



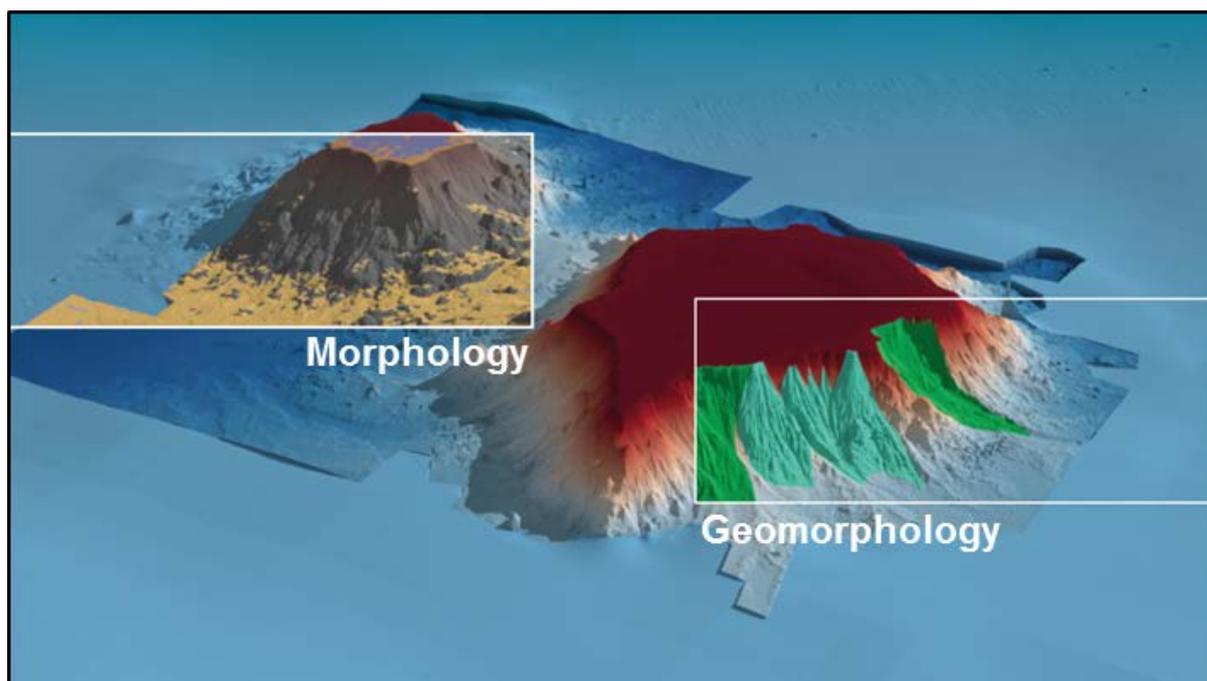
Australian Government

Geoscience Australia

National Seafloor GeMorphology (NSGM) mapping workshop

29th October 2018

Summary & Actions



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Introduction

Geoscience Australia is leading the development of a scheme to map and classify seabed morphology and geomorphology at multiple spatial scales, for use by a range of disciplines and end-users. Central to the effort is the development of a consistent vocabulary and mapping standard, which is now in draft form as the National Seafloor GeoMorphology (NSGM) mapping scheme.

On 29th October 2018 a National Seafloor Geomorphology workshop was held at Geoscience Australia. The workshop was attended by representatives from Commonwealth and State agencies, industry and universities (Appendix 1), and had the following objectives:

1. Engage with marine geoscience practitioners: we are seeking feedback and input on the science of the draft NSGM
2. Engage with state agencies: determine how to connect the draft NSGM scheme to the coast (intertidal and shallow subtidal)
3. Reach agreement towards the creation of a standard scheme for seafloor geomorphology mapping in Australia.

Coastal and marine researchers and practitioners in sedimentology, geomorphology and ecology, and state and Parks Australia representatives presented their own approaches to mapping the seafloor (presentations are available on [Google Drive](#)). Participants also commented on the translation of their own schemes to the draft NSGM scheme, and on the structure and breadth of the NSGM scheme. This feedback and other discussion points are represented later in this summary.

