at different geographic scales will be different (The scale effect). Additionally, the analyst may observe different results depending on how the aggregation occurs (The aggregation effect). The MAUP is integral to the display of statistical data as the information is often a product of the size, shape and scale of the geographic areas used in the data aggregation process (Openshaw et al. 1998).

Mesh blocks will allow data analysts and in particular spatial analysts to have greater flexibility over the level of aggregation and the size and shape of the geographic areas they use for analysis. Using the Mesh Block as a common base layer will enable analysts to start from the Mesh Block and aggregate these in a fashion relevant to their investigation. This flexibility to re-aggregate and design geographic areas specific to the problem under investigation gives analysts greater control over the MAUP than has been possible in the past.

REDUCED DUPLICATION OF EFFORT

The ability to more easily integrate data will decrease data duplication between organisations. It should no longer be necessary for two organisations to collect the same data simply because they use incomparable areas.

## WHAT DATA WILL BE PUBLISHED?

Aside from the information which Mesh Blocks will intrinsically provide through the shape and size of their boundaries and their classification system the ABS will publish, as a minimum, population and dwelling counts for each Mesh Block. In addition the ABS is investigating the possibility of publishing some limited additional variables at the Mesh Block level. These variables will vary depending on what minimum size criteria are adopted for Mesh Blocks. Table 7 shows the potentially publishable data for various minimum size criteria using the Census of Population and Housing as an example.

7 POTENTIAL DATA VARIABLES VERSUS MINIMUM MESH BLOCK SIZE

| Minimum number of dwellings | Variables which could be published |
|---|---|
| 20 | Dwelling and population count |
| 30 | Dwelling count and population by sex or by age in up to 4 roughly equal groups or marital status in two categories or employed/not employed |
| 50 | Dwelling count and population by sex or by age in up to 6 roughly equal groups or marital status in two categories or employed/not employed or born in Australia/overseas or Industry of employment (3 broad groups) |

The above table is for illustrative purposes only. It shows what level of data could be published. The actual data items to be published as standard outputs for Mesh Blocks will be included in consultation on census output products. This paper seeks feedback only on what users would prefer — smaller Mesh Blocks or a broader range of data at the Mesh Block Level.

## CONFIDENTIALITY

Maintaining confidentiality is important to both individual Australians and to the community in general's trust and confidence in the ABS. If confidentiality is not guaranteed, it is less likely that people will complete census forms truthfully, in turn degrading the accuracy and reliability of census information. Furthermore, the ABS has a legal requirement to honour confidentiality.

While very limited data will be published for each Mesh Block, in theory, the full range of census variables currently published for CDs could also be published for any grouping of five or more Mesh Blocks. There are a number of statistical measures that can be applied to these higher level aggregations to further preserve confidentiality. These include the suppression of records, rounding cells or publishing data in broad categories to reduce the level of detail. However there is another confidentiality issue which must be considered. If detailed data was made available for any possible grouping of Mesh Blocks it would be possible to obtain detailed data for one group of Mesh Blocks and then obtain data for another group which was only different from the first by one Mesh Block.

This is the problem commonly known in statistics as 'differencing' and refers to the possibility of subtracting two sets of data to obtain un-confidentialised data for a single Mesh Block. The differencing problem can be managed either by limiting the allowable flexibility or degree of customisation of the geography or by randomising all cells at all levels of geography so that any data derived for a single Mesh Block by differencing would not be true or accurate.

Again this paper seeks feedback on which is the most desirable option, the limitation of geographical outputs or the randomisation of data.

# CHAPTER 5 PROPOSED MESH BLOCK DESIGN

## PROPOSED MESH BLOCK DESIGN

There is increasing demand from users of census data to improve the relationship between small area geography and the social, physical and economic realities of the landscape. In particular a report produced by Hugo et al. (1997) highlighted the changing nature of census boundaries — from units of collection to a boundary system used for data display and analysis. While the CD will always need to cater for specific collection requirements, with the improvement of digital databases and nation wide land referencing systems it is now possible to design a micro level statistical output unit which is not constrained by the functional requirements of census collection. An important feature of Mesh Blocks is that data will be coded to Mesh Blocks independent of the census collection methodology. Mesh Blocks need not fit within existing or future CD boundaries.

One of the objectives of this paper is to establish a set of appropriate rules, which can be consistently applied to create Mesh Blocks. Once established these rules will be 'programmed' into a GIS which will electronically draw the boundaries for each of the approximately 200,000 Mesh Blocks. To minimise the cost of creating Mesh Blocks (and maximise their consistency) rules must be established which can be interpreted by computer algorithms designed to execute tasks in sequence and without intuition.

