



Census mapping methodology using remote sensing and GIS technology

Prepared for

The Seychelles National Statistics Bureau

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In cooperation with

The National Statistics Bureau

November 2007

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1. Introduction

The use of Aerial Photography/satellite imagery and GIS techniques in the census mapping process enables an organization to accurately demarcate the whole country within a prescribed and correct geographic frame. The purpose of this document is to describe the specific methodology to be implemented during the census mapping process, as well as ancillary processes, definitions or methodologies that are relevant to the main process.

1.1 Census Cartography Definition

Before enumeration is undertaken, the country is divided into smaller units of about equal population size, each of which will be assigned to at least one enumerator to enumerate its total population. The smaller units are called Standard Enumeration Areas (SEAs). For the purpose of this document, the acronym EA will be used to denote a SEA. Census Mapping is the process of dividing the country into smaller units of land, during which EA boundaries and type are clearly described and the number of communally based services is identified.

1.2 Objectives of Census Mapping

The main objective of census mapping is to subdivide the country into small Standard Enumeration Areas (EAs), each of which will be assigned a unique identification code on the basis of the country's administrative divisions.

The demarcation of EAs should be such that they satisfy the following requirements:

- a) boundaries and starting points are clearly identifiable.
- b) boundaries of EAs should not cut across existing Region or District Boundaries. All social boundaries should be respected.
- c) EAs should not overlap with one another.
- d) each EA should be of a reasonable size (in population and land area).

This will ensure that every person in the country is enumerated in the census, i.e. no one should be missed or double counted.

Other aims include:

- Determining the location of the population in advance of the enumeration in order to make possible the recruitment, training and allocation of a sufficient number of enumerators to ensure that enumeration is completed in time without omissions or duplications;
- Establishing the framework for sample surveys prior, during or after enumeration;
- Enabling the census organization to provide results for areas whose locations are known;
- To update the Place Name layer
- In the case of Seychelles to maintain the Geo-reference Dwelling frame that is in turn used for EA demarcation

2. Background and existing methodology

A digital EA dataset for Seychelles already exists. The dataset was created by the GIS Unit of NSB utilising the existing infrastructure.

Following is a brief description of the method used to create the digital Enumerator Area dataset:

A digital set of the EA boundaries were created by digitising the 1994 EA sketch maps using a digitising tablet. The sketch maps of the Enumerator Area Boundaries were drawn on hardcopy Topographical maps. The maps included the land parcels, contours and some topographical data such as roads. These hardcopy maps were used to digitise the EAS.

The EA boundaries were later modified to fit the 1998 digital colour aerial photography backdrop data. A digital set of the parcel boundaries was also used to realign the EA boundaries. Arcview 3.2 was used to digitise and modify the boundaries.

The EA dataset is currently being updated by the GIS Unit and field teams:

Following is a brief description of the EA updating methodology:

The Ministry of National Development was tasked to digitise the physical boundaries of all the buildings visible on the Digital Orthophotos. The above mentioned information together with the ministry of Lands and Transport, Roads and Parcel data as well as the Ministry of Environment's rivers data were printed on A2/A1/A0 fieldwork maps (depending on size of ea's). The fieldwork teams then set out to update the information, verify the EA boundaries and capture new data such as roads and places of interest. Buildings not captured by National Development together with new buildings were also captured and indicated on the maps. All the households were given a number per EA on the map; the corresponding number was captured on a listing form together with the following information: District Name, EA Number, Location Name, Name and Surname of Head of Household, Type of Building and Use.

The annotated maps were send back to the Ministry of National Development and the new structures indicated by the fieldwork teams were also captured in the GIS. The newly captured dwelling data was loaded into the NSB GIS system. The Household/Structure number was captured in the GIS and the listing information was separately captured and then linked to the GIS. All the other annotations were also captured.

The data in the listing forms linked to the household/structure per EA in the GIS is known as the Geo-referenced Dwelling frame. After all the data was successfully loaded, linked and captured the EA layer was updated.

The Geo-referenced dwelling frame is an important data set that must be maintained. The information will prove to be very valuable during the census as it will be of great assistance to the census enumerator, the data can also be used for subsequent surveys.

The fieldwork exercise for the creation of the geo-referenced dwelling frame, verifying/updating EA boundaries and capturing new information has been completed.

The creation of the *digital* Geo-referenced dwelling frame, editing of the EA boundaries and capturing of the annotation data in the GIS has not been completed as yet.

