Australian Government

BIOREGIONAL ASSESSMENTS

PROVIDING SCIENTIFIC WATER RESOURCE INFORMATION ASSOCIATED WITH COAL SEAM GAS AND LARGE COAL MINES

Description of the water-dependent asset register for the Gippsland Basin bioregion

Product 1.3 from the Gippsland Basin Bioregional Assessment

23 October 2015

A scientific collaboration between the Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia

The Bioregional Assessment Programme

The Bioregional Assessment Programme is a transparent and accessible programme of baseline assessments that increase the available science for decision making associated with coal seam gas and large coal mines. A bioregional assessment is a scientific analysis of the ecology, hydrology, geology and hydrogeology of a bioregion with explicit assessment of the potential direct, indirect and cumulative impacts of coal seam gas and large coal mining development on water resources. This Programme draws on the best available scientific information and knowledge from many sources, including government, industry and regional communities, to produce bioregional assessments that are independent, scientifically robust, and relevant and meaningful at a regional scale.

The Programme is funded by the Australian Government Department of the Environment. The Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia are collaborating to undertake bioregional assessments. For more information, visit http://www.bioregionalassessments.gov.au.

Department of the Environment

The Office of Water Science, within the Australian Government Department of the Environment, is strengthening the regulation of coal seam gas and large coal mining development by ensuring that future decisions are informed by substantially improved science and independent expert advice about the potential water related impacts of those developments. For more information, visit http://www.environment.gov.au/coal-seam-gas-mining/.

Bureau of Meteorology

The Bureau of Meteorology is Australia's national weather, climate and water agency. Under the *Water Act 2007*, the Bureau is responsible for compiling and disseminating Australia's water information. The Bureau is committed to increasing access to water information to support informed decision making about the management of water resources. For more information, visit http://www.bom.gov.au/water/.

CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation. For more information, visit http://www.csiro.au.

Geoscience Australia

Geoscience Australia is Australia's national geoscience agency and exists to apply geoscience to Australia's most important challenges. Geoscience Australia provides geoscientific advice and information to the Australian Government to support current priorities. These include contributing to responsible resource development; cleaner and low emission energy technologies; community safety; and improving marine planning and protection. The outcome of Geoscience Australia's work is an enhanced potential for the Australian community to obtain economic, social and environmental benefits through the application of first class research and information. For more information, visit http://www.ga.gov.au.

ISBN-PDF 978-1-925315-01-1

Citation

Doody TM, Pritchard J, Carey H, Galinec V and Walker K (2015) Description of the water-dependent asset register for the Gippsland Basin bioregion. Product 1.3 from the Gippsland Basin Bioregional Assessment. Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia.
http://data.bioregionalassessments.gov.au/product/GIP/GIP/1.3.

Authorship is listed in relative order of contribution.

Copyright

Disclaimer

The information contained in this report is based on the best available information at the time of publication. The reader is advised that such information may be incomplete or unable to be used in any specific situation. Therefore decisions should not be made based solely on this information or without seeking prior expert professional, scientific and technical advice.
The Bioregional Assessment Programme is committed to providing web accessible content wherever possible. If you are having difficulties with accessing this document please contact bioregionalassessments@bom.gov.au.

Cover photograph

Lake Victoria, Victoria, 2013

Credit: Hashim Carey, # Photography

Australian Government
Department of the Environment
Bureau of Meteorology
Geoscience Australia

CSIRO

Contents

Figures

Tables

Contributors to the Technical Programme

The following individuals have contributed to the Technical Programme, the part of the Bioregional Assessment Programme that undertakes bioregional assessments. Leaders are underlined.

Assistant Secretary	Department of the Environment: Matthew Whitfort
Programme Director	Department of the Environment: Anthony Swirepik
Technical Programme Director	Bureau of Meteorology: Bronwyn Ray
Projects Director	CSIRO: David Post
Principal Science Advisor	Department of the Environment: Peter Baker
Science Directors	CSIRO: Brent Henderson
	Geoscience Australia: Steven Lewis
Integration Lead	Bureau of Meteorology: Richard Mount
Programme management	Bureau of Meteorology: Graham Hawke, Louise Minty
	CSIRO: Paul Hardisty, Warwick McDonald
	Geoscience Australia: Stuart Minchin
Project Leaders	CSIRO: Alexander Herr, Tim McVicar, David Rassam
	Geoscience Australia: Hashim Carey, Kriton Glenn, Tim Evans, Martin Smith
	Bureau of Meteorology: Natasha Herron
Assets and receptors	Bureau of Meteorology: Richard Mount, Eliane Prideaux
	Department of the Environment: Larry Guo, Glenn Johnstone, Brad Moore, Wasantha Perera, Jin Wang
Bioregional Assessment Information Platform	Bureau of Meteorology: Derek Chen, Trevor Christie-Taylor, Melita Dahl, Lakshmi Devanathan, Angus MacAulay, Christine Panton, Paul Sheahan, Kellie Stuart, Carl Sudholz
	CSIRO: Peter Fitch
	Department of the Environment: Geraldine Cusack
	Geoscience Australia: Neal Evans
Communications	Bureau of Meteorology: Karen de Plater
	CSIRO: Chris Gerbing
	Department of the Environment: Lea Locke, Milica Milanja
	Geoscience Australia: Chris Thompson

Coordination	Bureau of Meteorology: Julie Burke, Sarah van Rooyen CSIRO: Ruth Palmer Department of the Environment: James Hill, Angela Kaplish, Megan Stanford, Craig Watson Geoscience Australia: Tenai Luttrell
Ecology	CSIRO: Tanya Doody, Brendan Ebner, Kate Holland, Craig MacFarlane, Patrick Mitchell, Justine Murray, Anthony O'Grady, Chris Pavey, Jodie Pritchard, Nat Raisbeck-Brown, Ashley Sparrow, Georg Wiehl
Geology	CSIRO: Deepak Adhikary, Luke Connell, Emanuelle Frery, Jane Hodgkinson, James Kear, Manoj Khanal, Zhejun Pan, Kaydy Pinetown, Matthias Raiber, Hayley Rohead-O'Brien, Regina Sander, Peter Schaubs, Garth Warren, Paul Wilkes, Andrew Wilkins, Yanhua Zhang Geoscience Australia: Stephen Hostetler, Steven Lewis, Bruce Radke
Geographic information systems	CSIRO: Caroline Bruce, Jody Bruce, Steve Marvanek, Arthur Read Geoscience Australia: Adrian Dehelean
Groundwater modelling	CSIRO: Olga Barron, Russell Crosbie, Tao Cui, Warrick Dawes, Lei Gao, Sreekanth Janardhanan, Luk Peeters, Praveen Kumar Rachakonda, Wolfgang Schmid, Saeed Torkzaban, Chris Turnadge, Binzhong Zhou
Hydrogeology	CSIRO: Konrad Miotlinski Geoscience Australia: Rebecca Cassel, Steven Hostetler, Jim Kellett, Jessica Northey, Tim Ransley, Baskaran Sundaram, Gabrielle Yates
Information management	Bureau of Meteorology: Belinda Allison, Jill McNamara, Brendan Moran, Suzanne Slegers CSIRO: Nick Car, Phil Davies, Andrew Freebairn, Mick Hartcher, Geoff Hodgson, Brad Lane, Ben Leighton, Trevor Pickett, Ramneek Singh, Matt Stenson Geoscience Australia: Luke Caruana, Matti Peljo
Products	CSIRO: Maryam Ahmad, Daniel Aramini, Heinz Buettikofer, Sonja Chandler, Simon Gallant, Karin Hosking, Frances Marston, Linda Merrin, Becky Schmidt, Sally Tetreault-Campbell, Catherine Ticehurst Geoscience Australia: Penny Kilgour, Kathryn Owen
Risk and uncertainty	CSIRO: Simon Barry, Jeffery Dambacher, Jess Ford, Keith Hayes, Geoff Hosack, Yang Liu, Warren Jin, Dan Pagendam, Carmel Pollino
Surface water hydrology	CSIRO: Santosh Aryal, Mat Gilfedder, Fazlul Karim, Lingtao Li, Dave McJannet, Jorge Luis Peña-Arancibia, Xiaogang Shi, Tom Van Niel, Neil Viney, Bill Wang, Ang Yang, Yongqiang Zhang

Acknowledgements

The Gippsland Basin Bioregional Assessment Team would like to thank the asset workshop participants for their contributions to discussion. The following organisations were represented at the asset workshop held in Traralgon on 1 December 2014:

- Agribusiness Gippsland
- Bass Coast Shire Council
- Baw Baw Shire Council
- Department of Economic Development, Jobs, Transport and Resources
- Department of Environment, Land, Water and Planning
- East Gippsland Shire Council
- Gippsland Coastal Board
- Gippsland Water
- Latrobe City Council
- South Gippsland Water
- Southern Rural Water
- Wellington Shire Council
- West Gippsland Catchment Management Authority.

This technical product was reviewed by several groups:

- Senior Science Leaders: David Post (Projects Director, CSIRO), Trevor Dhu (Science Director, Geoscience Australia), Brent Henderson (Science Director, CSIRO), Becky Schmidt (Products Manager, CSIRO)

Technical Assurance Reference Group: Chaired by Peter Baker (Principal Science Advisor, Department of the Environment), this group comprises officials from the New South Wales, Queensland, South Australian and Victorian governments.

Introduction

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) was established to provide advice to the federal Minister for the Environment on potential water-related impacts of coal seam gas (CSG) and large coal mining developments.

Bioregional assessments (BAs) are one of the key mechanisms to assist the IESC in developing this advice so that it is based on best available science and independent expert knowledge. Importantly, technical products from BAs are also expected to be made available to the public, providing the opportunity for all other interested parties, including government regulators, industry, community and the general public, to draw from a single set of accessible information. A BA is a scientific analysis, providing a baseline level of information on the ecology, hydrology, geology and hydrogeology of a bioregion with explicit assessment of the potential direct, indirect and cumulative impacts of CSG and coal mining development on water resources.

The IESC has been involved in the development of *Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources* (the BA methodology; Barrett et al., 2013) and has endorsed it. The BA methodology specifies how BAs should be undertaken. Broadly, a BA comprises five components of activity, as illustrated in Figure 1. Each BA will be different, due in part to regional differences, but also in response to the availability of data, information and fit-for-purpose models. Where differences occur, these are recorded, judgments exercised on what can be achieved, and an explicit record is made of the confidence in the scientific advice produced from the BA.

The Bioregional Assessment Programme

The Bioregional Assessment Programme is a collaboration between the Department of the Environment, the Bureau of Meteorology, CSIRO and Geoscience Australia. Other technical expertise, such as from state governments or universities, is also drawn on as required. For example, natural resource management groups and catchment management authorities identify assets that the community values by providing the list of water-dependent assets, a key input.

The Technical Programme, part of the Bioregional Assessment Programme, will undertake BAs for the following bioregions and subregions:

- the Galilee, Cooper, Pedirka and Arckaringa subregions, within the Lake Eyre Basin bioregion
- the Maranoa-Balonne-Condamine, Gwydir, Namoi and Central West subregions, within the Northern Inland Catchments bioregion
- the Clarence-Moreton bioregion
- the Hunter and Gloucester subregions, within the Northern Sydney Basin bioregion
- the Sydney Basin bioregion
- the Gippsland Basin bioregion.

Technical products (described in a later section) will progressively be delivered throughout the Programme.

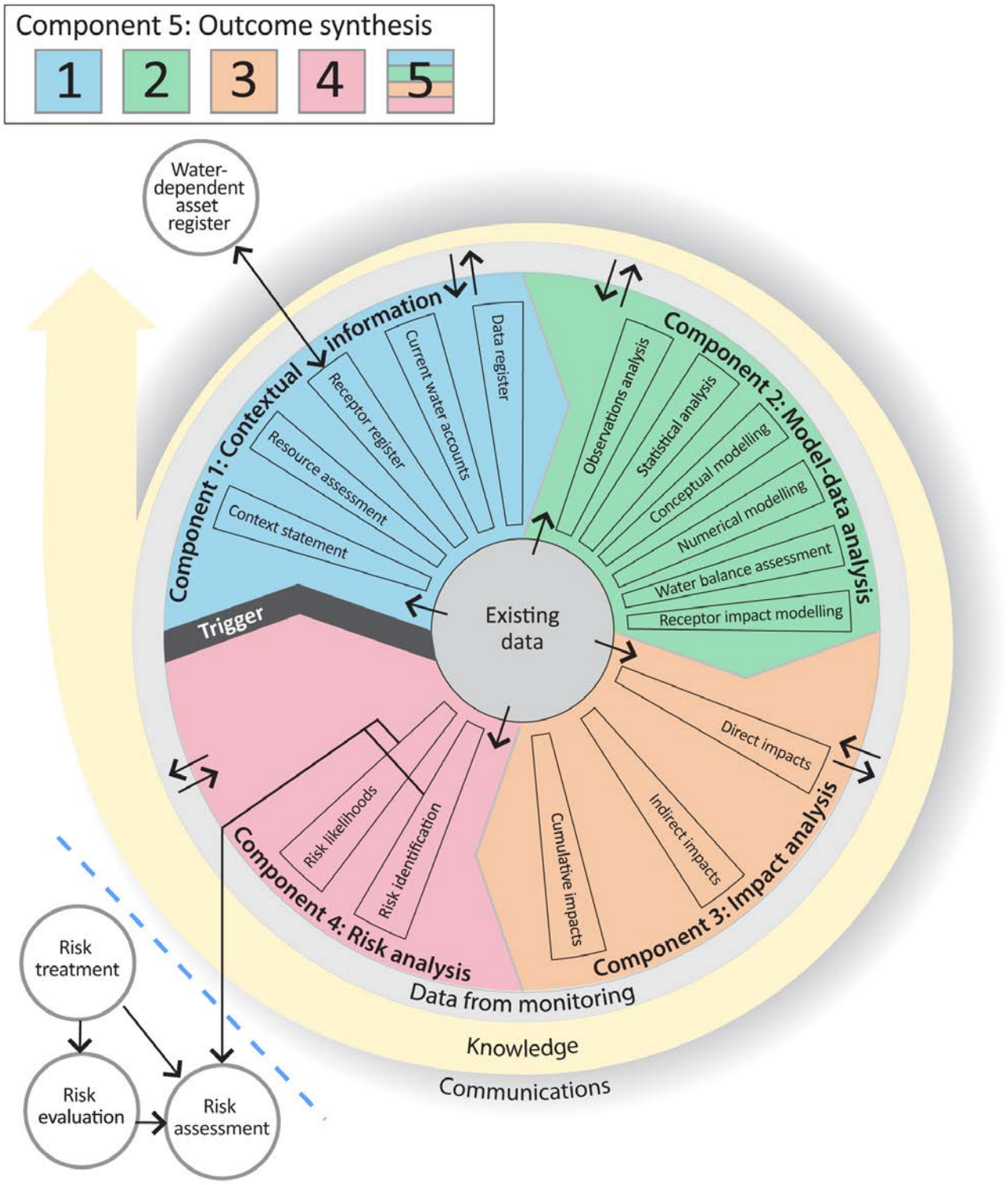

Figure 1 Schematic diagram of the bioregional assessment methodology

The methodology comprises five components, each delivering information into the bioregional assessment and building on prior components, thereby contributing to the accumulation of scientific knowledge. The small grey circles indicate activities external to the bioregional assessment. Risk identification and risk likelihoods are conducted within a bioregional assessment (as part of Component 4) and may contribute activities undertaken externally, such as risk evaluation, risk assessment and risk treatment. Source: Figure 1 in Barrett et al. (2013), © Commonwealth of Australia

Methodologies

For transparency and to ensure consistency across all BAs, submethodologies have been developed to supplement the key approaches outlined in the *Methodology for bioregional assessments of the impact of coal seam gas and coal mining development on water resources* (Barrett et al., 2013). This series of submethodologies aligns with technical products as presented in Table 1. The submethodologies are not intended to be 'recipe books' nor to provide step-by-step instructions; rather they provide an overview of the approach to be taken. In some instances, methods applied for a particular BA may need to differ from what is proposed in the submethodologies – in this case an explanation will be supplied. Overall, the submethodologies are intended to provide a rigorously defined foundation describing how BAs are undertaken.