The National Seafloor GeoMorphology (NSGM) mapping scheme

The first generation map of seafloor geomorphology of the Australian margin utilised a 250 m resolution bathymetry grid (Heap and Harris, 2008). During the past decade, the acquisition of high resolution multibeam sonar bathymetry has accelerated, providing the opportunity to develop more detailed maps of seafloor geomorphology at local scales. It is the intention of the NSGM scheme to utilise these finer-resolution topographic and bathymetric datasets to map Australia's coastal and marine estate in a consistent manner. The NSGM mapping approach is based on the two-part scheme developed by the MIM¹ working group in Europe, and distinguishes between seafloor morphology and

¹ [MAREANO](#) – Norway; [INFOMAR](#) – Ireland; [MAREMAP](#) – UK (MIM)

geomorphology (Dove et al., 2016). The surface *Morphology* of the seafloor is mapped using bathymetric data and derivatives (e.g. slope) and *Geomorphology* (genesis and composition) is subsequently mapped where additional datasets (e.g. seabed samples) and expertise are available. Figure 1 illustrates the distinction between these two parts, and emphasises the implications for the application of contrasting geomorphic interpretations. In this example, a Ridge Feature (*Morphology*) is mapped using bathymetry data (Step 1). With the use of additional information, such as sub-bottom profiles and sediment samples, the Ridge can be distinguished as a bedform that may either be active or relict (*Geomorphology*: Step 2), with distinct implications for the end-user applications.

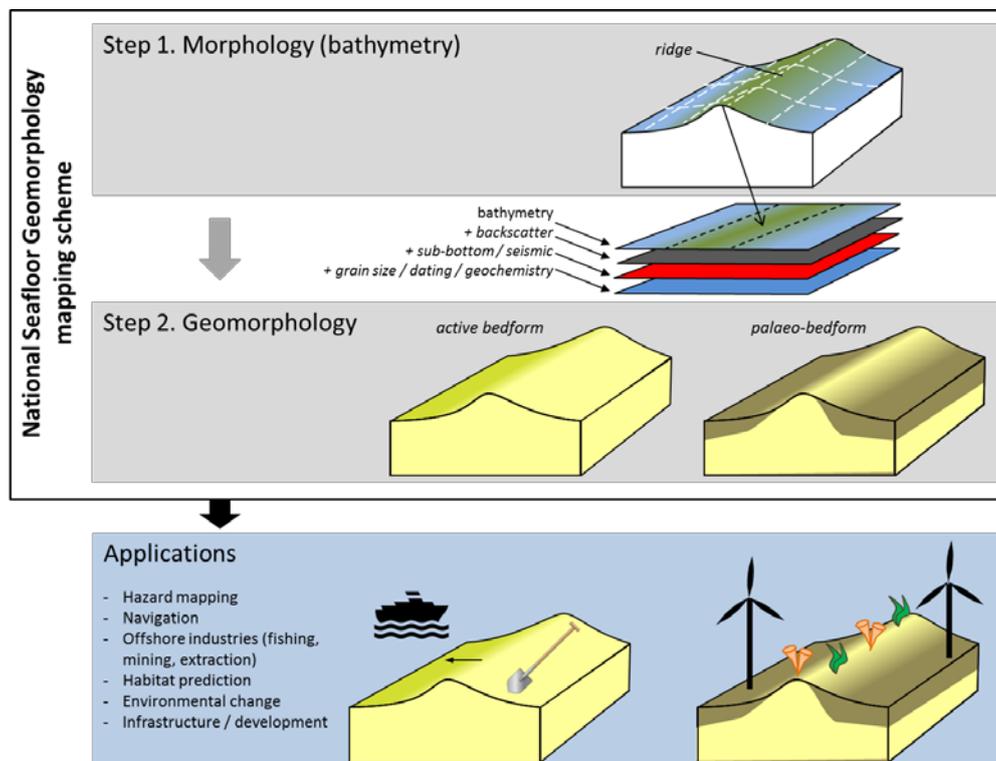


Figure 1. The Morphology of the seafloor can be mapped using bathymetry data alone (Step 1), however, additional data are required to extend the interpretation of these morphologies to determine their genesis and composition to produce a map of seafloor Geomorphology (Step 2). Potential applications for end-users are also illustrated.

A range of geomorphology-related schemes have been developed for Australia's coastal and marine realm, however, these are either restricted to intertidal to shelf settings, or do not include a comprehensive geomorphic component (Figure 2). The geomorphic components of these and other relevant international schemes have been integrated into the draft NSGM scheme. Of these other schemes, Dove et al (2016) is one of the few that attempts to apply the morphological and geomorphological mapping of coastal and

marine features to the full suite of offshore settings. They also structure this method by utilising a two-part approach that distinguishes morphological mapping from geomorphic interpretation, which is consistent with the fundamental principles of geomorphology. Geoscience Australia is collaborating with the MIM working group to progress their draft seafloor scheme and link it to the NSGM.

