

Volume

1

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Enumeration District Map Template

THE ENUMERATION DISTRICT MAP

Guide to Commonly Used Design, Pattern and Style Elements

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Acknowledgements

Geography: Why is what where and why is it there?

Special thanks to the CARICOM member states, who's valuable input contributed to addressing some of the most challenging problems related to map templates. Their thoughtful approaches and expertise provided an important insight in understanding key concepts and needs of the template. More than 11 countries contributed to the template components. My thanks to for taking the time out of their busy schedules to write and review the content presented. I am especially thankful to the authors of the annex maps, who provided additional illustrations about some of the more complex applications templates and in GIS.

Introduction

The mapping process has traditionally been an extensive manual process prone to large human error. Creating each map manually or digitally on an individual basis takes time and a template speeds up this process enormously. This Enumeration District/Enumeration Area mapping template is one of the latest versions of the numerous existing mapping template styles that have been used throughout history. It shares common components, yet it is fundamentally different from the versions used normally. Many different world and country map templates exist, particularly within GIS software that do not have a strict focus on the ED map. Included in this document is accompanied a unique best practices approach which focuses on an applied GIS programming approach used by some CARICOM countries. This best practices approach assists them to standardize and streamline the mapping process which has traditionally been very time consuming. The required accuracy of census statistics today prompts a more rigorous geographic approach that centers itself on geographic accuracy and geographic information systems and their integration.

Templates are now found most commonly in electronic format and used widely in GIS programs or Graphic design software. The use of software driven templates has many possibilities and allows the user to save a template and reuse the exact template to display any preferred data layers immediately without recreating the map template components. Further to this, digital templates can go far beyond the purpose of streamlining the creation process to allow automating the map creation

process. A brief introduction to an applied GIS programming approach used by some CARICOM countries that assists in standardizing and streamlining the Enumeration District mapping process follows.

Map template a pre-developed page layout in electronic or paper format.

A map template is a pre-developed page layout in electronic or paper format that can be used to make new map outputs with a similar design, pattern, or style. The page layout is the part of graphic design that deals in the arrangement and style treatment of elements or content on a page. In this context, the creation of Enumeration District census maps components will be presented and outlined that are necessary for creating standardized ED maps. It should be noted that the use of Enumeration District (ED) and Enumeration Area (EA) are used interchangeably since countries also use both terms. Discussion will also focus on other map related tasks with regard to ED map development and production.

The ED mapping template is geared for the CARICOM countries and was developed with the consideration and collaboration of its members and associate members. There is no one template that all countries employ. The ED map template is a dynamic document that can be flexible according to users needed but also have common elements that are universal in nature. It aims to specify the critical elements needed for census enumerators and these elements are often case specific since countries geographies and land use patterns differ widely, particularly with regard to urban/rural or developed/undeveloped characteristics. Some countries may be heavily urban with concentrated, gridded land use pattern while others are widely dispersed, rural and have no uniform land use pattern. Therefore, the template must be a flexible document that the user can cater to suit his/her needs. If you do not need a primer on Enumeration District Design, Pattern and Style Elements you can skip directly to the templates located online through the CARICOM website in electronic format (Scalable Vector Format.SVG) or for import into GIS programs, .MXD (For Import into a GIS).

International Recommendations and Common Standards

Many census offices attempt to adhere to internationally recognized standards as much as possible. However, enumeration area map design standards are not explicitly defined within any one document with specific examples of country use. Perhaps the most relevant resource for such recommendations and standards is found in the UN Handbook on Digital Mapping and GIS (2000) and the revised version UN Handbook on Geospatial Infrastructure in support of Census Activities (2009), both published by the United Nations Press (http://unstats.un.org/unsd/demographic/standmeth/handbooks/Series_F103en.pdf). These two handbooks explicitly reference ED map recommendations and standards and are a good resource to start from. However, neither includes a working template or a source for retrieving an ED template to use in a real world adaptation. These needs were the primary drivers for the creating this document.

The primary purpose of a census ED Map is to indicate the area and its boundaries which must be covered by the enumerator during the canvass of his/her individual ED. ED maps should be simple because they will be used by enumerators who have limited experience with maps. On the other hand, they must contain enough information to allow easy orientation. The following are some sample components of what an ED Map should contain according to the UN handbooks described above.

Sample components of a digital EA map

- The entire area to be enumerated, defined by a clearly indicated boundary line;
- Some parts of the neighboring areas (i.e., the peripheral area) to facilitate orientation;
- Any geographic and text information contained in the census cartographic database that will facilitate orientation within the EA: streets and roads, buildings, landmarks, hydrological features, and so on;
- A consistent map legend, including the exact names and codes of the administrative and enumeration zones, a north arrow, a scale bar and a legend explaining the symbols used for geographic features

The illustrations shown below in Figure 1 are the main individual components of a hypothetical urban EA map. All features are stored in separate map layers in the same spatial reference system or as graphics templates. The main components are the street network, buildings and EA boundaries layer. In addition, annotation, symbols, labels and building numbers are stored in separate data layers, although these could also be added dynamically. The last component is a template consisting of neatlines and a legend that is consistently used for all EAs.

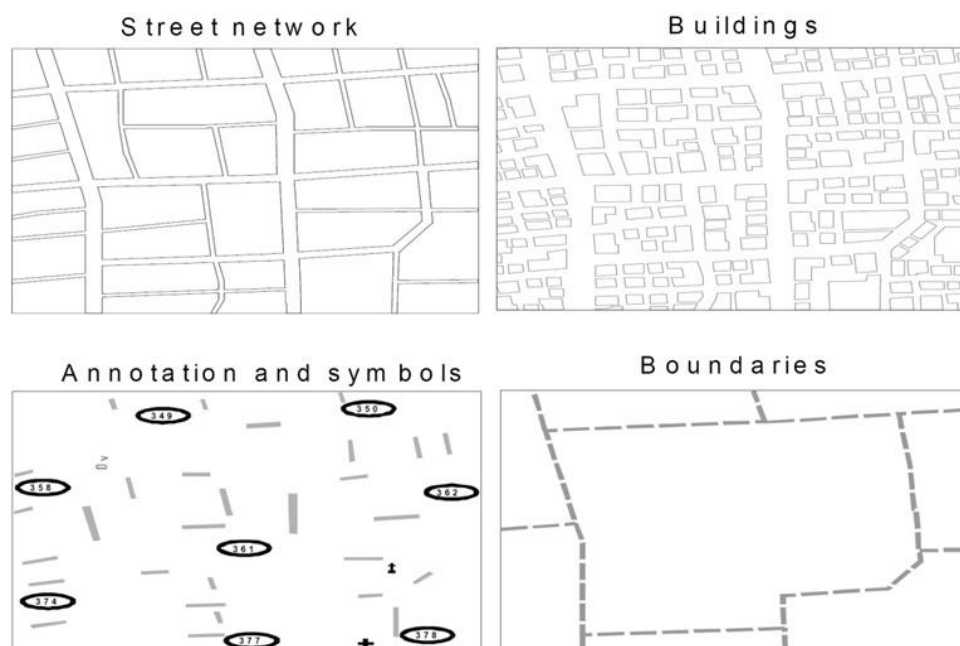


Figure 1. Main sample components of a digital EA map include street networks, buildings, annotations and symbols, boundaries, building numbers.

**UN Handbook
(2000 p 77-78)**

Sample components of a
digital EA map.