Table 1 Methodologies and associated technical products listed in Table 2

Code	Proposed title	Summary of content	Associated technical product
M01	*Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources*	A high-level description of the scientific and intellectual basis for a consistent approach to all bioregional assessments	All
M02	*Compiling water-dependent assets*	Describes the approach for determining water-dependent assets	1.3 Description of the water-dependent asset register
M03	*Assigning receptors and impact variables to water-dependent assets*	Describes the approach for determining receptors associated with water-dependent assets	1.4 Description of the receptor register
M04	*Developing a coal resource development pathway*	Specifies the information that needs to be collected and reported in product 1.2 (i.e. known coal and coal seam gas resources as well as current and potential resource developments). Describes the process for determining the coal resource development pathway (reported in product 2.3)	1.2 Coal and coal seam gas resource assessment 2.3 Conceptual modelling
M05	*Developing the conceptual model for causal pathways*	Describes the development of the conceptual model for causal pathways, which summarises how the 'system' operates and articulates the links between coal resource developments and impacts on receptors	2.3 Conceptual modelling
M06	*Surface water modelling*	Describes the approach taken for surface water modelling across all of the bioregions and subregions. It covers the model(s) used, as well as whether modelling will be quantitative or qualitative.	2.6.1 Surface water numerical modelling
M07	*Groundwater modelling*	Describes the approach taken for groundwater modelling across all of the bioregions and subregions. It covers the model(s) used, as well as whether modelling will be quantitative or qualitative. It also considers surface water – groundwater interactions, as well as how the groundwater modelling is constrained by geology.	2.6.2 Groundwater numerical modelling

Code	Proposed title	Summary of content	Associated technical product
M08	*Receptor impact modelling*	Describes how to develop the receptor impact models that are required to assess the potential impacts from coal seam gas and large coal mining on receptors. Conceptual, semi-quantitative and quantitative numerical models are described.	2.7 Receptor impact modelling
M09	*Propagating uncertainty through models*	Describes the approach to sensitivity analysis and quantifying uncertainty in the modelled hydrological response to coal and coal seam gas development	2.3 Conceptual modelling 2.6.1 Surface water numerical modelling 2.6.2 Groundwater numerical modelling 2.7 Receptor impact modelling
M10	*Risk and cumulative impacts on receptors*	Describes the process to identify and analyse risk	3 Impact analysis 4 Risk analysis
M11	*Hazard identification*	Describes the process to identify potential water-related hazards from coal and coal seam gas development	2 Model-data analysis 3 Impact analysis 4 Risk analysis
M12	*Fracture propagation and chemical concentrations*	Describes the likely extent of both vertical and horizontal fractures due to hydraulic stimulation and the likely concentration of chemicals after production of coal seam gas	2 Model-data analysis 3 Impact analysis 4 Risk analysis

Each submethodology is available online at http://www.bioregionalassessments.gov.au. Submethodologies might be added in the future.

Technical products

The outputs of the BAs include a suite of technical products variously presenting information about the ecology, hydrology, hydrogeology and geology of a bioregion and the potential direct, indirect and cumulative impacts of CSG and coal mining developments on water resources, both above and below ground. Importantly, these technical products are available to the public, providing the opportunity for all interested parties, including community, industry and government regulators, to draw from a single set of accessible information when considering CSG and large coal mining developments in a particular area.

The information included in the technical products is specified in the BA methodology. Figure 2 shows the information flow within a BA. Table 2 lists the content provided in the technical products, with cross-references to the part of the BA methodology that specifies it. The red rectangles in both Figure 2 and Table 2 indicate the information included in this technical product.

This technical product is delivered as a report (PDF). Additional material is also provided, as specified by the BA methodology:

- all unencumbered data syntheses and databases
- unencumbered tools, model code, procedures, routines and algorithms
- unencumbered forcing, boundary condition, parameter and initial condition datasets
- the workflow, comprising a record of all decision points along the pathway towards completion of the BA, gaps in data and modelling capability, and provenance of data.

The PDF of this technical product, and the additional material, are available online at http://www.bioregionalassessments.gov.au.

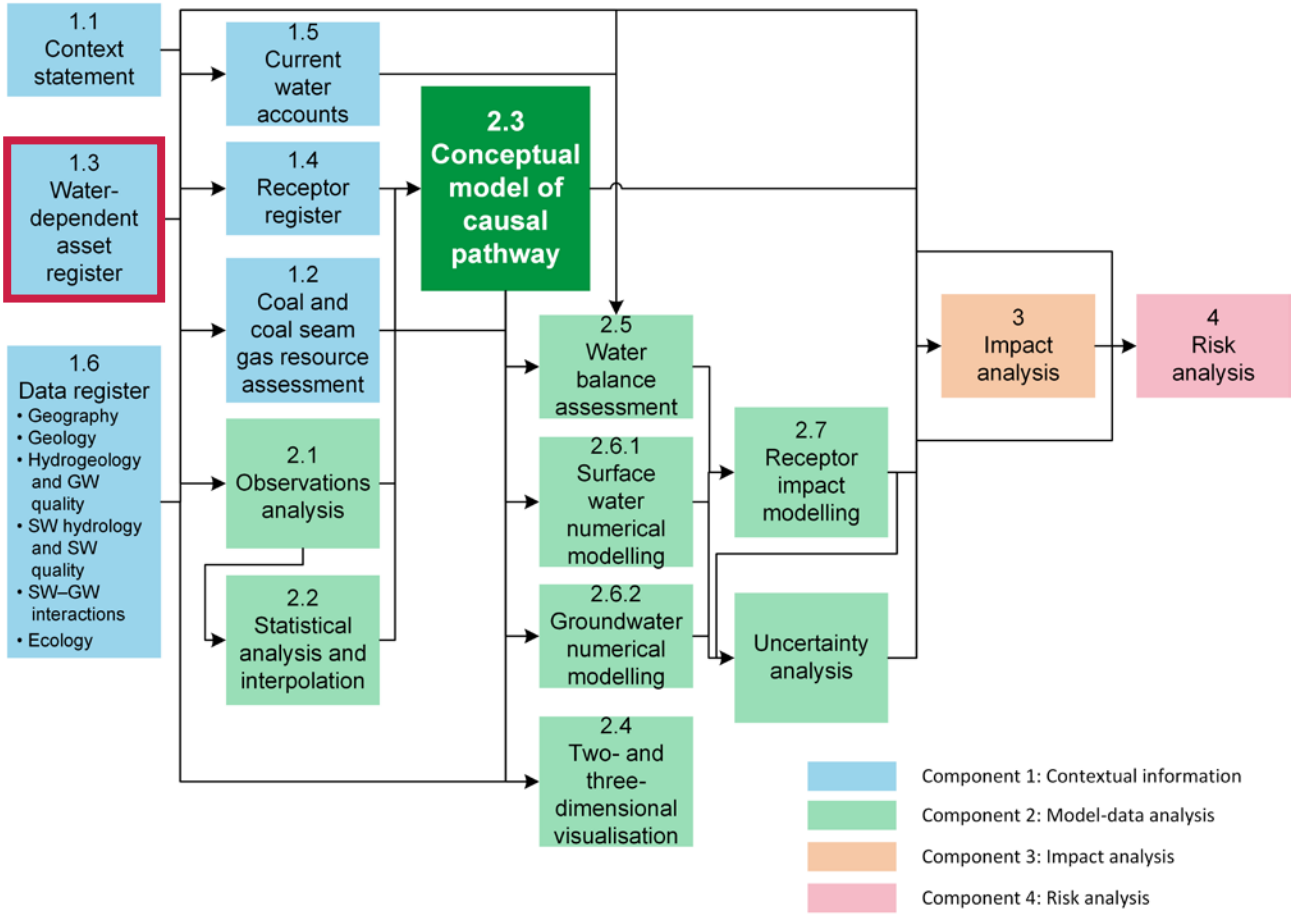

Figure 2 The simple decision tree indicates the flow of information through a bioregional assessment

The red rectangle indicates the information included in this technical product.

Table 2 Technical products delivered by the Gippsland Basin Bioregional Assessment

For each subregion in the Gippsland Basin Bioregional Assessment, technical products are delivered online at http://www.bioregionalassessments.gov.au, as indicated in the 'Type' column[a]. Other products – such as datasets, metadata, data visualisation and factsheets – are provided online.

Component	Product code	Title	Section in the BA methodology[b]	Type[a]
Component 1: Contextual information for the Gippsland Basin bioregion	1.1	Context statement	2.5.1.1, 3.2	PDF, HTML
	1.2	Coal and coal seam gas resource assessment	2.5.1.2, 3.3	PDF, HTML
	1.3	Description of the water-dependent asset register	2.5.1.3, 3.4	PDF, HTML, register
	1.4	Description of the receptor register	2.5.1.4, 3.5	PDF, HTML, register
	1.5	Current water accounts and water quality	2.5.1.5	PDF, HTML
	1.6	Data register	2.5.1.6	Register
Component 2: Model-data analysis for the Gippsland Basin bioregion	2.1-2.2	Observations analysis, statistical analysis and interpolation	2.5.2.1, 2.5.2.2	PDF, HTML
	2.3	Conceptual modelling	2.5.2.3, 4.3	PDF, HTML
	2.5	Water balance assessment	2.5.2.4	PDF, HTML
	2.6.1	Surface water numerical modelling	4.4	PDF, HTML
	2.6.2	Groundwater numerical modelling	4.4	PDF, HTML
	2.7	Receptor impact modelling	2.5.2.6, 4.5	PDF, HTML
Component 3: Impact analysis for Gippsland Basin bioregion	3-4	Impact analysis	5.2.1	PDF, HTML
Component 4: Risk analysis for the Gippsland Basin bioregion		Risk analysis	2.5.4, 5.3	
Component 5: Outcome synthesis for the Gippsland Basin bioregion	5	Outcome synthesis	2.5.5	PDF, HTML

[a]The types of products are as follows:

- 'PDF' indicates a PDF document that is developed by the Gippsland Basin Bioregional Assessment using the structure, standards, and look and feel specified by the programme.
- 'HTML' indicates the same content as in the PDF document, but delivered as webpages.
- 'Register' indicates controlled lists that are delivered using a variety of formats as appropriate.

[b]*Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources* (Barrett et al., 2013)

About this technical product

The following notes are relevant only for this technical product.

- All reasonable efforts were made to provide all material under a Creative Commons Attribution 3.0 Australia Licence.
- All maps created as part of this BA for inclusion in this product used the Albers equal area projection with a central meridian of 151.0° East for the Gippsland Basin bioregion and two standard parallels of –18.0° and –36.0°.
- Contact bioregionalassessments@bom.gov.au to access metadata (including copyright, attribution and licensing information) for all datasets cited or used to make figures in this product. At a later date, this information, as well as all unencumbered datasets, will be published online.
- The citation details of datasets are correct to the best of the knowledge of the Bioregional Assessment Programme at the publication date of this product. Readers should use the hyperlinks provided to access the most up-to-date information about these data; where there are discrepancies, the information provided online should be considered correct. The dates used to identify Bioregional Assessment Source Datasets are the dataset's published date. Where the published date is not available, the last updated date or created date is used. For Bioregional Assessment Derived Datasets, the created date is used.

References

Barrett DJ, Couch CA, Metcalfe DJ, Lytton L, Adhikary DP and Schmidt RK (2013) Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment. Department of the Environment, Australia. Viewed 9 December 2015, http://www.iesc.environment.gov.au/publications/methodology-bioregional-assessments-impacts-coal-seam-gas-and-coal-mining-development-water.

1.1 Description of the water-dependent asset register for the Gippsland Basin bioregion

A water-dependent asset has a particular meaning for bioregional assessments; it is an asset potentially impacted by changes in groundwater and/or surface water due to coal or coal seam gas development. Some ecological assets solely depend on incident rainfall and will not be considered as water dependent if evidence does not support a linkage to groundwater or surface water.

This product describes water-dependent assets that have been identified in the bioregional assessment and are listed in the water-dependent asset register (available at http://www.bioregionalassessments.gov.au).

1.1.1 Methods

Summary

The water-dependent asset register is a list of water-dependent assets identified for use in the bioregional assessment (BA) of the Gippsland Basin bioregion. This section details the specific application to the Gippsland Basin bioregion of methods described in the companion submethodology M02 for compiling water-dependent assets (Mount et al., 2015), outlining how the register was compiled. Key concepts and terminology are also explained.

The methods covered include: the process of collecting different groups of assets and determining their water dependency, the development and compilation of the water-dependent asset register, and the determination of the preliminary assessment extent (PAE) of the Gippsland Basin bioregion.