The Geo-referenced Dwelling frame will be used for demarcation and integrated as part of the New Census Mapping Methodology. It will be further enhanced and updated through the implementation of the new methodology. As mentioned, the existing 2002 EAS has been verified and updated on the fieldwork maps. The above mentioned information will form the base for updating and re-demarcating the EA boundaries.

The fieldwork teams are currently using a duplicate hardcopy fieldwork map to revisit some of the areas and update/verify the information and capture new information. The NSB fieldwork teams

plans to revisit all the EAS in the Seychelles to update the current EAS as well as the Georeferenced Dwelling frame. The new Census Mapping Methodology must be utilised in this instance.

3. Census Mapping Methodology

The basic steps in Census Mapping Methodology are:

- GIS Implementation
- Imagery Coverage
- Creation of accurate geographic frame
- Deciding on EA parameters
- Office demarcation, re-demarcation, updating and correction
- Map creation and printing
- Field verification
- Office updating and correction
- Map creation and printing

3.1 GIS Implementation

An operational GIS is the platform on which the whole methodology is built and therefore a necessity. An operational GIS consists of:

- Effective and relevant hardware, in place and operational, connected to a network
- Relevant and appropriate software
- Relevant, current, accurate and appropriate spatial and attribute data
- Dedicated, skilled and experienced staff who understands the technology, methodology and processes
- Appropriate and accurate methodology

Only once the GIS are operational can the rest of the steps be undertaken. The Mission report suggests steps that should be implemented in order for the GIS Unit to become fully operational.

3.2 Imagery coverage

Specific action items under image coverage will include:

- Store existing 1998 Color Aerial Photography imagery in appropriate format and load as part of database.
- Obtain new backdrop imagery for the entire Seychelles at appropriate accuracy and scale
- Store new 2007/2008 Color Satellite imagery in appropriate format and load as part of database.

3.3 Creation of accurate geographic frame

EA's forms the smallest building block of the Geographic Frame and falls within the Districts, the District Boundaries needs to be accurate. Since the District Boundaries were derived from topographic maps sheets, the accuracy is not sufficient. The District Boundaries must be recaptured using the official Electoral Commissions District Boundary descriptions.

Only once the District Boundary Layer of the geographic frame has been created, can the re-demarcation and updating of EA boundaries begin.

3.4 Deciding on EA parameters

A decision must be made and guidelines determined for the following parameters:

- EA Type definitions – Determine the types of EAs to be demarcated
- EA Size definitions – Determine the size of the EAs to be demarcated by type
- Determine the demarcation rules pertaining to EA location, boundary creation and attribute creation.
- Determine the correct EA geo-code

Only once all the relevant EA parameters have been determined, can actual EA demarcation commence.

3.5 Office demarcation, re-demarcation, updating and correction

Office demarcation entails the process by which one demarcates new and re-demarcates existing EAs through on-screen digitizing, editing and GIS functionality using the new imagery and vector data as a backdrop. The minimum information to be loaded and displayed on the GIS before demarcation can commence are:

- The relevant satellite imagery
- The Regional boundaries
- The District boundaries
- The existing 2002 Digitized EA Boundaries including any changes made during the current fieldwork exercise
- Newly created Dwelling Frame
- Place name points
- School points
- Health facility points
- Places of interest points
- Roads
- Rivers
- Cadastral/Parcel Boundaries

3.6 Field Verification

Field verification entails the process by which the information captured and created in the GIS office, is verified and updated in the field. This includes the EA data, Geo-referenced Dwelling frame, landmarks, and topographical features such as roads and rivers. Maps will be printed for the field workers to use in the field. The EA boundary, size and shape will be verified against the set criteria. The fieldworkers will suggest any changes for the EA by indicating this on the map. In addition, the fieldworker will also update the Geo-referenced dwelling frame. The existing data will be verified and updated and any new data will be captured. Other information such as landmarks will also be verified and captured, and any changes will be annotated.

3.7 Office updating and verification

Once all the fieldwork for an EA has been completed the updated information must be included in the GIS. The Geo-referenced Dwelling frame is also updated. The dwelling frame is an essential part of the methodology as it supports the decision making process regarding merging or splitting of EAS when looking at the EA size parameters. The fieldworkers suggestions regarding alterations to the EA delineation will also be taken into account and changed accordingly. The final decision to change the EA will be made in the GIS office. The decision to change an EA can only be made once all the above

mentioned information has been loaded and together with the annotated fieldwork maps, an informed decision can be made.