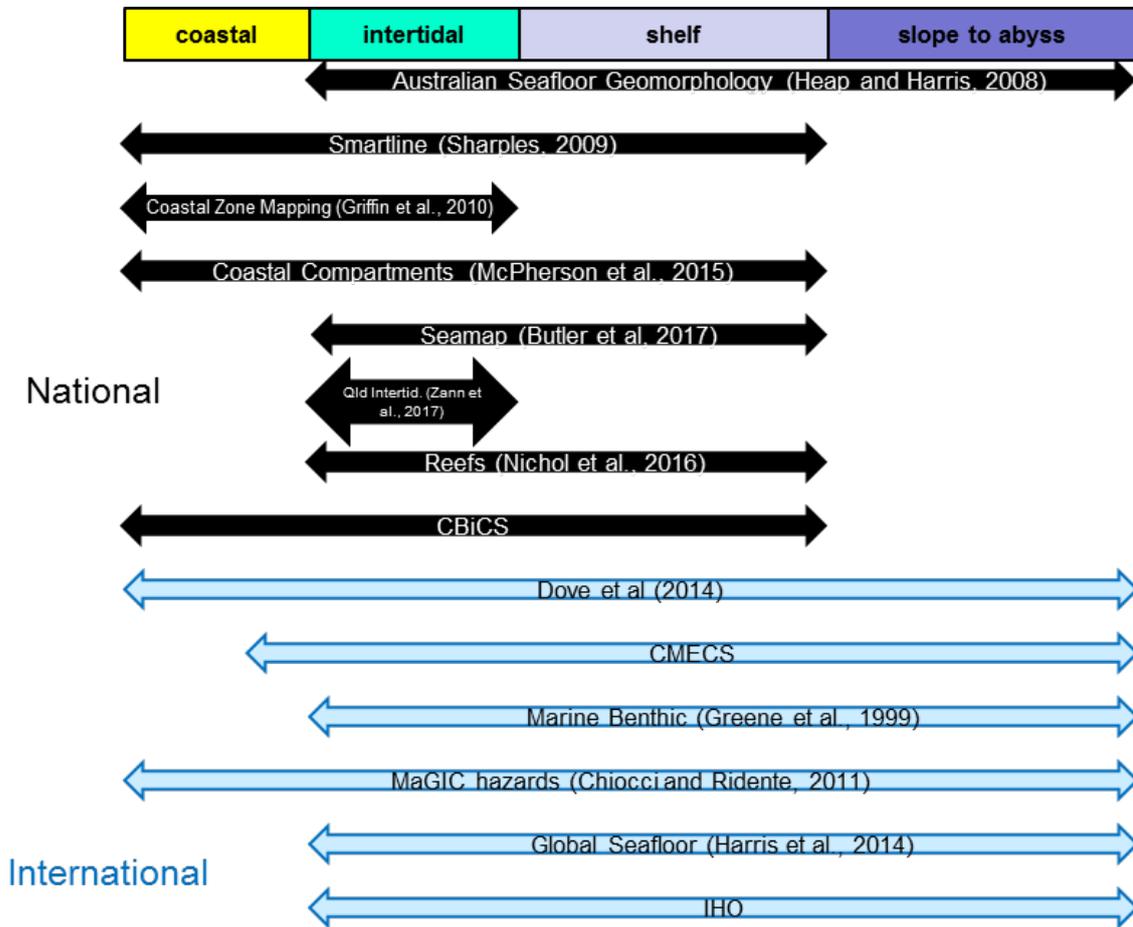
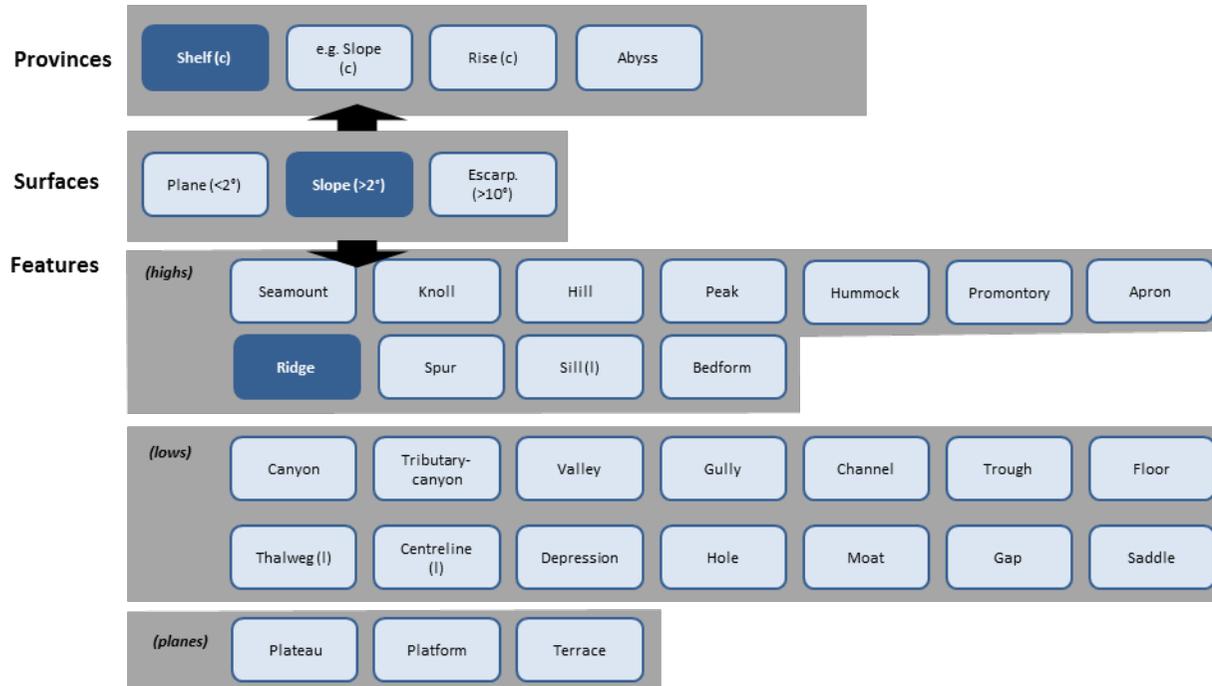