1.1.1.1 Background and context

This product presents information about the water-dependent asset register developed for the Gippsland Basin bioregion. The name of the dated snapshot of the asset register this description refers to is 'Water-dependent asset register and asset list for Gippsland Basin bioregion on 18 September 2015' (available at Doody et al., 2015). The point-of-truth version of the asset register that this snapshot was extracted from resides in the asset database (Bioregional Assessment Programme, Dataset 1). The asset database and the water-dependent asset register can be updated so a more current version might be available at http://data.bioregionalassessments.gov.au/product/GIP/GIP/1.3.

Development of the register used methods and processes defined and outlined in the companion submethodology M02 (as listed in Table 1) for compiling water-dependent assets (Mount et al., 2015); their specific application to the Gippsland Basin bioregion is described in the following sections.

An *asset* is an entity having value to the community and, for bioregional assessment (BA) purposes, is associated with a bioregion or subregion. Technically, an asset is a store of value and may be managed and/or used to maintain and/or produce further value. Each asset will have many values associated with it and they can be measured from a range of perspectives; for example, the values of a wetland can be measured from ecological, sociocultural and economic perspectives. A *bioregion* is a geographic land area within which coal seam gas (CSG) and/or coal mining developments are, or could, take place and for which BAs are conducted. A *subregion* is an identified area wholly contained within a bioregion.

A *water-dependent asset* has a particular meaning for BAs; it is an asset potentially impacted, either positively or negatively, by changes in the groundwater and/or surface water regime due to coal resource development. Some assets are solely dependent on incident rainfall and will not be considered as water dependent if evidence does not support a linkage to groundwater or surface water.

The *water-dependent asset register* is a simple and authoritative listing of the assets within the *preliminary assessment extent* (PAE) (discussed in Section 1.3.1.3) that are potentially subject to water-related impacts. A PAE is the geographic area associated with a bioregion or subregion in which the potential water-related impact of coal resource development on assets is assessed. The compiling of the asset register is the first step to identifying and analysing potentially impacted assets, which is the goal of the overall BA.

The asset source data are compiled into an *asset database*, including the geographic location, which are designated as *elements* (individual spatial features – points, lines and polygons e.g. components of a larger system) and *assets* (combinations of one or more elements). During the compilation process, assets are classified into three groups: (i) ecological, (ii) economic and (iii) sociocultural. Many assets are obtained from state and national databases and an important group of assets is compiled by natural resource management organisations (NRMs) via the BA-purpose-built *Water Asset Information Tool* (WAIT) database. The Office of Water Science liaised with Indigenous knowledge holders about Indigenous sociocultural water-dependent assets (further discussed in Section 1.3.4.1).

The *asset list* is created through selection of assets in the asset database that occur within the PAE. The assets in the asset list that pass the BA water-dependency test are then 'registered' in the water-dependent asset register. A preliminary version of the asset register is presented to experts and organisations with local knowledge at organised workshops. Feedback is sought about whether the asset register is complete and correct; appropriate amendments are then made. It is at this stage – when assets have been selected using the PAE and the amended water-dependent assets have been recorded in the database – that the water-dependent asset register is complete for the purposes of producing product 1.3. Note, however, that the addition of new assets to the asset database, or a review of the status of existing assets in the database will mean that the asset register may be updated. As this has implications for other BA components, any updates must be documented. The product 1.3 will not be updated or republished as part of bioregional assessments but an updated version of the asset register (derived from the asset database) may be published at the same time as other products, for example, those associated with Component 3: Impact analysis (Figure 1 and Figure 2).

Following development of the asset register, the connection of the registered assets to coal resource development is assessed using ‘materiality’ tests and, if potentially subject to water-related impacts, assigned *receptors* (after Barrett et al., 2013). A receptor is a point in the landscape where water-related impacts on assets are measured and/or estimated. The approach to assigning receptors and impact variables to water-dependent assets is described in the companion submethodology M03 (as listed in Table 1) for assigning receptors to water-dependent assets (O’Grady et al., 2015).

1.1.1.2 Compiling assets and developing the water-dependent asset register

1.1.1.2.1 Ecological assets

Asset information was compiled by the West Gippsland Catchment Management Authority and the East Gippsland Catchment Management Authority. These asset data were delivered for compilation into the asset database via the Water Asset Information Tool (WAIT) database. The

WAIT database was compiled by natural resource management organisations (NRMs) and contributions from those with expert local knowledge from local government, regional water corporations and other stakeholders. Data were also obtained from other national, state and regional authorities to complement the coverage of assets compiled in the WAIT database for the Gippsland Basin bioregion (Table 3).

Table 3 Data sources for ecological assets in the Gippsland Basin bioregion

Dataset[a]	Organisation	Website address
Collaborative Australian Protected Areas Database (CAPAD)	Department of the Environment	http://www.environment.gov.au/topics/land/nrs/science-maps-and-data/capad
A directory of important wetlands in Australia (DIWA)	Department of the Environment	http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important
National atlas of groundwater dependent ecosystems (GDE Atlas) including: • subsurface presence of groundwater data • surface expression of groundwater	Bureau of Meteorology	http://www.bom.gov.au/water/groundwater/gde/
Threatened ecological communities listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	Department of the Environment	http://www.environment.gov.au/biodiversity/threatened/communities
Threatened species listed under the EPBC Act	Department of the Environment	http://www.environment.gov.au/biodiversity/threatened/species

Data: Department of the Environment (Dataset 2), Australian Government Department of the Environment (Dataset 3), Bureau of Meteorology (Dataset 4), Australian Government Department of the Environment (Dataset 5, Dataset 6)
[a]The asset database (Bioregional Assessment Programme, Dataset 1) is a collation of all these source datasets. Some assets may be captured in multiple databases. These replicates are retained in the asset register as boundaries may differ between databases.

1.1.1.2.2 Economic assets

All economic assets are types of *water access entitlements*, either *water access rights* or *basic water rights*. In Victoria, water access entitlements come under the 'water entitlement framework' of the Victorian *Water Act 1989*. Water access rights in Victoria are known as 'take and use licences'. Within the asset database, every water access entitlement is an element. Elements are grouped by type and also spatially to create assets. *Basic landholder rights* (i.e. a type of basic water right), including riparian rights, maintain the right of those adjacent to rivers, estuaries, lakes or aquifers underlying the land to extract water for domestic and stock use without a water access licence. Basic landholder rights are defined by the jurisdiction based on the location of the water source and include an estimated volume of use based on the number of landholders with adjacent water sources. A fuller description of the process is given in the companion submethodology M02 for compiling water-dependent assets (Mount et al., 2015).

For economic assets, the water access entitlement assets are divided into two classes:

- basic water right (stock and domestic) – this is the right to take water for domestic and stock purposes only. In Victoria, a basic right for 'take of groundwater' requires approval for the works (bore infrastructure) but does not require a licence for the extraction of groundwater.

In Victoria, a basic right for 'take of surface water' does not require an approval for the works or approval for the extraction of surface water.

- water access right – In Victoria, this requires a licence both for the works and the extraction of the water. The extraction of the water can be for a range of purposes including irrigation, commercial, industrial, farming, dewatering, mining, intensive agriculture etc.

Groundwater and surface water access entitlement data were obtained from the Victorian Department of Environment, Land, Water and Planning and Southern Rural Water respectively (Bioregional Assessment Programme, Dataset 1; Bureau of Meteorology, Dataset 7). Data covered groundwater and surface water access licences, and their corresponding works locations. These data are not currently available publicly and were obtained by special request. Consistent with how water licensing information is published under the Commonwealth's *Water Act 2007,* this data will be published in an aggregated form.

In collating the economic elements, it was considered important to ensure no current water access entitlements were excluded, even where there was doubt about the use of the entitlement (e.g. 'sleeper' licences). For example, basic water rights (stock and domestic) do not have to be renewed on a frequent basis leading to some uncertainty about their current use status. This meant that only surface water and groundwater licences that were 'abandoned', 'cancelled' or 'suspended' as at 20 November 2013 were marked as not 'current' or 'active' and therefore excluded for BA purposes. Also excluded for assessment purposes were any water access licences that did not have a corresponding works approval with location information. Where works (locations) information was present it was linked to the particular surface water or groundwater licences, and a count added to show how many works were associated with each licence. The volume of the licence was then equally split among the works to ensure that the licence volumes were not double-counted. A geographic information system (GIS) layer was derived using the spatial coordinates provided with the licensed work approvals. This spatial layer was overlain with the PAE for the Gippsland Basin bioregion. The intersection of the two layers combined with the related attribute data gave a spatially explicit view of the entitlements of interest to the assessment within the PAE, with a volume of surface water or groundwater attributed to each works.

The class of asset (as described in the companion submethodology for compiling water-dependent assets (Mount et al., 2015) was aggregated using the Victorian Department of Environment, Land, Water and Planning 'F_Type' (purpose) field which records the purpose for which water is used. Any purpose that was listed as 'Domestic' and/or 'Stock' was included in the class 'Basic water right'. Where 'Stock' and/or 'Domestic' was listed with another licensed purpose, it was listed as a 'Water access right'. 'Water access right' was based on anything that had an extractive use purpose such as, for example, commercial, irrigation, farming, industrial, or mine dewatering.

Each water access right licence can have one or multiple works associated with it, where the works is the location where the water is extracted through a bore or pump. The processing for economic assets assumed that each of the works associated with a licence extracts an equal share of the volume. Therefore if there is one groundwater licence of 80 ML/year that has four works (bores) associated with it, then 20 ML/year is assigned to each of those works. It is not possible to validate this processing assumption for economic assets within the scope of this Gippsland Basin BA.

Furthermore, it is possible that the majority of extraction occurs at a single works location and is not evenly distributed across all works associated with the licence.

Groundwater elements that were not classified as a basic water right or a water access right were classed as 'null'. These included test bores, bores installed for groundwater remediation, exploratory bores, exploratory research, monitoring bores and waste disposal bores. These elements are 'flagged' in the asset database and are not included in the water-dependent asset register.

1.1.1.2.3 Sociocultural assets

Some sociocultural data were listed in the WAIT database, some have been sourced from the Australian Heritage Database (Department of the Environment, 2013) (Table 4).

Meetings have been held with Indigenous knowledge holders in the Gippsland Basin bioregion to gain an understanding of Indigenous cultural water-dependent assets. Where possible and appropriate, and with the agreement of Indigenous knowledge holders, these additional Indigenous water-related values will be published in a separate report. Identified assets will be incorporated into an updated water-dependent asset register (available at 'http://data.bioregionalassessments.gov.au/product/GIP/GIP/1.3') and/or incorporated into later technical products.

Table 4 Data sources in the Australian Heritage Database for sociocultural assets in the Gippsland Basin bioregion

Dataset[a]	Organisation	Website address
World Heritage List	Department of the Environment	http://www.environment.gov.au/topics/heritage/publications-and-resources/australian-heritage-database
National Heritage List	Department of the Environment	http://www.environment.gov.au/topics/heritage/publications-and-resources/australian-heritage-database
Commonwealth Heritage List	Department of the Environment	http://www.environment.gov.au/topics/heritage/publications-and-resources/australian-heritage-database
Register of the National Estate (RNE)	Department of the Environment	http://www.environment.gov.au/topics/heritage/publications-and-resources/australian-heritage-database

Data: Australian Government Department of the Environment (Dataset 8, Dataset 9, Dataset 10, Dataset 11)
[a]The asset database (Bioregional Assessment Programme, Dataset 1) is a collation of all these source datasets. Some assets may be captured in multiple databases. These replicates are retained in the asset register as boundaries may differ between databases.

1.1.1.3 Determining the preliminary assessment extent

The PAE is the geographic area associated with a bioregion or subregion in which potential water-related impacts of coal resource development on assets are assessed. It is the first step to identifying and analysing potentially impacted assets. The following details the rationale for the boundaries of the PAE, which is shown in Figure 3.

Northern boundary: The project's Victorian partners have identified in the system conceptualisation for the numerical model developed by the Victorian Water Science Studies

(Department of Economic Development Jobs Transport and Resources, 2014) that the prevailing control on development impacts to water resources along the northern boundary is geohydrologically constrained (GHD, 2012). Surface geology is used to identify the northern bounds of the surficial aquifers of the Haunted Hills Gravel and the Sale Group (for further detail see companion product 1.1 for the Gippsland Basin bioregion, Section 1.1.4). The northern bounds of these units delineate the transition from local scale groundwater flow systems (to the north of this boundary) and intermediate to regional scale flow systems (south of this boundary). It is anticipated the propagation of water resource impacts in local flow groundwater systems are unlikely to be as extensive as intermediate or regional flow systems (Coram et al., 2000). Regardless, the PAE introduces a 10 km buffer to the north of this geohydrologic transition to encompass any uncertainties associated with demarking a boundary according to mapped surface geology. The 10 km buffer will increase our confidence the project has captured all water-dependent assets or receptors that could be directly or indirectly associated with current or potential large coal mining and CSG resource developments.

Western boundary: The imposed Victorian Government moratorium on onshore gas exploration has resulted in little resource exploration interest further west. The western boundary is a surface water and groundwater divide. Surface water further to the west drains towards Western Port. Based on the scientific rationale and conceptualisation, the PAE boundary adheres to the conceptual understanding of groundwater boundaries in the Gippsland Basin.

Southern/coastal boundary: This southern boundary follows the coastline as the BAs are investigating onshore impacts of CSG and large coal mining developments. The PAE explicitly includes the Gippsland Lakes and is clipped to the national 1:250,000 national topography coastline. However, the Water Sciences Studies (Department of Economic Development Jobs Transport and Resources, 2014) numerical groundwater model used by this BA extends offshore to account for petroleum industry abstractions offshore.

Eastern boundary: The eastern boundary is similarly geologically constrained as the northern boundary, with the addition of likely prospectivity for CSG and large coal mining development geologically diminishing further east of the Gippsland Lakes.

Although the Gippsland Basin bioregion BA is not explicitly looking at offshore impacts, the project will comment groundwater flow along the coastal margin where applicable in later products.

