

National Elevation Data Framework

*The Shared Digital Representation of
Australia's Landform and Seabed*

User Needs Analysis

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Background

ANZLIC – the Spatial Information Council, with the support of the Australian Greenhouse Office (AGO), Geoscience Australia (GA) and the Cooperative Research Centre for Spatial Information (CRCSI) is sponsoring development of a National Elevation Data Framework (NEDF). A Project Team comprising representatives of these organisations has been set up to guide the process leading to the following deliverables:

1. **User Needs Analysis through direct contact with key stakeholders around Australia.**
2. Business Plan, setting out the intent and potential form of a NEDF, identifying key stakeholders and a preliminary review of existing usage of elevation data sets and products in Australia.
3. Science Case to support the implementation of the project.
4. Agreement on use of applicable data standards and access arrangements such as licensing.
5. Implementation Plan using the User Needs Analysis and feedback from stakeholders on issues such as governance arrangements, funding and technical standards.

This document is the User Needs Analysis. Its scope is limited to reporting user requirements obtained from over three hundred people who participated in a series of workshops held around Australia in the period 16 July to 29 August 2007. These workshops were held in all capital cities except Darwin.

Over 50 individuals also submitted written responses to a questionnaire, either before or after the workshops. The questionnaire mirrored the workshop content, asking participants to identify key drivers, data needs, existing gaps in elevation data availability and the key issues to be addressed in creating an NEDF. Input from workshop participants and those responding to the questionnaire are gratefully acknowledged.

A list of workshops, numbers attending and detailed findings for each workshop is attached at the end of this document. Questionnaire responses are not attached, but were used in the analysis.

The analysis is made for two distinct areas: the need for and form of a national framework for a coordinated approach to elevation data; and specific data needs and current gaps in existing data.

The results of the user needs analysis will be used to develop the NEDF Business Plan for the project. It will also be used as background in developing the project's Science Case and for discussion at a national workshop scheduled for December 2007.

Key Points

During the workshops there was strong support for a national approach by Australian and State government agencies, commercial interests and other workshop participants. This support is driven by:

- Calls for a national framework approach from the Council of Australian Governments (COAG) for the National Climate Change Framework and multi-jurisdictional bodies such as the National Spatial Information Management (NSIM) Committee in its Spatial Strategic Plan 2007-2010 for counter-terrorism and emergency management needs;
- The urgent data needs of the National Water Security Plan;
- The very wide range of applications using elevation data and products;
- A universal need for increased accuracy of elevation data to meet this wide range of applications;
- Need for better access to both existing and future elevation data sets by a wide range of users;
- Ability to use data derived from various sources to create new products, such as 3D visualisation for urban and infrastructure design and for communication with the general community.
- Current needs in key areas such as climate change, water management, wetland and coastal management, disaster mitigation, infrastructure planning and management, local planning and city management and industries such as insurance and mining.

Need for improvement was identified for:

- Development and application of national standards for elevation data and access;
- Moving from a project focus to programs that meet multiple requirements and use data collected from diverse sources;
- Ability to find and source data from State and local governments and the private sector;
- Program funding for digital elevation model (DEM) research and development;
- Advising fitness for purpose when using existing data;
- Importance of updating data to reflect change in the landscape;
- Filling gaps in data;
- Adopting an iterative approach to allow inclusion of improved data.

National agencies identified the need for a consistent continental specification for elevation data sets to meet a variety of national needs.

Many State government agencies expressed the need for a seamless multi-resolution, extensible DEMs and program to infill gaps. This should be done within a national framework and where possible meet the needs of national programs.

Several industry sectors expressed a strong need for better access to existing elevation data and emerging high resolution products. The insurance industry needs focussed on risk mitigation in areas such as coastal communities and floodplains. Utility services

and infrastructure providers stated a requirement for high resolution data for infrastructure development and management especially in urban areas. Mining was also a major user of elevation data. Their operations were often at national scale and a national framework would help to meet their requirements.

Particular mention was made by providers of elevation data in the private sector of their willingness to participate in a national framework approach, if there was an appropriate level of return on investment. Private sector concerns focused on the need for intellectual property (IP) issues to be addressed up front and carefully, as this will affect private sector investment. The private sector has shown it is willing to invest if both needs and risks (funding, IP) are known. Standards are needed but should fit the purpose of improving access to better data and development of innovative products. Adopting a point of truth should also not constrain opportunity for competition.

Local government was identified as a major user of elevation data. Local government often has very location-specific very high-resolution needs. Purchases made by local government were not always discoverable and available to other potential users. Often, these purchases were made using public funds from other levels of government and there was an opportunity to optimise this investment by wider use of the data.

There was general consensus about users having a better ability to find and access elevation datasets using a coordinated approach, virtual data repository and a one-stop portal. The concept of a virtual data repository and single online portal was supported as a way of identifying existing data and providing better data access through registration of data sets and documentation of data sources. There is a need to address how the portal will operate, including functions of data publishing, access, metadata and linking of data sets from diverse sources.

Identifying upcoming projects was seen as a way of facilitating partnerships and joint investment in elevation data acquisition, providing the opportunity to increase the coverage and accuracy of data in individual projects. A number of agencies showed a willingness to be part of a consortium approach to purchase of elevation data sets.

The top five needs voted by workshop participants (in order of importance) were:

- Develop and apply national standards for elevation data and access.
- Better ability to find and access elevation datasets, using a virtual data repository and a one-stop portal.
- Close the data gap along the coast between existing land and sea data sets.
- A common vertical datum for both land and sea elevation data, with an updated AHD specification fit for higher resolution data.
- Leadership to develop a coordinated national elevation data acquisition program that is funded and involves all stakeholders and sectors.

Although there were different elevation data requirements based on a wide range of different applications requiring various accuracies and coverage, there was still a use (as a default) for a nationally consistent “freely available” elevation data product of higher accuracy than the current 9 second data set. The coverage of such a product should be the entire area of Australia’s sovereignty, out to the edge of the continental shelf and preferably covering the Australian Antarctic Territory (AAT), Heard Island, Macquarie Island, Southern Ocean between Australia and the AAT.

National Framework

Key Needs

The following table shows the results of voting by all workshop participants on key requirements for a national approach. Needs that received less than a total of ten votes are not shown, but are recorded in individual workshop reports at the end of this document. Some of the issues identified at individual workshops have been combined in the table where they had the same intent.

Outcome	Need	Priority/Votes
Better data available	Develop and apply national data standards for elevation data and access	165
	Close the data gap along the coast between existing land and sea datasets	126
	Update and maintain existing data	69
	Move from low to high resolution data	43
	Consistent continental spec for data sets	42
Improved useability	Common (and improved) vertical datum	100
	Metadata requirements, use of consistent description of data and products	68
	Better data management, ability to integrate and update existing data, temporal resolution, change detection and handle large data volumes	48
	Increase capacity of users (technology, investment and decision making, better education and skills in use of elevation data)	23
	Recognition of terrain shape and hydrological enforcement in datasets, drainage and point data available	21
	Better description of data errors	19
	Need to prioritise R&D funding for data acquisition technologies especially over the seabed	15
Remove barriers to data and resource sharing	Leadership to develop a coordinated national elevation data acquisition program that is funded and involves all stakeholders and sectors	70
	Sort out IP issues, use existing scheme, encourage use, adopt consistent licensing	61
	Central clearinghouse of projects, develop funding and cost model(s) to maximise investment and collaboration	49
	Whole of govt purchasing models, provide access to jurisdictional data	15
	Develop funding and cost model(s) to maximise investment, especially from Australian Government sources	15
	Increase coordination of activity and access to private sector data through incentives	11
	Improved access to data and products	Virtual data repository and one stop portal (for putting data in, finding and getting data out)

Governance

Governance issues raised included leadership, governance structures, administrative arrangements, access to existing data and optimising investment in new data acquisition.

Need the ability to collaboratively share information and identify the gaps under a national framework – hence the development of the NSIM Spatial Strategic Plan 2007-2010!

1. Raising awareness of what the framework can provide to new and existing user communities.
2. Establishing an agency/department or authority “champion” that actively promotes and drives forward the use of the underlying data.
3. Ensuring that the framework uses national standards that are commonly used by existing capabilities to avoid the push-back when changes are demanded from those existing capabilities.
4. Building a framework based on actual user requirements so you develop a framework that achieves what the user wants, not what you think they want.
5. Confront licensing, information sharing and technical limitations issues and provide viable resolution options.

Questionnaire response from a national agency responsible for counter-terrorism and emergency management.

The State presenter strongly supported the national initiative, especially driven by national policy initiatives such as coastal vulnerability. There was a need for defensible decision-making backed up by agreed data sets. It was important to collaborate to maximise the benefit of investment being made at all levels and across sectors.

From input at one of the workshops

These excerpts encapsulate the key governance requirements for a national approach to elevation data enunciated in the workshops.

Data availability and access was a recurring theme at the workshops, with a need for national leadership to coordinate data acquisition requirements and funding. Participants felt that there was a lack of coordination, with no recognised authority to take national DEM ownership and responsibility. Participants indicated that a major issue centred on budgeting, funding and cost aimed at sharing of data and investment. The principal mechanism suggested was for an Australian Government agency to take leadership in developing a significant funded data acquisition and management program in the national interest. There was a view expressed that data acquisition should mainly be the responsibility of States, local government and the private sector.

A key was to develop innovative funding/investment models that encouraged all stakeholders to participate in order to meet growing demand for high resolution elevation (indeed all spatial) data, the need to reduce duplication of effort and investment and to get all sectors involved in the supply chain from acquisition to use.

At an operational level, there was a need for a central agency to facilitate a one-stop shop covering available elevation data, access, supply, distribution of data and metadata, user support, quality assurance and price/quality negotiations.