3.8 Map Creation and Printing

The map creation can now commence. Map creation entails creation of Census Enumeration Maps as well as all other maps associated with the management of the actual census. Census Enumeration Map Standards must be put in place in order to address the following issues:

- What features must be included on the maps?
- What colors must be used for the features on the maps?
- What is the best scale to be used?
- When must a map be split into more than one map?
- What other descriptive information must be included on the maps?
- What listing form information should be included with the map?
- Will the maps be A4, A3, A2 or A1 in size?
- Can a LaserJet printer be used or should a plotter be used?
- Will the maps be printed in duplicate?
- Will the maps be printed on water proof paper?
- Will water resistant print cartridges be used when using the plotter?

Only when the above mentioned topics have been addresses can the printing/plotting commence.

4. Seychelles proposed Geographic Frame

4.1 Current administrative frame

- 5 Regions
- 25 Districts
- Census Supervisor Areas
- Standard Enumerator Areas

4.2 2010 Census Geocode

The basic geocode will be constructed according to the geographic frame. It is imperative for proper GIS spatial and attribute analysis that the geocode accurately reflects the geographic frame and administrative hierarchy of the country. As Seychelles are relatively small a big complicated geocode is unnecessary.

The 2010 Census EA geocode will consist out of 4 digits and adhere to the following structure:

Geographic Frame	District		EA	
	1	2	3	4
Digit				

4.3 Settlement types

For the demarcation of EA's in Seychelles, no distinction will be made between settlement types. Institutions will form part of an existing EA.

Although no distinction will be made between urban and rural settlement types, care will be taken when EAS are demarcated to ensure that settlements areas with similar densities or patterns are demarcated together.

4.4 Main EA Types

Demarcation will adhere to the following EA types:

- Vacant EAs: In order to ensure the accuracy of spatial demographic and census indicator statistical analysis and map creation, settled areas cannot be demarcated as part of large unsettled areas such as grazing land since it will spatially misrepresent any statistical analysis. Therefore, large vacant areas will be demarcated as a separate entity which will add to the credibility and relevancy of GIS analysis and dissemination.
- Residential EAs: These are all predominantly residential EAs.
- Agricultural EAs: These are EAs covering predominantly agricultural land and settlements
- State/Parks: These represent all large tracks of state owned land such as national forests as well as national parks and reserves.
- Industrial/Mining: These are EAs predominantly covering industrial or mining settlements or areas
- Institutional EAs: These are EAs consisting out of large institutions, such as hospitals, army and police barracks and prisons. At the moment there is no such EA's in Seychelles

4.5 EA Subtypes

An EA subtype is a further definition to illustrate any subordinate types aspects of the EA, for example if there is an institution present as part of the larger EA. The subtype will be captured as part of the attribute information of the EA.

The following subtypes have been identified and will be used where relevant:

- No subtype
- Institution only – should the EA consist entirely of a large institution
- Part institution – where a small institution is part of the EA

4.6 EA Size Parameters

The EA size parameters have been chosen to ensure a balance between geographical size and population size while keeping in mind that the enumerator should comfortably be able to visit all households within the EA within the specified enumeration time frame.

EAs are demarcated from digital imagery using modern GIS techniques. The Geo-referenced dwelling frame households will be used as size indicators. Dwelling Units are normally used when the Dwelling frame is not included, this again illustrate the importance of an updated Geo-referenced Dwelling frame.

The following sizes are specified:

EA TYPE	PRESCRIBED SIZE
VACANT	<10 Square km
RESEDENTIAL	60-80 Households
STATE/PARKS	No size, demarcate by type only

AGRICULTURAL	60-70 Households
INSTITUTIONAL	Depends on type of institution

4.7 EA Attribute Table

ATTRIBUTE	DESCRIPTION	DATA TYPE
EA_NUMBER	Relevant EA geo-code	Number
ISLAND	Relevant Island geo-code	Number
REGION	Relevant region code	Number
DISTRICT	Relevant district code	Number
EA_TYPE	Relevant EA type code	Number
EA_SUBTYPE	Relevant EA subtype code	Number
EA_NAME	Primary Place Name	Text

5. CONCEPTS AND DEFINITIONS

The most important concepts we are defining are:

5.1 Standard Enumerator Areas - what are they?

As we have seen, the purpose of census mapping is to divide each district into small manageable geographical units called Standard Enumerator Areas (EAs). The whole country should be covered in this process.

