Australian & New Zealand Biosolids Partnership

ANZBP Literature Compendium

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Background

- The ANZBP Advisory Board released a RFT for a literature compendium of biosolids treatment, and management in November 2009
- The intent was to identify R&D relevant to ANZBP, published or unpublished within the last 5 years
- ANZBP sought to understand the scope, the breadth and the novelty of any R&D relating to biosolids management
- Topics prior to the point of biosolids stabilisation were **excluded**

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Background

- The successful tenderer was Curtin University (Rigby, Clarke and Pritchard)
- The team commenced work in January 2010 and the Compendium was completed (draft) in May 2010

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Deliverables

- A database in Excel of relevant literature, by Title, Institution, Author and Subject area, Rank & a brief description of the substance of each research document
- A summary report on the state of research and leading edge developments within relevant fields, identifying research gaps

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Categories used

- Processing technologies
- Organic contaminants (occurrence/sources, fate/removal)
- Incineration with or without energy recovery
- Odour
- Storage and transportation
- Emerging technologies for biosolids reuse (excluding land application)
- Regulations
- Community attitudes
- Land application
- Sustainability (triple bottom line, life cycle, feasibility studies, economic analysis).

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Approach

- Research identified through searches of the published literature (last 5 years)
- Direct contact with researchers and water utilities to identify unpublished research
- Domestic research & international research (when relevant to biosolids management in Australia and New Zealand)
- Priority contacts identified by ANZBP advisory board (see next slide)

No.	Rank	Institution	Location	Contact
To be contacted by Consultants				
International				
1	**1**	Water Environment Research Federation	US	Alan Hais
2	**2**	Virginia Tech	US	John Novak
3	**3**	Imperial College	UK	Stephen Smith
4	**4**	Tim Evans Environment	UK	Tim Evans
5	**6**	United Utilities/Cranfield (UK)	UK	Bill Barber+R&T contact
6	**7**	University of Arizona	US	Ian Pepper
7	**8**	University of Ghent	Belgium	Hans Saveyn
8	**10**	Cornell University	US	Murray McBride
Domestic				
9	**5**	UQ (AWQC)	Qld	Jurg Keller/Paul Lant
10	**9**	Brisbane Water	UK/Australia	Keith Panter/Bill Collie
11	**14**	Queensland University of Technology	Australia	Ted Gardner
12	**15**	ESR	NZ	Tom Speirs
13	**16**	NSW DPI	NSW	Mark Whatmuff
Self-Reporting				
14	**12**	Melbourne Water	Victoria	Karen Campisano
15	**13**	Water Corporation	Australia	Nancy Penney
16	**11**	CSIRO	Australia	Simon Toze/Michael Warne
17	**20**	RMIT	Victoria	Duncan Rouch
18	**19**	Sydney Water	NSW	Kevin Conna

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Approach

- Unpublished research included:
  i) communications strategies;
  ii) proposals for biosolids management; and
  iii) overview reports

- Research reports were ranked A-E according to the following definition:
  - A wish-list (e.g. research proposals/proposals for biosolids management)
  - B emerging or incomplete (e.g. progress reports)
  - C underway i.e. technology already capable of being adopted by a utility
  - D published/commercial (non-peer reviewed)
  - E published (peer reviewed)