Figure 2. Scope of existing marine and coastal seafloor classification schemes. Australia's seafloor mapping approaches are generally applied to the continental shelf, though several also extend landwards to characterise the coastal plain. A range of international marine mapping approaches span the shelf to the abyss.

We propose a semi-hierarchical approach to the Morphology part of the scheme, whereby the seafloor is mapped into *Provinces*, *Surfaces* and *Features* (Figure 3). *Provinces* define the broad bathymetric zone, ranging from the shelf to hadal zone. *Surfaces* comprise three slope categories (escarpments, slopes and planes) that are mapped as discrete (i.e. non-overlapping) polygons that do not overlap one another. *Features* describe the shape of the seafloor, are broadly divided into highs, lows and planes (Dove et al., 2016) and overlap *Surface* polygons.

PART 1 - Morphology



PART 2 – Geomorphology (tagging)

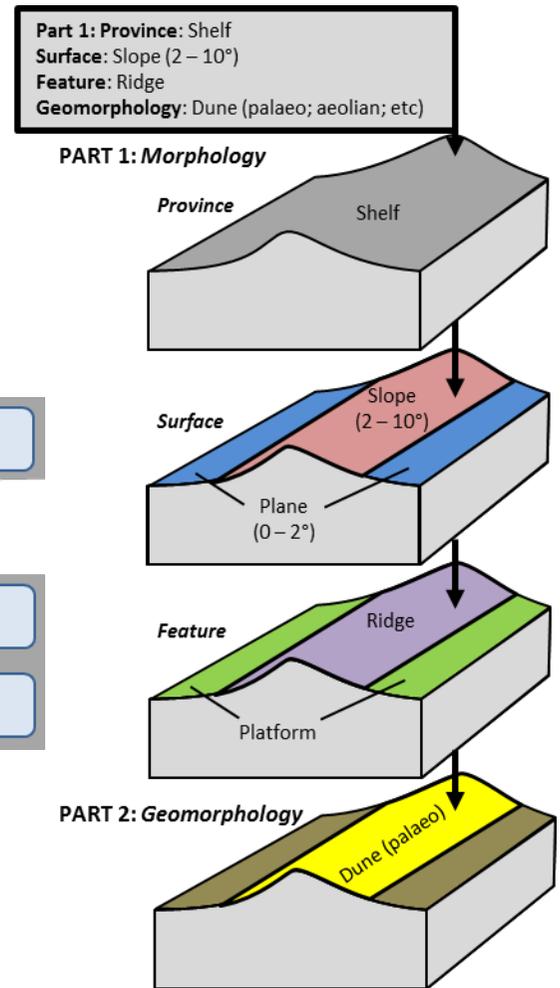


Figure 3. This schematic illustrates a draft (and incomplete) version of the proposed structure of the National Seafloor GeoMorphology (NSGM) mapping scheme. The full list of Morphology and Geomorphology terms are provided in Dove et al. (2016); the glossary for these terms is under construction. The diagrammatic example illustrates the NSGM scheme applied to the example in Figure 1.

A draft Glossary that defines each of these Morphology terms is still under construction. While these definitions are primarily based on IHO and CMECS (FGDC, 2012) definitions, and so are consistent with many other schemes (e.g. Figure 2), our glossary tightens some of their definitions. The NSGM glossary also proposes some additional terms, and presents idealised sketches, automation approaches and example bathymetric images for each.

A preliminary version of Part 2 of this approach (*Geomorphology*) is provided in Dove et al. (2016), however, the settings and their hierarchy's will be refined by specialists in each setting (e.g. Reefs, Coasts, Glacial) in subsequent drafts of the scheme. Geoscience Australia is collaborating with the MIM working group to refine Part 2 of the scheme, and seek to include Australian practitioners in this process.

Workshop feedback

The draft NSGM scheme was presented at the workshop and a broad range of suggestions for edits and additions were proposed on the day, and in follow-up correspondence; these are summarised in Table 2. Solutions to these issues are proposed in Table 2, however, further discussion of these and the draft NSGM are welcomed.

Table 2. Issues and discussion topics identified at the NSGM workshop, with initial responses

General issues	How to address	
How to apply consistently to different raster resolution	Develop a look-up table for recommended automation approach for varying grid resolution	
Should units be able to be mapped at different scales (e.g. ridges)?	Mapping at different scales: MORPHOLOGY - features can be mapped at various scales (e.g. small ridge on a larger ridge - these shapes are scale independent), but GEOMORPHOLOGY will have strict scale rules	