An EA is a small unit of about equal population size, each of which will be assigned to a single enumerator to enumerate its total population. A EA has distinct boundaries that are describable. Its size is determined by a number of factors, among which the most important are, but not limited to, and not in order of priority: -

- a) A number of households
- b) easily manageable by at least one enumerator for the specified period of enumeration;
- c) topographically accessible;
- d) unique in that it should not cut through any administrative boundary.
- e) EAs do not and should not overlap;
- f) An EA should have a unique number.

An enumerator area number is a unique -digit number given to a EA for purposes of record keeping and coding.

5.2 A Household

A household is either:

A one-person household, defined as an arrangement in which one person provides his or her own food or other essentials for living without combining with any other person to form part of a multi-person household, OR

A multi-person household defined as a group of two or more persons living together who make common provision for food or other essentials for living.

- the persons in a group may pool their incomes and have a common budget to a greater or lesser extent;

- they may be related or unrelated persons or a combination of persons both related and unrelated.

5.3 Head of Household

A *head of household* is the person that the household regards as such, and is usually the person who assumes responsibility for decision-making in the household. The head could be either a male or female. NB. There should be one head of a household.

Where property is equally owned and responsibilities of both the husband and the wife are seen as equal, then age should be considered to determine who the head of the household is.

5.4 Head of household, acting

A person, who assumes decision-making responsibility of the head of household in the absence of the designated head, is regarded as the *acting head of household*, sometimes referred to as reference person.

5.5 Dwelling(s)

Type of dwelling refers to various types of structures used for accommodation. Such structures include - houses, townhouses, flats/apartments, hostels, huts, shacks, semi-detached houses, and sometimes structures that are not intended for human occupation.

5.6 Dwelling unit

A dwelling unit is a unit of accommodation of a household that may be vacant or shared by more than one household. Dwelling unit, housing unit, living quarters and stands can be used interchangeably.

5.7 Physical address

A physical address is a physical location of a dwelling unit of household(s). It consists of a number and street name, e.g. 625 Church Street.

6. Basic Demarcation Rules

Based on global recommendations and past experiences the following guiding factors are recommended for EA delineation.

6.1 EA Boundaries

- a) An EA should be delineated within the lowest order of administrative divisions and in consideration of other sub-division/social structures for which the census data are to be reported.
- b) As far as possible, the boundaries of EAs should be made identifiable by delineating along some permanent (preferably physical) feature such as rivers, ridges, a street or visible parcel boundaries etc. Where such features are non-existent, parcel boundaries not visible can be used or imaginary boundary lines may be drawn and identified with reference to prominent buildings or other bench mark features.
- c) An EA delineated within the urban areas should not extend over the adjoining rural areas.
- d) All EAs have to be demarcated within the defined geographic and social boundary framework.

- e) Superimposed EA boundaries must follow and match the most recent officially proclaimed administrative boundaries
- f) As far as possible, boundaries should be demarcated on physical and visible features that makes geographic and demarcation sense.
- g) Where EA boundaries do not fit properly on the underlying backdrop data, it must be corrected, modified, moved and shifted to fit.
- h) Each map layout of an EA should point out an easily identifiable, permanent, physical starting point for the sake of the enumerator.

6.2 Size and shape

- a) EAs in an administrative area should cover its entire space in an exhaustive and mutually exclusive manner. That is, every parcel of land area should be allocated to one or the other EA and no gaps or overlaps must occur.
- b) An EA should be of a compact size, to the possible extent and must not have any outlying pockets.
- c) In the areas of sparse population distribution, the territorial size of EAs should be such that the respective enumerators can cover them by walking during the specified period of enumeration.
- d) As far as possible the enumeration areas should have population closer to the prescribed size.
- e) EAs should be demarcated as closed, contiguous polygons, without any gaps or overlaps, and within the specified size criteria as set by the CSO.
- f) Vacant areas should be demarcated on-screen as far as possible and then verified in the field if the need arises.
- g) Access to each part of the area should, as far as possible, be relatively easy.

7. Office demarcation, re-demarcation, updating and correction methodology

7.1 Inputs before demarcation can commence

Before demarcation can commence certain inputs need to be in place in order for one to make demarcation decisions effectively. The most basic inputs needed would be location, type and size.

Location: Where is this settlement? What is the name of this settlement? Are there any distinct social or administrative boundaries within this settlement?

Size: What is the size of the settlement? Given the size criteria of the demarcation parameters, how would you go about breaking the settlement up into small puzzle pieces of relatively the same size and structure type?

Collectively, we can refer the information noted above as **general demarcation information**, the minimum amount of information we would need to demarcate a given settlement.