To hold all of these layers and to indicate and reference these layers correctly, information must be contained in the ED map that explicitly calls out the components and their elements in each layer of information. For instance, legend items indicating a color and or size/type of line would be needed in order to distinguish which lines on the ED map were streets buildings or boundaries. Another example would be the need for orientation and scale to clearly understand where the enumerator is and what is there. This is the juncture of the ED map development process whereby the template needs to be considered. If you were to include other layers such as rivers and historical landmarks you would consider the information needed in your template. As maps get increasingly dense the importance of the ED template layout becomes more important. Often in urban areas roads (street centerlines) often overlap the boundary. To mitigate this issue a dotted line may represent a road and a hash line the ED boundary so that you would be able to distinguish the boundary from the road and clearly view the ED.

Figure 2 is an ED map template with neat lines and a legend. The legend is a key element in an ED map. Map Legends are used to help in the identification of boundaries and features from the symbols and names printed on the ED map. It is important to note in the template that all of the elements are in the legend area. This is one way of laying out your information that will reference the components in the template but there are many ways to arrange an ED template to make it work for your purpose. To restate, the primary purpose of the ED map is that it must contain enough information to allow easy orientation. Too much or too little information will hinder the enumerator's ability to perform.

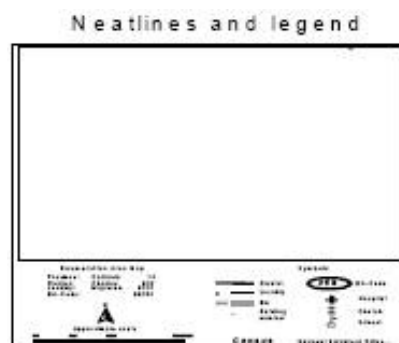


Figure 2. ED Map template illustrating neatlines and legend with no data shown in the data frame.

When the ED map template is populated with data and information it becomes a finished product. Often these maps, whether created by hand or digitally, take significant time to produce. Most countries are using GIS methods to create their census maps and on average the time it takes to produce the maps themselves after the geographic data or census GIS is complete or ready is approximately 2 months or greater. This is often far too long and frequently overlaps with other activities. Nevertheless, this is the case and having a template ready to use can help reduce time spent on design elements and allow more focus on GIS tasks, customization or other census preparatory work.

After the completion of verification and quality assurance procedures for all base maps and EA delineations, census cartography staff will prepare to print the final maps. This preparation process involves declaring a template for use that houses all necessary country information for each ED map. Figure 3 shows the complete EA map with all components overlaid in one map display. Depending on the scope of census mapping activities and the complexity of the enumerated area, EA maps may contain less or more information than this sample map. As GIS and digital mapping methods become widespread, more and more geographic information is contained in the ED maps due to the sheer amount of data that can fit on a paper using electronic means versus hand drawing.

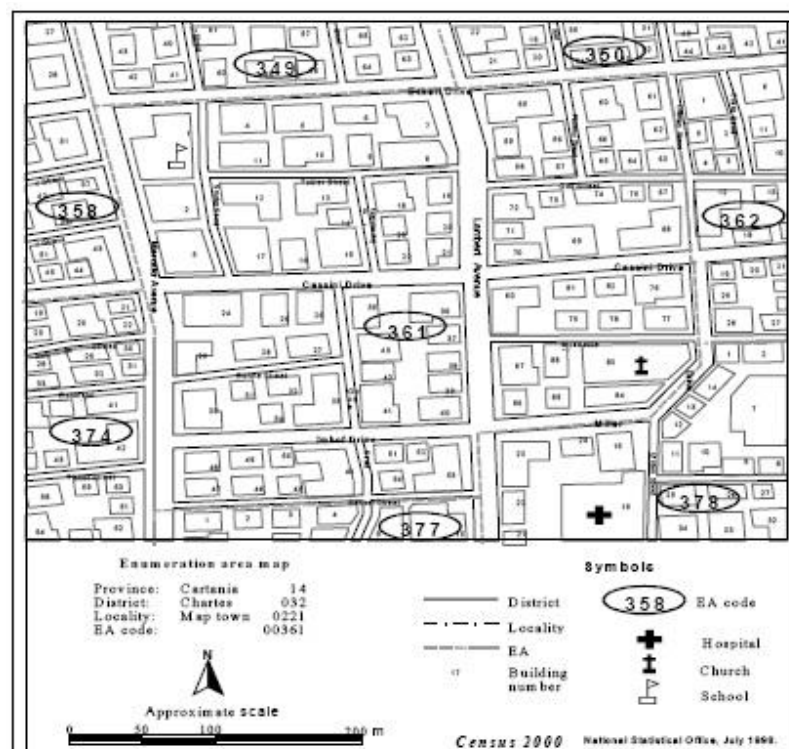


Figure 1 Example of an urban enumeration district area map. (UN Handbook 2000)

ED Map Template Elements

Elements: referred to here as components of a model or in this case a template.

The elements you choose to include in the ED map template are essentially what will guide all enumerators in your work. It is important that detail oriented approach is applied in preparation of the map template. With design based ED templates it is critical to understand direction and scale when creating the ED maps. These two components are the most difficult to consistently maintain in design based ED map template creation environment. GIS based template environments often prevent this from happening since the geographic data is georeferenced on the globe

within the view so any scale bar or north arrow added automatically adjusts to the respective view.

It is highly recommended that GIS based templates be used to avoid these issues and cannot be understated enough. Unless your template can be automatically georeferenced you will have a significant amount of extra work to do in adjusting the template for each map. This adjustment process is software specific and is not covered within the scope of this document. Most countries are using GIS programs to create their census maps and within these programs a seamless template can be created that links the data layer features with the legend, the north arrow with the template view, and so on. Below is a list of elements and other common considerations that require addressing in the development of an ED map template. Many of these elements apply to all census maps and maps in general.

Essential Elements

- ☐ North Arrow
- ☐ Legend
- ☐ Title Block
- ☐ Scale
- ☐ Boundary Lines
- ☐ Adjoining EDs
- ☐ Legend
- ☐ Mapping Symbols
- ☐ Disclaimer

Recommended Elements

- ☐ Start and Stop
- ☐ Canvassing Arrows
- ☐ Boundary Description (on the map itself)
- ☐ Names of Geographic features (e.g. Names of schools and Public Buildings)
- ☐ Peripheral Information
- ☐ Copyright Year

Additional/Optional Elements

- ☐ Map Inset
- ☐ Imagery or Aerial Photography
- ☐ Disclaimer
- ☐ Author
- ☐ Copyright Date

Scale Considerations

- ☐ 1:2500 is often optimal for best visual display on 11x17 ED map for densely populated areas
- ☐ 1:10,000 is often optimal for best visual display on 11x17 ED map for densely populated areas
- ☐ Most fluctuate between these ranges

Including Textual Information

Descriptions

Descriptions can be included in the map itself or on another sheet. The option to have the description on another sheet allows for more information to be provided to the enumerator rather than having a condensed description on the map itself. However, if there is room on the map to allow a description with the map becoming too cluttered with small textual descriptive information then descriptions should be included. This is also dependent on the level of training that the enumerators have of their selected areas for canvassing during the census. In some instances a description may not be needed

Disclaimers

Disclaimers are an important way to specify warnings or expectations to the general public (or some other class of persons) on the use right of maps produced.

Authoring

Authoring provides a source that links the process of preparing, assembling to the original creator.

Map Layout/Layout Styles

Data Frame

The data frame defines the context for the data with which you work; these include the coordinate system, measurement units, scale, the drawing order of layers, and so on. Often in a GIS, this data view isolates the contents of a data frame for you to edit or work with. The data frame is normally bound by a border that contains all the information in the map.

Insets

Inset maps are sometimes used to show related themes of data at smaller scales. Inset maps will either be open or closed forms. A closed form inset uses an immediately recognizable outline (a province, a country, the world, etc.) An open form is a portion of any of these that is a little harder for the reader to locate without additional information, unless your audience is already familiar with how you have cropped the area shown in the inset. Be sure to show a clear distinction between the inset and the main map (a border, drop shadow, etc.). You may also want to include orientation features as well such as a north arrow.