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Research by category

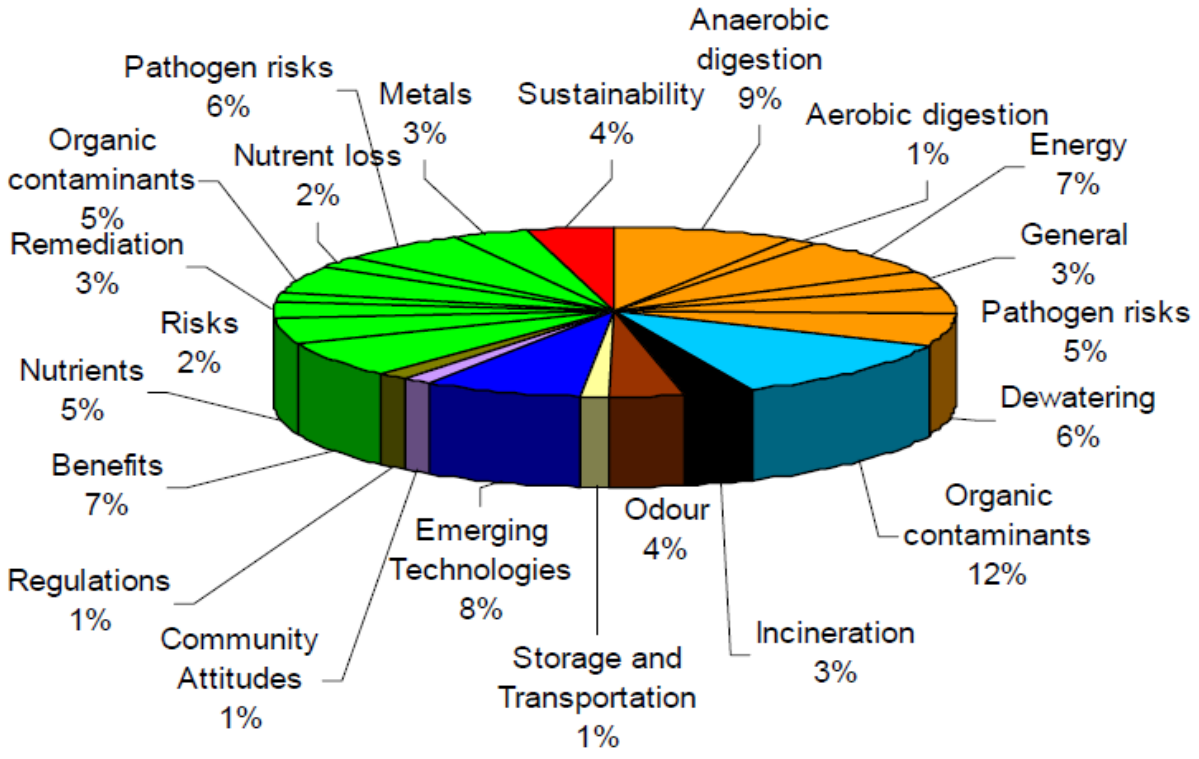

Figure 1 Proportion of research into in each category of the Biosolids Compendium; this relates to domestic and international literature conducted within the approximately the last 5 years in the area of Sustainable Biosolids Management