Once all this information has been accounted for, we need to load the backdrop or base map data to begin demarcation. Fortunately, the whole of Seychelles is covered with high-resolution digital satellite imagery, vector data, updated 2003 EA layer and the geo-referenced dwelling frame, which provides an excellent and accurate base for census cartography.

7.2 Basic principles

The basic principles of your methodology are as follow:

- Find the relevant area you want to demarcate
- Remember, demarcation must be done systematically so as to not miss any areas. The best way would be to use existing 2003 EA boundaries and place names.
- Once the specific area has been identified, assess the following:
 - Determine if you would like to demarcate a new EA or re-demarcate an existing EA taking into account the new District Boundaries
 - Determine if the existing Geo-referenced dwelling frame as well as any additional data annotated on the fieldwork maps have been completely captured for the EA that you would like to re-demarcate, or for the area that you would like to demarcate
 - Verify/Capture the Geo-referenced dwelling frame data as well as any additional data annotated on the maps
 - Determine the size of the EA, the geo-referenced dwelling frame will be used as a guide for the size parameter
 - Determine a permanent and physical starting point as far as possible
 - Verify the existing EA boundary and determine a new EA boundary if necessary using physical features (roads, rivers, footpaths, fences etc) as far as possible
 - Determine the geocode of the EA according to location and type.
 - Make sure that proper GIS rules are used when capturing and editing the data. The EA layer must be "clean". The vertexes of the EA boundary should run on top of the neighboring EAs vertexes. Where vector line or polygon data is used for delineating the boundary the vertexes should also be on top of the vector data vertexes. The EA boundary topology must be maintained and there must be no open spaces or gaps.

7.3 Basic Processes

Location

Use the boundary specifications as set out in the Demarcation Rules. All EA boundaries must fit to the backdrop. If not, why? All rules should be followed as far as possible. Reasons must be given for exceptions.

Boundaries must adhere to: Regional boundaries
 District boundaries

Other social boundaries, such as section boundaries within settlements and the like. Ensure that stands, plots or parcels are not split by EA boundaries.

Place Names

Determine the most correct place name from the additional spatial and attribute data available. Alternative names should also be listed. Use the updates 2003 Census EA data and the Geo-referenced dwelling frame.

Shape

Make sure that the EA has a logical shape.

Size

Each EA needs to be demarcated according to specified size criteria. If not possible, the reasons should be flagged as part of the EA attribute structure.

EA Number

Make sure the EA is geo-coded correctly according to the prescribed geo-code structure.

EA Type

Determine the correct classification by using the available digital and hardcopy data. If doubt exists, flag the EA to be verified in the field.

EA Sub Type

Determine the correct classification. If doubt exists, flag the EA for field verification.

Accessibility to the EA

Is the EA easily accessible by means of roads or footpaths?

The boundaries

Does the EA boundary make sense, i.e. it must not cut across national roads, rivers, mountain ranges etc. Moreover, the boundaries must not cut into another social or administrative area. All EA boundaries should concur with the Demarcation Rules.

Mobility within the EA

Can the enumerator move along easily within the EA, or is the terrain very difficult to negotiate. There should be no un-crossable obstacles (mountain ranges, big rivers etc.) within a EA.

Vacant EAs

All vacant EAs should be re-demarcated on-screen with the use of existing digital and hardcopy information as far as possible. Those that can not be dealt with by on-screen demarcation needs to be flagged for fieldwork verification. The following needs to be kept in mind when making decisions during on-screen demarcation of vacant land:

- Determine, with the use of current satellite photography, aerial photography or conventional fieldwork whether the EA is still vacant.
- The large vacant areas should be split into smaller, more manageable units
- Again, boundaries should as far as possible follow identifiable, physical features and should adhere to basic demarcation principles as set out in the demarcation rules

7.4 Institutions

All institutions in the Seychelles is currently demarcated and incorporated as part of the surrounding EA. An Institution demarcation methodology is included at the end of this document that can be used should it later become necessary to demarcate institutions separately.

7.5 Block of flats and apartments

From the new imagery, carefully determine new buildings that do not form part of the Geo-referenced dwelling frame that might be flat or apartment blocks. Also make use of cadastral information where relevant to determine the occurrence of apartment blocks. Flag these EAs so that they can be investigated during the fieldwork verification phase.