Map dimensions

11X17 is the most common map dimension used for census purposes. They tend to be portable and fold well with other documents that are carried by census workers. Depending on the scale of the map there may be instance where more than one 11x17 map is needed for a given census district. Multiple 11x17 maps are sufficient provided the maps clearly identify the areas of interest. In some cases larger maps might be the suggested choice. If larger maps are used it is critical that these map be portable enough for the enumerator and not cumbersome to fold and unfold during their work. Also, Census managers, alongside 11x17 maps might choose to have developed ANSE sized maps at 34 × 44(inches) or 864 × 1118 (mm). These maps are standard wall, general plotter sized maps that can contain a significant amount of information.

Most census mapping projects take advantage of as much canvas space as possible. The more canvas space available equals better (or larger scaled/more detail) geographic information in the ED map to guide the enumerator. Careful consideration must be given as to how many elements are needed for the ED map to be functional for the enumerator.

Regional Enumeration District Map Styles: Country Examples

Included in Annex I are examples of ED maps from different countries from the Caribbean region. There are numerous examples globally and regionally. These specific examples are dated circa 2009 and represent some of the trends in ED maps of the time. What is becoming more widespread is the use of two maps: one including imagery and one with vector data only. This has proven to be useful in providing the greatest amount of information to the enumeration so that they can quickly identify the building- dwelling unit- household. However, in many instances countries may only have the ability to produce one type of map (the maps may only have boundary data, streets, and building locations or vice versa/coupled with imagery).

As you can see in the examples provided many ED templates exist and tend to vary widely. What is common is that many appear to be produced electronically and most of them in a GIS. The fact that most are produced in a GIS reveals that since many countries are moving this direction some common flexible template framework is needed. With these maps in mind and the technologies used to create them CARICOM urged that a flexible template would be a strong way forward in setting the standard before a large deviation in template styles occurs. Already, as you can see, many of the ED maps vary with size, style and content within the different elements and components. However some commonalities exist. Before jumping to the template, without going into great detail, it is pertinent to quickly discuss briefly the evolution of the ED map creation process at this stage in order to clearly understand the template needs of countries and the content discussed further.

Where we stand/Evolution of the census mapping process

With information technology guiding the field of geography, increasingly adding deductive theoretical reasoning to the discipline, have come changes in the way geographic information is collected, stored and displayed. Geographic information systems have changed the way in which statistics offices data are stored and are produced for census purposes. With the exception of very few worldwide, countries have adopted GIS into their census mapping process in some extent. In the past there were often issues of timeliness that arose from being reliant on other departments, agencies or commercial suppliers for the production of census maps. This issue is being largely resolved through countries acquiring their own GIS program within the government or statistics office. This move has allowed all the census maps to be created in house and if preferred, out-sourced to a private firm for printing. With GIS, The statistics offices are given the right to be the data owners and cater the style of data to its working partners and clients.

Most countries use GIS to produce census maps or produce map outputs. This is often done on a per map basis whereby each map is created in the GIS the

saved electronically one at a time. In many cases countries have large geographic datasets and use these datasets exclusively to produce census maps. The maps can include but are not limited to enumeration maps, census manager maps, field supervisor maps, and regional maps. Some countries have set up full-operable systems whereby all statistics and geographic information are housed.

Census Mapping Template

This template was created in a GIS. As you see below, it is a straightforward template with many of the elements reflected in maps common to the region and the world. It is not meant to be complex or difficult to design. While templates are relatively simple to develop in a GIS for a technician, they may be confusing to develop for the outside user. The benefit of having the template, aside from common standards for Caribbean countries to follow and adapt, is the ability to import various software suites and start adding data immediately to the template without having to think about all of the map elements and design. For the novice ED map producer perhaps tasked with paper maps, the ED map template can be scanned or imported directly as an .mxd file (ArcGIS). For the GIS user, the template can be imported into GIS software and adapted programmatically to suit their needs. This template has been widely used by the CARICOM community.

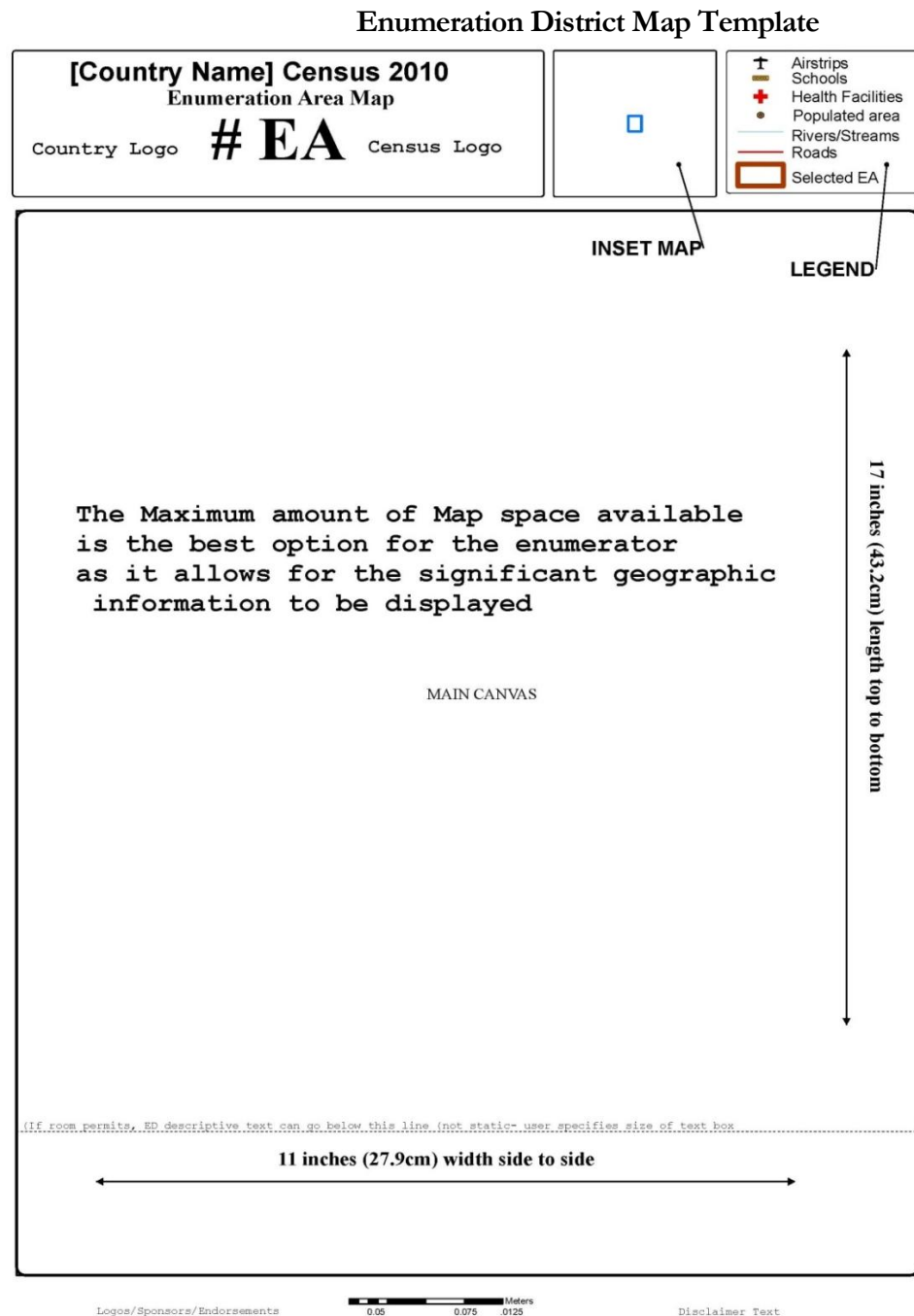


Figure 4. Enumeration District Map Template Used as a starting point reference for census.