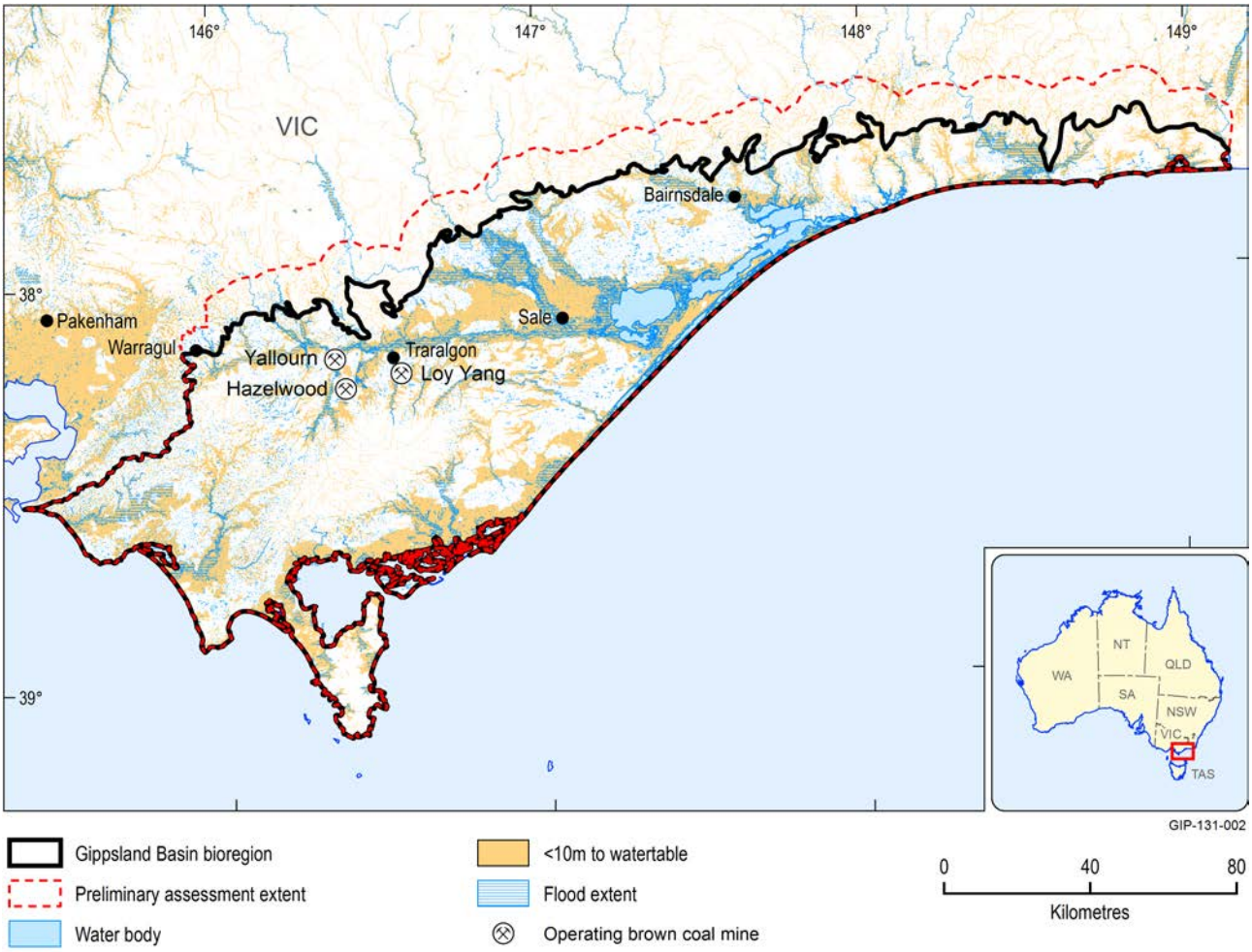

Figure 3 The preliminary assessment extent (PAE) relative to the Gippsland Basin bioregion boundary

Data: Victorian Department of Environment and Primary Industries (Dataset 12), Victorian Department of Environment and Primary Industries (Dataset 13)

1.1.1.4 Assessing water dependence

Once the assets were identified and compiled into the asset database and it was confirmed the assets were encompassed within the PAE, they were assessed for water dependence. All assets in the asset list that may be potentially impacted by changes in the groundwater or surface water regime (i.e. changes in the quality and quantity of surface water and groundwater) were identified. Although most of the assets will be clearly 'water dependent' in the general sense of the phrase (e.g. groundwater bores, rivers and wetlands), there is a small group of assets that could be affected but are not as readily identified as being 'water dependent'. Examples of these assets include historical buildings that may be potentially subject to inundation or salinity impacts, or Indigenous assets that may be more difficult to access due to changes in the water regime.

It is important to emphasise that BAs consider the potential impact to the habitat of species not the individual species per se. However, it is necessary to present species-based information to best reflect the available data; but implicit in this is the focus on habitat.

The preliminary version of the water-dependent asset register, with associated maps and data, were presented to experts and organisations with technical expertise of the Gippsland Basin bioregion BA asset workshop in Traralgon on 1 December 2014 for comment and feedback.

Fourteen local participants from relevant state and local governments attended (Table 5). They identified a number of shortfalls and subsequently provided data to amend the register. Some of the issues raised and actions identified are presented in Table 6.

Table 5 Organisations represented at the bioregional assessment asset workshop held in Traralgon, Victoria on 1 December 2014

Organisation	Number of participants
Agribusiness Gippsland	1
Bass Coast Shire Council	1
Baw Baw Shire Council	1
Bureau of Meteorology	1
CSIRO Land and Water Flagship	2
Department of Economic Development, Jobs, Transport and Resources, Victoria	1
Department of Environment, Land, Water and Planning, Victoria	1
East Gippsland Shire Council	1
Geoscience Australia	4
Gippsland Coastal Board	1
Gippsland Water	1
Latrobe City Council	1
Office of Water Science in the Australian Department of Environment	2
South Gippsland Water	1
Southern Rural Water	1
Wellington Shire Council	1
West Gippsland Catchment Management Authority	2
Total	**23**

Table 6 Summary of issues raised by participants at the asset workshop held in Traralgon, Victoria on 1 December 2014 and actions for the Assessment team of the Gippsland Basin bioregion

Description of issue	Action
Ecological assets	
Items for further consideration: • Burrunan Dolphin • South Gippsland Crayfish • Giant Gippsland Earthworm • Strzelecki Koala	The Burrunan Dolphin and the Strzelecki Koala are of significant ecological interest but limited research and detailed spatial distribution is available. Assessment team to be informed of progress. Southern Gippsland Crayfish and Giant Gippsland Earthworm incorporated into the asset register
Natural Damp Grasslands of the South East Coastal Plain IBRA bioregion	At the time of writing, the Natural Damp Grasslands threatened ecological community was in draft consultation and was not available for this study.
Economic assets	
Workshop participants emphasised that the boundaries of groundwater management units (GMU) reflect the current stresses to the system and that future stresses may change the distribution of management requirements and intensity. Also it was noted that there are entitlements outside these areas.	While it is noted that management areas may change with regards to requirements and intensity, this current bioregional assessment is to assess the risks and impacts to current management systems and regions as of December 2012.
Information on surface water access entitlement was offered by Southern Rural Water.	These data were subsequently obtained and incorporated into the asset register.
Irrigation areas/districts were identified as economic assets.	Irrigation districts dataset was obtained and incorporated into the asset register.
Farm dams, springs and soaks were identified as an economic asset.	The farm dam asset list has been obtained and incorporated.
Plantation forests were identified as a potential groundwater-dependent asset.	Plantation forest spatial coverages were obtained from West Gippsland Catchment Management Authority.
The Department of Environment, Land, Water and Planning has done studies with Melbourne and Deakin Universities to look at possible agricultural change from climate change. A result has been maps of potential future agriculture 'sweet spots'. Can these be considered as assets?	The regulator can draw upon all work including the results of this study. This is not a specific end point for the bioregional assessment.
Sociocultural assets	
Ovals and playing fields dataset was suggested as a sociocultural asset.	These data are held by the local councils in varying degrees of detail regarding the water source used for irrigation. Some data were obtained but require additional quality control for consistency and use.

The water dependency of threatened species assets or habitats was assessed by review of the habitat requirements for each species. In most cases profiles from the Species Profile and Threats Database (SPRAT) (Australian Government Department of the Environment, Dataset 14) were examined. The water dependence of each species-related asset was ranked as being 'likely', 'possible', 'unlikely' or 'potential'. Assets listed as 'likely' are those with a clear and demonstrated link to aquatic ecosystems (e.g. aquatic species). Assets listed as 'possible' may have some overlap with habitats that may be water dependent (e.g. species that may visit riparian areas). Assets listed as 'unlikely' show no water dependence in habitat requirements.

Species listed under Victoria's *Flora and Fauna Guarantee Act 1988* and the Victorian Department of Environment, Land, Water and Planning threatened species advisory list for areas covering East and West Gippsland CMAs were considered for inclusion in the asset database. However, there is currently insufficient habitat modelling information to make definitive determinations of:

- their occurrence within the PAE
- habitat requirements within the PAE.

As there was no available spatial information related to the distribution of assets associated with species and their habitats, they are recognised as being 'potential' assets but require further investigation before they can be included in the water-dependent asset register.

A preliminary assessment of the water dependency of vegetation assets was made using the following assumptions:

- Riparian vegetation was assumed to be water dependent (attributed as 'likely').
- Vegetation assets that intersect with the maximum floodplain extent were assumed to be water dependent (attributed as 'likely').
- Vegetation assets outside the maximum floodplain extent mapping, where groundwater was less than 10 m from the surface, were assumed to be water dependent (attributed as 'likely').
- Vegetation assets derived from the 'Groundwater-dependent ecosystem' class with a known groundwater dependency derived from previous field work or a high potential for groundwater dependency were assumed to be groundwater dependent (attributed as 'likely'). Assets with a moderate potential for groundwater dependency were attributed as 'possible'. Vegetation assets sourced from the *National atlas of groundwater dependent ecosystems* (GDE Atlas) (Bureau of Meteorology, 2012; Bureau of Meteorology, Dataset 4) with a low probability for groundwater dependence were given an attribution of 'unlikely'.
- Vegetation assets which intersect surface water features were assumed to be water dependent (attributed as 'likely').
- Vegetation assets which are located over shallow groundwater (i.e. watertable is less than 10 metres below ground level) were assumed to be water dependent (attributed as 'likely').

All non-vegetation based assets in the 'Surface water feature' and 'Groundwater feature (subsurface)' classes of the asset database were assumed to be water-dependent assets and attributed as 'likely'. Figure 3 shows the spatial coverage of the 100-year flood extent and regions where the watertable is within 10 m of ground surface.

Assets attributed as 'likely' or 'possible' are considered further in the BA and flagged as 'yes' with respect to water dependency in the asset database; assets attributed as 'unlikely' are flagged as 'no' in the asset database and are not considered further in the BA. Where uncertainty existed in relation to water dependence of an asset, a cautionary approach was taken and the asset was included in the water-dependent asset register.

Once water dependence was determined and the decisions recorded in the asset database, a preliminary version of the water-dependent asset register was generated from the asset database and presented to experts and organisations with local knowledge at the BA assets workshop for comment and feedback.

The characteristics of the groups of water-dependent assets identified in the Gippsland Basin bioregion, and the reasons for their inclusion or exclusion from the water-dependent asset register, are described in Section 1.3.2, Section 1.3.3 and Section 1.3.4.

The water-dependent asset register is a simple and authoritative listing of the names of the assets that will be included in other components of the BA; all the geographic and other data associated with each asset (including for each element) is stored in the asset database. Other BA components are described in the BA methodology (Barrett et al., 2014) including the companion submethodology M03.

References

Barrett DJ, Couch CA, Metcalfe DJ, Lytton L, Adhikary DP and Schmidt RK (2013) Methodology for bioregional assessments of the impacts of coal seam gas and coal mining development on water resources. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment. Department of the Environment, Australia. Viewed 2 October 2014, http://iesc.environment.gov.au/publications/methodology-bioregional-assessments-impacts-coal-seam-gas-and-coal-mining-development-water.

Bureau of Meteorology (2012) Australian Hydrological Geospatial Fabric (Geofabric) Version 2.1. Viewed 2 October 2014, http://www.bom.gov.au/water/geofabric.

Coram J, Dyson P, Houlder P and Evans R (2000) Australian groundwater flow systems contributing to dryland salinity. In: Bureau of Rural Sciences (ed). National Land and Water Resources Audit, Canberra.

Department of Economic Development Jobs Transport and Resources (2014) About the water sciences studies. State Government Victoria. Viewed 5 May 2015, http://naturalgasinfo.vic.gov.au/water-science-studies/about-the-water-studies.

Department of the Environment (2013) Australian Heritage Database. Department of the Environment, Australian Government. Viewed 10 December 2014, http://www.environment.gov.au/topics/heritage/publications-and-resources/australian-heritage-database.

Doody TM, Pritchard J, Carey H, Bell J, Moore B and Walker K (2015) Description of the water-dependent asset register for the Gippsland Basin bioregion. Product 1.3 from the Gippsland Basin Bioregional Assessment. Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia. Viewed 23 October 2015, http://data.bioregionalassessments.gov.au/product/GIP/GIP/1.3.

GHD (2012) Victorian aquifer framework: updates for seamless mapping of aquifer surfaces, Report prepared for Department of Sustainability and Environment. GHD, Australia.

Mount RE, Mitchell PJ, Macfarlane C, Marston FM, McNamara JM, Raisbeck-Brown N, O'Grady AP, Moran BT and Wang J (2015) Compiling water-dependent assets. A submethodology from the Bioregional Assessment Technical Programme. Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia. Viewed 23 October 2015, http://data.bioregionalassessments.gov.au/doc/submethodology/M02.

O'Grady AP, Mount R, Holland K, Sparrow A, Crosbie R, Marston F, Dambacher J, Hayes K, Henderson B, Pollino C and Macfarlane C (2015) Assigning receptors to water-dependent assets. Submethodology M03 from the Bioregional Assessment Technical Programme. Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia. Viewed 23 October 2015, http://data.bioregionalassessments.gov.au/submethodology/M03.

Datasets

Dataset 1 Bioregional Assessment Programme (2015) Asset database for the Gippsland Basin bioregion on 18 September 2015. Bioregional Assessment Derived Dataset. Viewed 18 September 2015, http://data.bioregionalassessments.gov.au/dataset/f67fbe66-2e36-4444-8575-2b0370ad7398.

Dataset 2 Australian Government Department of the Environment (2012) Collaborative Australian Protected Areas Database (CAPAD) 2012 - external. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/ef93a2a2-6701-47ce-804d-12f8413bd09a.

Dataset 3 Australian Government Department of the Environment (2001) Directory of Important Wetlands in Australia (DIWA) Spatial Database (Public). Bioregional Assessment Source Dataset. Viewed 15 April 2015, http://data.bioregionalassessments.gov.au/dataset/6636846e-e330-4110-afbb-7b89491fe567.