In discussing how to address these issues, common themes were shared responsibility and resourcing, needs driven by individual applications, with special implementation roles for a steering group comprising public and private sectors. Special roles were identified for the Commonwealth Minister for the Environment and Water Resources (leadership and funding), Geoscience Australia (facilitate access to more accurate data), ANZLIC (coordination) and CRC SI, ICSM and Standards Australia for research and standards development, with input from the private sector. Ministerial Councils are appropriate bodies to broker common legislation, policy and approve joint funding initiatives.

Most participants were of the view that existing mechanisms be used and not to “reinvent wheels”. In parallel was the need to address intellectual property (IP) issues, especially licensing of data and products for third party use to encourage use of existing data, preferably using an existing digital rights management scheme. Data access should be structured to encourage use of existing data and optimise investment. Participants felt economic development could be encouraged through ready access to data.

A major concern was that the process would take too long for national coordination to be useful. There was a degree of urgency to get a national framework in place before further large purchases of elevation data. Participants confirmed this need to get the framework developed and data capture underway as quickly as possible, even if early deliverables were simple and expedient.

Particular mention was made of the private sector’s willingness to participate, if there was an appropriate level of return on investment. The private sector has shown it is willing to invest if both needs and risks (funding, IP) are known. Private sector presenters expressed support for the approach being taken in the project. There was the need for a response from the public, private and academic sectors of the industry and to use the resources of all sectors. The private sector needed to be involved and to use its capacity in the supply chain including acquisition, processing, use of existing data, distribution, access, visualisation and value adding. Key issues were to build trust and respect intellectual property (IP) held by the private sector.

The key driver at present for the private sector is infrastructure development and the private sector is well positioned to provide high-resolution data needed for projects. A participant pointed out that Australia has world-class private sector capabilities in elevation data, which needs to be nurtured and used by governments. An action is for the project sponsors to sit down with the private sector to discuss IP issues.

Participants, especially from the private sector were supportive of a partnership approach if it clarified needs and led to clearer procurement processes. Multiple uses of data needed to be reflected in purchase price. Longer-term planning and long term projects could provide more certainty for private sector investment of equipment and knowledge. Accuracy requirements need to be made specific in procurement

processes, as they are a major determinant of cost and useability. In parallel was the need to address intellectual property (IP) issues, especially licensing of data.

An option to achieve a whole of State coverage, for example, was to buy once (at higher initial price) with licence to distribute at low cost; or engage the private sector to capture and then sell many times.

A governance model should:

- Acknowledge that there will be diverse sources of data and products and the need to coordinate effort;
- Coordinate data capture programs using a range of technologies such as multi-spectral scanning and LIDAR for delivery in priority areas;
- Use existing models for custodianship, IP, licensing and jurisdictional coordination;
- Have strong MoUs between players (including the private sector);
- Have strong leadership from the Australian Government;
- Assign roles, such as the Australian Government provide national data management, access and distribution, with States and private sector managing data acquisition;
- Must include local government and NRM regional bodies;
- Focus on improving accessibility to data and capabilities;
- Address limitations of access to sensitive data, such as to Defence and CSIRO high resolution data;
- Clarify role of existing bodies such as ICSM and PSMA.

Investment

There is a need to develop funding and cost model(s) to maximise investment. The formation of consortia to plan projects, share costs and manage IP was seen as an important way to extend the coverage and accuracy of data being purchased at the present in individual projects.

Industry (as users and providers) should be able to deal with all levels of government depending on where budget is coming from, although large national industry players may prefer to deal with a single point (the Australian Government) on national needs.

There is some benefit in better coordination of data spend across programs using Australian Government funds. Responses also indicated the need for integrated local, jurisdictional and national elevation data products, implying some level of national consistency.

Participants indicated that a major issue centred on budgeting, funding and cost aimed at sharing of data and investment, to capture data once and use many times. A key was to develop innovative funding/investment models that encouraged all stakeholders to participate. Particular mention was made of the private sector (shared funding model) and local government that was under-resourced but beginning to acquire more data and needed an incentive to collaborate.

A central clearinghouse was suggested by one group as a way of notifying and identifying data acquisition projects; registration of data sets; documentation of data sources; provide incentives and facilitate sharing costs through a collaborative funding model to facilitate partnering and cost sharing.

Issues at State level included lack of program funding for DEM development, with all funds being single project based; advising fitness for purpose when using existing data; growing demand for interoperability and accessibility between data sources.

Private sector providers encouraged consideration of public private partnerships in the supply chain to mobilise the resources from all sectors. There is a need to reduce risk by careful planning of data acquisition, based on real user needs. Models for private and public sector investment need to be developed, based on commercial realities and aimed at building a more robust spatial information industry in Australia.

An investment model should:

- Learn from initiatives such as NCRIS (CORS Network) that link R&D with delivery;
- Acknowledge that opportunities are being lost through individual projects wasting investment;
- Create a large central fund rolling up smaller funding sources, to act as a catalyst for shared resourcing;
- Allocation of funds based on delivering agreed priorities using a formula based on spatial extent of priority areas (eg. vulnerability);
- Private sector providers need a decent rate of return otherwise there is little incentive to work within a national framework;
- Should go for whole of government licences if cost effective and negotiate licence for wide usage;
- Otherwise, if private investment is involved, expect limits on third party access and resale;
- Model should provide for management of quality assurance and limits to liability;
- Local government should be offered incentives, such as cost sharing to make their data more accessible;
- Facilitate economic investment by making data readily accessible by wide range of users at reasonable (low) cost (such as for WA SLIP).

Access

We use elevation data mostly for presentation purposes in the emergence response scenarios such as nature disasters of inland/coastal flooding, server storms & drought. Therefore, in terms of business drivers, we don't demand very high resolution in both (X,Y) and Z dimensions. However, the business issues to us are the availability, easy and on-line accessibility, low cost, ready-to-use. For example, we hope not only data providers make data accessible but also provide software utilities for users to easily and flexibly extract customised data for area of interest, such as by coastal catchment or flood plain, from continental mosaic or from tiled data sets.

From a questionnaire response by an Australian Government agency

User expectations / perceptions (particularly non GIS trained) are that DEM data will be available for their area of interest and at the 'right' resolution (what ever that might be) when required. Their focus is more on an easily used product rather than data sets.

User perception is generally that the DEM is the responsibility of a data provider and it is just a product that is readily available. Regarding licensing, there is a likely legal perception that if a government department has an improved DEM for a particular area then it should be available to other government departments as all have the same employer.

A virtual data repository and single portal (for putting data in, finding and getting data out) maintained by an Australian Government agency was supported as a way of identifying data acquisition projects and data management through registration of data sets and documentation of data sources. The need to build on the existing ASDD linked to State metadata repositories was recognised as the way to aid discovery and access.

The audience identified the need for specifications and standards to provide national consistency, an audit of current holdings and development of whole of government requirements and ongoing data management and distribution requirements.

It is also important to understand that there will be restricted access to some sensitive data, for example held by Defence and owners of key infrastructure. This issue needs to be addressed within the national framework.

The primary business driver for the collection of elevation data by the private sector is the mining industry, mainly in WA, SA and QLD. Large companies, such as Woodside Petroleum were making large investments in data and embarking on major collection and use programs. A common complaint is finding and using data collected by or on behalf of local governments. Gaining access to these sources of data will need to be considered in any national approach.

Data Set and Product Requirements

Key Needs

Data acquisition priorities should be driven by specific policy outcomes. Climate change, water management and disaster management, as well as the needs of industries such as insurance, utility services and mining were specifically mentioned. The following table is a summary of specific needs enunciated at the workshops and in questionnaire responses. An average or majority view has been adopted to indicate the general need where participants gave different specifications or priorities. Where a range of resolution values is shown, it may represent a variety of different needs, such as for site selection versus detailed analysis or design requirements. Sometimes participants gave figures for resolution and sometimes for accuracy requirements. Therefore, figures shown in the table could be indicative of either resolution or accuracy. They should be treated only as a general guide and not an absolute specification of requirement.

User Application	Elevation Data Resolution Preferred		Coverage Required	Priorities
	X,Y	Z		
Landscape modelling and predicting water movement through landscapes, including hydro-geological modelling, surface and groundwater modelling; whole of catchment management and sub-catchment delineation for water quality modelling, hydrological analysis and ground water analysis for catchment management and water quality monitoring, surface analysis and 3D analysis for catchment risk analysis including climate change and drought	5-20m 20-50m 20m	<1m 1-5m with drainage enforcement 0.1m	Drainage data across Australia Whole of State NB. <u>Accuracy</u> 1-2m x,y <1m z For modelling	Stream networks Floodplains (especially the Murray Darling Basin) Metro and rural urban are also priorities Catchments adjacent to and over GBR
Coastal zone management, including terrain analysis; risk and vulnerability analysis for tidal surge, sea-level rise and other natural hazard impact assessment; urban development growth pressure along coast	5-10m 2m 250m	10-30cm on land 0.5-1m shallow water 10-25cm	Coastal areas from 20m contour out to 30m depth Dunes Deep water	Urban growth areas, especially those subject to coastal inundation. Very high resolution topography in coastal zone

Hydro-dynamic modelling	10-30m	<1m	Bathymetry, need out to 80m depth at least	Coastal area and reefs esp GBR Increased coverage of bathymetric data (deep water, inshore and enclosed waters such as estuaries, straits and gulfs)
International/national coastal navigation; management and planning of maritime navigation network; search and rescue	10-40m	0.5m	Major estuaries and ports, coastal out to 20m depth	Bathymetric data in areas of high vessel traffic and environmental significance (e.g. ports, channels, Great Barrier Reef, Torres Strait etc)
Land use and urban planning		<1m 1-2m	Populated, urban areas, built structures Rural areas	Coastal fringe and urban growth areas
Environmental planning, monitoring, assessment and reporting, water resource management, salinity	10m 25m	1-5m <5m	Whole of State Land suitability studies	Multi-spectral imagery, baseline data needed Vulnerable lands, steep areas subject to subsidence
Floodplain management, insurance risk, local government	6m 2-5m	0.15-1m dependent on terrain <0.5m	Floodplains At risk areas and assets	Populated areas, areas subject to flooding, flood plain mapping in MDB and Western Division
Stream modelling; gully/stream bank erosion monitoring	10m	0.5m		
Vegetation	1-10m	0.5-1m 10cm 0.2m	Extent, structure and condition Evaporation, transpiration modelling Vegetation mapping (canopy and bare earth)	Whole of State
Forestry operations	<1m	10-20cm	Tree cover/surface (multi-	State and private forests;