8. Fieldwork Map creation and printing

Once a specific district or manageable area has been completely demarcated, re-demarcated, updated and corrected, NSB will have to create and print EA verification maps for every single EA. The smaller more dense EA's can be printed on A3 size paper and the larger EAS on A2 size. All the relevant backdrop information including the Geo-referenced dwelling frame must be included on the map. The listing information must also be printed for every EA and must form part of the fieldwork verification. These field verification maps will then be distributed to the relevant fieldworkers to conduct the field verification and data capturing exercise.

9. Field verification

The following methodology will be implemented during field verification:

9.1 Protocol issues

Working on a settlement level, it is important to make your presence and purpose known and clear to the local inhabitants in order for you to continue your work in the area safely and without hassles. Informed people are cooperative people.

9.2 Fieldwork verification processes

- Make sure you have all the relevant demarcation information at hand, as well as the photo map and listing information.
- Follow fieldwork protocol
- **ORIENTATE** the photomap. Look for structures of features on the map that you can identify on the ground, such as a pond, community hall, prominent fence etc. Remember these photos are in colour and can therefore be used to help you orientate the photo map and determine where you are. If you see a prominent feature on the map but you do not know where it is or what it is, do not be afraid to ask the locals to point you in the right direction. Some people can pick features quite easily by looking at a photo.
- Once the photomap is orientated, determine the EA you want to verify.
- Drive or walk round the boundary of the EA to verify the starting point, the boundary itself as well as any prominent landmarks as far as possible.
- If there is a problem with the starting point (it might be a structure that was demolished since the maps have been printed), correct it by choosing another starting point that appears both on the ground and on the map
- If the EA boundary is incorrect for some reason, you should also correct it, bearing in mind that it will have an effect on the neighboring EA's boundary.
- Remember to adhere to administrative boundaries. Adhering to administrative and social boundaries gives more credibility to the dissemination process, since census information can accurately be displayed at different geographic levels, such as region, district, ward, village, sub-village, town or suburb.
- Verify the EA according to location and type.
- Remember that no overlaps of EAs or gaps between neighboring EAs should occur. It is easy to check this on the photo map when you have completed the section on which you were working. Make sure that the whole area that you were supposed to cover, has been done
- Verify the size, shape and general characteristics of the EA
- Verify and capture new dwellings on the maps, GPS the position of the dwellings in areas where it is difficult to correctly plot them on the maps. In areas where there is lush

vegetation it makes it extremely difficult to identify and correlate features on the ground and on the map.

- Indicate the relative position of the GPS point as well as the GPS point number on the map
- Identify the households and give new households a new number. The corresponding number must also be captured on the listing form.
- Verify and update the existing listing form information and capture new listing information to be included as part of the Geo-referenced Dwelling Frame.
- Determine the names of the prominent landmarks (school, police station, church, hospital etc.) and write it next to the appropriate number on the EA annotation list.
- Remember that the prominent landmark data as well as the Geo-referenced dwelling frame data will be part of the Enumerators Map during the Census and can therefore also be used as a starting point.
- Determine whether the area name in the EA in is the correct one, if not correct it.
- Ensure that your quick count listing is done accurately, make sure the household numbers on EA fieldwork map match those on the listing form.
- When a situation occurs where you are verifying one part of a settlement and another person\’s the rest of the settlement, make sure that every person is exactly sure which area he or she is responsible for. Areas can easily be missed or even verified twice by different people, therefore communication and coordination is of utmost importance.
- Determine whether an Enumerator will be able to complete the EA in the allotted time frame
- Remember to look after the maps, they are a valuable and restricted resource. All maps have to be filed properly and stored safely. During fieldwork, make sure to fold them neatly, keep them from getting wet and dirty and make sure they are not torn. If by some chance a map is torn, repair it immediately with clear sticky tape.
- Once every EA in the area have been verified, you can view the verification process as complete.

9.3 Basic Fieldwork processes

Initial preparation

Gather all relevant demarcation information and photomaps. While in the field, check the EA as a whole as well as the surrounding EAs.

Location

Use the boundary specifications as set out in the Demarcation Rules. All EA boundaries must fit to the backdrop. If not, why? All rules should be followed as far as possible. Reasons must be given for exceptions.

Place Names

Determine the most correct place name for the area that the EA falls within. Alternative names should also be listed; this information can be gathered from the local population. Also determine and note all relevant sub-place names.

Shape

Make sure that the EA has a logical shape. Eliminate “octopus” EAs;

Size

Each EA needs to be demarcated according to specified size criteria. Determine whether the EA complies with the criteria. If not, the EA should be corrected.

EA Type

Determine if the EA was correctly classified.