Dataset 4 Bureau of Meteorology (2012) National Groundwater Dependent Ecosystems (GDE) Atlas. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/e358e0c8-7b83-4179-b321-3b4b70df857d.

Dataset 5 Australian Government Department of the Environment (2000) Communities of National Environmental Significance Database - RESTRICTED - Metadata only. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/c01c4693-0a51-4dbc-bbbd-7a07952aa5f6.

Dataset 6 Australian Government Department of the Environment (1998) Australia - Species of National Environmental Significance Database (BA subset). Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/76744d1b-bd36-42e8-ad90-66deddd49888.

Dataset 7 Bioregional Assessment Programme (2015) Surface Water Economic Entitlements GIP 20141219. Bioregional Assessment Derived Dataset. Viewed 15 April 2015, http://data.bioregionalassessments.gov.au/dataset/e52eb72a-46c9-40d8-b4c3-986d0f02600b.

Dataset 8 Australian Government Department of the Environment (2000) Australia World Heritage Areas. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/4927789b-7ba7-4a77-b6fc-be1b29b6590c.

Dataset 9 Australian Government Department of the Environment (2004) National Heritage List Spatial Database (NHL) (v2.1). Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/26daa8d7-a90e-47f3-982b-0df362414e65.

Dataset 10 Australian Government Department of the Environment (2004) Commonwealth Heritage List Spatial Database (CHL). Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/57720684-4948-45db-a2c8-37259d531d87.

Dataset 11 Australian Government Department of the Environment (2004) Australia, Register of the National Estate (RNE) - Spatial Database (RNESDB) Internal. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/878f6780-be97-469b-8517-54bd12a407d0.

Dataset 12 Victorian Department of Environment and Primary Industries (2012) Victoria - 1 in 100 Year Flood Extent. Bioregional Assessment Source Dataset. Viewed 6 March 2015, http://data.bioregionalassessments.gov.au/dataset/6e59ed35-3fde-48e3-8135-eb05263ce4aa.

Dataset 13 Victorian Department of Environment and Primary Industries (2012) Victorian Aquifer Framework - Water Table. Bioregional Assessment Source Dataset. Viewed 6 March 2015, http://data.bioregionalassessments.gov.au/dataset/663871a0-0444-4be4-bd2b-6741e114036e.

Dataset 14 Australian Government Department of the Environment (1998) Species Profile and Threats Database (SPRAT) - Australia - Species of National Environmental Significance Database (BA subset - RESTRICTED - Metadata only). Bioregional Assessment Source Dataset. Viewed 14 April 2015, http://data.bioregionalassessments.gov.au/dataset/7276dd93-cc8c-4c01-8df0-cef743c72112.

1.1.2 Ecological assets

Summary

A total of 4139 ecological assets are listed in the water-dependent asset register for the Gippsland Basin bioregion preliminary assessment extent (PAE). There are 3187 assets within the 'Vegetation' subgroup of which 962 are classified as groundwater-dependent ecosystems by the *National Atlas of Groundwater Dependent Ecosystems* (GDE Atlas) (Bureau of Meteorology, Dataset 1). The asset register includes the potential spatial habitat distribution of 115 species listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Of these, the habitat of 83 of the species was considered water dependent. Twenty-four wetlands are listed in *A directory of important wetlands in Australia* (DIWA) (Australian Government Department of the Environment, Dataset 2): two are listed as Ramsar Wetlands of International Importance (Gippsland Lakes and Corner Inlet) and there are four Important Bird Areas – all of which are considered water dependent. Four threatened ecological communities and 31 aquifers also occur within the Gippsland Basin bioregion, which are all considered water dependent.

1.1.2.1 Description

There are a total of 4139 ecological assets included in the water-dependent asset register for the Gippsland Basin bioregion preliminary assessment extent (PAE). Of these, 922 are listed in the 'Surface water feature' subgroup, 30 in the 'Subsurface groundwater feature' subgroup and 3187 in the 'Vegetation' subgroup (Table 7). All surface water features, classed as either 'Lake, reservoir, lagoon or estuary'; 'Wetland, wetland complex or swamp'; or 'Marsh, sedgeland, bog, spring or soak', were assumed to be water dependent and included as such in the water-dependent asset register. Only one class of the 'Groundwater feature' subgroup was identified within the Gippsland Basin PAE ('aquifer, geological feature, alluvium or stratum') and all 30 assets were considered water dependent. Within the vegetation subgroup, 1029 assets were sourced from the GDE Atlas (Bureau of Meteorology, Dataset 1). Of these, 105 assets were considered not to be water dependent. A further 38 groundwater-dependent ecosystem assets were sourced from state groundwater-dependent ecosystem mapping in East and West Gippsland (Department of Environment and Primary Industries, 2014b; 2014c) — all of which are water dependent. A further 2815 assets classified as 'Habitat (potential species distribution or observed locations)' complete the vegetation subgroup, of which 2225 are water-dependent assets.

Table 7 Summary of ecological assets within the preliminary assessment extent (PAE) of the Gippsland Basin bioregion

Subgroup	Class	Not in water-dependent asset register	In water-dependent asset register	Total assets (asset list)
Groundwater feature (subsurface)	Aquifer, geological feature, alluvium or stratum	0	30	30
Surface water feature	Lake, reservoir, lagoon or estuary	0	136	136
	Wetland, wetland complex or swamp	0	52	52
	Marsh, sedgeland, bog, spring or soak	0	53	53
	Floodplain	0	1	1
	River or stream reach, tributary, anabranch or bend	0	680	680
Vegetation	Groundwater-dependent ecosystem	105	962	1067
	Habitat (potential species distribution)	590	2225	2815
Total		**695**	**4139**	**4834**

1.1.2.1.1 Wetlands, surface water and groundwater features

A total of 24 wetlands are present within the Gippsland Basin PAE that are listed nationally under *A directory of important wetlands in Australia* (Australian Government Department of the Environment, Dataset 2) and occur in the 'Wetland, wetland complex or swamp' class (Table 7), providing habitat for many assets. Two wetlands are also listed as Ramsar Wetlands of International Importance (Gippsland Lakes and Corner Inlet). A further 898 surface water features are considered water dependent (Table 7). Additional water features are listed in the GDE Atlas; however, these are presented in the 'Vegetation' subgroup (Table 7). Thirty assets included in the water-dependent asset register in the 'Groundwater feature' subgroup are aquifers that occur in the PAE. These aquifers are assumed to be water dependent.

1.1.2.1.2 Vegetation

Within the water-dependent asset register, 77% of assets are assigned to the 'Vegetation' subgroup, with 23% of these assets are classified as groundwater-dependent ecosystems. Included in the vegetation subgroup are the observed locations and potential distribution of individual flora and fauna species. Many of these species are either protected nationally under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or under state legislation through Victoria's *Flora and Fauna Guarantee Act 1988* (FFG Act). Additionally, flora and fauna may be listed under the Victorian Department of Environment and Primary Industries threatened species advisory lists (Department of Environment and Primary Industries, 2013, 2014a).

Four threatened ecological communities are EPBC Act listed (Table 8). All communities are considered critically endangered and are considered water dependent due to presence within the maximum floodplain extent in the PAE, intersection with surface water features and/or presence over shallow groundwater.

A total of 115 EPBC Act-listed species with potential spatial habitat distribution within the PAE are included. The habitats of 81 species are considered water dependent (Table 9) based on their association with floodplain or riparian communities adjacent to permanent open water bodies or presence in drainage, soakage or wetland areas. This includes the following species: 54 bird, ten plant, six mammal, four frog, three fish, three reptile and one invertebrate (Table 9). The remaining 34 species habitats are not considered water dependent due to their association with wet sclerophyll or rainforest; grassland, dry woodland or forest or heathland (Table 10). Fifteen habitats were related to birds, ten to plants, six to mammals, one to fish, and one to reptile. Some of these habitat distributions either occur only outside the PAE or habitats are associated with that of widespread migratory birds.

Table 8 Threatened ecological communities listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* within the preliminary assessment extent (PAE) of the Gippsland Basin bioregion

Community	Status	Rationale for inclusion in water-dependent asset register
Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *Mediana*) Grassy Woodland and Associated Native Grassland	Critically endangered	Intersect with maximum floodplain extent and present over areas of shallow groundwater
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically endangered	Intersect with maximum floodplain extent and present over areas of shallow groundwater
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically endangered	Intersect with surface water features and present over areas of shallow groundwater
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically endangered	Intersect with surface water features and present over areas of shallow groundwater

Table 9 Species listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* within the preliminary assessment extent (PAE) of the Gippsland Basin bioregion determined as potentially water dependent (based on a literature review of habitat requirements)

Although examples of individual species are listed, bioregional assessments consider the potential impact to the habitat of species not individual species per se.

Functional group	Asset name[a]	Status	Rationale for inclusion in water-dependent asset register
Bird	Australasian Bittern (*Botaurus poiciloptilus*)	Endangered	Habitat features consistent with water dependency, species is wetland dependent
	Australian Fairy Tern (*Sternula nereis nereis*)	Vulnerable	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Australian Painted Snipe (*Rostratula australis*)	Endangered	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays

Functional group	Asset name[a]	Status	Rationale for inclusion in water-dependent asset register
	Bar-tailed Godwit (*Limosa lapponica*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Black-tailed Godwit (*Limosa limosa*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Black-winged Stilt (*Himantopus himantopus*)	Marine	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Broad-billed Sandpiper (*Limicola falcinellus*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Caspian Tern (*Sterna caspia*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Cattle Egret (*Ardea ibis*)	Marine; Migratory	Habitat features consistent with water dependency, species requires permanent water for roosting
	Chatham Albatross (*Thalassarche eremita*)	Endangered	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Common Sandpiper (*Actitis hypoleucos*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Crested Tern (*Sterna bergii*)	Marine	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Curlew Sandpiper (*Calidris ferruginea*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Double-banded Plover (*Charadrius bicinctus*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Eastern Bristlebird (*Dasyornis brachypterus*)	Endangered	Habitat features consistent with water dependency, occurs in vegetation which show water dependency
	Eastern Curlew (*Numenius madagascariensis*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Fairy Tern (*Sterna nereis*)	Vulnerable	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Gibson's Albatross (*Diomedea exulans gibsoni*)	Vulnerable	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Great Egret (*Ardea alba*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent

Functional group	Asset name[a]	Status	Rationale for inclusion in water-dependent asset register
	Great Knot (*Calidris tenuirostris*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Greater Sand Plover (*Charadrius leschenaultii*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Grey Plover (*Pluvialis squatarola*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Grey-tailed Tattler (*Heteroscelus brevipes*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Hooded Plover (eastern) (*Thinornis rubricollis rubricollis*)	Vulnerable	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Hooded Plover (*Thinornis rubricollis*)	Vulnerable	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Latham's Snipe (*Gallinago hardwickii*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Lesser Sand Plover (*Charadrius mongolus*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Little Curlew (*Numenius minutus*)	Marine; Migratory	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Little Penguin (*Eudyptula minor*)	Marine	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Marsh Sandpiper (*Tringa stagnatilis*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Orange-bellied Parrot (*Neophema chrysogaster*)	Critically endangered	Habitat features consistent with water dependency, species is wetland dependent
	Osprey (*Pandion haliaetus*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Pacific Golden Plover (*Pluvialis fulva*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Pectoral Sandpiper (*Calidris melanotos*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Pin-tailed Snipe (*Gallinago stenura*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent

Functional group	Asset name[a]	Status	Rationale for inclusion in water-dependent asset register
	Red Knot (*Calidris canutus*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Red-capped Plover (*Charadrius ruficapillus*)	Marine	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Red-necked Avocet (*Recurvirostra novaehollandiae*)	Marine	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Red-necked Stint (*Calidris ruficollis*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Regent Honeyeater (*Anthochaera phrygia*)	Endangered	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Ruddy Turnstone (*Arenaria interpres*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Ruff (Reeve) (*Philomachus pugnax*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Sanderling (*Calidris alba*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Satin Flycatcher (*Myiagra cyanoleuca*)	Marine; Migratory	Habitat features consistent with water dependency, occurs in vegetation which show water dependency
	Sharp-tailed Sandpiper (*Calidris acuminata*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Shy Albatross (*Thalassarche cauta cauta*)	Vulnerable	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Southern Royal Albatross (*Diomedea epomophora epomophora*)	Vulnerable	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Swift Parrot (*Lathamus discolor*)	Endangered	Habitat features consistent with water dependency, occurs in vegetation which show water dependency
	Swinhoe's Snipe (*Gallinago megala*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
	Terek Sandpiper (*Xenus cinereus*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays
	Whimbrel (*Numenius phaeopus*)	Marine; Migratory	Habitat features consistent with water dependency and are characterised by intertidal areas, estuaries, coastal lagoons and bays

Functional group	Asset name[a]	Status	Rationale for inclusion in water-dependent asset register
	White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	Marine; Migratory	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	White-bellied Storm-Petrel (Tasman Sea) (*Fregetta grallaria grallaria*)	Vulnerable	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Wood Sandpiper (*Tringa glareola*)	Marine; Migratory	Habitat features consistent with water dependency, species is wetland dependent
Fish	Australian Grayling (*Prototroctes maraena*)	Vulnerable	Habitat features consistent with water dependency, species is predominately aquatic
	Eastern Dwarf Galaxias (*Galaxiella pusilla*)	Vulnerable	Habitat features consistent with water dependency, species is predominately aquatic
	Great White Shark (*Carcharodon carcharias*)	Vulnerable	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
Frog	Giant Burrowing Frog (*Heleioporus australiacus*)	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Green and Golden Bell Frog (*Litoria aurea*)	Vulnerable	Habitat features consistent with water dependency, species is wetland dependent
	Growling Grass Frog (*Litoria raniformis*)	Vulnerable	Habitat features consistent with water dependency, species is wetland dependent
	Spotted Tree Frog (*Litoria spenceri*)	Endangered	Habitat features consistent with water dependency, species is predominately aquatic
Invertebrate	Giant Gippsland Earthworm (*Megascolides australis*)	Vulnerable	Habitat features consistent with water dependency, associated with alluvium (river and creek flats) as well as upland sites
Mammal	Australian Fur Seal (*Arctocephalus pusillus*)	Marine	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Blue Whale (*Balaenoptera musculus*)	Endangered	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Grey-headed Flying-fox (*Pteropus poliocephalus*)	Vulnerable	Habitat features consistent with water dependency, occurs in vegetation which show water dependency

Functional group	Asset name[a]	Status	Rationale for inclusion in water-dependent asset register
	Humpback Whale (*Megaptera novaeangliae*)	Vulnerable	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Long-footed Potoroo (*Potorous longipes*)	Endangered	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Southern Right Whale (*Eubalaena australis*)	Endangered	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
Plant	Aniseed Boronia (*Boronia galbraithiae*)	Vulnerable	Habitat features consistent with water dependency, associated with riparian and alluvial sites
	Dwarf Kerrawang (*Rulingia prostrata*)	Endangered	Habitat features consistent with water dependency, associated with lowland habitats and wetlands
	Leafless Tongue-orchid (*Cryptostylis hunteriana*)	Vulnerable	Habitat features consistent with water dependency, associated with lowland habitats and wetlands
	Leafy Greenhood (*Pterostylis cucullata*)	Vulnerable	Habitat features consistent with water dependency, occurs in vegetation which show water dependency
	Maroon Leek-orchid (*Prasophyllum frenchii*)	Endangered	Habitat features consistent with water dependency, species is wetland dependent
	Matted Flax-lily (*Dianella amoena*)	Endangered	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees
	River Swamp Wallaby-grass (*Amphibromus fluitans*)	Vulnerable	Habitat features consistent with demonstrated water dependency, species is wetland dependent
	Strzelecki Gum (*Eucalyptus strzeleckii*)	Endangered	Habitat features consistent with water dependency, occurs in riparian zones and alluvial flats
	Swamp Everlasting (*Xerochrysum palustre*)	Vulnerable	Habitat features consistent with water dependency, species is wetland dependent
	Swamp Greenhood (*Pterostylis tenuissima*)	Vulnerable	Habitat features consistent with water dependency, occurs in vegetation which show water dependency
Reptile	Green Turtle (*Chelonia mydas*)	Vulnerable	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)
	Leatherback Turtle (*Dermochelys coriacea*)	Endangered	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)

Functional group	Asset name[a]	Status	Rationale for inclusion in water-dependent asset register
	Loggerhead Turtle (*Caretta caretta*)	Endangered	Habitat features consistent with demonstrated water dependency and are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea)

Data: Department of the Environment (Dataset 3)
[a]Punctuation and typography appear as used in the asset database.

