Strengths and weaknesses of the three methodologies and classifications

Each remoteness classification and its underlying methodology has its advantages and disadvantages depending on how it is used. All of these classifications are useful for differentiating between areas with different levels of generalised remoteness (in the case of the ARIA classification and ASGC Remoteness Areas) and between areas with both different levels of remoteness and different local town sizes (in the case of RRMA).

Strengths and weaknesses of RRMA

The release of the RRMA classification in 1994 was significant in that it was the first time that a remoteness classification was made widely available, applied to administrative and survey data and used in the allocation of funding to areas. Its widespread acceptance and usage, over the past decade, by a number of organisations has been an important step in the development of more precise measures of remoteness (classifications based on ARIA and ARIA+ methodologies).

The RRMA classification was the only widely available remoteness classification from 1994 until 1999 (when the ARIA classification was released).

Strengths and weaknesses of RRMA methodology

RRMA's widespread acceptance and usage has been due to several factors:

- All areas within an SLA boundary are given the same remoteness class. This makes RRMA a simple tool to use for both research purposes and in allocating funding to SLAs.
- The three zones (Metropolitan, Rural and Remote) are fairly logical groupings of areas within Australia. These zones exhibit differences in relation to service and infrastructure provision, economic base, land use, natural resources, demography and social structure (DPIE & DHSH 1994).

The RRMA methodology does, however, have a number of weaknesses, compared to the ARIA and ARIA+ methodologies.

The RRMA methodology is a 'rougher' measure of remoteness than the ARIA and ARIA+ methodologies because it:

- is based on SLAs. All areas within the SLA boundary are assigned the same remoteness class even though some SLAs are, in fact, heterogeneous in terms of remoteness (that is, they contain populations with widely varying levels of access to goods and services). ARIA and ARIA+ index values are built up from grid points rather than being based on fixed geographical boundaries;
- uses the centroid of the SLA as the reference point for calculating distance to service centres. The use of the SLA's centroid can be a source of error in calculating distance to service centres because most people may, in large SLAs, live some distance from the

centroid. The ARIA and ARIA+ methodologies are based on distance from populated localities to service centres and this is more reflective of where people actually live;

- uses an 'Index of remoteness' derived from indices based on straight-line distance from the centroid of the SLA to the centroid of the nearest urban centres within each population category. For example, the centroid of an SLA may be 50 km from a large urban centre 'as the crow flies'; however, the road distance to that centre could be twice the distance. The distance measure used in the ARIA and ARIA+ methodologies is preferable because it is based on actual road distance between a populated locality and its nearest service centres (DHAC & GISCA 2001);
- uses an 'Index of remoteness' based on population density as well as distance measures to distinguish between rural and remote SLAs (ARIA and ARIA+ index values are based on distance measures alone). Although population density can provide an indication of the 'urban-ness' of an area, the results can become relatively meaningless when applied to spatial units, such as SLAs, which vary widely in physical size. For example, in 1991 the Cities of Broken Hill and Kalgoorlie/Boulder both contained urban centres with similar sized populations. The boundary of Broken Hill City approximated the boundary of the urban centre of Broken Hill. In contrast the boundary of Kalgoorlie/Boulder City stretched from the urban centre of Kalgoorlie/Boulder to the Western Australia/South Australia border. The difference in population densities contributed to Broken Hill City being designated as a Rural SLA and Kalgoorlie/Boulder City as a Remote SLA.

Strengths and weaknesses of the RRMA classification

The RRMA classification also has the following weaknesses in comparison to the ARIA classification and ASGC Remoteness Areas:

- Although a measure of remoteness is used to distinguish between rural and remote SLAs, the RRMA classification itself does not compare the relative level of accessibility/remoteness of each Rural and each Remote SLA. Instead, it uses the population of urban centres within an SLA to distinguish between remoteness classes. Thus an SLA classified as an 'Other rural area' is not necessarily more remote than an SLA classified as a 'Small rural centre' or a 'Large rural centre'. The classes in the ARIA classification and ASGC Remoteness Areas, on the other hand, are based on a remoteness measure (that is, ranges of ARIA and ARIA+ index values), rather than the urban centre population. Therefore it can be said that under the ARIA classification a Moderately Accessible locality is more remote than an Accessible locality and, under ASGC Remoteness Areas, a locality in Outer Regional Australia is more remote than a locality in Inner Regional Australia.
- In the RRMA classification, 'Capital cities' are based on Capital City Statistical Divisions (see page viii). Thus there is no differentiation between people living closer to the middle of a capital city and those living on the outskirts. Under ASGC Remoteness Areas, however, some parts of the outer suburban SLAs are classed as Inner Regional Australia, reflecting the lower level of access to goods and services experienced by people living in these areas compared to people living closer to the city centre.
- Under the RRMA classification, all capital cities are classed as 'Capital cities' regardless of the population size and relative remoteness of the individual cities. Under this classification, Darwin (population of approximately 70,000 and surrounded by sparsely

populated areas), and Hobart (population of approximately 125,000) are placed in the same class as Sydney (with a population of more than 4 million).