	<10m	1-5m	attribute) Drainage (bare earth)	especially slopes; LIDAR preferred to give tree penetration
Infrastructure development and management (road, rail, mining, water, ports) Corridor mapping (telecommunications, powerlines, roads, pipelines)		1-10m 1m 20cm 10cm	Variable depending on asset Investigation General Planning Conceptual design Construction	Localised and route based, generally require a high resolution surface model
Aviation safety; airport and flight path management	Depends on location	*	National * Refer to RTCA DO-276 March 5, 2005 User Requirements for terrain obstacle data.	30km around airports Up to date Obstacle Database to be created and then maintained
Safeguarding communities and infrastructure; situational awareness for defence, CIP, CT and EM operations			National and State wide	Using current data sourced from mainly from Australian and State government agencies
Defence operations and flight simulation; reconnaissance and surveillance; cross-country mobility	10m (DTED 3) 5-20m 2m	1m <30cm 0.5m	National For obstructions, first and ground surfaces, national Major infrastructure	High points; 150km radius from airports; areas of operation
Emergency Services	6-10m 10m 10m	<50cm 5m 50cm	Line of sight Location of radio repeater sites for search and rescue coverage (urban and peri-urban areas) Police radio coverage (all State)	Accuracy is critical in populated areas; police require DTED 2 minimum
Bushfire management	25m 20-50m	10m 5m	National Slope and fuel loads	Bushfire prone areas, urban interface, environmental and fire

	<25m 5-10m	5m 0.5-2m	Populated areas, roads Fire modelling	models; need existing data or better
Local government	20m 20m 5m	1m 10cm 10cm <1m 25-50cm	Landslide mapping Storm water modelling 3D modelling in cities Infrastructure management Planning and development	Urban areas, generally use LIDAR to give 0.2m vertical accuracy
Visualisation, including 3D city views, image draping; public consultation	60cm	10cm 5m	Capital cities State/regional coverage	High resolution DEM (ie survey accurate) in metro areas
Ortho rectification of photography, production of ortho photos	25m	1m 10m contours 2m	Urban Whole State Series mapping at 1:25,000	Need better resolution on coast Peri-urban is priority Existing data, may be replaced with high res data as it becomes available
Precision agriculture, farm management	1-5m	50cm	Agricultural areas	
Water resources and supply		50cm 1m	Modelling Visualisation	State-wide
Marine (fisheries, oil spill response, estuaries, habitat mapping, maritime environmental protection services)		<1m	Project based	High use areas, aquaculture
Oil and gas offshore, including pipeline design, anchoring, infrastructure planning, surface models for geological and geomorphologic interpretations	100m 25m 1-5m	20m 10m <1m	Regional bathymetry Geophysical horizons Detail	Seamless offshore bathymetric coverage, detail site specific data
Geological, Landform, regolith mapping and soil mapping	10-20m		Continental/global	High resolution in coastal areas The resolution must be equal or

				better than the scale at which surface processes operate
Telecommunications (spectrum management, line of sight analysis)	6-10m	0.15-1m	Populated areas and trunk routes	
Climate studies; climate change impacts; ozone modelling			Continental (both bathymetric and topographic data) covering Australia's sovereignty out to the edge of the continental shelf, including island and Antarctic territories	Linked to the rest of the world coverage, use existing data

Summary of key data requirements

Some ideas on data acquisition programs included:

- One aspect of identifying needs of specific drivers was their need for data currency and hence acquisition cycle.
- Be staged depending on priorities.
- Look to investing in existing data sources that may yield high resolution before new acquisitions where cost effective.
- Many sources give visible surface, not necessarily bare earth – need to be clear about what is being shown, both source and derived surfaces.
- Good relative accuracy rather than absolute accuracy was more important.
- Data should be hydrographically correct (using drainage enforcement).
- Need for number of surfaces depending on different requirements, including bare earth, tops of structures, tree canopy, water level, lake bed, etc
- Need both original and modelled data, so if there are problems with derived data, users can go back to original data.

There was support from a number of national agencies for a “standard” consistent DEM coverage of Australia’s land surface. Applications included hydrological studies under the National Water Security Plan, land use studies, emergency management and for aeronautical purposes amongst others. These stakeholders anticipate the need for a seamless consistent national DEM with 10-40m postings (x,y) and less than 1m (z), down to 0.1m vertical (z) accuracy. Further work will be needed to produce a workable (and fundable) specification, but it was useful feedback “on-the-fly”. One participant thought that the 10 m DLI coverage of the southwest of WA was suitable template.

At State level, a common specification was 5-10m horizontal and 10-30cm vertical for coastal areas to support planning and identification of at-risk areas, repeated mapping of coastal erosion and monitoring at-risk areas broadly from 20m depth to 20m elevation. For the rest of the State, it was 10-30m consistent horizontal coverage and 1-5m vertical for applications such as hydrological modelling. Expect that this need and the need for better resolution data will increase as water scarcity becomes a bigger issue. In Brisbane, the State presenter put a proposition that a worthwhile goal is to achieve State coverage with vertical accuracy of 7.5m, down to 50cm in urban and coastal areas.

There was a strong sense that one product could not meet all needs. In fact, it is not possible to develop a single product specification to meet a majority of needs. These needs are diverse at State and local level, from overall coverage for planning purposes down to project-specific coverage. In general, highest accuracy was needed for specific tasks in particular areas, with lesser accuracy for general terrain mapping.

High-resolution elevation data was needed across a number of applications. Particularly fine resolution was needed in vulnerable coastal and low lying (eg floodplain areas) where accuracy and precision to sub metre level is required. A high fidelity data set was needed especially along the coast, capable of discerning small but

significant features such as frontal dunes, steep slopes and overhangs that are missed in current data sets, but have a major impact on modelling coastal inundation and landslips. LIDAR was specifically mentioned as a pertinent technology.

In low relief areas, of which there are many, precision better than 1 metre is required. Assessment of shape and drainage accuracy is a challenge in itself – most readily measured in terms of accuracy of derived streamlines and absence of spurious depressions.

Some broad scale applications are well catered for, such as 9 second DEM in support of climate surface models and broader scale catchment analysis. Finer scale applications relate to assessment of inundation and fine scale modelling of surface flows of water, catchment delineation, sediments and pollutants, shape-based calibration of fine scale remotely sensed data, local engineering and farming applications.

Users may also need different products, so product specifications are needed. Some users require dense raw spot heights to pick up special features of interest lost in a grided dataset, such as sharp changes in grade that indicate fault lines. Others are satisfied with the general coverage presently available in grided DEMs. Surface (buildings / canopy) data needs to be included as a valuable resource in its own right.

The point was made that elevation data must represent the shape of the terrain, with drainage lines imbedded in the elevation dataset to improve fidelity. This aspect is demonstrated by the wide use of the ANUDEM software using drainage enforcement.

Considerations

List of Technical Issues

ICSM was nominated in most workshops to develop a standards framework. Requirements include:

- Develop and apply national standards for elevation data and access (one of the top five issues identified at all workshops).
- Need for a common vertical datum (nominated at most workshops), with an updated AHD specification fit for higher resolution data (synchronised with geodesy network upgrade), better geoid and tide models, tidal model for adjusting coastal and offshore soundings to AHD.
- Need a better specification for reporting accuracy/timeliness of existing data and ascertaining fitness for purpose, both for raw data and derived products. This will aid users to search and assess fitness for purpose.
- Address lack of standards in elevation data, modelling, metadata and temporal data, use of consistent description of data and products.
- Use metadata to describe all elevation data sets and products, use of ASDD and jurisdictional directories encouraged. Need metadata to describe the source data and the models used to derive the grid. Need to educate users about fitness for purpose using metadata.

- Standards for error surfaces and modelling consistency, ortho rectification of imagery specification. Need modelling standards so derived surface products are defined consistently. Need bare earth or the canopy/buildings or a mix of both and need to be clear which is provided.
- Licensing – need a standard approach. What does a whole of government license mean? Use an existing DRM scheme that takes account of public and commercial needs and encourages use of elevation data.
- Need data management practices and capacity to handle large data volumes.
- How do we better describe accuracy, define what we mean by ‘resolution’.
- Need to store both source and derived surface data, able to go back to source to remodel.
- Need to address accuracy of attribute data used with elevation data. May find that high-resolution elevation becomes available but other related data (such as cadastral) remains low resolution, hence integration problems.
- Some data capture systems/platforms do not capture relevant attribute data, needs to be considered in choosing the right capture method.
- Need for flexibility to combine elevation data sources of varying accuracy.

Creation of seamless data sets and derived products may require access to multiple data sources. There is a need to address problems in combining data sets of different coverage and accuracy. In that case, there is a need for a useful common sense standard that can encompass data of different accuracy and currency and take care of edge effects. Participants believed there was a need for greater density of survey control to facilitate stitching of diverse data sources.

The three-dimensional transformation/integration of elevation data from disparate sources/technologies is a challenging task that should be acknowledged but not be a limiting factor in the usage of elevation data for some applications. LIDAR data sets would be highly suitable for that void filling task. DIGO has developed a void filling capability with in-house software.