Increasingly, GIS users are more and more overwhelmed with daily office requests for census and field maps. This prompts further investigation into the needs of GIS users in charge of census. With this in mind it was necessary to move beyond just the template and briefly discuss some automation routines that can speed up the

production of the hundreds and thousands of maps that must be produced by offices that normally have heavy workloads and differing resource constraints.

Automated Mapping through Programming Methods

The aim of this section is to show some capabilities of GIS for ED mapping beyond the use of the template. It is not a lesson on programming, object oriented languages, or GIS. The automated mapping through Programming Methods described here is shown using country specific examples. It is not an endorsement of software products, companies or country personnel. You are welcome to download the code and use it but beyond that you will be moving outside the scope of this document. If you choose to do so there are many sources available in geography forums, GIS websites, programming forums and specific user groups that can guide your excitement and interest in developing similar census products (that's the underscored aim here).

To better understand the needs of countries in terms of producing ED maps it is necessary to have a firm grasp of the dominant technologies used to create such outputs. The most dominant suite of mapping products worldwide for census mapping and GIS for that matter is the ESRI suite of products. With this in mind it is necessary to produce products that would easily integrate into this suite of these products. This document does not cover the ESRI suite of products in detail or the programming languages used to create the map **form**. Rather, the form overview is meant for countries that may not have access and/or expertise to develop a catered census map form and want something to work from immediately.

Form: foundation of a user interface and are guided through the use of controls with which users interact.

The form described here is a user interface that has controls that interact with the mapping software or more particularly in this case, the map template. Controls are the various widgets with which users interact. The form is aimed to quickly provide a given country with a working product that can develop capacity, initiate the learning process and be used quickly. It is hoped that this template will be a building block for countries to move more rapidly to technology driven methods to achieve a result. It is also hoped that the templates of this nature created by countries can be shared among users for others to develop and build upon. It is not meant as an endorsement for any products but for an extension of tools that are often not put to use in common mapping products due to various reasons.

Lastly, programming is complicated. Everything is so interrelated that it's difficult, if not impossible, to isolate each programming concept and then present the material in a linear fashion. That is precisely why it is used here to show the potential and be used as a way to teach the capabilities within a software, capabilities that are normally neglected but available to others to use to prepare for future census map projects.

The Need/Rationale

Most countries now use GIS and/or digital mapping to create series of maps for enumeration in a census. However, the production of these maps is still a manual process. Average time to complete could take up to 2-3 months or longer. This is often an unacceptable time frame for most National Statistical Offices charged with production of maps.

Constraints include:

- ☐ Digital map data for census work is of varying quality and formats differ from Census requirements
- ☐ Time: short timeframe of census lifecycle
- ☐ High staff turnover
- ☐ Lack of skilled staff and IT literacy
- ☐ Financial Issues

Addressing the Need

Integration options in a GIS allow for the creation of a geodatabase to be used within programming languages to create an automated process that is normally thought of as a manual process of adding layers to the view and graphically arranging text and icons to create a single census map. The automation of GIS mapping capabilities within GIS software will not limit other design needs and uses of the maps and overall display of data. Design needs such as adding an ED number or label for each map is streamlined.

Enumeration Map Form Layout Application Characteristics

Geodatabase: a collection of geographic datasets for use by GIS software (mainly ESRI)

User controls in the form define level of geography and map extent – from census EA, Village, Island, Province. These controls are fully integrated with the GIS software and flexible (meaning you can edit them). This integration is flexible to any workload such as fieldwork and preliminary mapping tasks as it automates map production against any geodatabase. Below is an illustration of the Form accompanied by the GIS data it is referencing in the map. Once the user selects the EA to preview, the GIS zooms to the ED and it is displayed within the template.

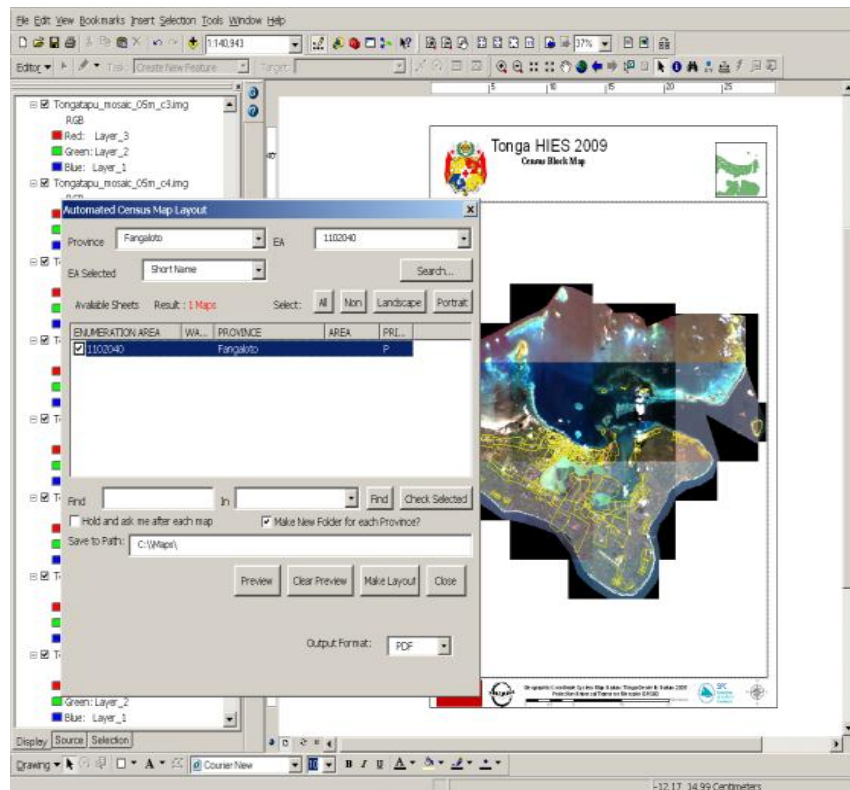


Figure 5. Illustration of the Form accompanied by the GIS data it is referencing in the map layout and template.

Once the ED is selected and preview is clicked the map layout zooms to the selected ED. From this point on the map can be viewed, checked, edited, and/or exported for print. You can select or unselect layers in the table of contents as you go. If the ED map appears to cluttered you can unselect a layer and vice versa. The illustration below shows the layout view with the selected ED displayed and layers selected to be included in the map (the selected ED is outlined in a lighter green).

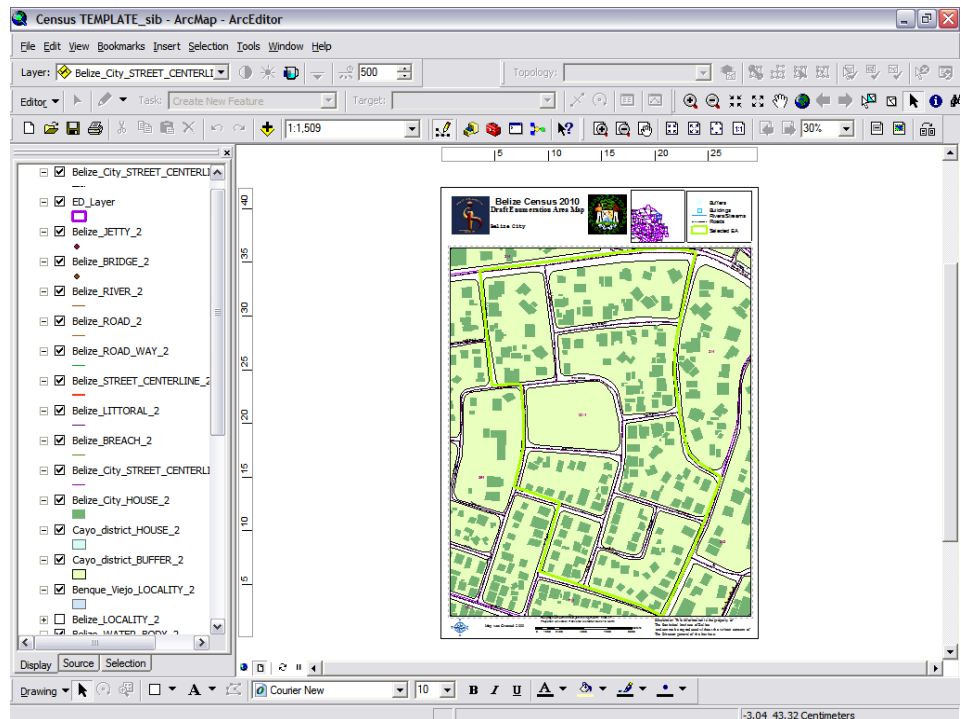


Figure 6. Illustration showing the layout view with the selected ED displayed and layers selected to be included in the map.