Strengths and weaknesses of ARIA

Strengths and weaknesses of ARIA methodology

The ARIA methodology has a number of advantages over the RRMA methodology:

- The ARIA methodology is conceptually simpler than the RRMA methodology in that it measures remoteness only in geographic terms whereas RRMA's 'Index of remoteness' combines a distance measure with a population density measure.
- The ARIA methodology uses the point location of towns and measures the distance of populated localities to the nearest of each category of service centre by road, whereas RRMA's 'Index of remoteness' uses a straight line measure from the centroid of the SLA to the closest of each category of service centre.
- The ARIA index values of an area are less likely to change over time than the RRMA class of an area. The ARIA index value of a populated locality will only change when the population in one or more of the four service centres changes significantly, resulting in a reclassification to a different service category. This robustness is enhanced by the wide range in population size defining each service centre category, and the fact that service centres with populations under 5,000 people are not included in the calculation of ARIA index values. (DHAC & GISCA 2001). The RRMA class of an area can also be affected by population changes in nearby service centres and by boundary changes. Additionally, the RRMA class of an area should change if the population of the urban centre within the SLA breaches a class threshold. For example, if an urban centre within a rural SLA increased in population from below 10,000 to above 10,000 then the RRMA class for this SLA would need to change from Other rural area (R3) to Small rural centre (R2).

A weakness in the ARIA methodology is that it can sometimes result in highly dissimilar areas being given the same remoteness score. For example, in 1999, the City of Dubbo and the shire of Urana (with populations of 36,701, and 1,497 respectively in 1996) had almost identical ARIA scores (2.82) and were therefore included in the same ARIA class (Accessible). The City of Dubbo was in this class mainly because it is a large regional centre, whereas Urana is in this class mainly as a result of its moderate proximity (approximately 100 km by road) to Wagga Wagga and Albury. Accessibility of health professionals and other issues affecting health in each of these two areas would likely be quite different. This is less of a problem in the methodologies underlying the RRMA and ASGC Remoteness classifications. In RRMA, the population size of the urban centre within the SLA is also taken into consideration. In ASGC Remoteness, ARIA+ better differentiates in regional and remote areas because it also reflects distance to the small service centres. Additionally, ASGC Remoteness Areas are based on the average ARIA+ score in CDs (rather than the larger SLAs).

The ARIA methodology is a purely geographical methodology based on distance measures. This is a strength of the ARIA methodology but also a limitation. This pure approach means that the methodology has to work with a number of assumptions which may not always be accurate. Two such assumptions relate to levels of car ownership and road conditions. Firstly, it is assumed that persons living in an area have access to road transport. While car ownership in Australia is widespread, some population groups, such as persons in rural areas (where, in addition, public transport can be lacking or limited) have lower levels of

access to road transport than the general population. Secondly, the ARIA methodology does not allow for differences in terms of road quality and road serviceability in calculating distance to service centres. For example, the remote Northern Territory community of Nhulunbuy is without road access for substantial parts of the year due to flooding (ABS 2001b). It should be noted that access to transport and road quality are also not addressed in either the RRMA or ARIA+ methodologies.

Strengths and weaknesses of the ARIA classification

A strength of the ARIA classification, in comparison to the RRMA classification, is that it differentiates between areas in terms of levels of accessibility/remoteness. Moderately Accessible areas are less accessible than Accessible areas but more accessible than Remote areas. Although the RRMA methodology allocates SLAs into Metropolitan, Rural and Remote zones the RRMA classification does not however describe the differing levels of accessibility/remoteness of SLAs within each zone, except by reference to the size of the population in the local town.