The ABS recognises that the success of Mesh Blocks, in both the public and private sectors, is dependent on the rules developed for their design. To achieve the most suitable design the ABS encourages stakeholder feedback to this Information Paper as well as any issues which this paper or the process to date may have overlooked.

## SPATIAL HIERARCHY

A spatial hierarchy consists of multiple levels, with the higher levels in the hierarchy being aggregations of the smaller units. Mesh Blocks are being designed to provide the basis not of a single hierarchy but essentially any sensible hierarchy.

The properties which describe the relationship between the elements within a theoretic spatial hierarchy (Janus effect, whole-part, near decomposability and embeddedness) are described in Eagleson et al. (2002). One such property, the Part-whole relationship, relates directly to Mesh Blocks as each Mesh Block is formed through the aggregation of smaller units (e.g. land parcels) to form a whole Mesh Block. At the same time the Mesh Block forms a part of the overall system.

When reviewing the criteria proposed within this paper it is important to consider the Mesh Block as a whole unit, as well as a part of the higher order geographic boundaries within which it will be embedded. These will include the units of the ASGC but may also include geographical areas defined for non-statistical purposes and completely without reference to ststistical geography.

## PROPOSED CRITERIA

This section details the criteria established by the Panel for the design of Mesh Blocks. It is important to note that each of the criteria has a weighting (high, medium or low) assigned to it. Once the ABS has finalised the criteria are finalised the associated weighting will be used to assign priority to that boundary or feature within the computer program which will 'draw' the final boundaries.

## RURAL/URBAN

One of the most obvious distinctions in the Australian landscape is between rural and urban. In urban areas people live close together and in a relatively uniform pattern of population distribution. In rural areas population may be sparse and very irregular in distribution. In terms of landscape and infrastructure for the design of Mesh Blocks urban areas comprise relatively uniform size land parcels and well-developed location referencing systems, i.e. street addresses. In contrast land parcels in rural areas are highly variable in size and the location referencing systems are not always complete or widely used. It is therefore proposed that different sets of criteria be used to delineate Mesh Blocks in urban and rural areas and the rural-urban boundary should therefore be incorporated within the design of Mesh Blocks with the highest priority rating.

It is also important to note that the problem of incongruent boundaries in rural regions is amplified by the large variation in boundary sizes. CDs in rural regions are generally much larger than those in urban areas. As a result of the large variation in the physical size and shape of rural boundaries, they are an odd assortment of 'building blocks' to make comparisons with non-census spatial units (Haslam-McKenzie 2001). Additionally because the CDs in rural regions are generally large, it is currently difficult to distinguish emerging population clusters or very small towns.

## EXISTING GEOGRAPHICAL AREAS

As outlined in Chapter 4 there are many and various administrative boundaries used in Australia. The relationship between Mesh Block and administrative boundaries is important. Although it is not possible to align the Mesh Block with every existing boundary system the Panel has made the following recommendations:

1. Mesh Blocks will align with officially gazetted suburb and locality boundaries.
2. Mesh Blocks should not be constrained within CD boundaries but, to support time series analysis, concordance tables between the Mesh Blocks and 2006 CD boundaries will be developed.
3. To meet the need for accurate Local Government Area (LGA) population estimates, Mesh Blocks will align with LGA boundaries in 2006. But thereafter it is hoped that LGA boundary changes will not divide Mesh Blocks.
4. The panel recognised the importance of higher level geography such as postcodes and electoral boundaries but advised that Mesh Blocks should not be constrained by boundaries which are highly temporal and which in time could become aggregations of the more stable Mesh Blocks.

## TOPOGRAPHY

Topographic barriers, roads and waterways are influential in the design of effective geographic areas. As Morphet (1993) and Hugo et al. (1997) explain, major topographic boundaries not only present barriers that limit route planning, they often segment demographic classes. It is therefore important in demographic analysis to ensure major barriers are preserved. A number of topographic barriers exist within the landscape. Some occur because of infrastructure such as freeways and walls; while others occur

TOPOGRAPHY *continued*

naturally such as rivers and ridges. Each barrier has the potential to segment communities.

*Waterways*

In rural areas waterways provide connecting threads for different land uses along their banks and flats. In urban areas waterways act as divides because crossing points (such as bridges) are often limited.

*Major Roads*

It is recognised that in rural areas the road has a central integrating function for a community. For example it is common for a small community to form around the intersection of two major roads and such a community should be kept together in a single Mesh Block. In contrast, in Urban areas where roads do not play a vital role in uniting communities, the road network does provide valuable infrastructure for route planning and the allocation of workloads, and can be incorporated into the design of Mesh Blocks. The weighting given to an urban road however should depend on its potential to separate communities of interest. For example, people and businesses are unlikely to interact across a large expressway whereas a suburban Cul-de-sac may form its own community.

