SPATIAL INFORMATION MANAGEMENT TOOLKIT

Module 9

Map production guidelines

(a joint initiative of the Australian Local Government Association (ALGA) and ANZLIC - the Spatial Information Council)

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Guide for managers

Context

Maps are by definition a generalised representation of real-world geography. Cartographers or technicians who make maps, use symbols to represent real-world features; such as lines for rivers or roads, points for cities and polygons for regions or districts. During the map making process, information is usually generalised in order to make maps clearer and easier to understand. For example, the mapmaker might choose to show only those cities with populations greater than 25,000 rather than cluttering up a map with every settlement with a population count recorded in the census database.

Modern day computer-assisted cartography (map making assisted by computers) is faster and more efficient than traditional cartography. Current geographic information systems (GIS) and computer-aided design (CAD) applications allow for the rapid development of many map products and an effective means of communicating results. Prior to commencing the physical production of a map it is important to understand a number of principles involved in composing a map. The importance of quality and suitability of the datasets used for the job cannot be over emphasised.

Module 9: Map production guidelines provides background information on principles of cartographic design and how to apply them to produce high-quality maps.

This guide provides general information on how to make a map to be either printed out or displayed on a screen. In doing so the Module should not considered as exhaustive. It should be recognised that each State/Territory and local government jurisdiction may have specific overarching protocols that need to be considered.

Actions

For maps to be effective they need to convey relevant information to the expected audience.

Managers need to ensure that mechanisms are in place as part of quality assurance procedures to ensure that map production fulfils relevant compliance criteria. In this respect, checklists identifying minimum requirements for internal and external map production are a useful method of facilitating quality control.

Printing large map products (e.g. A0-size) is often time consuming and so sufficient time needs to be allowed when preparing such products. Managers should also ensure that stocks of standard products are maintained to service day-to-day requests.

Guide to symbols

The following symbols are used throughout the Toolkit as a guide to users, and draw attention to important issues and information.

	Information which readers should take particular note of.
	Best practice information.
	Tips for readers. Tips are based on experience and are aimed at saving time and resources.
	Caution. Readers are advised that particular care should be taken or that the subject issue may be complex.
	Capability raising. Used to show a signpost to a higher capability level.
Bold Text	Used to highlight a particular issue.
Boxed Text	Highlighting of issues specifically related to ANZLIC — the Spatial Information Council, ALGA or State/Territory Local Government Associations.

9.1   Introduction

9.1.1 What makes a good map

There are two main categories of map that are displayed on screen or as hard copy:

- General reference maps.
- Thematic maps.

Most atlases are considered general reference maps and typically contain numerous features, none of which predominate. Reference maps are generally rich in detail and take longer to produce than other maps.

Thematic maps are at the other end of the spectrum of cartographic products. They generally emphasise one or two map features relative to other background items. A map showing land-use zoning is an example of a thematic map. Zoning is highlighted over any other map feature. Thematic maps are generally easier and faster to produce than a good general reference map.

Maps can be classified anywhere in the continuum between reference and thematic maps. For example a road map may be rich in detail thus resembling a reference map, but the highways tend to be more predominantly displayed, making it more of a thematic map.

For all maps the following elements form the basis of a 'good' map:

- Descriptive title.
- The map itself, including symbolisation of geographic features.
- Legend that explains the geographic symbols.
- Map scale.
- Map projection.
- North arrow (or compass).
- Copyright, source and publisher statements.

Departmental documented map production guideline(s) have been produced and communicated to key staff based on the components outlined in *Module 9: Map production guidelines.*

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9.1.2 Descriptive title

A *descriptive title* is a short description about the purpose of the map. Consider a map showing state population change between 1980 and 2003 by a graduated change in levels of grey. A quick non-informative title for the map would be *State Population*. The title provides the user with very little information about the map. A more appropriate title would be *Victorian Provincial Population Growth: 1980–2003*. This title, although an improvement on

the first, is still potentially incorrect as the title implies an increase in population not a decrease. Some local government areas may have decreased in population.