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Research by country

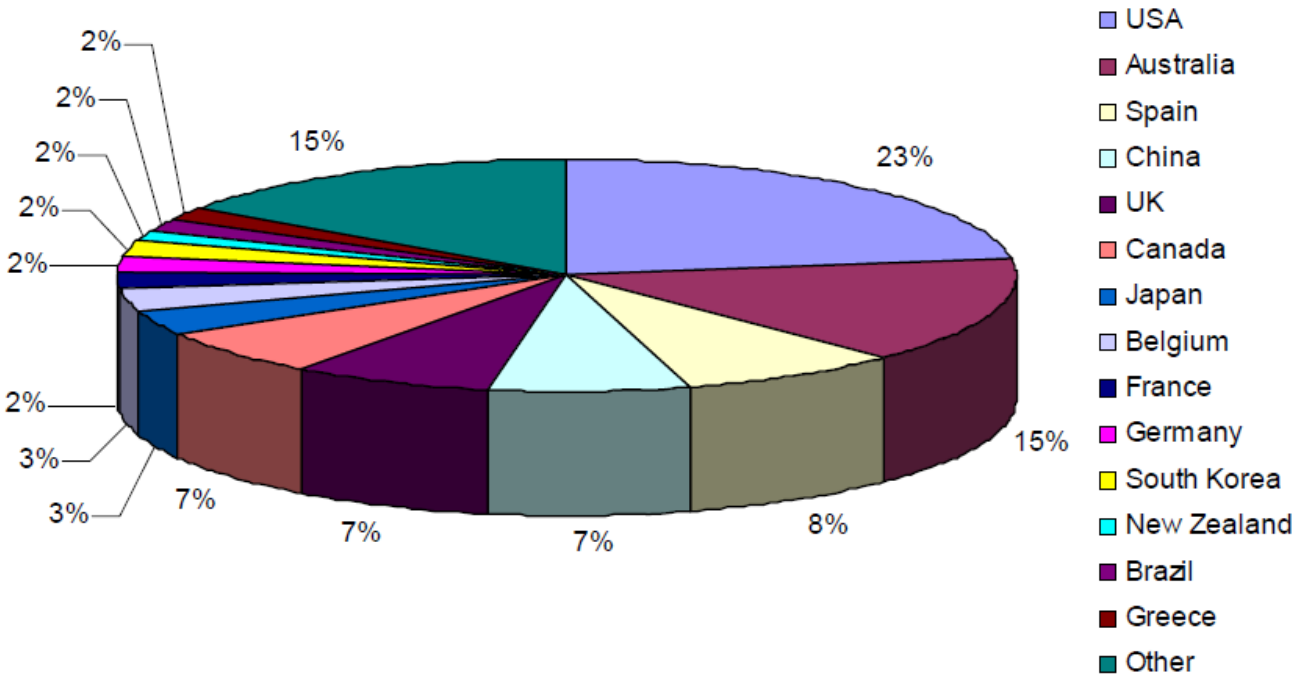

Figure 3 Countries represented in the survey of research into Sustainable Biosolids Management over the last 5 years

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Biosolids Compendium

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Processing technologies

- International Research Highlights:
  - China (developments in anaerobic digestion and incineration); Spain (anaerobic digestion and energy from thermal processes); USA (anaerobic digestion); Japan (energy from thermal processes and energy recovery from incineration);Belgium (dewatering and drying).
  - Co-digestion of sewage sludge with other organic wastes for improved energy recovery & digestate properties (United Utilities & WERF);
  - Improved sludge thickening & digestion (United Utilities);
  - Ultrasound assisted bioleaching for heavy metal removal (Université de Savoie, France);

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Processing technologies

- Australian Research:
  - Novel developments in anaerobic digestion at the University of Queensland including unique ‘Advanced Stability Sensor’ project in conjunction with Brisbane City Council and Gold Coast City Council
  - Phytoremediation for removal and stabilisation of heavy metals is underway at the University of Melbourne
  - Improved indicators of pathogenic organisms and verification of pathogen inactivation during treatment, including viral detection methods, at CSIRO Land and Water (WERF funded project). A unique study was also undertaken by this research team into helminth detection
  - Key developments have been made at RMIT to investigate pathogen survival in air-dried biosolids, and research into process verification is underway

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Processing technologies

Research gaps/priorities:

- Lack of research in Australia & NZ (with exception of AD);
- Priority areas:
  - Energy recovery;
  - Pathogen indicators;
  - Analytical procedures for pathogens (consistent methods required);
  - Process verification (i.e. in regional areas- research planned at RMIT);
  - Cost-effective Class A/P1 biosolids production;
  - Removal of metals

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Organic contaminants

- UK:
  - Review of 'emerging' organic contaminants in biosolids and assessment of international research priorities for the agricultural use of biosolids (Clarke & Smith, 2010)

- Australia and New Zealand:
  - Leading edge research at RMIT (Clarke *et al.*, 2008a, Clarke *et al.*, 2010b, Clarke *et al.*, 2010c); the Centre for Environmental Toxicology (CENTOX), New Zealand (Leusch *et al.*, 2005); School of Environmental Studies, Queensland (Tan *et al.*, 2007a; Tan *et al.*, 2007b) and the University of Adelaide (Langdon *et al.*, 2010). This research includes unique studies into risks associated with biosolids land application in Australia (Clarke *et al.*, 2010a, Langdon *et al.*, 2010).

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Organic contaminants

- Research gaps/priorities:
  - Continued surveys of ‘emerging contaminants’
  - New chemicals of concern: PFCs and PCAs (soluble in water);
  - Ecological risk assessments

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Odour

- Leading edge research developments:
  - studies in odour causing compounds & strategies to reduce odour (eg. use of alum & iron) conducted at Virginia Tech & Bucknell University, USA

- Research underway in Australia:
  - odour & biosolids stability (Sydney Water);
  - strategies to reduce odour including use of metal salts underway at Curtin University

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Emerging uses for biosolids

- Leading-edge research
  - China & Japan: use of ash & biochar in construction material
  - USA (CUNY College, New York): extensive research in production of activated carbon and adsorbents from sewage sludge ash and biochar
  - Switzerland, Japan, Germany: P recovery from sewage sludge ash
- Research priorities:
  - Resource recovery (N, P and precious metals)
  - Production of pesticides, ethanol and enzymes