When looking at a consistent continental data set, it is worth investigating use of Defence (DTED) and international hydrographical (IHO) product specifications.

Implications for Business Plan

Detailed user needs are now better known and requirements for a national framework understood. The business plan needs to reflect key requirements for the national framework identified in the analysis. The findings should form the basis for developing the business and investment models and priorities for the implementation plan. Priority user needs for improved elevation data sets can also be analysed and placed in the Business Plan to add weight to the argument for shared investment in further data acquisition.

Implications for Science Case

A list of technical issues is a good reference point for the science case. Key user requirements can be used as the basis for determining options in the science case.

Implications for Stakeholder Engagement

Feedback now needs to be provided to workshop participants and questionnaire respondents. The User Needs Analysis needs to be provided to all stakeholders and especially workshop participants. The updated Business Plan should be widely distributed to stakeholders and used in briefings to sponsor bodies. Key findings from the user needs analysis should be reported at the proposed national workshop.

Issues for Implementation Plan

- Given widespread support for a national framework for elevation data, what are the most appropriate governance and investment models to make it work?
- What are the priorities for addressing both short-term and long-term data needs?
- What needs to be done, given the stated need for a seamless continental coverage utilising multiple sources of data, to develop a model for finding then “stitching” data together?
- Is it possible to develop a central clearinghouse as a way of notifying and identifying data acquisition projects; registration of data sets; documentation of data sources; provide incentives and facilitate sharing costs through a collaborative funding model to facilitate partnering and cost sharing?
- How can users be assisted to find and access elevation datasets using a federated approach and developing a virtual data repository and a one-stop portal?

Attachment: List of Jurisdictional Workshops

Place	Date	Time	Venue	Attendees
Canberra (AG and ACT)	16 July	2-5 pm	Raggatt Lecture Room, Geoscience Australia, Symonston ACT	75
Sydney	20 July	10am- 1pm	Rolleston Room, Lands Dept building, Level 3, Queens Square	44
Hobart	27 July	9am – noon	6th Floor Conference Room, 134 Macquarie Street, Hobart	27
Melbourne	30 July	9.30am- 12.30	Inglis Room, Level 16, 570 Bourke Street, Melbourne	38
Brisbane	1 Aug	1pm-5pm	Auditorium, 111 George St, Brisbane	49
Perth	7 Aug	9.30am- 12.30	45 Plaistowe Mews, City West Centre, West Perth	48
Adelaide	29 Aug	9.30- 12.30	Lecture Theatre, State Library Corner North Tce & Kintore Ave, Adelaide	32
			Total	313

Attachment: Individual Jurisdictional Workshop Reports

Workshop Report : Canberra 16 July 2007

Summary

The workshop had 75 attendees. Over half the attendees indicated they are users of elevation data. The remainder were probably data product or service providers. Most were from Australian Government agencies, with a small number from the ACT Government, academia and private sector. The format for the workshop appeared to work, although some streamlining will be made in the discussion format at subsequent workshops. Phil Tickle precirculated a questionnaire to those accepting the invitation. 19 responses were received from 13 agencies and summarised in Phil's presentation. Attendees were encouraged to fill in the questionnaire after the workshop if they had not already done so. Discussion was robust and led to prioritising issues of concern to national agencies. This output will be used in State workshops.

Key Points Arising

- There was support from a number of national agencies for a “standard” consistent DEM coverage of Australia-wide land surface. Applications included hydrological studies under the National Water Initiative, land use studies, emergency management and for aeronautical purposes amongst others.
- These stakeholders aspire to a seamless consistent national DEM with 10-40m postings (x,y) and down to 0.1m vertical (z) resolution. Further work will be needed to produce a workable (and fundable) specification, but it was useful feedback “on-the-fly”. Note: new space sensors now on line (e.g. ALOS) and soon coming on line (such as TerraSAR), could make a national DEM coverage at 10m or better (x,y) and 1-2m (z) realisable and cost effective given the widespread benefit.
- There were a range of needs identified by the audience that differed in coverage, specification and timing. Those mentioned by the audience are shown in Appendix A.
- Users may also need different products, so product specifications are needed. Some require dense raw spot heights to pick up special features of interest lost in a grided dataset, such as sharp changes in grade that indicate fault lines. Others are satisfied with the general coverage presently available in grided DEMs. Surface (buildings / canopy) data needs to be included as a valuable resource in its own right.
- The point was made that elevation data must represent the shape of the terrain, with drainage lines imbedded in the elevation dataset to improve fidelity. This aspect is demonstrated by the wide use of the ANUDEM software using drainage enforcement. Many new remote sensing platforms collect drainage as part of data capture.
- Specific coverage mentioned included:
 - 30 nautical miles around aerodromes;
 - Between -10 and +10 contour lines around the coast to fill the current gap between existing bathymetric and topographic data;
 - Areas affected by tide, both off- and on-shore;

- Great Barrier Reef and adjacent catchments;
- Floodplains (especially the Murray Darling Basin)
- Urban growth areas, especially those subject to coastal inundation;
- Continental (both bathymetric and topographic data) covering Australia's sovereignty out to the edge of the continental shelf, including island and Antarctic territories;
- Global, with Australia's coverage linked to the rest of the world coverage (specifically mentioned in regards to climate studies).
- Most needs identified require data now or in the near future, others were ongoing or require an update of existing elevation data.
- Attendees and questionnaire responses identified over fifty issues to be addressed (these need to be categorised as there was some overlap).
- The top five unresolved issues voted (scores) by the audience were:
 - Develop and apply national standards for elevation data and access (27);
 - Need for a common vertical datum to be used in new (and where possible existing) elevation datasets (23);
 - Better ability to find and access elevation datasets, using a virtual data repository and a one-stop portal (19);
 - Close the data gap along the coast between existing land and sea datasets (16);
 - Develop a consistent continental dataset specification (15).
- In discussing how to address these issues, common themes were shared responsibility and resourcing, with special implementation roles for Geoscience Australia (models and data), ANZLIC (coordination and standards) and CRC SI, ICSM and Standards Australia for research and standards development.
- There is some benefit in better coordination of data spend across programs using Australian Government funds. Responses also indicated the need for integrated local, jurisdictional and national elevation data products, implying some level of national consistency.

Appendix A: Identify Needs

The following is a compilation of pre-workshop questionnaire responses and audience input at the workshop.

Primary Business Drivers:

- Modelling and predicting water movement through landscapes, including hydro-geological modelling, surface and groundwater modelling and catchment modelling;
- Landform, regolith mapping and soil mapping;
- Risk and vulnerability analysis for tidal surge, flooding, sea-level rise and other natural hazard impact assessment (including climate change and tsunami vulnerability and impact assessment)
- Safeguarding communities and infrastructure, situational awareness for defence CIP, CT and EM operations.
- Coastal zone management
- Search and rescue response
- Defence operations and flight simulation
- Infrastructure design
- National transport infrastructure planning, safety and operations (air, land and sea)

- Management and Planning of maritime navigation network
- Biodiversity modelling
- Telecommunications
- Pollutant modelling
- Sovereign boundary mapping
- Maritime environmental protection services

Needs

Coverage	Timing	Issues
+/- 10m coastal contour zone including tidal zone Environment protection/ defence / includes jurisdictional users	Now – ongoing	Common vertical datum Mismatch between Topo-Bathy data Jurisdictional issues Better tidal modelling
Great Barrier Reef World Heritage area and associated catchments	Existing data out of date, better data required now	10 years out of date
Catchments for hydrologic modelling on-shore and off-shore	Now at low resolution, high resolution within 12 months	Some low resolution data available, but need 10m x,y and 1m z
Global data for climate and soil studies	Global soils map with 90m DEM in 5 years	
Urban development growth pressure along coast, inundation mapping	Some available but patchy Ongoing	Coverage and quality unknown Small LG areas – under resourced
Flood plain in Murray Darling Basin	High resolution vertical data needed now	Magnitude of the data – high volume management issues
Within 30 nautical miles of registered aerodromes		Consistent data sets High resolution data not available Need data repository – one stop shop Data update and correction frequency – mining areas
Drainage data across Australia	Now	Understanding the errors in the data especially vertical
Truly national coverage including external territories		Better data access Regulatory regime for collecting data from foreign vessels

Technical Considerations

- How do we better describe accuracy
- Define the derived surface products consistently
- Define what we mean by ‘resolution’

- Modelling consistency– are you seeing the ground or the canopy or a mix of both
- Need metadata to describe the source data and the models used to derive the grid
- Licensing – what does a whole of government license mean

Issues to be Resolved

From pre-workshop questionnaire responses:

- 1.Governance
- 2.Cost recovery
- 3.Cost sharing
- 4.Free
- 5.Data sharing between all levels of government
- 6.Broad stakeholder involvement in framework development
- 7.Data availability and access
- 8.Consistent licensing and pricing policies across all levels of government
- 9.National coverage and consistency
- 10.Geographic coverage
- 11.Stakeholder awareness of data availability
- 12.Online data catalogues
- 13.Online data access
- 14.Seamless joins between datasets (a challenge but should not be seen as a limiting factor)
- 15.Integrated near-shore and littoral bathymetry coverage
- 16.Whole of government purchasing models
- 17.Recognition of terrain shape and drainage accuracy
- 18.Comprehensive documentation
- 19.Metadata requirements
- 20.Collaborative technical development
21. Education on appropriate use of data
- 22.Easy data access
- 23.Standards for accuracy
- 24.National Obstacle database
- 25.Coordinated planning and acquisition
- 26.Information and knowledge sharing
- 27.Raising awareness of the benefits of a national approach
- 28.Establishing a champion to drive the process forward
- 29.Development of national standards
- 30.Access to existing proprietary data
- 31.Maintenance of raw and derived data products
- 32.Establishment of data collection and maintenance responsibilities
- 33.Issues of National Security
- 34.Addressing data gaps in the coastal and littoral zone
- 35.Seamless topography and bathymetry (datum's)
- 36.Regular technical workshops
- 37.Resolutions matched to the landscape and task
- 38.Quality management
- 39.Guaranteed data integrity