Possibly the best title would be *Population Change by Local Government in Victoria 1990–2001*. This title conveys a lot of information in a short phrase and does not mislead the map user.

9.1.3 The map

The *map* itself is a generalised representation of the real-world geography of an area. During the map making process information is usually generalised in order to make maps clearer and easier to understand. For example, the map maker might choose to show only those cities with populations greater than 25,000 rather than cluttering the map with every settlement with a population count recorded in the census database.

9.1.4 Map legend

The map *legend* clearly explains the symbols used to represent geographic features on the map. A legend does not necessarily need to include every symbol used in the map. For example, most map readers understand that wavy blue lines represent a river. The major symbols or themes however should always be prominent in the legend.

9.1.5 Map scale

Maps present a view of geography that is smaller than the real world, and as such it is necessary to note the scale of the map on the final map product. *Scale* can be shown as a unit measure (e.g. 1:50 000) or as a graphic scale bar. Maps of a scale of 1:50 000 and less are considered large-scale maps, whereas maps of a scale of 1:500 000 or greater are classed as small-scale maps. Large-scale maps generally show more geographic detail than small-scale maps.

9.1.6 Map projection

Map projections allow the cartographer to represent a portion of the 3-D curved surface of the Earth on a flat (or 2-D) piece of paper. A *map projection* is either set in the geographic data when it is created (and should be noted in the metadata), or it can be added or modified within most spatial information system applications. The most popular projections used in Australia are:

- For the whole of the Australian continent:
  - If users need to compare areas → Albers Equal Area Projection.
  - If users need to compare distances/angular relationships → Lambert Conformal Conic Projection.
- For small local areas of the Australian continent use the Map Grid of Australia (MGA). Data are mapped using the Geocentric Datum of Australia (GDA).

9.1.7 North arrow

Most spatial information system and mapping applications enable a *north arrow* or compass to be included on the map document. Depending on the map's extent and projection, the geographic north may be directly at the top of a page or slightly to the right or left of the top.

9.1.8 Copyright, source and publisher statements

A source statement informs users of where the map data originated and at what scale the data was captured. A publisher statement identifies who produced the map and when the current version was printed. A copyright statement identifies any copyright details. As part of best practice procedures it is important that copyright information is included.

9.2 Things to consider prior to making a map

Before making a map the following points need to be considered:

- The intended audience.
- Data sources.
- Composition tools.

9.2.1 Audience

Most spatial information system and other mapping applications can produce a wide variety of map products, from simple letter-sized maps to large wall maps printed on A0 plotters. It is important to consider and understand the intended requirements of the primary audience when producing a map product.

9.2.2 Data sources

It is widely acknowledged that approximately 90% of the time invested in a typical spatial information project involves the capturing or building of the geographic data. **When the time arrives to compile the data and produce a map it is critical that the map maker understands the data.** For example, what projection is the data in? At what scale was the data captured? When was the data gathered and who did it? If the map is saved, where is it on the local government network? This information should be available from the metadata associated with each data theme and emphasises the importance of producing and maintaining metadata.

9.2.3 Composition tools

Most spatial information system and mapping applications have a range of composition tools that are available for making maps. A good understanding of them is required in order to produce a streamlined and efficient map production system. For example, within ESRI's ArcView 3.x software there are two similar ways of constructing a legend in the layout document:

(i)   using the Legend Frame Tool, or
(ii)   using the Custom Legend Extension.

The use of templates is useful when making a series of maps which require a consistent format (e.g. for a report). Most GIS software support templates, and once created can save considerable time and effort leading to improved overall efficiency and effectiveness.