EA Sub Type

Determine the sub type of the EA, where applicable.

Accessibility to the EA

Is the EA easily accessible by means of roads? If not, what alternative transport can be used? As a last resort, the EA should be re-demarcated.

Starting Point

Is the starting point clearly identifiable?

The boundaries

Does the EA boundary make sense, i.e. it must not cut across national roads, rivers, mountain ranges etc. Moreover, the boundaries must not cut into another social or administrative area. All EA boundaries should concur with the Demarcation Rules as far as possible.

Mobility within the EA

Can the enumerator move along easily within the EA, or is the terrain very difficult to negotiate. There should be no uncrossable obstacles (mountain ranges, big rivers etc.) within a EA.

Quick count

Do the household quick count according to the prescribed methodology

9.4 Vacant EAs

The following should be considered when demarcating vacant areas in the field:

- Determine if there are any areas within the EA that is not vacant anymore.
- If not, the part that has population should either be incorporated into a neighboring populated EA, or, if the population is big enough, should be demarcated as a EA on its own.
- The large vacant areas should be split into smaller, more manageable units
- Again, boundaries should as far as possible follow identifiable, physical features and should adhere to basic demarcation principles as set out in the demarcation rules.

9.5 Institutions

Identify all institutions in the EA by following the flagged structures as well as canvassing the EA for institutions and finding out from the local populace about institutions that might occur within the EA. The normal demarcation rules apply as set out previously.

9.6 Block of flats and apartments

Identify possible apartment buildings or hostels within the EA, using the flagged information as well as canvassing the EA and using the knowledge of the local populace. Determine the name as well as the amount of flat units within the building. Add the corresponding landmark number to the list with the corresponding flat name and number of units so that it can be added to the GIS database back at the office. If the structure has not been captured in the GIS and are therefore not visible on the map, it must be annotated on the map as accurately as possible. The structure must be drawn in such a way so that the number of flats or apartments is clearly visible on the drawing.

10. Office updating and correction

Once all the fieldwork for an EA has been completed the updated information must be included in the GIS. The Geo-referenced Dwelling frame must also be updated. The dwelling frame is an essential part of the methodology as it supports the decision making process regarding merging or splitting of EAS when looking at the EA size parameters.

The listing form information must be separately captured per EA in a database. The dwelling number of every dwelling must also be updated per EA in the attribute table in the GIS. The linking of the data to form the Geo-referenced Dwelling frame can now commence. As mentioned, this information together with the annotated fieldwork maps must be used to realign, split or merge the EAs.

If an EA is split, merged or realigned it might have an impact on the dwelling frame numbers. The dwelling numbers must therefore be updated to ensure that the Dwelling frame and EA number correspond. All the other annotation on the maps must also be captured. After all the information is captured and the EAs and Dwelling frame has been updated the EA GIS dataset can be used for subsequent Analysis and dissemination.

11. Map creation and printing

Once all the Office updating and correction has been completed Enumeration Area maps can be printed. A map template with all the relevant information must be set-up per map type. Map types can include: EA map, Supervisor Map, Orientation Map and District Map. The type of maps must be decided upon and finalized when the automated plotting tool is created. The data in the attribute table will be used to automatically update text feature in the Template thereby reducing the time spend creating the maps as well as reducing the amount of errors that might occur due to finger trouble.

12. Separate Institution Demarcation Methodology

The normal demarcation rules apply. If an institution does not meet the prescribed size criteria, it should be incorporated into the surrounding EA and given the sub type of mixed. If it complies with the size criteria it should be demarcated as an EA on its own.

- **Dealing with institutions.**

As part of the demarcation of areas you will also come across institutions. You will deal with institutions separately because they have a separate way of being enumerated.

For the purpose of the Census, an institution is a communal living place or care (educational, recreational, custodial) facility, where people live under the supervision, control or care of the authority. People in institutions may have been there on a short-term temporary basis, for example an overnight guest at a tourist hotel on census night, or may have been there on a long-term or permanent basis, for example residents of children's or old people's homes. The distinguishing feature is that they were not living independently, either by themselves or in a private household, on census night.

- **Types of institutions**

- a) Where residents are catered for communally in one common kitchen (non-private household). NB. These types of EAs can have private households, but the majority of the inhabitants live communally, e.g. the warden or housekeeper of a full catering university residence.