Table 10 Species listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* within the preliminary assessment extent (PAE) of the Gippsland Basin bioregion determined as unlikely to be water dependent (based on a literature review of habitat requirements)

Although examples of individual species are listed, bioregional assessments consider the potential impact to the habitat of species not individual species per se.

Functional group	Asset name[a]	Status	Rationale for exclusion in water-dependent asset register
Bird	Antipodean Albatross (*Diomedea exulans antipodensis*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	Black-browed Albatross (*Thalassarche melanophris*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	Black-faced Monarch (*Monarcha melanopsis*)	Marine; Migratory	Habitat features not consistent with demonstrated water dependency, occurs in wet sclerophyll and rainforest
	Campbell Albatross (*Thalassarche melanophris impavida*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	Flesh-footed Shearwater (*Puffinus carneipes*)	Marine; Migratory	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	Fork-tailed Swift (*Apus pacificus*)	Marine; Migratory	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	Malleefowl (*Leipoa ocellata*)	Vulnerable	Habitat predominantly outside of PAE
	Northern Royal Albatross (*Diomedea epomophora sanfordi*)	Endangered	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	Oriental Plover (*Charadrius veredus*)	Marine; Migratory	Habitat predominantly outside of PAE
	Rufous Fantail (*Rhipidura rufifrons*)	Marine; Migratory	Habitat features not consistent with demonstrated water dependency, occurs in wet sclerophyll and coastal rainforest
	Salvin's Albatross (*Thalassarche cauta salvini*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	Sooty Tern (*Sterna fuscata*)	Marine	Habitat features not consistent with demonstrated water dependency, widespread migratory bird

Functional group	Asset name[a]	Status	Rationale for exclusion in water-dependent asset register
	Wandering Albatross (*Diomedea exulans (sensu lato)*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	White-capped Albatross (*Thalassarche cauta steadi*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
	White-throated Needletail (*Hirundapus caudacutus*)	Marine; Migratory	Habitat features not consistent with demonstrated water dependency, widespread migratory bird
Fish	Porbeagle (*Lamna nasus*)	Migratory	Habitat predominantly outside of PAE
Mammal **Plant**	Brush-tailed Rock-wallaby (*Petrogale penicillata*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in rocky gorges
	Konoom (*Pseudomys fumeus*)	Endangered	Habitat features not consistent with demonstrated water dependency, occurs in open heathlands, woodlands and forests
	Leadbeater's Possum (*Gymnobelideus leadbeateri*)	Endangered	Habitat features not consistent with demonstrated water dependency, occurs in wet sclerophyll and rainforest
	New Holland Mouse (*Pseudomys novaehollandiae*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in open heathlands, woodlands and forests
	Southern Brown Bandicoot (Eastern) (*Isoodon obesulus obesulus*)	Endangered	Habitat features not consistent with demonstrated water dependency, occurs in dry woodlands and open forest
	Spot-tailed Quoll (*Dasyurus maculatus maculatus*) (SE mainland population))	Endangered	Habitat features consistent with water dependency, associated with groundwater-dependent riparian trees
	Clover Glycine (*Glycine latrobeana*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in grasslands, woodlands and open forest
	Colquhoun Grevillea (*Grevillea celata*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in dry woodlands and open forest
	Cream Spider-orchid (*Caladenia fragrantissima subsp. orientalis*)	Endangered	Habitat features not consistent with demonstrated water dependency, occurs in open heathlands, woodlands and forests
	Dense Leek-orchid (*Prasophyllum spicatum*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in open heathlands, woodlands and forests

Functional group	Asset name[a]	Status	Rationale for exclusion in water-dependent asset register
	Gaping Leek-orchid (*Prasophyllum correctum*)	Endangered	Habitat features not consistent with demonstrated water dependency, occurs in grasslands, woodlands and open forest
	Green-striped Greenhood (*Pterostylis chlorogramma*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in dry scrub and open forest
	Limestone Blue Wattle (*Acacia caerulescens*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in grasslands, woodlands and open forest
	Metallic Sun-orchid (*Thelymitra epipactoides*)	Endangered	Habitat features not consistent with demonstrated water dependency, occurs in grasslands, woodlands and open forest
	Spiral Sun-orchid (*Thelymitra matthewsii*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in open heathlands, woodlands and forests
	Thick-lipped Spider-orchid (*Caladenia tessellata*)	Endangered	Not enough habitat information and extinct in PAE
	Wellington Mintbush (*Prostanthera galbraithiae*)	Vulnerable	Habitat features not consistent with demonstrated water dependency, occurs in open heathlands, woodlands and forests
Reptile	Hawksbill Turtle (*Eretmochelys imbricata*)	Vulnerable	Not enough habitat information to assess

Data: Department of the Environment (Dataset 3)
[a]Punctuation and typography appear as used in the asset database.

The habitat locations of 147 FFG Act-protected species occur within the PAE. Of these, 135 are considered water dependent as they are present within the maximum PAE floodplain extent, intersect surface water features and/or occur in areas with shallow groundwater. This includes the habitat locations of 51 birds, 36 plants, 17 fish, 16 mammals, five frogs, four marine species, four reptiles and two invertebrates (Table 11). The remaining 12 habitat locations are not water dependent and include seven plants, four birds and one mammal.

Similarly, 122 observed fauna species habitat locations are included under the Victorian advisory listing (Table 12), of which 114 are considered water dependent. These include the habitat locations of 59 birds, 23 fish, eight frogs, six reptiles, 10 mammals, four invertebrates and four marine species. The habitat locations of one bird and two mammals are not considered water dependent. A total of 102 plant species are listed of which 97 are considered water dependent.

The water-dependent asset register contains 924 assets from the GDE Atlas (Bureau of Meteorology, Dataset 1). The GDE Atlas identifies ecosystems which include springs, wetlands, rivers and vegetation that interact with the subsurface presence or surface expression of groundwater. Within the asset register, there are 156 groundwater-dependent ecosystems (GDEs) that rely on the subsurface presence of groundwater, and 768 GDEs that rely on the surface expression of groundwater.

Within the subsurface GDEs, 91 are considered not water dependent as they are assigned a 'low' potential for interaction with groundwater in the GDE Atlas. Of the remaining 156 subsurface GDEs, 76 are classified with a 'high potential' and 80 with a 'medium potential' in the GDE Atlas, indicating water dependence. A total of 14 surface water GDEs are considered not to be water dependent ('low potential') with 538 classified as 'high potential' and 230 classified as 'medium potential'.

A further 38 GDEs derived from Victorian Government state mapping (Department of Environment and Primary Industries, 2014a) are also included in the asset register. All are considered water dependent as they occur in the PAE maximum flood extent, intersect surface water features and/or occur in areas with shallow groundwater.

The vegetation subgroup of the asset register includes 198 ecological vegetation communities, of which 196 are considered water dependent as well as five water-dependent Important Bird Areas. Eighty-three Collaborative Australian Protected Area Database (CAPAD) areas occur in the PAE and include nature conservation reserves (e.g. New Zealand Hill Bushland Reserve) and natural feature reserves (e.g. Longford Natural Features Reserve). Areas of plantation forest considered in the asset register total 1850 of which 1359 are considered water dependent.

Table 11 Species listed under Victoria's *Flora and Fauna Guarantee Act 1988* determined as potentially water dependent according to spatial analysis (Section 1.3.1)

Although examples of individual species are listed, bioregional assessments consider the potential impact to the habitat of species not individual species per se.

Functional group	Asset name[a]	Status
Bird	Ancient Greenling (Hemiphlebia mirabilis)	Threatened
	Australasian Bittern (*Botaurus poiciloptilus*)	Threatened
	Australian Painted Snipe (Rostratula australis)	Threatened
	Baillon's Crake (Porzana pusillapalustris)	Threatened
	Barking Owl (Ninox connivensconnivens)	Threatened
	Blue-billed Duck (*Oxyura australis*)	Threatened
	Brolga (*Grus rubicunda*)	Threatened
	Buller's Albatross (*Thalassarche bulleri*)	Threatened
	Caspian Tern (Hydroprogne *caspia*)	Threatened
	Chestnut-rumped Heathwren (*Calamanthus pyrrhopygius pyrrhopygius*)	Threatened
	Diamond Firetail (*Stagonopleura guttata*)	Threatened
	Eastern Bristlebird (*Dasyornis brachypterus*)	Threatened
	Eastern Great Egret (Ardea modesta)	Threatened
	Fairy Tern (*Sternula nereis nereis*)	Threatened
	Freckled Duck (*Stictonetta naevosa*)	Threatened
	Glossy Black Cockatoo (*Calyptorhynchus lathami lathami*)	Threatened
	Great Knot (*Calidris tenuirostris*)	Threatened
	Grey Goshawk (*Accipiter novaehollandiae novaehollandiae*)	Threatened

Functional group	Asset name[a]	Status
	Grey-headed Albatross (*Thalassarche chrysostoma*)	Threatened
	Grey-tailed Tattler (*Tringabrevipes*)	Threatened
	Ground Parrot (*Pezoporus wallicus wallicus)*	Threatened
	Gull-billed Tern (*Gelochelidon nilotica macrotarsa*)	Threatened
	Hooded Plover (*Thinornis rubricollis rubricollis*)	Threatened
	Hooded Robin (*Melanodryas cucullata cucullata*)	Threatened
	Indian Yellow-nosed Albatross (*Thalassarche carteri*)	Threatened
	Intermediate Egret (*Ardea intermedia*)	Threatened
	King Quail (*Coturnix chinensis victoriae*)	Threatened
	Lewin's Rail (*Lewinia pectoralis pectoralis*)	Threatened
	Light-mantled Sooty Albatross (*Phoebetria palpebrata*)	Threatened
	Little Bittern (*Ixobrychus minutus dubius*)	Threatened
	Little Egret (*Egretta garzetta nigripes*)	Threatened
	Little Tern (*Sternula albifrons sinensis*)	Threatened
	Magpie Goose (*Anseranas semipalmata*)	Threatened
	Masked Owl (*Tyto novaehollandiae novaehollandiae*)	Threatened
	Orange-bellied Parrot (*Neophema chrysogaster*)	Threatened
	Painted Honeyeater (*Grantiella picta*)	Threatened
	Powerful Owl (*Ninox strenua*)	Threatened
	Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*)	Threatened
	Regent Honeyeater (*Anthochaeraphrygia*)	Threatened
	Shy Albatross (*Thalassarchecauta*)	Threatened
	Sooty Albatross (*Phoebetria fusca*)	Threatened
	Sooty Owl (*Tyto tenebricosa tenebricosa*)	Threatened
	Southern Giant-Petrel (*Macronectes giganteus*)	Threatened
	Speckled Warbler (*Chthonicola sagittatus*)	Threatened
	Square-tailed Kite (*Lophoictinia isura*)	Threatened
	Superb Parrot (*Polytelis swainsonii*)	Threatened
	Swift Parrot (*Lathamus discolor*)	Threatened
	Terek Sandpiper (*Xenus cinereus*)	Threatened
	Turquoise Parrot (*Neophema pulchella*)	Threatened
	White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	Threatened
	White-browed Treecreeper (*Climacteris affinis*)	Threatened
Fish	Australian Grayling (*Prototroctes maraena*)	Threatened
	Australian Mudfish (*Neochanna cleaveri*)	Threatened
	Australian Whitebait (*Lovettia sealii*)	Threatened