During the workshop, other issues, ranking of all issues:

Issue	Votes	Action to resolve
Develop national standards and Access	13	ICSM working on it (eg LIDAR standard) CRCSI involved Imprimatur of Standards Australia
Licensing	3	

Common vert datum	23	Continue to improve the Ausgeo models (GA) Better geoidal and tidal models Apply to new data, may not be possible for legacy data
Vertical integration		
Gap issues topo – bathy	16	Shared task CRCSI
Access to jurisdictional data	5	
Out of date data	12	
Move from low to hi res	3	
Under-resourcing of local government	2	
Consistent description	4	
Management of large data volumes	1	
Better definition of requirements	3	
Better tidal models	2	
Consistent continental spec for data sets	15	Shared responsibility through working group
Need drainage and point data	8	
Data repository – one stop shop	19	One portal, not one database A virtual repository GA? / Sources / ANZLIC
Describing errors	8	
Governance	5	
National security	9	National obstacle database
Cost sharing	1	
Free data	4	
Development of national standards	14	
Access to proprietary data	1	
Online data catalogues	11	
Online data access	4	
Gaps in Bath data	2	
Whole of Gov purchasing models	2	
Recognition of terrain shape in datasets	8	
Guaranteed data integrity	1	
Metadata requirements (educate and compliance)	15	How do we get people to comply? Working group
Resolution matched to the task		
Education on use	2	

Summary of issues of concern:

Outcome	Issue	Votes
Better data available	Develop national data standards	27
	National security	9
	Fill land sea gap on coast	16
	Update and maintain existing data	12
	Move from low to high resolution data	3
	Better definition of user requirements	3
	Better geoid and tide models	2
	Consistent continental spec for data sets	15
	Drainage and point data available	8
	Fill gaps in bathymetric data	2
Improved useability	Common vertical datum	23
	Consistent description of data and products	4
	Better description of data errors	19
	Recognition of terrain shape in datasets	8
	Metadata requirements (educate and compliance)	15
	Education on use of data	2
Remove barriers to data and resource sharing	Consistent licensing	3
	Access to jurisdictional data	5
	Under-resourced local government	2
	Address governance issues	5
	Data cost (preferably free)	4
	Whole of govt purchasing models	2
Improved access to data and products	Virtual data repository and one stop portal	8
	Online data catalogues	11
	Online data access	4

Workshop Report: Sydney 20 July 2007

Summary

The workshop had 44 attendees. Most were from NSW Government agencies, with a significant number from the private sector. There was a small local government representation. The format for the workshop appeared to work, with input obtained from all participants by breaking up into 6 groups for session 5. Attendees and those who accepted but did not attend have been sent a post-workshop questionnaire to provide further information if they wish to do so. A number of points were raised in discussion, mainly from private sector participants.

Key Points Arising

- There was a strong sense that one product could not meet all needs. In fact, it is not possible to develop a single product specification to meet a majority of needs. These needs are diverse at State level, from overall coverage for planning purposes down to project-specific coverage. Explicit monitoring is required for specific small areas to meet reporting requirements.
- Elevation data product specification may also vary depending on topography, that is denser in mountainous and urban areas but more widely spaced in flat rural areas. However, participants acknowledged the need for high-resolution data across a number of applications.
- There were a range of needs identified by the audience that differed in coverage, specification and timing. Those mentioned by participants are shown in Appendix A.
- The NSW Government presenter identified key issues as digital rights management (especially simplified licensing), need for specifications and standards to provide national consistency, an audit of current holdings and development of whole of government requirements and ongoing data management and distribution requirements.
- The private sector presenter highlighted the need to engage with the private sector during the project and to use the resources of both public and private sectors. Key issues were to build trust and respect intellectual property (IP) held by the private sector. Major concern is that the process will take too long for national coordination to be useful. The private sector has shown it is willing to invest if both needs and risks (funding, IP) are known. The key driver at present for the private sector is infrastructure development and the private sector is well positioned to provide high-resolution data needed for projects. An action is the project sponsors to sit down with the private sector to discuss IP issues. A participant pointed out that Australia has world-class private sector capabilities in elevation data, which needs to be nurtured and used by governments.
- One group said options to achieve a whole of State coverage were to buy once (at higher initial price) with licence to distribute at low cost; or engage private sector to capture and sell many times.
- The top five issues found at the Canberra workshop were included in the list of major issues. Four received high votes, with “Develop a consistent continental dataset specification” getting a low vote.
- The top six unresolved issues voted (scores) by the audience were:

- Increased accuracy of elevation data to meet a wide range of needs (38);
 - Develop and apply national standards for elevation data and access (from Canberra workshop) (36);
 - Better currency and maintenance of elevation data (27);
 - Proper management of intellectual property and application of copyright using an appropriate existing DRM scheme, talk with industry (25);
 - Need for a common vertical datum to be used in new (and where possible existing) elevation datasets (from Canberra workshop) (20);
 - Better ability to find and access elevation datasets, using a federated approach, virtual data repository and a one-stop portal (from Canberra workshop) (20).
- In discussing how to address these issues, common themes were shared responsibility and resourcing, needs driven by individual applications, with special implementation roles for Geoscience Australia (more accurate data), ANZLIC (coordination) and ICSM (standards) with input from the private sector.

Appendix A: Identify Needs

The following is a summary of audience input at the workshop.

Needs

Application	Product/Coverage	Gap/Timing
Road, rail and water infrastructure development, asset management	Localised and route based Investigation 1-10m vert Conceptual 20cm vert	No gap, ongoing, as required
Defence maritime operations	Major estuaries and ports, coastal out to 20m depth 10-40m horizontal 0.5m vertical	Non-channels, project based
International/national coastal navigation, oil and gas offshore	National	
Geological mapping	High resolution in coastal areas	
Sea level rises, land subsidence, coastal modelling	Very high resolution topography in coastal zone 6m hor, 0.15m vert	Patchy coverage and incomplete, especially in intertidal zone, needed now
Local councils, development consents, flood modelling	Specific areas Digital 3D models, sub-metre (1:500 spec)	Ongoing
Fire risk identification	Bushfire prone areas, urban interface, environmental and fire models	Now
Communications	Line of sight analysis	Not available at

Line of sight	6-10m hor, 0.15-1m vert	present, needed now
Vulnerable lands	Steep areas subject to subsidence, terrain modelling	
Environmental planning, monitoring, assessment and reporting, water resource management	Multi-spectral imagery Say 10m hor, 1m vert	Baseline data needed
Precision agriculture, farm management	1-5m hor, 0.5m vert	
Insurance risk		
Flood plain mapping, hydrologic modelling	Populated areas, areas subject to flooding, in-stream monitoring 6m hor, vert dependent on terrain (say 0.15 to 1m)	Include breaklines, existing data not suitable, major gap is Western Division
Marine, aquaculture leases	Project based	
Defence - cross-country mobility	10m hor, 1m vert	
Vegetation – extent, structure and condition	1-10m hor 0.5-1m vert	Now

Technical Considerations

- Define the derived surface products consistently
- Need bare earth or the canopy/buildings or a mix of both
- Need metadata to describe the source data and the models used to derive the grid
- Licensing – use an existing DRM scheme
- Datum issue – what is the problem, do we need a common land/sea datum?

Issues to be Resolved

Outcome	Issue	Votes
Better data available	Develop national data standards	36
	Availability of data with increased accuracy	38
	Close data gap on coast	15
	Need to update existing data, maintain currency	27
	Declassify relevant defence data	3
Improved useability	Common vertical datum	20
	Better data management	3
	Documentation of fitness for purpose/liability	10
	Provide metadata, improve search ability	6
	Better education and skills in use of elevation data	10
Remove barriers to data and resource sharing	Protection of IP, copyright	25
	Whole of govt purchasing models	7
Improved access to data and products	Virtual data repository and one stop portal	20
	Develop funding model involving public and private	10

Workshop Report: Hobart, 27 July 2007

Summary

The workshop had 27 attendees. Most (17) were from Tasmanian Government agencies, with smaller representation from local government (3), private sector (2), academia (3) and CSIRO (1). Twenty participants identified themselves as users and only seven as providers of elevation data and products. The format for the workshop appeared to work, with input obtained from all participants by breaking up into 5 groups for session 5. Attendees and those who accepted but did not attend will be sent a post-workshop questionnaire to provide further information if they wish to do so. A number of points were raised in discussion. At the end, a number of participants passed a motion that Tasmania should have “a funded whole of State high resolution digital elevation data set”.