Breadth of end-users, needs to be multi-purpose	Continue to tailor to and engage environmental managers, executive managers (non-specialists), offshore industries, ecologists	
Involve AHO	Send draft and invite feedback on National NSGM Standard Operating Procedure (SOP)	
How to update the national map of seabed geomorphic features (i.e. Heap and Harris, 2008)	Keep Heap and Harris (2008) unmodified but link to new NSGM maps (shapefiles) by listing their shapes as "parent" geomorphic features in attribute tables/field.	Create new postage stamps of higher resolution NSG mapping and regularly (annually?) update a "National Coverage" shapefile that identifies higher resolution mapped datasets.
Integrate / edit Coastal Compartments to match	Edit Coastal Compartments based on NSGM interpretations of new bathymetry data as needed; ensure consistency between datasets	

List potential habitats associated with each feature	Explicitly state what each feature type can be used as a potential ecological surrogate for	
Topology rules are needed for what features can overlay one another	100% coverage of Provinces and Surfaces, but Features can overlap. Can we attempt rules for what defines overlaps and edges?	
Part 1: MORPHOLOGY issues		
Consistency in application	Develop a tight glossary	automate morphology mapping and scale for mapping raster resolutions; record analyst in metadata
Lumping and splitting terms	Apply Dove et al (2016) hierarchy of highs, lows and planes - then split as user needs	
Size constraints on hills and seamounts are interpretations of genesis or potential habitat	We could group all hill-like features into one category, and allow depth and genesis of those features to be captured in the GEOMORPHOLOGY section	Could also add a field for the potential habitat / ecosystem the Morphology might support
Part 2: GEOMORPHOLOGY issues		
Prioritise the development of Part (ii) Geomorphology	Underway	
Consistency in application	Develop a tight glossary	expert application for interpreting geomorphology - record analyst in metadata
Expand the list of Features	Complete the glossary	
Record sediment transport characteristics	Add azimuth and volume estimate fields; "bedform activity status" interpretation and age where known (e.g. relict, 6000 years BP C14; active);	Add process for formation (e.g. turbidity current; storm wave base; East Australia Current)
Include information on substrate	Include field(s) in Geomorphology	

Future plans and Actions

- In May 2019, Geoscience Australia will provide feedback from the NSGM workshop to the next face-to-face meeting of the MIM working group (Dove et al).
- GA will develop a draft National Standard Operating Procedure for mapping seafloor geomorphology to be circulated for comment in 2019. As a part of this process we will continue to communicate our progress on the NSGM scheme to workshop participants and those who have registered their interest, and invite your ongoing feedback and input.
- Geoscience Australia to scope options for a second workshop of the NSGM working group in mid- 2019.