*Other topographic boundaries*

Physical boundaries like forests, mountain ranges, lakes etc. form natural barriers and should be used as boundaries in the design of Mesh Blocks.

SHAPE

Although it is well known what is meant by 'shape', it is difficult to derive one rule for the 'optimum shape' of Mesh Blocks. Some people believe that a compact or circular shape is optimal. Cain (1984, p. 32) provides an interesting statement relating to shape and peoples' perception

> '...fingers, slivers jagged edges non-contiguous census tracts, and complicated shapes are the images associated with gerrymander, whereas compact forms such as circles and squares are associated with good government'

Although compact shapes may give the perception of a well-ordered set of geographic areas and are pleasing to the eye, the panel has agreed that consideration should be given to long, thin mesh blocks which border features such as main roads, water edges and open space. These would provide the ability to analyse 'frontage' issues such as air and noise pollution, polarisation of land values and accessibility with more accuracy. Where important linear features are not present it was decided that the Mesh Block should be compact.

*Contiguity*

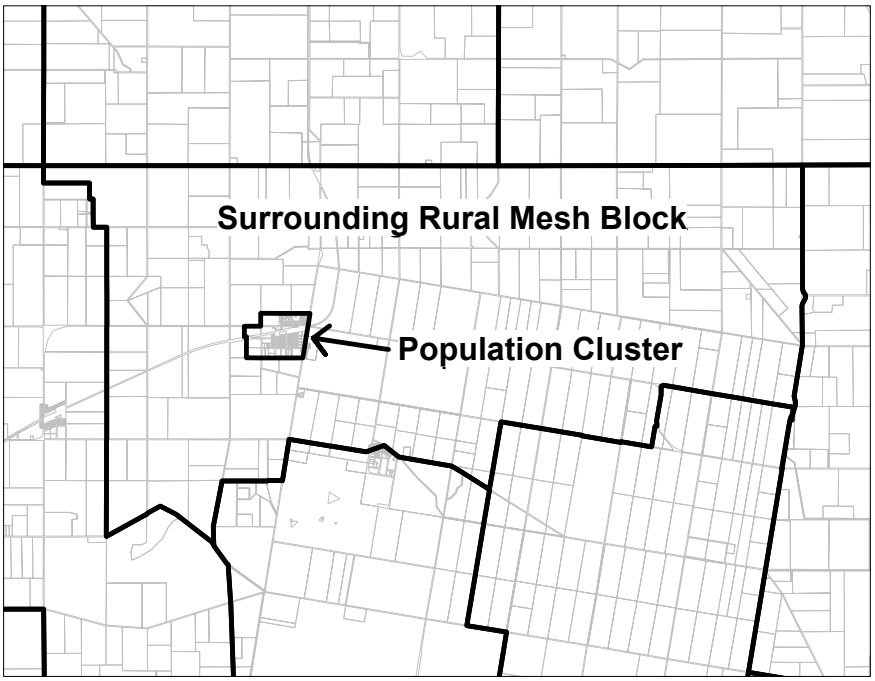
For both statistical and administrative purposes it is important that Mesh Block boundaries are contiguous and provide complete coverage across the whole of Australia without gaps or overlaps.

*Doughnut*

Often in rural or peri-urban areas small communities exist surrounded by large expanses of land containing only a small population. These small communities will form one or more homogeneous Mesh Blocks while the outer area forms a larger rural Mesh Block. This pattern of geographic formation can be thought of as 'Doughnut polygons' (Refer to figure 8.)

*Doughnut continued*

8 DOUGHNUT GEOGRAPHY




The panel did however express the need for caution. Although doughnuts were seen as acceptable the process of separating out small communities in peri-urban environments could result in areas which resemble more Swiss cheese than doughnut. Swiss cheese geography makes areas difficult to describe and understand and lends itself to errors both in aggregation of data and in analysis.

*Cul-de-sac*

The panel agreed that both sides of a Cul-de-sac should be kept in the same Mesh Block wherever possible. This may require the Mesh Block boundary to run along the back fences of some properties.

LAND USE

As outlined in Chapter 4 one of their benefits is the ability to make Mesh Blocks reasonably homogeneous in terms of their predominant Land Use. The panel agreed that a classification system should be developed to broadly describe Mesh Block type.

