MODULE 9

MODULE 9: Map Production Guidelines

Building capacity to implement natural resources information management systems.

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Guide for managers

Context

Maps are by definition a generalised representation of the 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 provinces or districts. During the map-making process information is usually generalised 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 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 much faster and more efficient than traditional cartography. Current geographic information systems (GIS) and computer aided design (CAD) software programs 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 making a good map. In this respect the importance of quality and appropriateness of the underlying datasets 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. In doing so they are not considered to be exhaustive and it should be recognised that each state/territory jurisdiction or NRM regional group may have specific overarching protocols which need to be considered.

The following elements form the basis of a 'good' map and thereby reflect best practice:

- 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, data source/s and publisher statements.

Actions

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

Managers need to make sure that mechanisms are in place (as part of quality assurance procedures) to ensure 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 a very time-consuming process. As such, sufficient time needs to be allowed when preparing such products. Managers should ensure that stocks of standard products are maintained to service day-to-day requests.

Acknowledgements

This module draws heavily on material from the book by Ed Madej (2001*) Cartographic Design Using ArcView GIS*, published by OnWord Press.

In addition, material from the Audit's operation manual has also been incorporated. These sources are duly acknowledged.

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—based on experience and aimed at saving time and resources
	Caution—readers are advised that particular care should be taken or that the subject issue may be complex
	Additional information
	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 or the Audit

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 soil type in a catchment is an example of a thematic map. The soil type is highlighted over any other map feature. Thematic maps are generally easier and faster to produce than good general reference maps.

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

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, data source/s and publisher statements.

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 itself

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. *Map 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 projection allows 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 SIS 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 SIS software and other 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, data source and publisher statements

A source statement informs users of where the map data originated and at what scale the data were 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 SIS software and other mapping applications can produce a wide variety of map products, from simple A-4 sized maps to large wall maps printed on A-0 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 are the data in?
- At what scale were the data captured?
- When were the data gathered and who did it?
- If the map is saved, where is it located on the NRM regional body's 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 SIS and mapping applications have a range of composition tools that are available for making maps. A good understanding of them is required to produce a streamlined and efficient map production system.

The use of templates is useful when making a series of maps which require a consistent format (e.g. for a report). Most SIS software supports 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 things the user should note when viewing the map are the zones and ward boundaries, and then any other information.

When viewed from a cartographic perspective, it is important that SIS 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 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 to draw attention to different 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). Map makers should ensure 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 SIS and mapping applications enable the map maker 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 map maker 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 checklist, taken from the operations manual prepared for the Audit, provides an example of a checklist 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.

Checklist for map production—mandatory elements

☐	**Title**	A descriptive name of the map
☐	**Publisher**	The name of the publisher and place 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, and ensure readers are able to easily distinguish between them. 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 (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. This allows the maps to be printed out in black and white and still accurately convey the information. Do not use a red colour ramp. While this is a little constraining, it ensures that your 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, such as Verdana, Univers, Triumvirate or Helvetica are recommended, particularly for web products.
☐	**Projection and datum**	Australian continent: users need to compare areas → Albers Equal Area Projection

		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 (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: map units: metres projection: Albers Equal-Area Conic spheroid: GRS80 or WGS84 Central Meridian of 132 degrees East (132°E) 1st standard parallel 18 degrees South (18°S) 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.
☐	**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's logo should receive equal prominence, however, logos should not be overly prominent on the map. Where more than one logo is included, they should be of the same size and prominence and generally grouped together.

9.5 Sample guidelines

The Herbert Resource Information Centre (HRIC) Map Production Guidelines is included at Attachment 9–1. Alternatively the guidelines are available online from the HRIC web site at http://www.hric.org.au/hric_site/hric_info/policies/map%20guidelines.pdf

9.6 Tips

Printing large A-0 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 SIS 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).

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

9.7 Additional support

General material on making maps is included in most documentation supplied with SIS 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 online.

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

Map Gallery on the Directions Magazine web site: http://www.directionsmag.com/mapgallery/

Attachment 9–1
HRIC Map Production Guidelines

HRIC Map Production Guidelines

Minimum Requirement of Maps for External Use:

1. HRIC logo and/or JVP logo;
2. Scale bar and/or statement;
3. Scale projection statement – e.g. 'Universal Transverse Mercator Projection Zone 55. Geocentric Datum of Australia';
4. Descriptive title;
5. Data acknowledgements (Source, scale and currency) – e.g. 'Drainage information supplied by the Wet Tropics Management Authority, sourced from 1:100 000 Army repromats, current at July 1995.';
6. Disclaimer – 'While every care is taken to ensure the accuracy of the data used on this map, the HRIC and its partners make no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the data being inaccurate or incomplete in any way for any reason.'
7. Usage statement – e.g. 'This map is not to be sold or re-made as part of a commercial product.'
8. Reference and legend;
9. Copyright statement; - eg "© Hinchinbrook Shire Council [year]"
10. Graticule or North arrow;
11. Cartographer and date.

Minimum requirements of Maps for Internal Use:

1. Descriptive title;
2. Scale bar or statement;
3. Data acknowledgements;
4. Reference and legend;
5. "Internal Use Only – Not to be Distributed" statement.

Additional requirements for **ALL** maps containing DCDB information:

Points 1 and 2 should be displayed on every map containing DCDB information near the DCDB source acknowledgement regardless of use or map size. Point 3 may be replaced with the more general "HRIC & partners" version (under minimum requirements for External Use) where appropriate.

1. © The state of Queensland (Department of Natural Resources and Mines) [year of publication];
2. Based on Cadastral Data provided with the permission of the Department of Natural Resources and Mines (Current as at month/Year);
3. While every care is taken to ensure the accuracy of this data, the Department of Natural Resources and Mines makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including direct or consequential damage) and costs which you might incur as a result of the data being inaccurate or incomplete in any way and for any reason.

GIS Cheat Sheet

Media Sizes – Metric (ISO)

Size:	Portrait:	Landscape:
• A4	210 x 297 mm	297 x 210 mm
• A3	297 x 420 mm	420 x 297 mm
• A2	420 x 594 mm	594 x 420 mm
• A1	594 x 841 mm	842 x 594 mm
• A0	841 x 1189 mm	1189 x 841 mm

Area Calculations

1. 100 square millimetres (mm2) = 1 square centimetre (cm2);
2. 10 000 square centimetres (cm2) = 1 square metre (m2)
3. 10 000 square metres (m2) = 1 hectare (ha)
4. 100 hectares (ha) = 1 square kilometre (km2)
5. 1 acre = .405 ha
6. 1 ha = 2.47 acres

Scale Information

Scale 1:	Length (1km)	Area (1ha):
2 500	400.0 mm	40.0 mm2
5 000	200.0 mm	20.0 mm2
10 000	100.0 mm	10.0 mm2
20 000	50.0 mm	5.0 mm2
25 000	40.0 mm	4.0 mm2
30 000	33.3 mm	3.3 mm2

40 000	25.0 mm	2.5 mm2
50 000	20.0 mm	2.0 mm2
80 000	12.5 mm	1.3 mm2
100 000	10.0 mm	1.0 mm2
250 000	4.0 mm	0.4 mm2