The controls are easy for non-GIS specialists to use. However, to edit and create such controls requires a jump into understanding programming! The controls are designed to operate within ESRI's ArcGIS to enable automated mapping of EA areas at different levels of census geography.

Selection: Choose geography to map

Automated Census Map Layout

Province: EA:

EA Selected:

Available Sheets: Result: 1 Maps Select: All Non Landscape Portrait

ENUMERATION AREA	WARD	PROVINCE	AREA	PRINT ORIENTATION
<input checked="" type="checkbox"/> 1102040		Fangaloto		P

Find: In: Find Check Selected

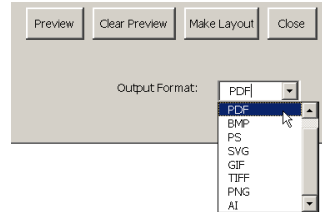
☐ Hold and ask me after each map ☒ Make New Folder for each Province?

Save to Path:

Preview Clear Preview Make Layout Close

Output Format:

Selection: Choose the map output type



The interface also allows users to select groups of EAs for census mapping by selecting the relevant geography of the country. The created maps can then be exported to a range of different formats such as PDF BMP EMF JPEG AI SVG GIF. The output image quality of the export can also be changed by assigning a value for example in the range 1 to 5. 1 corresponds to "Best" (larger file), 5 corresponds to Fast (smaller file).

Automated Mapping through Programming Methods developed through the use of forms save time and improves census office responsiveness and ability to create EA maps on demand for fieldwork and census execution. It is less labor intensive and increases focus on data quality of EA maps while not requiring staff to manually spend hours creating maps.

Furthermore, GIS is no longer isolated and users of all levels of GIS experience can produce, print maps ready to go out in the field through such an interface. Such interfaces are currently in use in Barbados, Belize and St. Lucia and others for the census and the applications within NSOs continue to grow. A few examples of the Automated Enumeration District Map Product Prototype are displayed below (It is referred to as a prototype until agreed by the NSO to be used for the enumerator in the census)

Enumeration District Form

The Forms codes that have been created by the countries are not included. The illustrations are meant to show the products produced from similar forms. In some cases the form provided here has been used directly to create the products shown or have inspired the production of a new form interface. The Forms code has to be catered to the users' geographic information within the GIS. Therefore no one form can be used for all countries since all different countries geographic data are unique!

Note: This form template is built through programming ArcObjects with Visual Basic for Applications. The VBA environment has been used widely for building custom applications in ArcGIS products. This template, more specifically, is normally referred to as a form class used in a GIS mapping software. The form class is used to create and show forms at runtime.

Annex I.

Output Examples from the use of the ED map Template

The following examples are some pre-developed page layouts in electronic format used by countries. They are produced largely through automated mapping programming methods. In no way do these examples represent census material that is used during the census. These examples represent the graphical outputs resulting from the template during testing phases of assistance visits or later correspondence. For explicit comprehensive examples on the ED maps generated from the template for the census, contact the countries directly. These images were provided by statistics offices for example purposes only and cannot be used for distribution without consent of the National Statistics Office and/or in conjunction with the permission by CARICOM.

Enumeration District Form for Use

The Forms code that have been created by the countries are not included. The illustrations are meant to show the products produced from similar forms. In some cases the form provided here has been used directly to create the products shown or have inspired the production of a new form interface. The Forms code has to be catered to the users geographic information within the GIS. Therefore no one form can be used for all countries since all different countries geographic data are unique!

This form template is built through programming in .NET, Python, as well as ArcObjects with Visual Basic for Applications. The .NET and VBA environment has been used widely for building custom applications in ArcGIS products. Python is now scalable as well in GIS software. This template, more specifically, is normally referred to as a form class used in a GIS mapping software. The form class is used to create and show forms at runtime.

- pre-developed page layouts in electronic format used by countries

- Automated Mapping through Programming: Output Examples

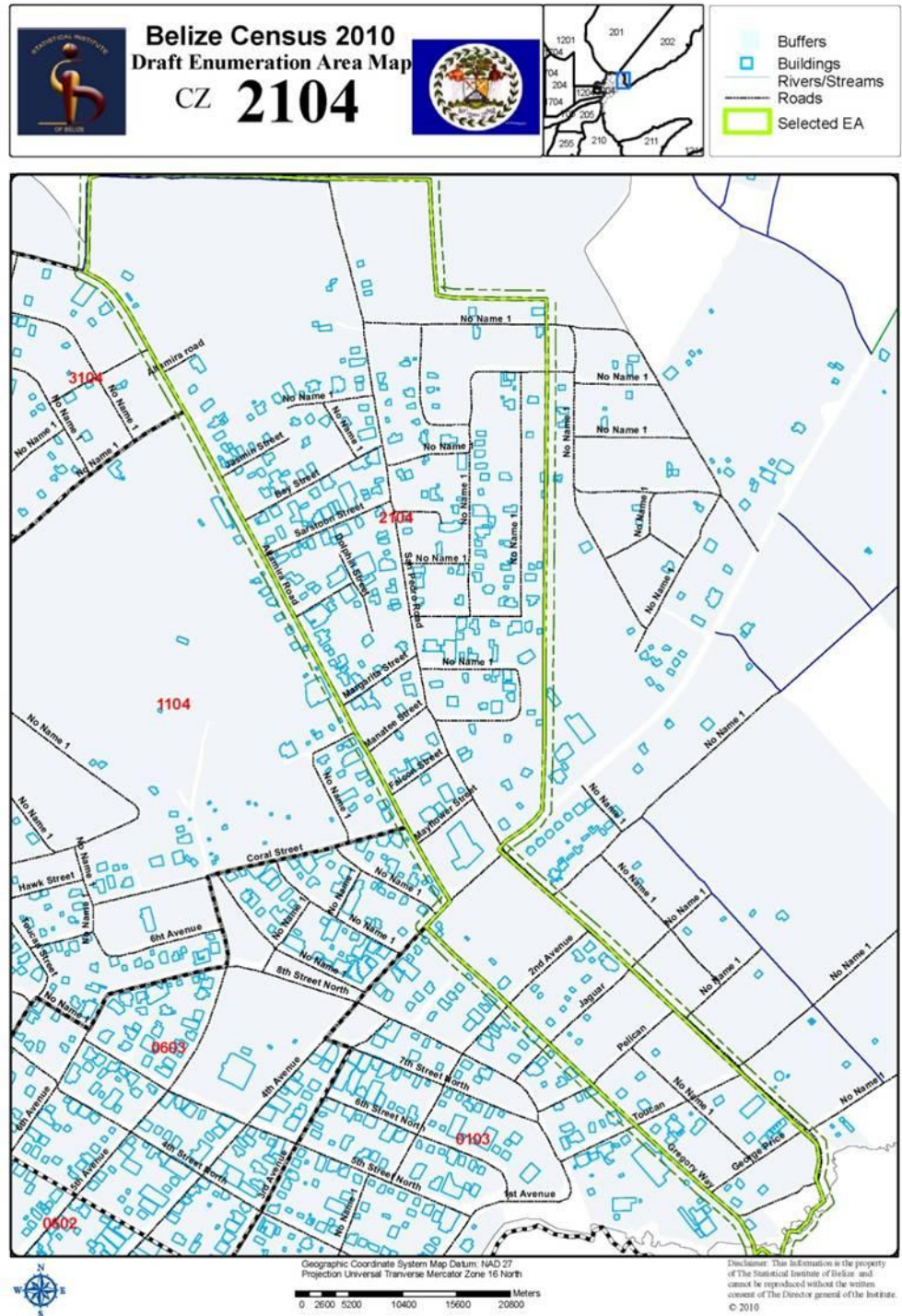
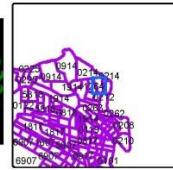