*Zero Population Mesh Block*

The ability to define zero population Mesh Blocks is a step forward in census geography. This enables people to quickly distinguish between inhabited and uninhabited regions. In Urban areas the panel agreed that transport corridors should be created as zero population Mesh Blocks. However where transport corridors are elevated above ground level, the other land uses underneath will take priority.

ISLAND MESH BLOCKS

The panel agreed that where islands are small, more than one island may be aggregated to form a Mesh Block. However, islands should not be included in the same Mesh Block as mainland areas.

INDIGENOUS

The panel recommended that Mesh Blocks should be drawn around well established Indigenous communities. Because of the practical difficulties involved, even large communities should not be divided into multiple Mesh Blocks. People who are counted in Mesh Blocks adjacent to the community, but are linked for cultural or administrative

INDIGENOUS *continued*

reasons to it, should, wherever possible, be coded back to the Indigenous community Mesh Block.

MESH BLOCKS TO SUPPORT TIME SERIES ANALYSIS

Australia is undergoing continuous change with rapid expansion causing boundaries to be reassessed at regular intervals. Clearly defined methods must be in place to ensure Mesh Blocks remain as stable as possible but still in aggregate represent less stable higher level units. See Chapter 6 for a discussion on Mesh Block maintenance.

URBAN AND RURAL CRITERIA WEIGHTING

Tables 9 and 10 summarise the recommendations of the Panel highlighting the criteria to be used for Mesh Block design in urban and rural landscapes and the weighting to be applied to each criteria.

9 URBAN MESH BLOCK CRITERIA AND WEIGHTING

| Feature (Criteria) | Weighting | Comments |
|---|---|---|
| Confidentiality Protection | Essential | Protecting confidentiality is a legal requirement. |
| **High Order Boundaries** | | |
| Collection District (CD) | Low | While Mesh Blocks will generally fit within urban CDs, in rural areas CD boundaries are often not suitable for defining Mesh Blocks. CD time series could be maintained through the use of concordance tables (rather than using 2001 CD boundaries to constrain Mesh Block design). |
| Suburb/Locality | High | It is essential that Mesh Blocks align with officially gazetted suburb/locality boundaries. |
| Local Government Areas (LGA) | High* | Mesh Blocks will align with LGA boundaries in 2006. As a result LGA boundaries have been assigned a HIGH* weighting. However after 2006 LGA boundary changes should only encompass whole Mesh Blocks so that the Mesh Blocks themselves remain stable. |
| Electoral Boundaries | Low | The panel recognised the importance of higher level geography such as postcodes and electoral boundaries and the goal of Mesh Blocks aggregating to these boundaries. However it was considered the Mesh Blocks should not be constrained by boundaries which are highly temporal and which in time could become aggregations of the more stable Mesh Blocks. |
| Australia Post Postcode Boundaries | Medium | |
| **Topographic Features** | | |
| Transportation corridor (Freeway, large river, rail corridor) | High | Where possible transport corridors should be created as zero population Mesh Blocks. However when transport corridors are elevated above ground level, the other land uses underneath will take priority. |
| Rivers | Medium | Main roads and rivers can unite or divide an area — depending on the number of crossing points (bridges/traffic lights). Suburb boundaries often take this into account but some cases such as strip shopping areas may require individual investigation. |
| Main Road | Medium | |
| Mountain Range | Low | Not Applicable in urban areas |
| **Shape — ability to illustrate heterogenous regions** | | |
| Compactness | Medium | |
| Linear (following significant frontages i.e. Ocean, rivers lakes) | Medium | There could be benefits from defining long thin Mesh Blocks facing a particular water or land feature. |
| Doughnut | Acceptable | The Panel did however express the need for caution (although doughnuts have been recognised as acceptable) the process of separating out small communities in peri-urban environments could result in Swiss cheese geography. |
| Cul-de-sac | High | Both sides of a Cul-de-sac should be kept in the same Mesh Block wherever possible. This may require the Mesh Block to run along the back fence boundaries. |
| Contiguous | High | Wherever possible Mesh Blocks should be contiguous units. (Islands are an exception to this rule) |
| Maximum dwelling count | Low | There is little benefit in splitting apartment block or other small areas with large dwelling counts where the Mesh Block is already compact in size and shape. |
| Cadastre | High | The cadastre is a fundamental dataset supporting the development of Mesh Blocks and will form the integrating layer in the GIS algorithms for creating Mesh Blocks. |
| **Land Use** | | |
| Urban/Rural | High | The boundary between rural and urban regions will be the first or primary boundary defined in building Mesh Blocks. |
| Residential/commercial/ industrial | High | A Mesh Block classification system will be established to distinguish between residential/commercial/industrial land uses. The Panel agreed that as long as there are not too many different Mesh Blocks classed, such a classification system has the ability to facilitate land use mapping, journey to work analysis and more meaningful population/dwelling density counts. |
| Uninhabited areas (land or water forming zero population Mesh Blocks) | High | The integrity of housing/population density counts should (where possible) be maintained. Thus areas such as schools and parkland should be separated and allocated a zero population count. |
| Visibility on the ground | Medium | While Mesh Block boundaries, unlike CD boundaries, do not have to be visible on the ground, consideration should be given to easily described, identifiable and understandable boundaries. |