Key Points Arising

- There was a strong sense that one product could not meet all needs. In fact, it is not possible to develop a single product specification to meet a majority of needs. These needs are diverse at State level, from overall coverage for planning purposes down to project-specific coverage.
- In general, highest accuracy was needed for specific tasks in particular areas, with lesser accuracy for general terrain mapping.
- High resolution elevation data was needed across a number of applications. A high fidelity data set was needed especially along the coast, capable of discerning small but significant features such as frontal dunes, steep slopes and overhangs that are missed in current data sets, but have a major impact on modelling coastal inundation and landslips. LIDAR was specifically mentioned as a pertinent technology.
- There were a range of needs identified by the audience that differed in coverage, specification and timing. Those mentioned by participants are shown in Appendix A.
- The audience identified the need for specifications and standards to provide national consistency, an audit of current holdings and development of whole of government requirements and ongoing data management and distribution requirements.
- The private sector presenter highlighted the need to move quickly. The audience confirmed this need to get the framework developed and data capture underway as quickly as possible, even if early deliverables were simple and expedient. Major concern is that the process will take too long for national coordination to be useful.
- The private sector presenter recognised the need to meet growing demand for high resolution elevation (indeed all spatial) data, the need to reduce duplication of effort and investment and to get all sectors involved in the supply chain from acquisition to use.
- The top five issues found at the Canberra workshop were included in the list of major issues. Three received high votes, with “Need for a common vertical datum” and “Develop a consistent continental dataset specification” getting low votes.
- The top six major issues voted (scores) by the audience were:

- Develop and apply national standards for elevation data and access (17);
 - Close the data gap along the coast between existing land and sea datasets (16);
 - Governance (leadership, involve all stakeholders and sectors) (10);
 - Better ability to find and access elevation datasets, using a virtual data repository and a one-stop portal (9);
 - Metadata, especially a profile for elevation data and products (8);
 - Move quickly, something simple at first (8).
- In discussing how to address these issues, common themes were shared responsibility and resourcing, needs driven by individual applications, with special implementation roles for the relevant Commonwealth Minister (for the Environment and Water Resources) (leadership and funding), Geoscience Australia (more accurate data), ANZLIC (coordination) and ICSM (standards) with input from peak bodies in all sectors the private sector. The need to build on the existing ASDD was recognised to aid discovery and access, and that Tasmania already had a repository and access mechanism in the LIST system. The audience was of the strong view that existing mechanisms be used and not to “reinvent wheels”.
 - A question arose as to whether the national project was about a framework and/or data. Clarification is needed in the business plan. [Note business plan does treat framework creation and data acquisition as two separate implementation activities; acquisition programs should be seen as users of the framework.]
 - The formation of consortia to plan projects, share costs and manage IP was seen as useful, but not a major issue.

Appendix A: Identify Needs

The following is a summary of audience input at the workshop.

Needs

Application	Product/Coverage	Gap/Timing
Coastal zone management, including terrain analysis, hazards and inundation	Coastal areas from 10m contour out to 30m depth 5-10m x,y 0.2-0.3m z (land), 0.5-1m z (shallow water). Could use 0.5 z but better preferred.	Current gap, now Lack of accurate bathymetric data
Land use planning	Ditto	Ditto
Stream modelling	10m x,y 0.5m z	
Road design	Ditto	Ditto
Bushfire management	25m x,y 10m z	Existing
Local government -floodplain mapping -storm water modelling - 3D modelling in cities - infrastructure management - planning and development	20m x,y 0.1m z Ditto Ditto 5m x,y <1m z 0.25m x,y 0.25-0.5 z	Current gap, now

Orthorectification of photography, production of orthophotos	Urban 25m x,y 1m z Whole State 10m contours	Current gap Existing data
Forestry - tree cover/surface (multi-attribute) - drainage (bare earth)	<1m x,y 0.1-0.2m z 2-3m x,y 1m z	Ditto Use LIDAR for tree penetration
Emergency Services - flooding risk - line of sight - snow impact	Accuracy is critical in populated areas Floodplains, 0.25 z Ditto Urban areas	Gap, now Gap, now Existing data
Water resources and supply (eg dam studies)	State-wide	
Marine - fisheries - oil spill response - estuaries (high use areas, agriculture) - habitat mapping	<1m z	Gaps

Technical Considerations

- Define the derived surface products consistently, modelling standards.
- Need bare earth or the canopy/buildings or a mix of both and need to be clear which is provided.
- Need metadata to describe the source data and the models used to derive the grid.
- Need to store both source and derived surface data, able to go back to source to remodel.
- Need to address accuracy of attribute data used with elevation data, may find that high resolution elevation becomes available but other related data (such as cadastral) remains low resolution, hence integration problems.
- Some data capture systems/platforms do not capture relevant attribute data, needs to be considered in choosing the right capture method.
- Licensing and IP – use an existing DRM scheme

Issues to be Resolved

Outcome	Issue	Votes
Better data available	Develop national data standards	17
	Close data gap on coast	16
	Need to update existing data, temporal resolution, change detection	7
	Develop consistent national coverage	2
	Accuracy	2
Improved	Better data management, data quality down to point	3

useability	level is flagged Provide metadata, improve search ability Increase capacity of users (technology, investment and decision making, better education and skills in use of elevation data)	8 5
Remove barriers to data and resource sharing	Governance (leadership, involve all stakeholders and sectors) Move quickly, even if something simple Use appropriate mechanisms, do not reinvent wheels Importance of data sharing and accessibility	10 8 4 7
Improved access to data and products	Virtual data repository and one stop portal Develop funding and cost model(s) to maximise investment	9 6/5

Workshop Report: Melbourne, 30 July 2007

Summary

The workshop had 38 attendees. There was a fairly even spread of participants from Victorian Government agencies, private sector and RAAF, with smaller representation from local government, and academia. Twenty participants identified themselves as users and only eight as providers of elevation data and products. Input was obtained from all participants by breaking up into 7 groups for session 5. There were 15 responses to a pre-workshop questionnaire and participants were offered the opportunity to provide further information after the workshop if they wished to do so.

Key Points Arising

- There was a good spread of issues determined by participants, covering data standards, ongoing data management and distribution requirements, access, intellectual property (IP) and implementation activities.
- Time did not allow for detailed consideration of coverage and resolution needs.
- High resolution elevation data was needed across a number of applications.
- There were a range of needs identified by the audience that differed in coverage, specification and timing. Those mentioned by participants are shown in Appendix A. Fifteen participants provided pre-workshop responses to the questionnaire, much of which was reported during the workshop. Common issues included need for increased availability/access to data and lower costs.
- The jurisdictional presenters identified digital elevation data as one of the nine framework data sets in the Victorian spatial information strategy and outlined current situation with data collection, management (custodianship), access and pricing.
- The private sector presenter expressed support for the approach being taken. He also stated the need for a response from the public, private and academic sectors of the industry. The private sector needs to be involved and to use its capacity in the supply chain including acquisition, processing, use of existing data, distribution, access and value-adding. IP needs to be addressed up front and carefully as this will affect private sector investment. Standards are needed but should not constrain innovation. Adopting a point of truth should not constrain opportunity.
- The top five issues found at the Canberra workshop were included in the list of major issues. Two received high votes, with “Close the gap along the coast” getting some support, but “Better ability to find and access elevation datasets, using a virtual data repository and a one-stop portal” and “Develop a consistent continental dataset specification” getting low votes.
- The top five major issues voted (scores) by the audience were:
 - Develop and apply national standards for elevation data and access (28);
 - Management of large data volumes, need to update data to reflect and monitor change, ability to integrate diverse elevation sources and problems with integrating high resolution elevation data with other data types (27);
 - Development and use of a common vertical datum, need to clarify what issue needs to be addressed (20);
 - Need to sort out IP issues and develop relevant DRM structure to encourage access and use of elevation data (17);

- Need to optimise investment (especially funds from Australian Government programs), reduce costs, develop budgets and obtain funding for improving elevation data.
- In discussing how to address these issues, common themes were shared responsibility and resourcing, needs driven by individual applications, with special implementation roles for a steering group comprising public and private sectors. The audience was of the view that existing mechanisms be used and not to “reinvent wheels” and that a single specification [resolution] for an elevation data set would not meet all needs.
- At the end, some participants expressed surprise that governance was not raised by any of the groups. The audience did not have strong views on administrative arrangements and did not identify organisations that could take action on the key issues, perhaps reflecting the more operational focus of participants. [IP and budget/cost issues were raised and given high individual scores].

Appendix A: Identify Needs

The following is a summary of audience input at the workshop.

Needs

Application	Product/Coverage	Gap/Timing
Shape of natural and built environment, especially anything to do with water	Priority is flat areas, client driven	Coast, floodplains and assets at risk are priorities
Forestry management,	Need terrain and canopy surfaces, also extra attributes, <10m x,y <5m z	Project specific, forests, esp slopes
Climate change, coastal development, impacts	Especially in areas of coastal development, require from 20m contour out to 20m depth, 5-20m x,y 0.1m z (topo), 0.5m z (bathy)	Shallow water bathymetry
National security, verification of landing grounds	high points, hypsometric shading, <0.3m z, for obstructions, first and ground surfaces, national	
Access to satellite and pseudolite signals for navigation	Line of sight analysis, vertical obstructions	Some existing data
Visualisation, including 3D city views, image draping	Large untapped market 0.6m x,y 0.1m z for capital city (ie survey accurate)	High resolution DEM
Evaporation, transpiration modelling	0.1m z whole of State	Gap
Telecommunication	Surface model, high	Urban areas a priority

planning	resolution	
Carbon accounting	Non-ground forest data	
Land use and urban planning	Populated, urban areas, built structures High resolution <1m z, whole of State	Coastal fringe and urban growth areas are priority
Airspace management	150km radius from airports, 5-20m x,y national <1m z, national	
Hydro-geological modelling	20-50m x,y, 1-5m z with drainage enforcement, whole of State	
Landslide mapping (local government)	1m z	
Orthophoto control, more accurate ortho-rectified images	Project based	Existing data, may be replaced with high res data as it becomes available
Catchments, overland flows, flood inundation	5-20m x,y <1m z national	Metro and rural urban are priorities
Emergency services	Slope and fuel loads, 20-50m x,y 5m z, whole of State	

Technical Considerations

- Address lack of standards in data, modelling, metadata, temporal.
- Need bare earth or the canopy/buildings or a mix of both and need to be clear which is provided.
- Need metadata to describe the source data and the models used to derive the grid.
- Need to address data integration, may find that high resolution elevation data becomes available but other related data remains low resolution, hence linking problems.
- Need flexibility to combine elevation data sources of varying accuracy.
- Licensing and IP – use an existing DRM scheme that takes account of public and commercial needs and encourages use of elevation data.