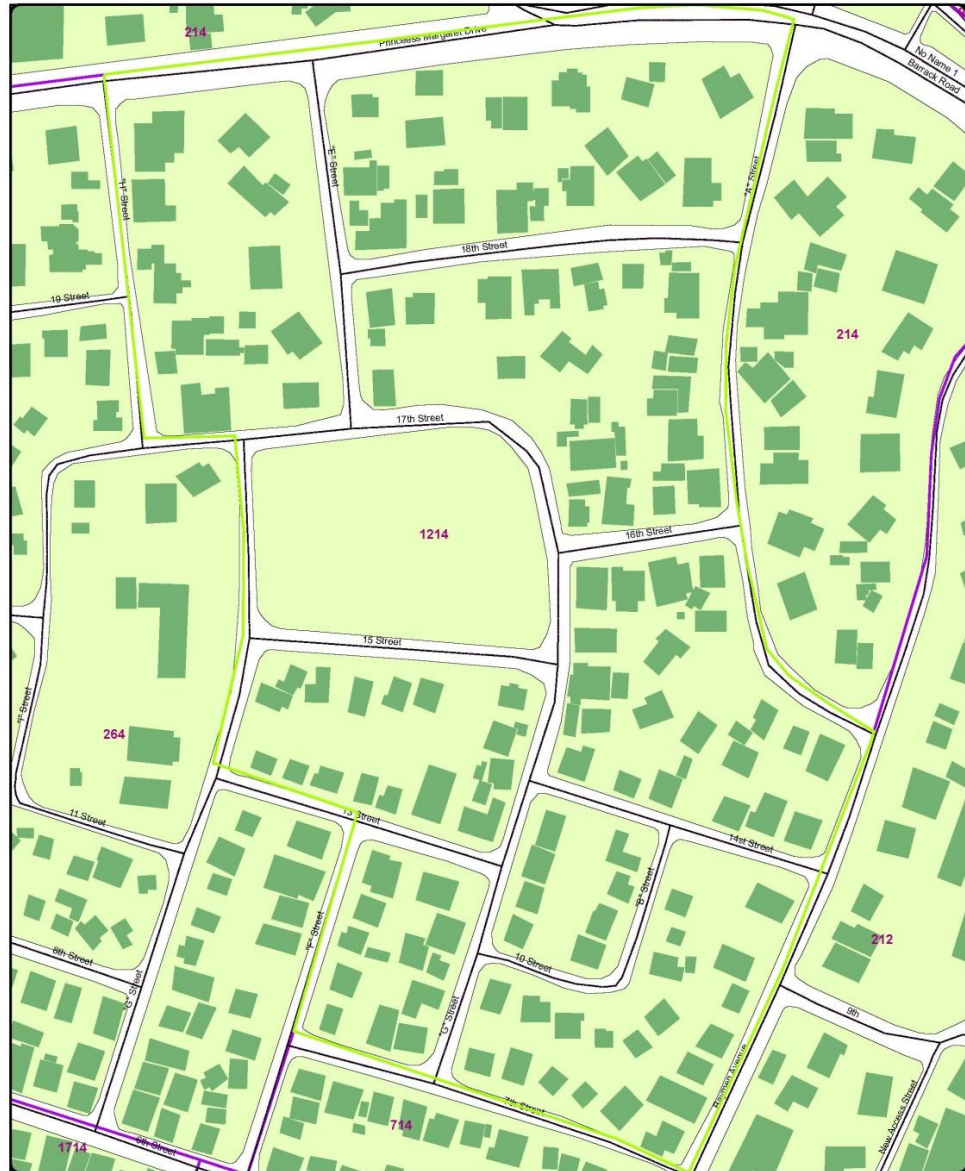
Figure 2 Belize Automated Enumeration District Map Product Prototype



Belize Census 2010 Draft Enumeration Area Map Belize City 1214



- Buffers
- Buildings
- Rivers/Streams
- Roads
- Selected EA



Map was Created: 2009

Geographic Coordinate System Map Datum: NAD 17
Projection: Universal Transverse Mercator Zone 16 North
0 1200 2400 4800 7200 9600 Meters

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The Director general of the Institute.