10 RURAL MESH BLOCK CRITERIA AND WEIGHTING

| Feature (Criteria) | Weighting | Comments |
|---|---|---|
| Confidentiality Protection | Essential | Protecting confidentiality is a legal requirement. |
| **High Order Boundaries** | | |
| Collection District (CD) | Low | While Mesh Blocks will generally fit within urban CDs, in rural areas CD boundaries are often not suitable for defining Mesh Blocks. CD time series could be maintained through the use of concordance tables (rather than using 2001 CD boundaries to constrain Mesh Block design). |
| Locality | High | Mesh Blocks will align with officially gazetted locality boundaries.<br>In areas where the gazetting process has not yet taken place it may be necessary to accelerate this process. The Panel also expressed some concern about the stability of the already gazetted boundaries. |
| Local Government Areas (LGA) | High* | Mesh Blocks will align with LGA boundaries in 2006. As a result LGA boundaries have been assigned a HIGH* weighting. However after 2006 when LGA boundaries change they should always encompass whole Mesh Blocks. |
| Electoral Boundaries | Low | The panel recognised the importance of higher level geography such as postcodes and electoral boundaries and the goal of Mesh Blocks aggregating to these boundaries. However it was considered that Mesh Blocks should not be constrained by boundaries which are highly temporal and which in time could become aggregations of the more stable Mesh Blocks. |
| Australia Post Postcode Boundaries | Medium | |
| **Topographic Features** | | |
| Rivers | Medium | Main roads and rivers often unite rural communities depending on the number of crossing points (bridges/traffic lights) so should not be used as boundaries where a small community consists of only one Mesh Block. |
| Main Road | Medium | |
| Water Catchments | High | Catchment areas of Australia's major rivers. |
| Mountain Range | Medium | Where the mountain range limits communication and access or forms a river catchment boundary. |
| **Shape — ability to illustrate heterogenous regions** | | |
| Compact | Medium | In the past the ABS has used wedge shaped CDs which tend to divide small communities and include both rural and urban land use within the one CD. Mesh Blocks should be homogeneous in terms of urban/rural land use. Where a community or population cluster is large enough it can be divided into two or more Mesh Blocks but these in aggregate should represent the whole cluster without the inclusion of large areas of rural land. |
| Linear (following points of interest i.e. Ocean frontage) | Medium | There could be benefits in long thin Mesh Blocks facing a particular water or land feature. |
| Doughnut | Acceptable | The Panel did however express the need for caution about Swiss cheese geography. |
| Cul-de-sac | High | As in urban areas both sides of the cul-de-sac should be kept in the same Mesh Block but particularly in rural/residential subdivisions where a pattern of cul-de-sac road networks is an indicator of a low population density community often surrounded by very low population density agricultural land. |
| Contiguous | High | Wherever possible Mesh Blocks should be contiguous units. (Islands are an exception to this rule). |
| Cadastre | High | The cadastre is a fundamental dataset supporting the development of Mesh Blocks. |
| Property (group of parcels in a single ownership) | Low | It may not be possible to keep each property in a single Mesh Block where properties are large and lie across important topographic boundaries. |
| Land Use | High | A classification of Mesh Blocks will be established to distinguish major differences in land use.<br>Catchment Scale Land Use mapping will be used to inform mesh Block design. |
| National Parks, Nature Reserves and other Managed Conservation Areas | High | The integrity of housing/population density counts should (where possible) be maintained. Thus areas such as National Parks/Wilderness areas should be separated and allocated a zero population count. |
| Visibility on the ground | Medium | While Mesh Block boundaries, unlike CD boundaries, do not have to be visible on the ground, consideration should be given to easily described, identifiable and understandable boundaries. |

## DATASETS TO SUPPORT MESH BLOCK DEVELOPMENT

As outlined in Chapter 3, organisations design geographic areas to facilitate management, administrative and political activities and only a few share common boundaries. However most organisations are also concerned to some extent with more exact location of clients or service outlets within their administrative regions. In the past systems of location referencing have been established by different agencies in support of different functions. Now agencies are realising the benefits of using a coordinated approach to identifying location. The following section highlights the benefits of using the cadastre and location referencing systems such as the cadastre and the G-NAF to underpin the design of Mesh Blocks.