Issues to be Resolved

Outcome	Issue	Votes
Better data available	Develop national data standards	28
	Common vertical datum	20
	Close data gap on coast	11
	Fill other gaps, holes in data	6
	Develop consistent national coverage	6
	Restrict access to sensitive data	5
Improved	Better data management, ability to integrate, need to	

useability	update existing data, temporal resolution, change detection	27
	Communicate relative/absolute accuracy in metadata	8
Remove barriers to data and resource sharing	Sort out IP issues, use existing scheme, encourage use	17
Improved access to data and products	Virtual data repository and one stop portal	6
	Develop funding and cost model(s) to maximise investment, esp from Australian Government sources	15

Workshop Report: Brisbane, 1 August 2007

Summary

The workshop had 49 attendees. Most attendees (40) indicated they are users of elevation data. Around 20 indicated they were data product or service providers. Half were from Queensland Government agencies, 10 from the private sector, with a small number from academia and local government. Five were from Australian Government agencies, including CSIRO. The format for the workshop included a session where the audience was split into ten groups, the largest number attempted so far. The local organiser pre-circulated a questionnaire to those accepting the invitation. 15 responses were received. Attendees were encouraged to fill in the questionnaire after the workshop if they had not already done so. Discussion was robust and led to prioritising issues of concern to participants.

Key Points Arising

- Participants indicated that a major issue centred on budgeting, funding and cost aimed at sharing of data and investment, to capture data once and use many times. A key was to develop innovative funding/investment models that encouraged all stakeholders to participate. Particular mention was made of the private sector (shared funding model) and local government that was under-resourced but beginning to acquire more data and needed an incentive to collaborate.
- A central clearinghouse was suggested by one group as a way of identifying data acquisition projects, registration of data sets, documentation of data sources, provides incentives and facilitates sharing costs through a collaborative funding model.
- In parallel was the need to address intellectual property (IP) issues, especially licensing of data and products for third party use to encourage use of existing data.
- There were a range of needs identified by the audience that differed in coverage and specification, although little was said about timing. Those requirements mentioned by participants are shown in Appendix A.
- Users may also need different products, such as surface (buildings / canopy) data as well as bare earth. Drainage enforcement is also needed to increase fidelity of DEMs.
- Specific coverage mentioned included:
 - Coastal areas, especially urban;
 - Great Barrier Reef and adjacent catchments;
 - Floodplains;
 - Catchments, streams;
 - Corridors for powerlines, roads and pipelines.
- Both State and private sector presenters strongly supported the national initiative. It was important to collaborate to maximise the benefit of investment being made at all levels and across sectors. The State representative pointed out that often Australian Government programs funded local data acquisition and further benefits were not being achieved due to lack of access to the data. The National Disaster Mitigation Program was specifically mentioned. Several local governments have acquired high precision elevation data with 0.2m accuracy for urban areas and need to be approached individually to gain access.

- Issues for the State included lack of program funding for DEM development, all funds are project based; advising fitness for purpose when using existing data; growing demand for interoperability and accessibility between data sources.
- The State presenter put a proposition that a worthwhile goal is to achieve State coverage with vertical accuracy of 7.5m, down to 0.5m in urban and coastal areas.
- The private sector presenter encouraged consideration of public private partnerships in the supply chain to mobilise the resources from all sectors. There is a need to reduce risk by careful planning of data acquisition, based on real user needs. Models for private and public sector investment need to be developed, based on commercial realities and aimed at building a more robust spatial information industry in Australia.
- One audience member encouraged engagement with the Spatial Sciences Institute when considering best use of skills and people in the industry.
- The top six unresolved issues voted (scores) by the audience were:
 - Better ability to find and access elevation datasets, using a virtual data repository and a one-stop portal (31);
 - Collect data once and use many times, coordinate efforts and encourage collaboration (31);
 - Develop a clearinghouse to enable cost sharing in data acquisition, documentation and access to elevation data. Develop innovative funding and investment models that provide incentives to collaborate, involve all stakeholders, especially in the private sector and local governments (20);
 - Develop and apply national standards for elevation data and access (19);
 - Close the data gap along the coast between existing land and sea datasets (18);
 - Address IP issues, especially licensing use by third parties, standardise data licensing (18).
- Two priority issues identified in the Canberra workshop “Need for a common vertical datum” and “Develop a consistent continental dataset specification” did not obtain any votes.
- Time did not allow discussion about how to address these issues. Suggestions from the floor included the urgent need to develop business model for the national project and the use of demonstrators to show benefits.

Appendix A: Identify Needs

The following is a compilation of pre-workshop questionnaire responses and audience input at the workshop.

Needs

Application	Product/Coverage	Gap
Hydro-dynamic modelling	Bathymetry, coastal area and reefs esp GBR 10-30m x,y <1m z	Gap
Infrastructure (mining, water, ports)	Project-based, mainly by companies	

	0.15 z	
Gully/stream bank erosion monitoring	1m x,y	Gap, use LIDAR separating veg and ground
Environmental modelling and monitoring (esp water quality)	10m x,y 2.5-5m z	
Image correction	National, satellite data coverage	Nationally consistent
Orthophoto rectification	Depends on scale, need better resolution on coast	Some existing data
Whole of catchment management and sub-catchment delineation	All catchments and GBR 25m x,y 5m z 10m x,y for SEQ	
Stochastic terrain shape analysis (show distribution of errors in elevation data)		
Reconnaissance and surveillance	Major infrastructure 2m x,y 0.5m z	
Public consultation (visualisation)	State/regional coverage 5m z	
Natural hazard, floodplain mapping (local government)	At risk areas and assets 2-5m x,y <0.5m z	To be determined by local governments
Land suitability studies	25m x,y <5m z	
Corridor mapping (powerlines, roads, pipelines)	Variable depending on asset (Powerlines 0.5-2m z) General Planning 1m z Construction 0.1m z	
Location of radio repeater sites for search and rescue coverage	SEQ 10m x,y 5m z	
Police radio coverage	All State and northern NSW 10m x,y 0.5m z	
Line of sight analysis	Urban areas High resolution, <0.5m	Gap
Fishery habitat and aquaculture	Coastal areas	Existing SRTM?
Bushfire risk analysis	Populated areas, roads <25m x,y 5m z	Existing data or better
Forestry, vegetation mapping	Canopy and bare earth 0.2m z	LIDAR preferred
Regional planning and urban studies	1m z	
Orthophoto and 1:25,000 mapping	Peri-urban is priority 2m z	

Technical Considerations

- Metadata, documenting who has compatible data, use of ASDD
- Standards for error surfaces and modelling consistency, orthorectification of imagery specification.
- Licensing – need a standard approach
- Data management practices and capacity to handle large data volumes

Issues to be Resolved

Outcome	Issue	Votes
Better data available	Develop and apply national standards for elevation data and access	19
	Close data gap on coast	18
	Need to update existing data, temporal resolution, change detection	12
	Improve data accuracy and fill gaps	5
	Need for drainage enforcement	5
	Go beyond continental shelf (to model water movement)	2
Improved useability	Better data management, able to handle large data volumes	5
	Importance of metadata, improve documentation, use of ASDD	11
	Ability to integrate data from varying sources, data types and accuracy	10
Remove barriers to data and resource sharing	Collect once, use many times, coordination of effort	31
	Address IP issues, especially licensing use by third parties, standardise data licensing	18
Improved access to data and products	Virtual data repository and one stop portal	31
	Central clearinghouse, develop funding and cost model(s) to maximise investment	20
	Business model to encourage collaboration	11

Workshop Report: Perth, 7 August 2007

Summary

The workshop had 48 attendees. Most attendees (35) indicated they are users of elevation data. Around 20 indicated they were data product or service providers. Over half (31) were from WA Government agencies, 9 from the private sector, with a small number from academia (3) and local government (3). The format for the workshop included a session where the audience was split into six groups, to identify gaps and issues. The local organiser pre-circulated a questionnaire to those accepting the invitation. 9 responses were received. Attendees were encouraged to fill in the questionnaire after the workshop if they had not already done so. The final session of workshop was changed from previous, taking the form of a “hypothetical” implementation model for consideration by COAG. Discussion was robust and led to prioritising issues of concern to participants and ideas on implementation of a national approach.

Key Points Arising

- Data availability and access was a recurring theme at the workshop, with a need for national leadership to coordinate data acquisition requirements and funding.
- Participants indicated that a major issue centred on budgeting, funding and cost aimed at sharing of data and investment. The principal mechanism was for an Australian Government agency to take leadership in developing a significant funded data acquisition and management program in the national interest. Australian Government agencies need to cooperate. A key was to develop innovative funding/investment models that encouraged all stakeholders to participate. Particular mention was made of the private sector’s willingness to participate, if there was an appropriate level of return on investment.
- Data acquisition priorities should be driven by specific policy outcomes. Climate change and disaster management, as well as the needs of industry were specifically mentioned.
- A virtual data repository and single portal maintained by an Australian Government agency was supported as a way of identifying data acquisition projects and data management through registration of data sets and documentation of data sources. Data acquisition should mainly be the responsibility of States, local government and the private sector.
- Data availability, especially in priority areas such as urban centres and the coast was important. Data access should be structured to encourage use of existing data and optimise investment. The audience supported the current WA Government policy aimed at encouraging economic investment through ready access to data. In parallel was the need to address intellectual property (IP) issues, especially licensing of data and products for commercial use.
- The audience was not asked to specify application areas and coverage needs, as this had been canvassed in an earlier WA workshop on coastal issues and in the circulated questionnaire. Instead, the audience identified gaps in data and issues to be addressed. Those requirements mentioned by participants are shown in Appendix A.