Figure 3 Belize Automated Enumeration District Map Product Prototype



Figure 5 St. Lucia Automated Enumeration District Map Product Prototype

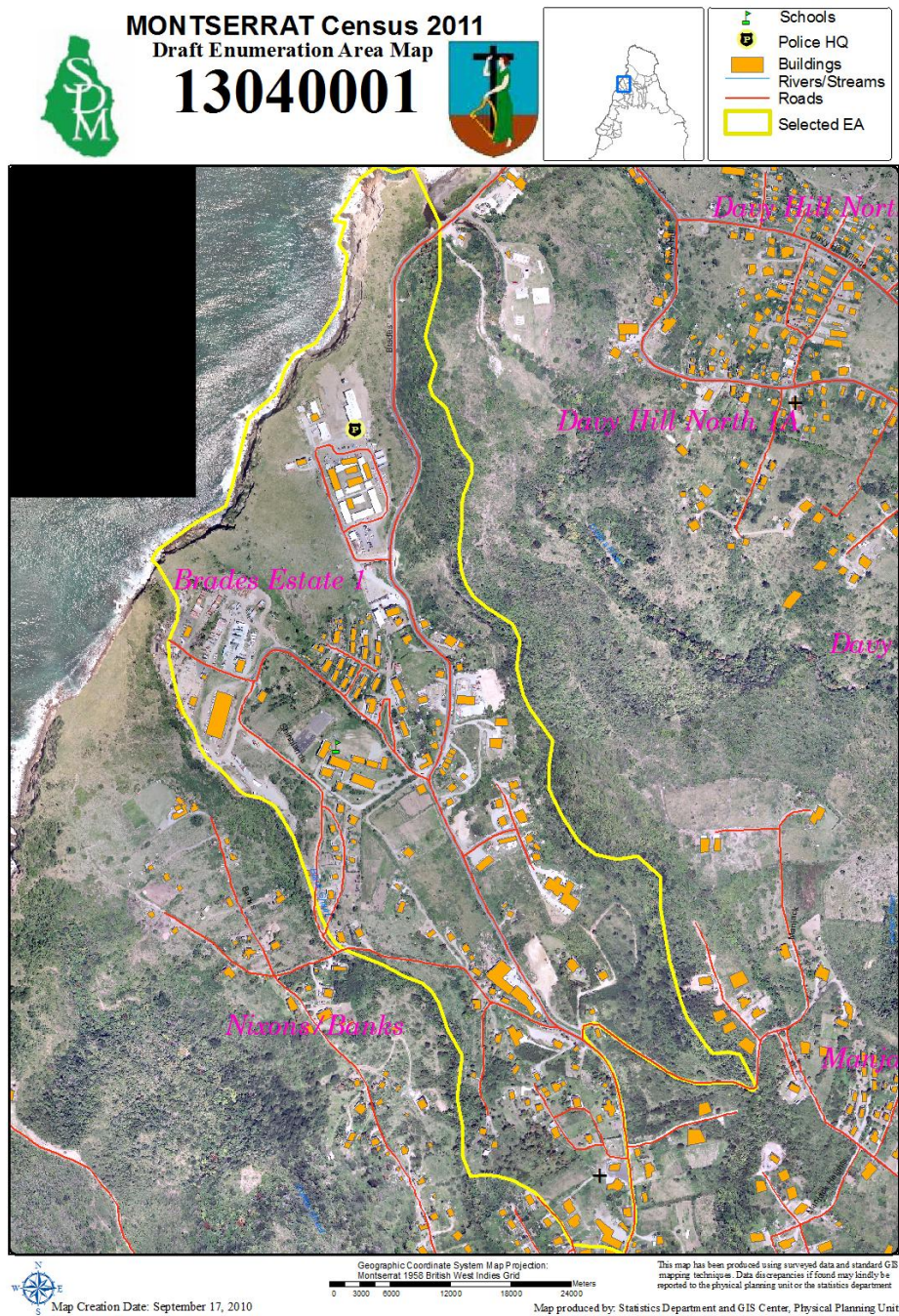


Figure 11 Montserrat Automated Enumeration District Map Product Prototype

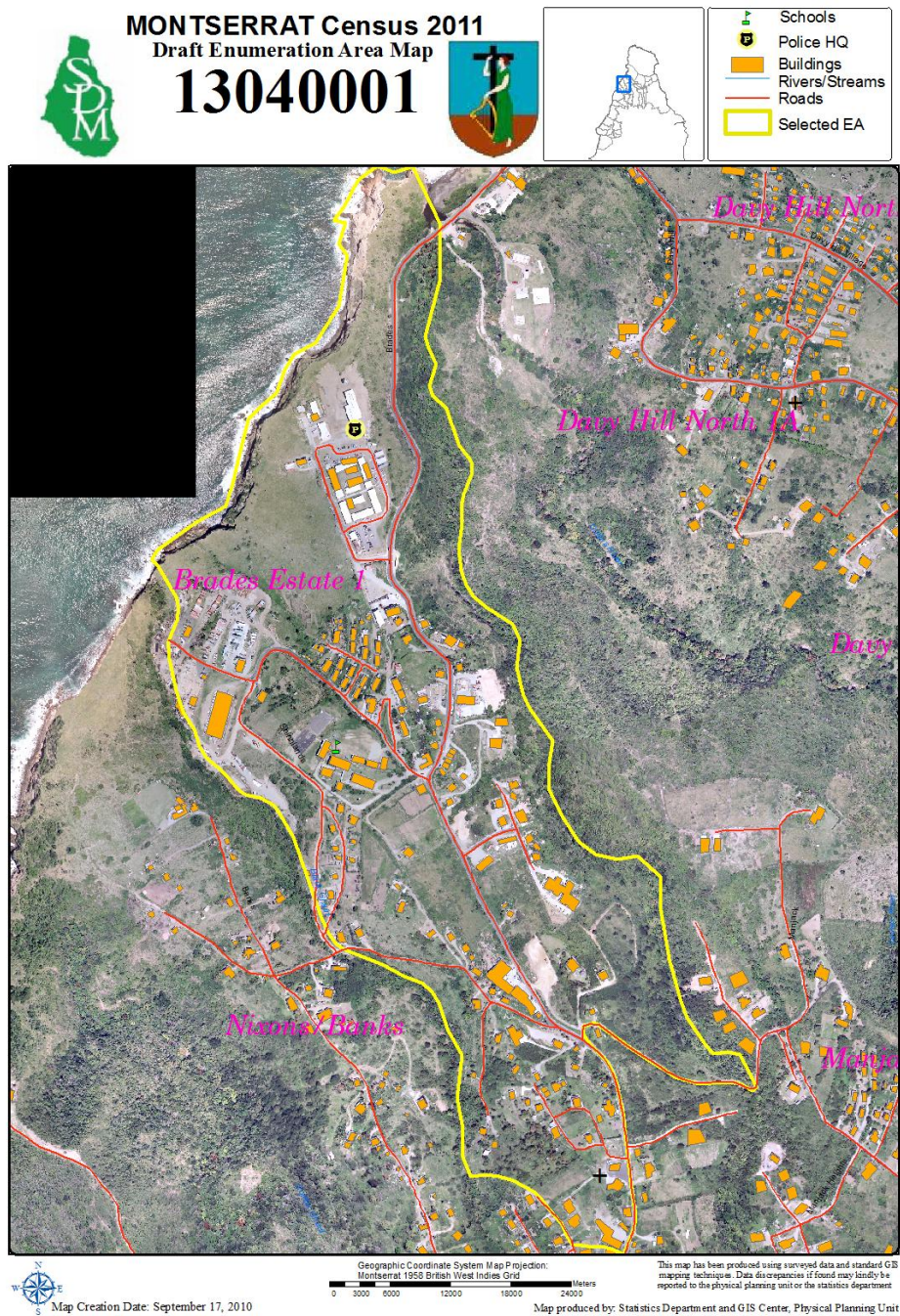
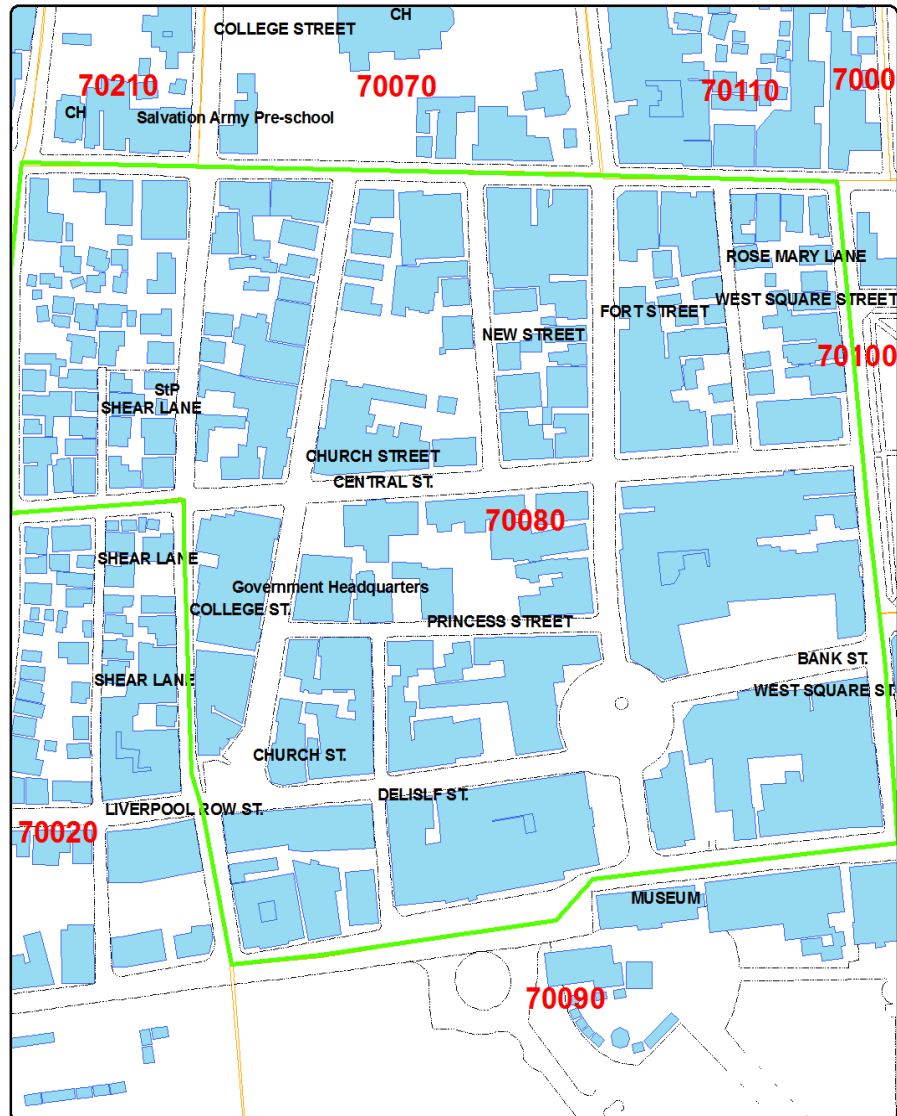
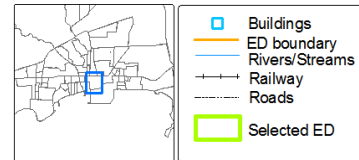