9.3   Design process

Producing a map that is simple, clear, uncomplicated and pleasing to the eye requires planning, and above all it has to convey the information in the correct manner. When a user requests a map to assist making a decision, it is important that the map reflects what the user wants to see. For example, if the issue is to display council ward boundaries and town planning scheme zones, the first thing the user should note when viewing the map are the zones and ward boundaries, and then any other information. Note: when viewed from a cartographic perspective, **it is important that GIS people are aware of the basic elements of graphic design as well as where and how to apply them.**

9.3.1 Cartographic design principles

There are four basic principles to consider during the cartographic design process:

- Legibility.
- Visual contrast.
- Borders and neatlines.
- Hierarchical organisation of layers.

9.3.2 Legibility

Map symbols must be legible to the reader. For example, lines representing roads need to be clearly differentiated from lines representing rivers. Circular points symbolising settlements must be clearly different from points symbolising traffic monitoring locations. Map feature labels, should be easily read by the map user within the context that the map is designed for.

9.3.3 Visual contrast

Thematic maps in which map symbols represent data should have good contrast with other map features so that attention is drawn to contrasting shapes and colours. The layer or theme that contains the important data should stand out from the background or other layers.

The role of the mapmaker is to ensure the reader's eye is drawn to the features that define the map's purpose, and is not confused with other less important information.

9.3.4 Borders and neatlines

The use of borders and neatlines can aid overall presentation and give a map a professional finish. Borders can be placed around the whole map and/or around other elements (e.g. the

legend, source, copyright and publisher statements). Mapmakers should ensure that borders are aligned and clearly distinguishable.

9.3.5 Hierarchical organisation

A well-presented map is not a jumble of features but an intentionally organised series of geographic layers.

Most spatial information system and mapping applications enable the mapmaker to establish a hierarchical organisation of features between thematic layers. When carried out correctly, a typical layering hierarchy will involve raster data (e.g. satellite image or digital elevation grid) on the bottom layer, polygon layers above this, then line and point themes on the top. Ordering can also occur within a single theme or layer. For example, with road classifications different line widths and styles can be assigned to represent local roads, state roads or federal highways. In this situation, the ability to illustrate such features is dependent on the data source (i.e. the road dataset must have attribute coding that differentiates road type).

Hierarchical organisation (or ordering) also applies to layers of the same type. For example, when dealing with line themes in mountainous country the mapmaker may position contours under creeks, which in turn are lower than roads in the hierarchy. Note: exceptions may occur, for example, when dealing with thematic maps. The subject layer can often be at the top, even though it may be a polygon (e.g. fire scars) or when dealing with very sparse or discrete polygons (e.g. swamp polygons may override contour lines and drainage to illustrate that a creek drains into the swamp).

9.4   Map production process steps

9.4.1 Preparation

Item	Task
On paper	Determine map purpose and audience.
	Choose appropriate map product.
	List data needed to accomplish map purpose.
	Sketch draft map.
On the computer	Gather and organise data layers and metadata documentation.

9.4.2 Map production checklist

The following check list, taken from the operations manual prepared for the National Land & Water Resources Audit (the Audit), provides an example of a check list identifying mandatory and optional elements for the production of Audit maps. It serves as a useful template for the production of maps in most project type activities.

Check list for map production — mandatory elements		
☐	**Title**	A descriptive name of the map.
☐	**Publisher**	The name of the publisher, place of publication and date of publication.
☐	**Copyright**	A statement indicating who holds copyright for the map and the year of publication.
☐	**Acknowledgments and source**	The origin and nature of the information shown on the map, including derived or interpreted data. The statement should also indicate the currency of the data.
☐	**Scale**	A scale bar with optional representative fraction in the form of "Scale 1: xxx xxx".
☐	**Legend**	Clearly depict colouring and display characteristics for the information shown on the map. The legend should display symbols or coloured boxes with a brief description of each.
☐	**Colours and shading**	In general for large areas on the map use light colours. For small areas use dark colours. Ensure that readers of the map are able to easily distinguish between colours on the map.
		For maps to be viewed on a screen do not use colour spectrums (e.g. blue-green-yellow-red) as they do not print out well in black and white and some colour blind people have difficulty reading them on the web (particularly red-green combinations).
		The main principle to follow when choosing colour ramps to represent increasing or decreasing values is to use colours of increasing intensity or darkness. Do not use a red colour ramp. That way the maps can be printed out in black and white and still accurately convey the information. While this is a little constraining, it ensures that our information products will cater for as broad an audience as possible.
☐	**Symbols**	Use established simple and clear symbols wherever possible.
		Symbols which create a mental image of the object or concept represented are preferred.
		Symbols portraying related objects or concepts should have common characteristics.
☐	**Font**	The number of different fonts and font sizes used should be kept to a minimum. Fonts that are sans (without) serifs,