### *The Cadastre*

The cadastre has been identified as an important spatial layer from which to develop Mesh Blocks. The cadastre is a land parcel based, information system containing records of interest in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, ownership or control of those interests and often the value of the parcel and its improvements (Williamson & Hunter 1996).

The cadastre is an important spatial layer for relating administration policy and procedures to owners and residents of the land. Therefore it makes sense that any given cadastral unit should be wholly contained within a Mesh Block. By embedding the parcels within the Mesh Block and similarly embedding Mesh blocks within the overlying larger units it can be readily determined to which administrative areas the parcel belongs (Dale & McLaughlin 1988). In the past the cadastre has not been readily accessible by agencies such as the ABS but with the development of integrated national snapshots of the cadastre (CadLite) and changes to pricing and access policies in most jurisdictions this resource is now readily available and extensively used by the ABS.

## G-NAF

PSMA Australia Ltd. (a company wholly owned by Australian governments) has recently completed a G-NAF. G-NAF is a database of every known address in Australia along with its latitude and longitude. It is a substantial step forward in Australia's geographical infrastructure and is essential to the design and construction of Mesh Blocks and the coding of addressed based data to Mesh Blocks. G-NAF is the authoritative database of addresses for all of Australia, however, the use of address in rural areas is still problematic. It is anticipated that lack of unique and unambiguous address for rural properties may impact on the design of Mesh Blocks and ultimately limit the data which will be available for non-urban Australia.

## MESH BLOCK DESIGN PROCESS

In the past, the procedure for mapping and defining land-based small area boundaries has been largely manual and map based, involving human judgement. This can mean that different rules are applied in different situations. In essence automating the design of Mesh Blocks will enable the boundaries to be drawn in a way that is fast, repeatable and consistent across Australia.

# CHAPTER 6 IMPLEMENTATION OF MESH BLOCKS

## IMPLEMENTATION OF MESH BLOCKS

The ABS aims to have Mesh Blocks designed and built in time for the dissemination of data from the 2006 Census. While August 2006 may seem a long way off, many key milestones need to be achieved within the next year. For example, to meet the planning time frames and stringent risk management procedures of the Census, Mesh Blocks must be virtually finalised in time for the census Dress Rehearsal in May 2005.

At the time of the census the ABS will only have a very approximate idea of the number of dwellings in each Mesh Block. We will not know that minimum dwelling counts have been achieved until census data has been coded to the Mesh Blocks. At that stage some Mesh Blocks may need to be merged together to achieve the minimum size criteria. For this reason Mesh Blocks boundaries will be available to key stakeholders in mid 2005 but will remain 'draft' until after the 2006 Census.

Table 11 below summarises the implementation timetable for Mesh Blocks.

11 TIMETABLE FOR IMPLEMENTATION OF MESH BLOCKS

| Date | Activity |
|---|---|
| June 2003 | Fact finding visit to Statistics New Zealand and Land Information New Zealand |
| July/December 2003 | A Panel of Experts develop options for Mesh Block criteria |
| March 2004 | Views of stakeholders sought |
| March 2004 | G-NAF available for all of Australia |
| July/September 2004 | ABS to review feedback from stakeholders and finalise criteria for Mesh Block design |
| September 2004/May 2005 | ABS creates Draft Mesh Block and supporting infrastructure |
| May 2005 | Draft Mesh Block tested in Census Dress Rehearsal processing |
| July/December 2005 | Draft Mesh Block boundaries validated by key stakeholders |
| August 2006 | Draft Mesh Block implemented in census processing systems |
| June 2007 | Standard census outputs on current (CD based) geography |
| June/August 2007 | Draft Mesh Block finalised using 2006 Census counts |
| September 2007 | Digital Mesh Block boundaries available at marginal cost of transfer via the Australian Spatial Data Infrastructure |
| December 2007 | Basic census counts available for Mesh Blocks |
| January 2008 | Customised geography service available for census data |
| June 2008/June 2009 | Consultation on new standard geographical units to replace Cds for data dissemination |
| August 2011 | New standard geographical units implemented |

## MAINTENANCE OF MESH BLOCKS

Once Mesh Block boundaries have been finalised the aim will be to keep them as stable as possible. Where urban growth occurs a formerly rural Mesh Block may need to be split into its urban and rural components. The expansion of urban areas is expected to be the main impetus for splitting Mesh Blocks but other major changes in land use may also precipitate Mesh Block maintenance. Where a Mesh Block is split a strict one to many relationship will be maintained between old and new.