A disadvantage of the ARIA classification is the broadness of the range of index values of the non-remote classes. The class definitions used for the non-remote classes in the ARIA classification are broader than those used in ASGC Remoteness Areas. For example, the ARIA class 'Highly Accessible' includes metropolitan fringe areas and many regional centres whereas the ASGC Remoteness Area class of 'Major Cities of Australia' does not tend to include metropolitan fringe areas or any of the regional centres. The broadness of the ARIA classes therefore prevents comparisons between metropolitan, metropolitan-fringe and regional centre populations. The application of different cut-off index values to the continuous ARIA index would yield a version of the ARIA classification similar (but by no means identical) to ASGC Remoteness Areas.

Another disadvantage of the ARIA classification is that it defines 81% of the population as living in the most accessible class (Highly Accessible areas). This leaves 19% of the population to be shared between the other four areas, making statistical comparisons less reliable because of small population sizes in these areas. In ASGC Remoteness Areas only 66% of the population are allocated to the most accessible ASGC Remoteness Areas class (Major Cities of Australia), providing scope for greater statistical discrimination in areas outside this class.

Strengths and weaknesses of ASGC Remoteness Areas

ASGC Remoteness Areas classification is based on ARIA+ index values, rather than ARIA index values. ARIA+ has all of the advantages of the ARIA methodology (see 'Strengths and weaknesses of ARIA methodology' on page 15) as well as some additional advantages.

Strengths and weaknesses of ARIA+ methodology

In ARIA+, average distance is calculated from each populated locality to category E service centres (centres with a population of 1,000 to 4,999 persons) as well as to the four types of service centre used in the ARIA methodology. This gives ARIA+ a greater level of precision in its measurement of remoteness than the ARIA methodology (particularly in the more remote areas). However with the additional 545 (category E) towns on the list of reference

service centres, it is more likely that population change over time will result in the re-categorisation of service centres, creating a need to update the ARIA+ index values of an area. Thus ARIA+ index values are less stable over time than ARIA index values, particularly in remote areas (however, as a consequence, they may better reflect actual levels of remoteness at any time).

The ARIA+ methodology has the same weaknesses as the ARIA methodology (see 'Strengths and weaknesses of ARIA methodology' on page 15).

Strengths and weaknesses of ASGC Remoteness Areas

An advantage of the ASGC Remoteness Areas classification is that it defines the least remote areas more tightly than the ARIA classification because it has a lower cut-off index value for the least remote area. For example almost 8% of the population of the outer Sydney SLA of Baulkham Hills and 24% of the population of the outer Perth SLA of Mundaring live in CDs classified as Inner Regional Australia. This acknowledges the likelihood that outer suburban areas would have lower levels of access to goods and services than areas closer to the Central Business District. In the ARIA classification these two SLAs are classed as Highly Accessible, as are regional centres such as the Cities of Tamworth, Orange and Wagga Wagga.

An advantage of this classification over the RRMA classification is that it does not include the least accessible of the capital cities in the least remote class. Areas within Hobart are classed as Inner Regional Australia and areas in Darwin are classed as Outer Regional Australia because these capital cities are not category A service centres (service centres with populations of equal to or more than 250,000 persons) in their own right.

Although ASGC Remoteness Areas defines the least remote classes more closely than the RRMA and ARIA classifications, the classification is not perfect. The cut-off index values used to distinguish between each ASGC Remoteness Areas class are 'relatively arbitrary' (as they are in the ARIA classification). ASGC Remoteness Areas groups areas that have similar, but not identical, characteristics of remoteness (ABS 2003).

The practical limitations of remoteness classifications

Certain limitations have been identified in relation to the use of remoteness classifications:

- Boundary and population changes can make concordances based on remoteness classifications less precise over time and this can affect the quality of data that is cross-classified by remoteness, particularly data collected during the years between the censuses.
- Remoteness classifications only indicate relative levels of accessibility to goods and services. As such, their effectiveness as a means of determining funding to non-metropolitan areas may be limited (page 20).
- Use of any of the three classifications at the local level should be cautious (page 21). Changes to the boundaries of administrative areas such as SLAs, population change affecting real levels of remoteness within an SLA, and the wide range of levels of remoteness within some SLAs could adversely affect the accuracy of the perceived level of remoteness for at least some residents within an SLA.

The ravages of time

The fictional SLA of Kickatinalong would always be classified as an 'Other Rural Area' under the RRMA classification, as 'Moderately Accessible' under the ARIA classification, and as 'Outer Regional Australia' under ASGC Remoteness Areas if:

- the population in this area (and surrounding areas—including the major metropolitan centres) remained the same;
- new roads were never built (and old roads were maintained); and
- Kickatinalong's boundary did not change.