- The State presenter strongly supported the national initiative, especially driven by national policy initiatives such as coastal vulnerability. There was a need for defensible decision making, backed up by agreed data sets. It was important to collaborate to maximise the benefit of investment being made at all levels and across sectors. The State representative pointed out that the WALIS Marine Group had identified that inter-tidal zone and off-shore data coverage was the priority.
- Large companies, such as Woodside Petroleum were making large investments in data and embarking on major collection and use programs and gaining access to this data would need to be considered in any national approach.
- Issues included lack of program funding for DEM research and development; advising fitness for purpose when using existing data; importance of updating data to reflect change in the landscape; filling gaps in data; adopting an iterative approach to allow inclusion of improved data; and facilitating access to visualisation/fly throughs for the general community especially in remote areas.
- The private sector presenter encouraged using the private sector in the full supply chain from acquisition to visualisation. Issues were more data, metadata, standards, up-to-date in areas of change/priority.
- One aspect of identifying needs of specific drivers was their need for data currency and hence acquisition cycle.
- The top five unresolved issues voted (scores) by the audience were:
 - Leadership to develop a coordinated national elevation data acquisition program that is funded (55)
 - Close the data gap along the coast between existing land and sea datasets (34);
 - Better ability to find and access elevation datasets, using a virtual data repository and a one-stop portal (32);
 - Develop and apply national standards for elevation data and access (25);
 - Need for a common vertical datum, with an updated AHD specification fit for higher resolution data (20).
- Only one priority issue identified in the Canberra workshop “Develop a consistent continental dataset specification” did not get a high vote (5).
- Discussion during the “hypothetical” implementation session highlighted important governance, investment and implementation issues.
- The governance model should:
 - Acknowledge that there will be diverse sources of data and products and the need to coordinate effort;
 - Coordinate data capture programs (cf role of ICSM for topographic information) using a range of technologies such as multi-spectral scanning and LIDAR for delivery in priority areas;
 - Use existing models, such as WALIS, custodianship, IP, Australian Government agencies need to cooperate through OSDM;
 - Have strong MoUs between players (including the private sector);
 - Have strong leadership from Australian Government;
 - Assign roles, such as Australian Government provide national data management, access and distribution, with States and private sector managing data acquisition;
 - Must include local government and NRM regional bodies;

- Industry able to deal with all levels depending on where budget is coming from, although large national industry players may prefer to deal with a single point (the Australian Government) on national needs;
- Focus on improving accessibility to data and capabilities;
- Address access to Defence (especially SRTM 1 second data from US) and CSIRO high resolution data;
- Clarify role of existing bodies such as PSMA;
- Ministerial Councils are appropriate bodies to broker common legislation, policy and tick off joint funding initiatives.
- The investment model should:
 - Learn from initiatives such as NCRIS (CORS Network) that link R&D with delivery;
 - Acknowledge that currently opportunities are being lost through individual programs wasting investment;
 - Create a large central fund rolling up smaller funding sources, to act as a catalyst for shared resourcing;
 - Allocation of funds based on delivering agreed priorities using a formula based on spatial extent of priority areas (eg. vulnerability);
 - Private sector needs a decent rate of return otherwise no incentive to work within a national framework;
 - Should go for whole of government licences if cost effective and negotiate licence for wide usage;
 - Otherwise, if private investment is involved, expect limits on third party access and resale;
 - Model should provide for management of quality assurance and limits to liability;
 - Local government should be offered incentives, such as cost sharing to make their data accessible;
 - Facilitate economic investment by making data readily accessible by wide range of users at reasonable (low) cost (such as for WA SLIP).
- Implementation should also:
 - Provide a digital rights management model that manages IP, commercial use, liability, etc;
 - Be staged depending on priorities;
 - Look to investing in existing data sources that may yield high resolution before new acquisitions where cost effective.

Appendix A: Identify Needs

The following is a compilation of pre-workshop questionnaire responses and audience input at the workshop.

Gaps

Integrated multi-resolution, extensible DEM and program to infill gaps
Coastal DEM between +30m and -30m contours – big data gap, priorities are ports and coastal communities
Improve resolution generally
Increased density of bathymetric data (coastal, estuarine)

Rivers and streams

Local government location-specific very high resolution needs

No tidal model for adjusting coastal and offshore soundings to AHD

Lack of coordination, no existing authority to take national DEM ownership and responsibility

Forested areas

Ningaloo Reef

Legislation to gain access to local change information eg local government building and land contour data.

Issues to be Resolved

Outcome	Issue	Votes
Better data available	Close the data gap along the coast between existing land and sea datasets	34
	Develop and apply national standards for elevation data and access	25
	Need for a common vertical datum, with an updated AHD specification fit for higher resolution data (synchronised with geodesy network upgrade)	20
	Update data to reflect changes due to development, etc	5
	Develop a consistent continental dataset specification	5
	Define priority areas according to landform/bathymetric characteristics rather than administrative boundaries	3
Improved useability	Need priority funding R&D for data acquisition technologies especially offshore	15
	Education for users to judge fitness for purpose	6
Remove barriers to data and resource sharing	Leadership to develop a coordinated national elevation data acquisition program that is funded	55
Improved access to data and products	Virtual data repository and one stop portal (for putting data in, finding and getting data out)	32
	Increase coordination of activity and access to private sector data through incentives	11

Workshop Report: Adelaide, 29 August 2007

Summary

The workshop had 32 attendees. Around half of the attendees were users of elevation data. Most were from SA Government agencies, 6 from the private sector, with a small number from academia (1) and none from local government. BoM, CSIRO, DSTO and GA were represented. The format for the workshop included a session where the audience was split into six groups, to identify gaps and issues. Attendees were encouraged to fill in the questionnaire after the workshop if they had further information to give. The final session of the workshop was dropped due to lack of time.

Key Points Arising

- Data availability and access was a recurring theme at the workshop.
- Major gaps identified were in the coastal zone and bathymetric data coverage out to 80m depth. Very high resolution data was needed on the coast (2m x,y and between 10-25cm in z). Outside this zone, a consistent coverage of 10-30m x,y was needed. Good relative accuracy rather than absolute accuracy was more important. Data should be hydrographically correct.
- A virtual data repository and single online portal was supported as a way of identifying existing data and providing better data access through registration of data sets and documentation of data sources.
- Identifying upcoming projects was seen as a way of facilitating partnerships in elevation data acquisition, providing the opportunity to increase the coverage and accuracy of data in individual projects. It also led to a greater understanding of available data sets.
- Participants, especially from the private sector were supportive of a partnership approach if it clarified needs and led to clearer procurement processes. Multiple uses of data needed to be reflected in purchase price. Longer term planning and long term projects could provide more certainty for private sector investment of equipment and knowledge.
- In parallel was the need to address intellectual property (IP) issues, especially licensing of data.
- Accuracy requirements need to be made specific in procurement processes, as it is a major determinant of cost and useability.
- The audience was not asked to specify application areas and coverage needs, as this had been canvassed in an earlier SA report published in early 2007 based on an audit of existing elevation data sources suitable for emergency management applications.
- The State presenter who prepared the SA State DEM audit strongly supported the national initiative in order that new high-resolution data and existing data was able to meet a range of needs.
- The private sector presenter encouraged use of the private sector, especially in data acquisition.
- The top six issues voted (scores) by participants were:
 - Better ability to find and access elevation datasets, using a virtual data repository and a one-stop portal (34);

- Develop and apply national standards for elevation data and access (27);
 - Need for a common (and improved) vertical datum (17);
 - Close the data gap along the coast between existing land and sea datasets (16);
 - Address data licensing and IP (16);
 - Develop a consistent continental dataset specification (14).
- These included the top five priority issues identified in the Canberra workshop, with the addition of the licensing/IP issue.
 - The concept of an online portal was supported, but there was a need to address how the portal will operate, including functions of data publishing, access, metadata, linking of data sets, etc.

Appendix A: Identify Needs

The following is a summary of audience input at the workshop.

Gaps

Too much of the State is not covered; need a seamless multi-resolution, extensible DEM and program to infill gaps
Need a useful common sense standard that can encompass data of different accuracy and currency
A high resolution coastal DEM (1-2m x,y and 10-25cm in z) to support planning and identification of at-risk areas, repeated mapping coastal erosion and monitoring at-risk areas broadly from 10m depth to 20m on dunes.
Increased coverage of bathymetric data (deep water, inshore and enclosed waters such as estuaries, straits and gulfs)
Data out to 80m depth needed to improve risk analysis of water movement onto the coast
Little data outside 1:50,000 mapping coverage area
Higher accuracy data needed in flat land areas to support applications like land management, especially agriculture and outback areas.
Need consistent coverage over non-coastal parts of SA 10-30m x,y and 1m in z for applications such as hydrological modelling and flood mapping.
Need greater density of survey control to facilitate stitching of diverse data sources
Data required for line-of-site analysis for infrastructure development, radio reception and security applications.
Better specification of accuracy/timeliness of existing data to aid searching and assessment of fitness for purpose
Need for number of surfaces depending on different requirements, including bare earth, tops of structures, tree canopy, water level, lake bed, etc
Better documentation of data type (bare earth, other surface)
Central agency to facilitate one stop shop covering available elevation data, access, supply, distribution of data and metadata, user support, quality assurance and price/quality negotiations.

Issues to be Resolved

Outcome	Issue	Votes
Better data available	Close the data gap along the coast between existing land and sea datasets	16
	Develop and apply national standards for elevation data and access	27
	Need for a common (and improved) vertical datum, better correlation between local tidal data and AHD	17
	Update data to reflect changes due to development, etc	6
	Develop a consistent continental dataset specification	14
	Need both original and modelled data, so if there are problems with derived data can go back to original	5
Improved useability	Address problems in combining data sets of different coverage and accuracy (edge effects)	5
	Need improved availability and quality of metadata	7
Remove barriers to data and resource sharing	Address licensing and IP	16
	Notify/register for data acquisition plans to facilitate partnering and cost sharing	8
Improved access to data and products	Virtual data repository and one stop portal (for putting data in, finding and getting data out)	34