While CDs are only maintained on a five-yearly census cycle, organisations may need to make use of Mesh Block boundaries for defining their own regions at any time. Mesh Blocks will therefore be maintained on an annual cycle to ensure that they are as current and up to date as possible to minimise the possibility of an overlying region being defined on an out of date boundary.

## MAINTENANCE OF MESH BLOCKS *continued*

Mesh Block boundaries will in all cases be a topographic feature or a cadastral (land parcel) boundary. In GIS terminology they will be topologically linked to an underlying map feature. Where this feature changes or moves due to map revision the Mesh Block boundary will move with it. This will be considered simply a remapping of the same Mesh Block. It will not be considered a change.

Similarly where the feature which forms a Mesh Block boundary physically moves, for example a road is realigned or upgraded in a slightly different position, the area between its old and new locations will be examined. If the area of change contains no dwellings or businesses the boundary will be 'nudged' to the new location but the Mesh Block will not be considered to have changed.

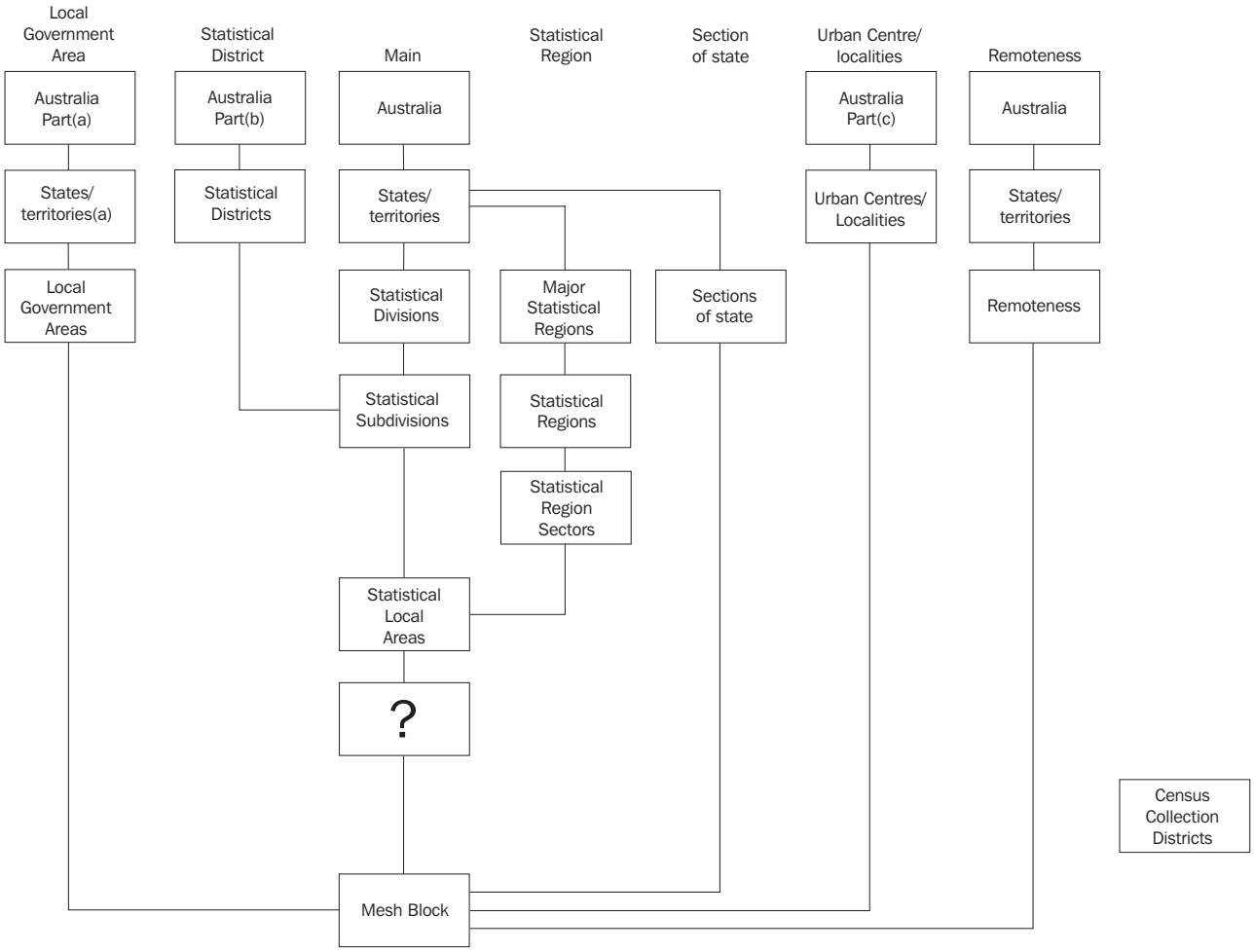
## RESULTING CHANGES TO THE ASGC

After the 2006 Census, Mesh Blocks will open up a range of possibilities not only for customised geographic outputs but also for enhancement of standard geography.