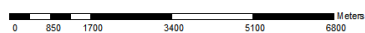
Figure 12 Montserrat Automated Enumeration District Map Product Prototype

St. Kitts & Nevis Census 2011
Draft Enumeration Area Map
 St. George **70080**



Map was Created: 2011

Geographic Coordinate System Map Datum: NAD 1983 UTM Zone 20N



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Figure 13 St. Kitts Automated Enumeration District Map Product Prototype



Figure 14 St. Kitts Automated Enumeration District Map Product Prototype

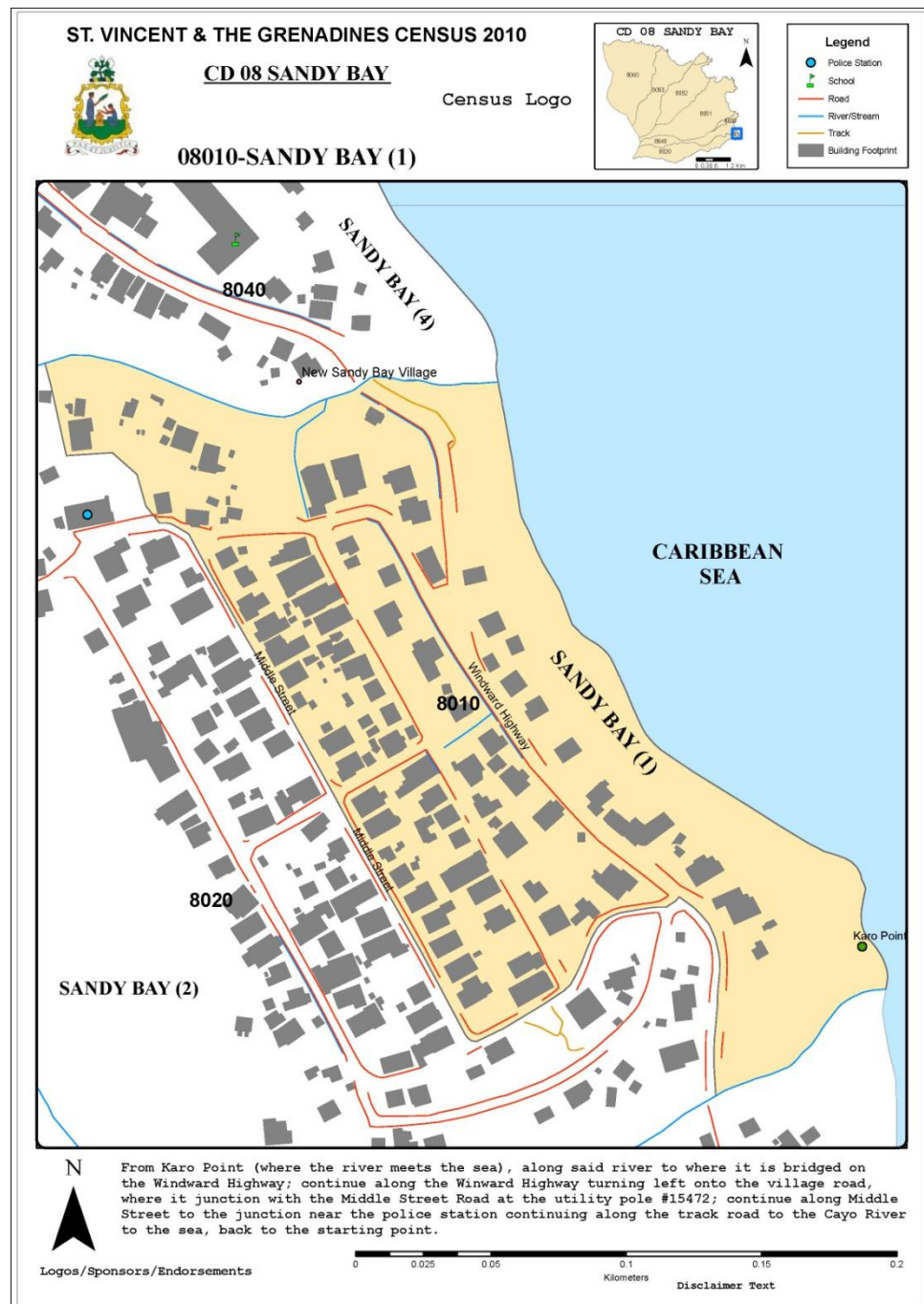


Figure 15 St. Vincent & the Grenadines Automated Enumeration District Map Product Prototype



Figure 16 Jamaica Automated Enumeration District Map Product Prototype

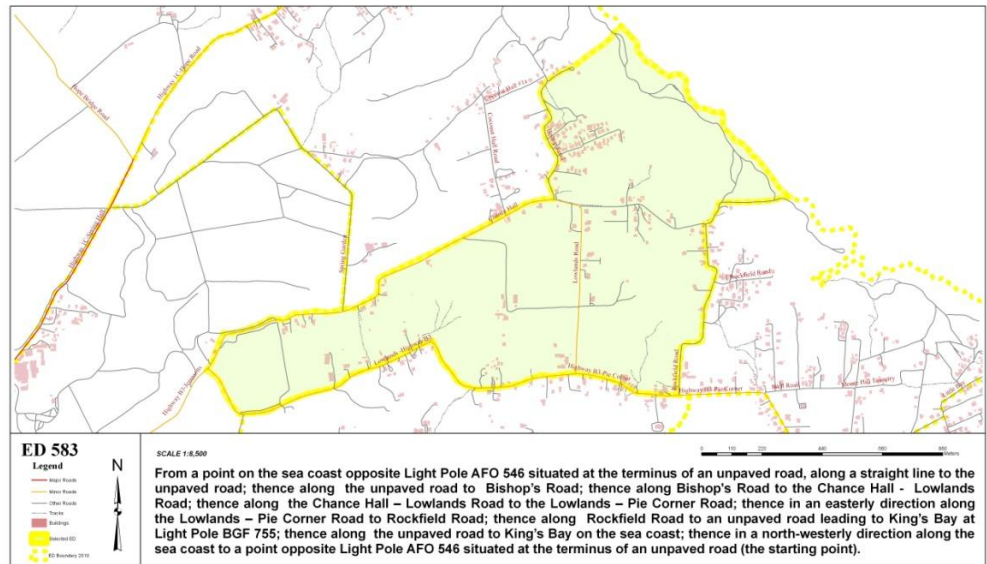


Figure 17 Barbados Automated Enumeration District Map Product Prototype