Functional group	Asset name[a]	Status
	Bluenose Cod (Trout Cod) (*Maccullochella macquariensis*)	Threatened
	Coxs Gudgeon (*Gobiomorphus coxii*)	Threatened
	Dwarf Galaxias (*Galaxiella pusilla*)	Threatened
	Eastern Freshwater Shrimp (*Australatya striolata*)	Threatened
	Freshwater Catfish (*Tandanus tandanus*)	Threatened
	Macquarie Perch (*Macquaria australasica*)	Threatened
	Murray Cod (*Maccullochella peelii*)	Threatened
	Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*)	Threatened
	Narracan Burrowing Crayfish (*Engaeus phyllocercus*)	Threatened
	Northern Giant-Petrel (*Macronectes halli*)	Threatened
	Orbost Spiny Crayfish (*Euastacus diversus*)	Threatened
	Silver Perch (*Bidyanus bidyanus*)	Threatened
	South Gippsland Spiny Crayfish (*Euastacus neodiversus*)	Threatened
	Strzelecki Burrowing Crayfish (*Engaeus rostrogaleatus*)	Threatened
Frog	Alpine Tree Frog (*Litoria verreauxii alpina*)	Threatened
	Giant Burrowing Frog (*Heleioporus australiacus*)	Threatened
	Growling Grass Frog (*Litoria raniformis*)	Threatened
	Large Brown Tree Frog (*Litoria littlejohni*)	Threatened
	Spotted Tree Frog (*Litoria spenceri*)	Threatened
Invertebrate	Bull-ant species (*Myrmecia* sp. 17)	Threatened
	Giant Gippsland Earthworm (*Megascolides australis*)	Threatened
Mammal	Broad-toothed Rat (*Mastacomys fuscus mordicus*)	Threatened
	Brush-tailed Phascogale (*Phascogale tapoatafa*)	Threatened
	Common Bent-wing Bat (eastern ssp.) (*Miniopterus schreibersii oceanensis*)	Threatened
	Common Bent-wing Bat (*Miniopterus schreibersii* GROUP)	Threatened
	Dingo (*Canis lupus subsp. dingo*)	Threatened
	Eastern Horseshoe Bat (*Rhinolophus megaphyllus megaphyllus*)	Threatened
	Grey-headed Flying-fox (*Pteropus poliocephalus*)	Threatened
	Humpback Whale (*Megaptera novaeangliae*)	Threatened
	Long-footed Potoroo (*Potorous longipes*)	Threatened
	Long-nosed Potoroo (*Potorous tridactylus tridactylus*)	Threatened
	Southern Bettong (*Bettongia gaimardi*)	Threatened
	Southern Right Whale (*Eubalaena australis*)	Threatened
	Spot-tailed Quoll (*Dasyurus maculatus maculatus*)	Threatened
	Swamp Antechinus (*Antechinus minimus maritimus*)	Threatened
	White-footed Dunnart (*Sminthopsis leucopus*)	Threatened

Functional group	Asset name[a]	Status
	Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	Threatened
Marine	Brittle Star species (*Amphiura triscacantha*)	Threatened
	Brittle Star species (*Ophiocomina australis*)	Threatened
	Sea Cucumber (species 5258) (*Pentocnus bursatus*)	Threatened
	Sea-cucumber species (*Trochodota shepherdi*)	Threatened
Plant	Aniseed Boronia (*Boronia galbraithiae*)	Threatened
	Austral Moonwort (*Botrychium australe*)	Threatened
	Bonnet Orchid (*Cryptostylis erecta*)	Threatened
	Buff Hazelwood (*Symplocos thwaitesii*)	Threatened
	Buxton Gum (*Eucalyptus crenulata*)	Threatened
	Cabbage Fan-palm (*Livistona australis*)	Threatened
	Dainty Bitter-cress (*Cardamine tryssa*)	Threatened
	Dwarf Kerrawang (*Rulingia prostrata*)	Threatened
	Eastern Spider-orchid (*Caladenia orientalis*)	Threatened
	Filmy Maidenhair (*Adiantum diaphanum*)	Threatened
	Grey Billy-buttons (*Craspedia canens*)	Threatened
	Heath Spider-orchid (*Caladenia peysleyi*)	Threatened
	King Greenhood (*Pterostylis baptistii*)	Threatened
	Leafless Tongue-orchid (*Cryptostylis hunteriana*)	Threatened
	Leafy Greenhood (*Pterostylis cucullata subsp. cucullata*)	Threatened
	Leafy Greenhood (*Pterostylis cucullata*)	Threatened
	Leafy Nematolepis (*Nematolepis frondosa*)	Threatened
	Maiden's Wattle (*Acacia maidenii*)	Threatened
	Maroon Leek-orchid (*Prasophyllum frenchii*)	Threatened
	Matted Flax-lily (*Dianella amoena*)	Threatened
	Oval Wedge-fern (*Lindsaea trichomanoides*)	Threatened
	Prickly Tree-fern (*Cyathea leichhardtiana*)	Threatened
	Prostrate Cone-bush (*Isopogon prostratus*)	Threatened
	Purple Blown-grass (*Lachnagrostis punicea subsp. filifolia*)	Threatened
	Purple Diuris (*Diuris punctata var. punctata*)	Threatened
	Robust Spider-orchid (*Caladenia valida*)	Threatened
	Round-leaf Pomaderris (*Pomaderris vacciniifolia*)	Threatened
	Slender Mud-grass (*Pseudoraphis paradoxa*)	Threatened
	Slender Tree-fern (*Cyathea cunninghamii*)	Threatened
	Small Scurf-pea (*Cullen parvum*)	Threatened
	Small Sickle Greenhood (*Pterostylis lustra*)	Threatened

Functional group	Asset name[a]	Status
	Strzelecki Gum (*Eucalyptus strzeleckii*)	Threatened
	Swamp Everlasting (*Xerochrysum palustre*)	Threatened
	Swamp Sun-orchid (*Thelymitra incurva*)	Threatened
	Willow Needlewood (*Hakea macraeana*)	Threatened
	Yellow Elderberry (*Sambucus australasica*)	Threatened
	Yellow-wood (*Acronychia oblongifolia*)	Threatened
Reptile	Corangamite Water Skink (*Eulamprus tympanum marnieae*)	Threatened
	Diamond Python (*Morelia spilota spilota*)	Threatened
	Leathery Turtle (*Dermochelys coriacea*)	Threatened
	Swamp Skink (*Lissolepis coventryi*)	Threatened

Data: Department of the Environment (Dataset 3); Victorian Department of Environment and Primary Industries (Dataset 4, Dataset 5)
[a]Punctuation and typography appear as used in the asset database.

Table 12 Species listed under the Victorian Department of Environment, Land, Water and Planning threatened species advisory list determined as potentially water dependent according to spatial analysis

Although examples of individual species are listed, bioregional assessments consider the potential impact to the habitat of species not individual species per se.

Functional group	Asset name[a]	Status
Bird	Australasian Bittern (*Botaurus poiciloptilus*)	Endangered
	Australasian Shoveler (*Anas rhynchotis*)	Vulnerable
	Australian Painted Snipe (*Rostratula australis*)	Critically endangered
	Baillon's Crake (*Porzana pusilla palustris*)	Vulnerable
	Barking Owl (*Ninox connivens connivens*)	Endangered
	Black-tailed Godwit (*Limosa limosa*)	Vulnerable
	Black Falcon (*Falco subniger*)	Vulnerable
	Blue-billed Duck (*Oxyura australis*)	Endangered
	Brolga (*Grus rubicunda*)	Vulnerable
	Chestnut-rumped Heathwren (*Calamanthus pyrrhopygius*)	Vulnerable
	Common Greenshank (*Tringa nebularia*)	Vulnerable
	Common Sandpiper (*Actitis hypoleucos*)	Vulnerable
	Curlew Sandpiper (*Calidris ferruginea*)	Endangered
	Eastern Bristlebird (*Dasyornis brachypterus brachypterus*)	Endangered
	Eastern Curlew (*Numenius madagascariensis*)	Vulnerable
	Eastern Great Egret (*Ardea modesta*)	Vulnerable
	Elegant Parrot (*Neophema elegans*)	Vulnerable
	Fairy Tern (*Sternula nereis nereis*)	Endangered
	Freckled Duck (*Stictonetta naevosa*)	Endangered
	Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*)	Vulnerable

Functional group	Asset name[a]	Status
	Great Knot (*Calidris tenuirostris*)	Endangered
	Greater Sand Plover (*Charadrius leschenaultii*)	Critically endangered
	Grey-headed Albatross (*Thalassarche chrysostoma*)	Vulnerable
	Grey Goshawk (*Accipiter novaehollandiae novaehollandiae*)	Vulnerable
	Grey Plover (*Pluvialis squatarola*)	Endangered
	Grey-tailed Tattler (*Tringa brevipes*)	Critically endangered
	Ground Parrot (*Pezoporus wallicus wallicus*)	Endangered
	Gull-billed Tern (*Gelochelidon nilotica macrotarsa*)	Endangered
	Hooded Plover (*Thinornis rubricollis rubricollis*)	Vulnerable
	Indian Yellow-nosed Albatross (*Thalassarche carteri*)	Vulnerable
	Intermediate Egret (*Ardea intermedia*)	Endangered
	King Quail (*Coturnix chinensis victoriae*)	Endangered
	Lesser Sand Plover (*Charadrius mongolus*)	Critically endangered
	Lewin's Rail (*Lewinia pectoralis pectoralis*)	Vulnerable
	Little Bittern (*Ixobrychus minutus dubius*)	Endangered
	Little Egret (*Egretta garzetta nigripes*)	Endangered
	Little Tern (*Sternula albifrons sinensis*)	Vulnerable
	Marsh Sandpiper (*Tringa stagnatilis*)	Vulnerable
	Masked Owl (*Tyto novaehollandiae novaehollandiae*)	Endangered
	Musk Duck (*Biziura lobata*)	Vulnerable
	Orange-bellied Parrot (*Neophema chrysogaster*)	Critically endangered
	Pacific Golden Plover (*Pluvialis fulva*)	Vulnerable
	Painted Honeyeater (*Grantiella picta*)	Vulnerable
	Powerful Owl (*Ninox strenua*)	Vulnerable
	Red Knot (*Calidris canutus*)	Endangered
	Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*)	Endangered
	Regent Honeyeater (*Anthochaera phrygia*)	Critically endangered
	Ruddy Turnstone (*Arenaria interpres*)	Vulnerable
	Shy Albatross (*Thalassarche cauta*)	Vulnerable
	Sooty Owl (*Tyto tenebricosa tenebricosa*)	Vulnerable
	Southern Giant-Petrel (*Macronectes giganteus*)	Vulnerable
	Speckled Warbler (*Chthonicola sagittatus*)	Vulnerable
	Square-tailed Kite (*Lophoictinia isura*)	Vulnerable
	Superb Parrot (*Polytelis swainsonii*)	Endangered
	Swift Parrot (*Lathamus discolor*)	Endangered
	Terek Sandpiper (*Xenus cinereus*)	Endangered

Functional group	Asset name[a]	Status
	Whimbrel (*Numenius phaeopus*)	Vulnerable
	White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	Vulnerable
	White-browed Treecreeper (*Climacteris affinis*)	Vulnerable
Fish	Australian Grayling (*Prototroctes maraena*)	Vulnerable
	Australian Mudfish (*Neochanna cleaveri*)	Critically endangered
	Australian Whitebait (*Lovettia sealii*)	Critically endangered
	Bluenose Cod (Trout Cod) (*Maccullochella macquariensis*)	Critically endangered
	Cox's Gudgeon (*Gobiomorphus coxii*)	Endangered
	Dwarf Galaxias (*Galaxiella pusilla*)	Endangered
	East Gippsland Galaxias (*Galaxias* sp. 4)	Endangered
	East Gippsland Spiny Crayfish (*Euastacus bidawalus*)	Vulnerable
	Flat-headed Galaxias (*Galaxias rostratus*)	Vulnerable
	Flinders Pygmy Perch (*Nannoperca* sp. 1)	Vulnerable
	Freshwater Catfish (*Tandanus tandanus*)	Endangered
	Gippsland Burrowing Crayfish (*Engaeus hemicirratulus*)	NA
	Hardhead (*Aythya australis*)	Vulnerable
	Lilly Pilly Burrowing Crayfish (*Engaeus australis*)	Vulnerable
	Macquarie Perch (*Macquaria australasica*)	Endangered
	Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*)	Vulnerable
	Murray Cod (*Maccullochella peelii*)	Vulnerable
	Narracan Burrowing Crayfish (*Engaeus phyllocercus*)	NA
	Orbost Spiny Crayfish (*Euastacus diversus*)	NA
	South Gippsland Spiny Crayfish (*Euastacus neodiversus*)	NA
	Southern Pygmy Perch (Murray-Darling lineage) (*Nannoperca australis* (Murray-Darling lineage))	Vulnerable
	Strzelecki Burrowing Crayfish (*Engaeus rostrogaleatus*)	NA
	West Gippsland Galaxias (*Galaxias* sp. 9)	Critically endangered
Frog	Alpine Tree Frog (*Litoria verreauxii alpina*)	Critically endangered
	Giant Burrowing Frog (*Heleioporus australiacus*)	Critically endangered
	Green and Golden Bell Frog (*Litoria aurea*)	Vulnerable
	Growling Grass Frog (*Litoria raniformis*)	Endangered
	Large Brown Tree Frog (*Litoria littlejohni*)	Endangered
	Martin's Toadlet (*Uperoleia martini*)	Critically endangered
	Southern Toadlet (*Pseudophryne semimarmorata*)	Vulnerable
	Spotted Tree Frog (*Litoria spenceri*)	Critically endangered
Invertebrate	Bullant (*Myrmecia* sp. 17)	Vulnerable

Functional group	Asset name[a]	Status
	Giant Gippsland Earthworm (*Megascolides australis*)	NA
	Cadisfly (*Plectrotarsus gravenhorstii*)	Vulnerable
	Cadisfly (*Tanjistomella verna*)	Vulnerable
Mammal	Broad-toothed Rat (*Mastacomys fuscus mordicus*)	Endangered
	Brush-tailed Phascogale (*Phascogale tapoatafa*)	Vulnerable
	Common Bent-wing Bat (eastern ssp.) (*Miniopterus schreibersii oceanensis*)	Vulnerable
	Eastern Horseshoe Bat (*Rhinolophus megaphyllus megaphyllus*)	Vulnerable
	Grey-headed Flying-fox (*Pteropus poliocephalus*)	Vulnerable
	Humpback Whale (*Megaptera novaeangliae*)	Vulnerable
	Long-footed Potoroo (*Potorous longipes*)	Vulnerable
	New Zealand Fur Seal (*Arctocephalus forsteri*)	Vulnerable
	Southern Right Whale (*Eubalaena australis*)	Critically endangered
	Spot-tailed Quoll (*Dasyurus maculatus maculatus*)	Endangered
Marine	Brittle Star species (*Amphiura triscacantha*)	Vulnerable
	Brittle Star species (*Ophiocomina australis*)	Vulnerable
	Sea-cucumber species (*Trochodota shepherdi*)	Vulnerable
	Sea Cucumber (species 5258) (*Pentocnus bursatus*)	Vulnerable
Plant	Aniseed Boronia (*Boronia galbraithiae*)	Vulnerable
	Annual Bitter-cress (*Cardamine paucijuga s.s.*)	Vulnerable
	Austral Moonwort (*Botrychium australe*)	Vulnerable
	Avon Peppermint (*Eucalyptus ornans*)	Endangered
	Beech Finger-fern (*Grammitis magellanica* subsp. *nothofageti*)	Vulnerable
	Beechworth Silver Stringybark (*Eucalyptus aff. cinerea* (Beechworth))	Vulnerable
	Black Stem (*Adiantum formosum*)	Vulnerable
	Blackfellow's Hemp (*Commersonia rossii*)	Vulnerable
	Blakely's Bush-pea (*Pultenaea blakelyi*)	Endangered
	Blotched Diuris (*Diuris* sp. *aff. dendrobioides* (Bairnsdale))	Endangered
	Blotched Sun-orchid (*Thelymitra benthamiana*)	Vulnerable
	Blunt-leaf Pomaderris (*Pomaderris helianthemifolia* subsp. *helianthemifolia*)	Vulnerable
	Bonnet Orchid (*Cryptostylis erecta*)	Endangered
	Brickmaker's Sedge (*Gahnia grandis*)	Vulnerable
	Buff Hazelwood (*Symplocos thwaitesii*)	Endangered
	Bushy Hedgehog-grass (*Echinopogon caespitosus var. caespitosus*)	Endangered
	Cabbage Fan-palm (*Livistona australis*)	Vulnerable