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Land application

- Leading-edge developments:
  - Australia and New Zealand: Contaminant limits for Cu, Zn and Cd (NBRP); geotechnical fill (Melbourne Water); pathogen indicators & inactivation in soil/transfer to crops (CSIRO/Curtin University); pathogen risks, forestry (Murdoch)
  - Role of biosolids in climate change mitigation: eg. C sequestration & GHG emissions (CSIC, Spain);
  - Management of P in biosolids applications (USA)

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Land application

- Research gaps/priorities:
  - Improved understanding of mineralisation, leaching, runoff, erosion of N and P and gaseous emissions of N in Australian soils and conditions
  - Improved P management
  - Contaminants of potential concern: molybdenum, silver, tin, perchlorate
  - Antibiotic resistant bacteria in the environment & survival or viruses and prions
  - The effects of biochar on soil properties
  - Land application and climate change mitigation in Australia.

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Additional Research Priorities

- Community attitudes and public perception- key to continuing beneficial biosolids management programmes;
- Legislation & regulations: changing status of biosolids to ‘non-waste’
- Life-Cycle & ‘triple bottom line’ analyses to maintain sustainable biosolids management practices

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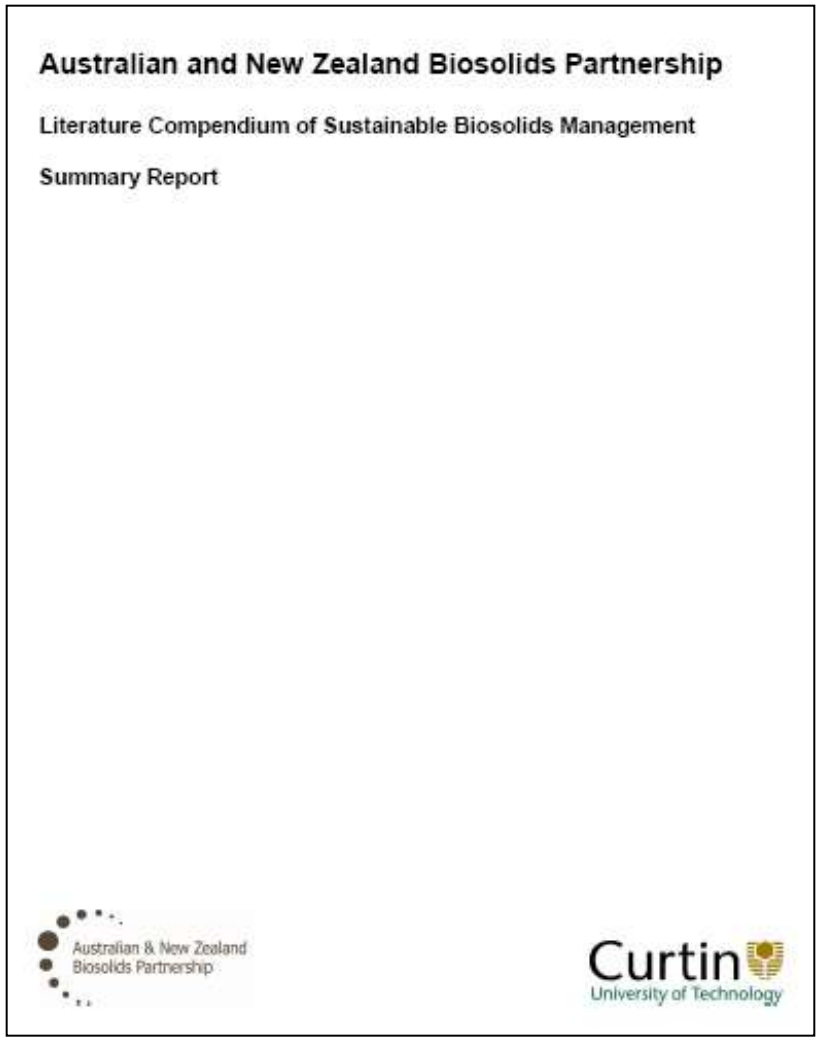

Available at
www.biosolids.com.au

The Australia & New Zealand Biosolids Partnership is managed by the Australian Water Association