For the 2011 Census, CD will no longer be a geographical output unit. It will only be used for the management of the collection phase of the census. CD will be replaced in the ASGC by a new spatial unit, about the same size, (i.e. 200 to 220 dwellings). but specifically designed for data output. Other ASGC units which are currently aggregates of CD could instead be defined as aggregates of Mesh Blocks. For example Mesh Blocks would provide a much more refined definition of the urban/rural dichotomy in the Urban Centres and Localities classification.

Figure 12 shows how the familiar ASGC hierarchy, *Australian Standard Geographical Classification (ASGC)* (cat. no. 1216.0 p. 3) could look after the implementation of Mesh Blocks. However there will be an extensive consultation process, particularly in regard to the unit which will replace CD, before these changes are implemented for the 2011 Census.

## 12 ASGC AFTER IMPLEMENTATION OF MESH BLOCKS




(a) Incorporated areas only.
(b) Areas covered by S Dist only.
(c) Areas covered by UC/L only.

APPENDIX

# PANEL OF EXPERTS

MEMBERS OF THE PANEL OF EXPERTS TO ADVISE THE ABS ON MESH BLOCK CONCEPTS

Dr. Michele Barson
Chief Scientist Bureau of Rural Sciences

Frank Blanchfield
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Prof. Ian Williamson
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## GLOSSARY

**Aggregation** is the process of adding information about individuals together to form summary statistics for a class in a classification or adding together the smaller categories in a classification to form statistics for a larger category. In geographically referenced statistics aggregation refers to adding together the data for individuals to form data for an area or adding smaller areas together to form a larger area.

**Align** Spatial units are aligned when their boundaries follow the same topographical features or lie one on top of the other. In a spatial hierarchy the boundaries of the smaller units fit within and aggregate to the larger units.

**Cadastre** is a record of rights and obligations in land. It usually includes some description of the location and extent of the land. In Australia all states and territories use a Digital Cadastral Data Base (DCDB) as an index to their cadastral records. A DCDB typically contains a spatial object representing the land parcel and a unique identifying number for each parcel.

**Coding** is the process of assigning an individual to a specific category in a classification. In the case of geography it involves allocating an individual person or other entity to a geographical area based on location.

**Concordance** is the relationship between one class in a classification and another class in the same or a different classification. Within a single spatial hierarchy a concordance simply lists which smaller units aggregate to form a particular larger unit. Where there is no direct relationship between spatial units, (i.e. they are from different classifications) a weighted concordance provides an estimate of the percentage of one unit which falls within the other unit.

**Concording** is the process of converting summary statistics for one category in a classification to summary statistics for a category in a different classification.

**Disaggregation** refers to the level of aggregation for which data is available. If data has been aggregated to larger spatial units then it cannot be disaggregated without some addition information on the distribution of the population within the larger area. Disaggregation in statistics is similar to scale in topographical mapping. Large scale mapping can be generalized into small scale mapping but the reverse is not true.

**Locality** is used by different people to mean different things. In the Urban Centre and Locality structure of the ASGC it refers to a population cluster of 40 or more non-farm dwellings with a population between 200 and 999 people. Official localities are gazetted by the Geographical Names Board of the relevant state or territory. They are generally defined to cover the whole state where ABS Localities are only defined where there is a population cluster. ABS Localities often have the same name as the official locality in which they lie but will generally only encompass the higher population density portion of the larger locality.

**Peri-urban area** is the area on the fringe of large city.

**Polygon** is a closed geometrical object. It has three or more sides. A GIS typically records the length of the sides and can compute the area of the polygon.

**Randomise** in statistical terms refers to perturbing statistics by randomly adding or subtracting from the numeric value in a data cell.

**Raster** is a rectangular area or grid cell commonly used in satellite imagery but also used in various sizes to divide the landscape into regular sized areas.

**Rural** The ABS normally defines rural as areas which are not contained within any Urban Centre within the Urban Centre and Locality structure of the ASGC. As such ABS Localities are normally defined as rural. In the context of this paper includes any population cluster which would be large enough to form a Mesh Block.

**Urban** In the context of this paper includes any population cluster which would be large enough to form a Mesh Block, (i.e. more than 20 to 50 dwellings).

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