☐	**Projection and datum**	• Australian continent:
		o Users need to compare areas → Albers Equal Area Projection.
		o Users need to compare distances/angular relationships → Lambert Conformal Conic Projection.
		• Small local areas of the Australian continent use the Map Grid of Australia (MGA94). Data are mapped using the Geocentric Datum of Australia (GDA94).
		• For Albers Equal Area, the parameters used when creating a map of Australia should be set to:
		o Map units: metres
		o Projection: Albers Equal-Area Conic
		o Spheroid: GRS80 or WGS84
		o Central Meridian of 132 degrees East (132°E)
		o 1st standard parallel 18 degrees South (18°S)
		o 2nd standard parallel 36 degrees South (36°S)
☐	**North arrow**	Only show if the clear delineation of north will be advantageous. If a graticule is used then a north arrow is redundant. Do not use a north arrow for small-scale maps with projections in Albers Equal-Area Conic or Lambert Conformal Conic as north varies across the map.

Check list for map production — optional elements		
☐	**Map number**	Should be included if the map is part of a numbered series. Normally grouped with the title.
☐	**Contact**	Use the format "For further information contact [name and/or position], [phone], [email]."
☐	**Status and constraints**	The status of the map may be draft, working map, version number, etc. Access constraints may include confidential, internal use only.
☐	**Caveats**	A statement of the reliability and restrictions on use.
☐	**Graticule**	At scales larger than 1:5 million the minimum requirement to delineate geographic coordinates (e.g.

		latitude and longitude) is to display labelled graticule 'tics' (short lines) around the borderline of the map sheet.
☐	**Additional text**	Additional text should generally be the same font, size and colour as text for the publication block.
☐	**Logos**	Where a number of organisations are responsible for the content and publication of a map, each organisation should receive equal prominence. Logos should not be overly prominent on the map. Where more than one logo is included, the logos should be the same size and prominence and would generally be grouped together.

9.5 Tips

Printing large maps is often a very time consuming and expensive process. Specialised PostScript Raster Image Processing (RIP) software is available from numerous software vendors to speed up the process of plotting and exporting map outputs on inkjet plotters. Most mapping application vendors can supply information on RIP products that seamlessly integrate within spatial information system applications.

It is often good practice to identify a range of standard products and maintain printing consumables at sufficient levels to service day-to-day user requests.

The use of automated map production routines and templates (standard layouts) should be considered to improve efficiency in map production and streamline many of the tasks identified in the checklist above (e.g. north arrows, logos, caveats).

The City of Brimbank (VIC) include the date of the aerial photograph when using orthophotography as a backdrop to their spatial information system output. Brimbank have found that this avoids confusion when overlaying other digital data, such as cadastre, have a different generation date — often younger than the aerial photography.

Develop formal, documented and ongoing processes to ensure continuous improvement of map production guideline(s) for on-line and hardcopy maps. These are generated by quantified regional analysis and user feedback and implemented across regions through structured change management.

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9.6   Additional support

General material on making maps is included in most documentation supplied with spatial information system software. These manuals can usually be purchased separately from software vendors.

Additional advanced material and support is also available in technical publications and reference books, and from software lists on the internet.

Useful online resources exist that provide examples of map layouts, such as:

Map Gallery on the Directions Magazine web site:
http://nt1.directionsmag.com/mapgallery/default.asp