- b) Where residents cook separately in one common kitchen and eat separately then they should be treated as private households in an institution e.g. self-catering residences in a tertiary institution.
- c) Where residents cook and eat separately in their individual rooms they should also be treated as private dwelling units
- d) Where there is a combination of private and non-private dwelling units then each type should be treated separately as either a private dwelling unit or as members of the institution.
- e) Examples of institutions
 - Tourist hotel/motel - which contains mainly short-term residents.
 - Residential hotel/boarding house/private hotel - which contains mainly long-term residents
 - Home for the aged
 - Home for the disabled (sight, hearing, physical or mental)
 - Hospital/medical facility/clinic (including mental hospitals)
 - Shelter for the homeless/night shelter/ refuge
 - School hostel/hostel at an educational institution
 - Child care institution/ orphanage
 - Children's correctional institution/place of safety
 - Prison/correctional institution/place of safety
 - Church hall/community centre/recreation centre
 - Convent/monastery/religious retreat/mission station
 - Caravan park/camping site/marina
 - Defense force quarters
 - Refugee settlements, for example a camp for refugees

The following procedures should be followed when dealing with an institution:

- a) Determine the type of institution that you are dealing with.
- b) Contact the Head of that institution and ask for assistance. They would be able to give you valuable information about the population size in the particular institution.
- c) Remember that each institution would be unique and you should approach it in that way. Please be sensitive when dealing with institutions.
- d) Note that most institutions will be demarcated as part of the surrounding EA. However, if an institution is very big, like a big army base, correctional facility or medical care facility, it must be demarcated as an EA on its own. The general criteria for demarcating an institution on its own will be if it has the capacity to house more than 500 people.

The following provides guidelines regarding the demarcation for specific institution types:

For the purpose of Census 2010, an institution shall be a communal living place or care facility such as a tourist hotel, a motel, a prison, a police cell, a home for the aged or the disabled, or a hospital. Accommodation for pupils at schools or students at universities, accommodation at children's homes and orphanages, convents, monasteries and religious retreats, where people are living under the supervision, control or care of others, are also institutions. People in institutions may have been there on a short-term temporary basis, for example an overnight guest at a tourist hotel on census night,

or they may have been there on a long-term or permanent basis, for example a child in a children's home. The distinguishing feature is that they are not living independently, either by themselves or in a household, on census night.

- Tourist hotel/motel - which contains mainly short-term residents: If the hotel/motel has a capacity of more than 500 persons, it must be demarcated as a separate EA. If it has less inhabitants than that, it must be demarcated as part of the surrounding EA.
- Residential hotel/boarding house/private hotel - which contain mainly long-term residents: The same applies as above.
- Home for the aged. There are mainly two types of old age homes.
 - The first is much the same, like a boarding school where you have separate rooms, but they eat in a central dining room. The same applies as above.
 - The second type is the so-called retirement village. Here we have separate houses or flats and the people make their own food. Thus, in effect we have private dwellings that have to be listed. If there are more than 100 dwelling units in the institution, it should be demarcated as an EA on its own. If however, it is less than that, it should be made part of the surrounding EA.
- Home for the disabled (sight, hearing, physical or mental). If the home has the capacity for more than 500 persons, it must be demarcated as a separate EA. If it has less than that, it must be demarcated as part of the surrounding EA.
- Hospital/medical facility/clinic (including mental hospitals): The same applies as above.
- Shelter for the homeless/night shelter/refuge: The same applies as above.
- School hostel/hostel at an educational institution: All educational institutions, which contain hostels, should be demarcated as a separate EA. If there are numerous hostels which satisfy the size criteria, they should be subdivided into EAs. Under no circumstances must part of one hostel and part of another hostel together make one EA. One hostel can constitute two or three whole EAs, but not parts of an EA.
- Child care institution/orphanage: If the facility has the capacity for more than 500 persons, it must be demarcated as a separate EA, if it is less than that, it must be demarcated as part of the surrounding EA.
- Children's correctional institution/place of safety: The same applies as above.
- Prison/correctional institution/place of safety: This should constitute separate EAs, no matter their size.
- Police quarter: These should constitute separate EAs
- Nurses' quarters: If it has a capacity of less than 500 persons, the facility should be made part of the surrounding EA. If it is separate households this should be included in the institution as long as it falls within the boundary of that institution.
- Convent/monastery/religious retreat/mission station: The same applies as above.
- Caravan park/camping site/marina: The same applies as above.
- Diplomatic mission abroad: Would not form part of any EAs and would be done by the Diplomatic Corps.
- Defense force base: All defense force bases should be demarcated as an EA on its own.
- Refugee settlements, for example a camp for refugees: The camp would be an EA on its own.