Such a situation would rarely, if ever, occur and there are a number of scenarios that could result in Kickatinalong's RRMA, ARIA and ASGC Remoteness Areas classes changing.

The RRMA class for the non-metropolitan SLA of Kickatinalong could change if any of the following occurred:

- Kickatinalong SLA's boundary changed either by being broken up and/or amalgamated with adjoining SLAs. This would alter the population of the SLA, and the 'personal distance' and 'distance' factors from which the RRMA zone of non-metropolitan SLAs are derived.
- Kickatinalong's index of remoteness score changed from a rural score (less than or equal to 10.5) to a remote score (greater than 10.5), or vice versa, because of population change within the SLA and/or in the nearest service centres.
- The population of the urban centre within Kickatinalong increased or decreased beyond the population thresholds of the original RRMA class. For example, if Kickatinalong was a rural SLA with a population of 24,500 in 1991, it would then have been classed as a Small Rural Centre (rural SLAs with an urban centre population of between 10,000 and

24,999). However, if its population became equal to or greater than 25,000 in 2001, it would need to be reclassified as a Large Rural Centre.

The ARIA and ARIA+ index values of points within Kickatinalong SLA could change if:

- Kickatinalong SLA's boundary changed either by being broken up and/or amalgamating with adjoining SLAs;
- The population of the nearest service centres that contributed to Kickatinalong's ARIA and ARIA+ index values changed significantly. For example, suppose that, in 1991, Kickatinalong was a category C centre of 18,100 persons. Suppose also that it was 2.0 times as distant from the nearest category A service centre as the average distance of all populated localities to their nearest category A service centre, 2.8 times as far as the average from a category B centre and 0 times as far from a category C centre (Kickatinalong itself is a C centre) as the average and therefore 0 times as far from a category D centre as the average.[8] Its ARIA index value in 1991 would have been 4.8. Suppose, however, that by 2001 Kickatinalong's population had declined to 17,900, thus making it a D type centre. If the nearest C centre was 2.5 times the average distance away then the new ARIA index value would be 7.3 (2.0 + 2.8 + 2.5 + 0).

In both scenarios, the ARIA class of Kickatinalong SLA could change, and the proportion of the SLA's population living in each ASGC Remoteness Areas class could change. Such changes would be reflected once the ARIA and ARIA+ grids were recalculated and new ARIA and ASGC Remoteness concordances were produced.

An interim fix for boundary changes

Boundary changes are a common occurrence, particularly at the SLA level. In most years, boundaries of some of the (approximately) 1,300 SLAs change to reflect changes in Local Government Area boundaries, and for other reasons. Users who wish to analyse data by remoteness, collected in a particular year, use interim concordances based on that year's SLA boundaries.

These concordances attempt to reflect how a change in an SLA boundary has affected the way the SLA's population is distributed among remoteness classes. For example, suppose that in 2001, all of the population of Kickatinalong lived in CDs classified as 'Outer Regional' and all of the population in the neighbouring fictional SLA of One Tree Plains lived in CDs classified as 'Remote'. The 2001 ASGC Remoteness Areas population-weighted concordance for these two areas would be:

One Tree Plains	R
Kickatinalong	OR

Suppose that in 2003 Kickatinalong was amalgamated with One Tree Plains SLA to form the new SLA of Kickatinalong/One Tree Plains. In 2001, One Tree Plains had half the population of Kickatinalong. The new 2003 ASGC Remoteness Areas population-weighted concordance would therefore be:

Kickatinalong/One Tree Plains	OR 66.7%	R 33.3%

8 Where a larger centre is closer to a populated locality than a smaller centre, the ratio of the distance to the smaller centre is calculated as 0. This is because it is assumed that the goods and services available in the smaller centre are also available in the larger centre.

This is a neat example. In other cases, however, it is more difficult to determine how to accurately apportion the new SLA's population into remoteness classes (for example, when an SLA is split or amalgamated with only a proportion of a neighbouring SLA). Thus these interim concordances can be somewhat imprecise.

The alternative to using these interim concordances would be to exclude from the analysis any areas subject to boundary changes. This could result in large and growing data loss, and introduce bias to the results, particularly during periods when many administrative boundaries are being changed (for example, Victoria for a period in the 1990s, when many Local Government Areas were amalgamated).

At the local (e.g. individual SLA) level, use of these 'imprecise' yearly concordances could create considerable inaccuracy; however at an aggregated (e.g. national) level, their use is unlikely to result in systematic bias.