Acknowledgements

The *draft* National Seafloor Geomorphology Mapping scheme is based on the two-part approach and list of terms presented by Dove et al (2016). The advancement of this scheme is an ongoing collaboration between Geoscience Australia (Rachel Nanson, Kim Picard, Scott Nichol, Alix Post, Zhi Huang, Jodie Smith) and the Mareano-Infomar-Maremap (MIM) group.

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APPENDIX 1: Workshop participants and agenda

Institution	Name
Qld Department of Environment and Science	Maria Zann
NSW Office of Environment and Heritage	Michelle Linklater
WA Department of Transport	Ralph Talbot-Smith
University of Wollongong	Colin Woodroffe
University of Melbourne	David Kennedy
University of Tasmania	Chris Sharples
Parks Australia	Cath Samson
Fathom Pacific	Adrian Flynn
RPS Group	Piers Larcombe
James Cook University	James Daniell
University of NSW @ADFA	Tom Oliver
Department of Environment and Energy	Carolyn Armstrong
Geoscience Australia	Scott Nichol Rachel Nanson Kim Picard Alix Post Jodie Smith Zhi Huang Brendan Brooke Jonah Sullivan Tony Nicholas

Start	Finish	Topic	Detail	Presenter
9:00 - 9:15		Coffee and greet		
9:15	9:45	Introduction	<ul style="list-style-type: none"> Workshop objectives GA's perspective on seabed mapping Example applications (e.g. habitats, hazards, resources) GA seabed mapping plan AusSeabed 	1. Scott Nichol (GA)
Session 1: Marine and coastal geomorphology				
9:45	10:15	From the coast to the deep sea: coastal and marine geomorphology	<ul style="list-style-type: none"> Overview of marine and coastal geomorphic forms and processes: what these features can tell us about environmental change, including hazards 	2. Colin Woodroffe (UoW)
10:15	10:35	Mapping bedforms	<ul style="list-style-type: none"> Bedforms as indicators of sediment transport pathways: applications to 	3. Piers Larcombe

			offshore engineering	(RPS Group)
10:35-11:00 Morning tea				
11:00	11:30	Geomorphology mapping approaches	<ul style="list-style-type: none"> Existing geom. mapping schemes New National Seafloor GeoMorphology (NSGM) mapping approach Translation of NSGM to state and other schemes Presentation of scheme strawman 	4. Rachel Nanson (GA)
11:30	11:45	Discussion	<ul style="list-style-type: none"> Of NSGM DRAFT 	Scott Nichol and Rachel Nanson
Session 2: Geomorphology within existing mapping schemes				
11:45	12:15	Coastal Compartments + Smartline	Geomorphic mapping within a compartment context and Smartline	5. Chris Sharples (UTas)
12:15	12:35	Ecological Classifications – CBiCS	Linking the scheme into abiotic components of biotope and habitat schemes	6. Adrian Flynn (Fathom Pacific)
12:35 – 1:30 Lunch				
1:30	1:50	Qld Intertidal and Ecosystem Classification scheme		7. Maria Zann (Department of Environment and Science)
Session 3: Regional mapping programs and needs				
1:50	2:10	A national perspective + Tasmania		8. Cath Samson (Parks Australia)
2:10	2:25	NSW		9. Michelle Linklater (OEH – NSW)
2:25	2:40	WA		10. Ralph Talbot-

			Smith (DoT - WA)
2:40	3:00	VIC	11. David Kennedy (Melb Uni)
3:00	3:15	SA	(absent) Alison Wright (DEW - SA)
3:15 – 3:30 Afternoon tea + discussion of compatibility of the strawman scheme			
Session 4 DISCUSSION: Mapping scheme priorities			
3:30	4:00	Part A – In small groups, determine priority geomorphic / compatible aspects from each existing scheme to the draft NSGM scheme	
4:00	4:45	Part B – Add priority features and edits to NSGM scheme poster	