Funding and remoteness classifications

Apart from their use in statistical reporting, RRMA and ARIA have been used as a means to allocate funding to different areas. For example, ARIA index values are used to assess the remoteness of the location of rural aged care homes for the purpose of increasing viability funding (DHAC 2001). The ARIA and ARIA+ methodologies measure relative access to services (with distance measures at its foundation) and are considered quite good at measuring relative access to health services[9]. This has been an argument for using the various remoteness classifications as a 'stand alone' indicator in determining funding allocation.

However, remoteness may not be the only issue affecting health issues and the need for additional funding. For example, remote localities where a large proportion of the population is Indigenous, or where health outcomes are worse, could arguably require higher levels of funding than other remote localities. Remote areas, where the local town has a population of 100, are arguably less capable of providing certain (e.g. GP) services or opportunities for their populations than those where the local town has a population of 4,000. Areas where the physical and social environment is attractive are likely to be more successful in recruiting and retaining health workers than other areas. People living in areas with restricted access to work, or with lower paying jobs, are likely to be more disadvantaged than people in other areas. Over large areas, the level of remoteness and some of these other issues can be correlated (for example, nationally, remoteness is correlated to the proportion of the population who are Indigenous), but this is not always the case at the local level.

Because issues other than remoteness can also be important, caution is advised in using remoteness classifications to determine levels of funding, or as the basis for the reporting of regional statistics.

The ABS, in releasing ASGC Remoteness Areas, has advised caution in using remoteness classifications in isolation from other variables when addressing policy issues such as funding. They state that it '…is vitally important that anyone developing policies, funding formulae or intervention strategies understands the alignment, or lack of alignment, between

9 Analysis of services information, undertaken by Desk Top Mapping Services Pty Ltd and based on information obtained from Telstra White Pages and Yellow Pages, shows quite a strong relationship between population size and availability of health services (DHAC & GISCA 2001).

a particular geographical classification and their business objective' (ABS 2003). In most cases, several variables, besides remoteness, may be pertinent, and remoteness '…is not intended to be a "stand alone" indicator of advantage or disadvantage' (ABS 2003).

Using remoteness classifications at the local level

All three geographic classifications are most valid when used to aggregate data over large geographic areas, but may be misleading when used for smaller areas. At the local level, they should be used very carefully indeed.

Use at the local level can involve the matching of a person's or organisation's postcode or SLA, with a concordance that relates that postcode or SLA to a level of remoteness (for example, where a particular level of remoteness attracts a financial bonus). Alternatively, remoteness may be allocated at the local level for statistical reporting.

At issue is the accuracy of the estimate of remoteness given to a particular local area (such as an SLA or an area approximating a postcode).

At the local level, the allocated category may not be appropriate for any of the following reasons:

- Under all the classifications (particularly ARIA and RRMA), some of the population living in geographically large SLAs can live in areas that are substantially more (or less) remote than the 'official ' level of remoteness allocated to those SLAs. This issue is well illustrated by the SLAs of Kalgoorlie/Boulder (part B) and Balranald, within which are areas with very diverse levels of remoteness (with ARIA index values ranging from 3.9 to 12.0, and 3.4 and 8.2 respectively). There are many other such areas.
- Population changes and additions to road networks over time will tend to alter the level of remoteness in specific areas. While the effect of these changes on 'average' national data is likely to be small and gradual, its effect at the local level may be substantial. If classifications are not updated to reflect real levels of remoteness in specific areas, the population in affected areas runs the risk of being incorrectly classified as having one level of remoteness, while experiencing another.
- Without regular revision of concordances, SLA boundary changes make it increasingly difficult over time to accurately allocate specific areas with a valid measure of remoteness. Use of 'interim concordances' (that is, those updated to allow for changes in SLA boundaries), while being serviceable at the national level, can be inaccurate at the local level.
- In the case of ASGC Remoteness, the boundary between one level of remoteness and another may cut across SLAs or postcodes. This obviously complicates the allocation of a remoteness category to the area, because from the concordance, it is unclear which remoteness category to allocate to which particular areas within the SLA or postcode boundary.

Application of geographic classifications, using spatial markers such as postcodes or SLAs, should be considered especially carefully where:

- the area exhibits a wide range of ARIA index scores;
- the populations of the area and/or nearby service centres have changed;
- the area has been affected by boundary changes since the concordance was developed.

At the broad geographic level (for example, when comparing rates of death in each of the five broad ASGC Remoteness Areas), the inaccuracies involved in allocating remoteness using concordances are expected to 'average out'.