Functional group	Asset name[a]	Status
	Cherry Rice-flower (*Pimelea drupacea*)	Vulnerable
	Coast Bitter-bush (*Adriana quadripartita* (pubescent form))	Vulnerable
	Coastal Greenhood (*Pterostylis alveata*)	Vulnerable
	Colquhoun Grevillea (*Grevillea celata*)	Vulnerable
	Common Morel (*Morchella esculenta*)	Vulnerable
	Creeping Loosestrife (*Lysimachia japonica*)	Vulnerable
	Crimson Berry (*Leptecophylla juniperina* subsp. *oxycedrus*)	Vulnerable
	Dainty Bitter-cress (*Cardamine tryssa*)	Endangered
	Dune Fan-flower (*Scaevola calendulacea*)	Vulnerable
	Dwarf Kerrawang (*Rulingia prostrata*)	Endangered
	Dwarf Milkwort (*Polygala japonica*)	Vulnerable
	Eastern Bitter-cress (*Cardamine microthrix*)	Vulnerable
	Eastern Spider-orchid (*Caladenia orientalis*)	Endangered
	Filmy Maidenhair (*Adiantum diaphanum*)	Endangered
	Fringed Pennywort (*Hydrocotyle comocarpa*)	Vulnerable
	Granite Greenhood (*Pterostylis tunstallii*)	Vulnerable
	Green Leek-orchid (*Prasophyllum lindleyanum*)	Vulnerable
	Green-striped Greenhood (*Pterostylis chlorogramma*)	Vulnerable
	Grey Billy-buttons (*Craspedia canens*)	Endangered
	Grey Pouchwort (*Acrobolbus cinerascens*)	Vulnerable
	Hoary Sun-orchid (*Thelymitra orientalis*)	Vulnerable
	Island Celery (*Apium insulare*)	Vulnerable
	Japanese Lady-fern (*Deparia petersenii* subsp. *congrua*)	Vulnerable
	Jointed Mistletoe (*Korthalsella rubra* subsp. *rubra*)	Vulnerable
	King Greenhood (*Pterostylis baptistii*)	Vulnerable
	Lanky Buttons (*Leptorhynchos elongatus*)	Endangered
	Leafless Tongue-orchid (*Cryptostylis hunteriana*)	Endangered
	Leafy Greenhood (*Pterostylis cucullata* subsp. *cucullata*)	Endangered
	Leafy Greenhood (*Pterostylis cucullata*)	Vulnerable
	Leafy Nematolepis (*Nematolepis frondosa*)	Vulnerable
	Limestone Blue Wattle (*Acacia caerulescens*)	Vulnerable
	Long Clubmoss (*Huperzia varia*)	Vulnerable
	Long Rope-rush (*Calorophus elongatus*)	Vulnerable
	Maiden's Wattle (*Acacia maidenii*)	Endangered
	Maroon Leek-orchid (*Prasophyllum frenchii*)	Endangered
	Matted Flax-lily (*Dianella amoena*)	Endangered

Functional group	Asset name[a]	Status
	Mauve-tuft Sun-orchid (*Thelymitra malvina*)	Vulnerable
	Naked Sun-orchid (*Thelymitra circumsepta*)	Vulnerable
	Oval Wedge-fern (*Lindsaea trichomanoides*)	Endangered
	Oval-leaf Grevillea (*Grevillea miqueliana* subsp. *miqueliana*)	Vulnerable
	Poverty Wattle (*Acacia dawsonii*)	Vulnerable
	Prawn Greenhood (*Pterostylis pedoglossa*)	Vulnerable
	Prickly Tree-fern (*Cyathea leichhardtiana*)	Vulnerable
	Promontory Daisy-bush (*Olearia allenderae*)	Vulnerable
	Prostrate Cone-bush (*Isopogon prostratus*)	Endangered
	Purple Diuris (*Diuris punctata var. punctata*)	Vulnerable
	Robust Spider-orchid (*Caladenia valida*)	Endangered
	Round-leaf Pomaderris (*Pomaderris vacciniifolia*)	Endangered
	Rusty Velvet-bush (*Lasiopetalum ferrugineum*)	Vulnerable
	Scarlet Greenhood (*Pterostylis coccina*)	Vulnerable
	Sea Bindweed (*Calystegia soldanella*)	Vulnerable
	Shore Spleenwort (*Asplenium obtusatum* subsp. *northlandicum*)	Vulnerable
	Showy Boronia (*Boronia ledifolia*)	Vulnerable
	Skirted Tree-fern (*Cyathea X marcescens*)	Vulnerable
	Slender Fork-fern (*Tmesipteris elongata*)	Vulnerable
	Slender Leek-orchid (*Prasophyllum parviflorum*)	Vulnerable
	Slender Mud-grass (*Pseudoraphis paradoxa*)	Endangered
	Slender Tree-fern (*Cyathea cunninghamii*)	Vulnerable
	Small Scurf-pea (*Cullen parvum*)	Endangered
	Small Sickle Greenhood (*Pterostylis lustra*)	Endangered
	Small-leaf Star-hair (*Astrotricha parvifolia* subsp. 2)	Vulnerable
	Small-leaf Star-hair (*Astrotricha parvifolia*)	Vulnerable
	Spotted Gum (*Corymbia maculata*)	Vulnerable
	Star Cucumber (*Sicyos australis*)	Vulnerable
	Strzelecki Gum (*Eucalyptus strzeleckii*)	Vulnerable
	Swamp Everlasting (*Xerochrysum palustre*)	Vulnerable
	Swamp Greenhood (*Pterostylis tenuissima*)	Vulnerable
	Swamp Onion-orchid (*Hydrorchis orbicularis*)	Vulnerable
	Swamp Sun-orchid (*Thelymitra incurva*)	Endangered
	Tasman Pomaderris (*Pomaderris apetala* subsp. *maritima*)	Vulnerable
	Thin-leaf Daisy-bush (*Olearia tenuifolia*)	Vulnerable
	Trailing Hop-bush (*Dodonaea procumbens*)	Vulnerable

Functional group	Asset name[a]	Status
	Tullach Ard Grevillea (*Grevillea polychroma*)	Vulnerable
	Two-colour Panic (*Panicum simile*)	Vulnerable
	Viscid Daisy-bush (*Olearia viscosa*)	Vulnerable
	Wellington Mint-bush (*Prostanthera galbraithiae*)	Vulnerable
	Willow Needlewood (*Hakea macraeana*)	Endangered
	Woolly Waterlily (*Philydrum lanuginosum*)	Vulnerable
	Yawning Leek-orchid (*Prasophyllum chasmogamum*)	Endangered
	Yellow Elderberry (*Sambucus australasica*)	Vulnerable
Reptile	Corangamite Water Skink (*Eulamprus tympanum marnieae*)	Critically endangered
	Diamond Python (*Morelia spilota spilota*)	Endangered
	Glossy Grass Skink (*Pseudemoia rawlinsoni*)	Vulnerable
	Lace Monitor (*Varanus varius*)	Endangered
	Leathery Turtle (*Dermochelys coriacea*)	Critically endangered
	Swamp Skink (*Lissolepis coventryi*)	Vulnerable

Data: Advisory list of threatened vertebrate fauna in Victoria 2013 (Department of Environment and Primary Industries, 2013); Advisory list of rare or threatened plants in Victoria 2014 (Department of Environment and Primary Industries, 2014a)
NA=data not available. These species are designated important to the community but are not protected under legislation.
[a]Punctuation and typography appear as used in the asset database.

1.1.2.2 Gaps

The participants at the Gippsland Basin bioregion asset workshop identified several ecological assets for possible inclusion (Table 5). The Natural Damp Grasslands of the South East Coastal Plain Interim Biogeographic Regionalisation for Australia bioregion was identified. The assessment team attempted to obtain the data, however the asset is in the process of being assessed for the Threatened Ecological Community status under the EPBC Act and the spatial information for the asset was not available for incorporation in this assessment's time frame. Additional species were also identified at the workshop including the Burrunan Dolphin and the Strzelecki Koala. These species are of specific ecological interest to local community, with limited research or detailed spatial distribution available. It is anticipated these particular species will be indirectly assessed via associated water-dependent assets.

Additional assets which are not included due to a lack of availability of detailed spatial data include significant waterbird breeding sites in the Gippsland Lakes (Department of Sustainability, Environment, Water, Population and Communities, 2010) and Corner Inlet (Department of Sustainability, Environment, Water, Population and Communities, 2011); fishery habitats important to Gippsland Lakes (Department of Sustainability, Environment, Water, Population and Communities 2010); silt jetties within the Gippsland Lakes (Department of Sustainability and Environment 2003). State game reserves may also be important. Again, it is anticipated these particular assets will be indirectly assessed via associated water-dependent assets.

References

Department of Environment and Primary Industries (2013) Advisory list of threatened vertebrate fauna in Victoria. The State of Victoria, Department of Environment and Primary Industries 2013. Viewed 6 December 2014, http://www.depi.vic.gov.au/__data/assets/pdf_file/0019/210439/Advisory-List-of-Threatened-Vertebrate-Fauna_FINAL-2013.pdf.

Department of Environment and Primary Industries (2014a) Advisory list of rare or threatened plants in Victoria 2014. The State of Victoria, Department of Environment and Primary Industries 2014. Viewed 6 December 2014, http://www.depi.vic.gov.au/__data/assets/pdf_file/0005/277565/Advisory-List-of-Rare-or-Threatened-Plants-in-Victoria-2014.pdf.

Department of Environment and Primary Industries (2014b) Potential groundwater dependent ecosystem (GDE) mapping for the East Gippsland CMA. The State of Victoria, Department of Environment and Primary Industries 2014. Viewed 4 December 2014, https://www.data.vic.gov.au/data/dataset/potential-groundwater-dependent-ecosystem-gde-mapping-for-the-east-gippsland-cma.

Department of Environment and Primary Industries (2014c) Potential groundwater dependent ecosystem (GDE) mapping for the West Gippsland CMA. The State of Victoria, Department of Environment and Primary Industries 2014. Viewed 4 December 2014, https://www.data.vic.gov.au/data/dataset/potential-groundwater-dependent-ecosystem-gde-mapping-for-the-west-gippsland-cma.

Department of Sustainability and Environment (2003) Gippsland Lakes Ramsar Site Strategic Management Plan. Viewed 14 April 2015, http://parkweb.vic.gov.au/__data/assets/pdf_file/0007/313279/gippsland-lakes-ramsar-site.pdf.

Department of Sustainability, Environment, Water, Population and Communities (2010) Gippsland Lakes Ramsar Site ecological character description. Australian Government. Viewed 14 April 2015, http://www.environment.gov.au/system/files/resources/0c0185c8-8e0b-4194-a6ca-d0f795bef410/files/21-ecd.pdf.

Department of Sustainability, Environment, Water, Population and Communities (2011) Corner Inlet Ramsar Site ecological character description. Australian Government. Viewed 14 April 2015, http://www.environment.gov.au/system/files/resources/97f19db6-cc7c-429b-9431-7577f1d99907/files/13-ecd.pdf.

Datasets

Dataset 1 Bureau of Meteorology (2012) National Groundwater Dependent Ecosystems (GDE) Atlas. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/e358e0c8-7b83-4179-b321-3b4b70df857d.

Dataset 2 Australian Government Department of the Environment (2001) Directory of Important Wetlands in Australia (DIWA) Spatial Database (Public). Bioregional Assessment Source Dataset. Viewed 15 April 2015, http://data.bioregionalassessments.gov.au/dataset/6636846e-e330-4110-afbb-7b89491fe567.

Dataset 3 Australian Government Department of the Environment (1998) Species Profile and Threats Database (SPRAT) - Australia - Species of National Environmental Significance Database (BA subset - RESTRICTED - Metadata only). Bioregional Assessment Source Dataset. Viewed 11 March 2015, http://data.bioregionalassessments.gov.au/dataset/7276dd93-cc8c-4c01-8df0-cef743c72112.

Dataset 4 Victorian - Department of Environment and Primary Industries (2014) Victorian Biodiversity Atlas fauna - 1 minute grid summary. Bioregional Assessment Source Dataset. Viewed 12 March 2015, http://data.bioregionalassessments.gov.au/dataset/516f9eb1-ea59-46f7-84b1-90a113d6633d.

Dataset 5 Victorian - Department of Environment and Primary Industries (2014) Victorian Biodiversity Atlas flora - 1 minute grid summary. Bioregional Assessment Source Dataset. Viewed 12 March 2015, http://data.bioregionalassessments.gov.au/dataset/d40ac83b-f260-4c0b-841d-b639534a7b63.

1.1.3 Economic assets

Summary

The water-dependent asset register for the Gippsland Basin preliminary assessment extent (PAE) has 270 economic water-dependent assets. There are 225 economic assets in the 'Surface water management zone or area' economic asset class made up of 65,309 surface water elements (of which are 61,934 are farm dam elements) and 45 economic assets in the 'Groundwater management zone or area' economic asset class made up of 31,005 groundwater elements.

1.1.3.1 Description

The total number of economic water-dependent assets in the PAE of the Gippsland Basin bioregion is 270. There are 225 economic surface water assets. There are 45 economic groundwater assets. The assets comprise 96,314 elements including 65,309 surface water access elements and 31,005 groundwater elements with total share components (a specified share or volume of water that can be extracted within a specified water management area) of 96,397 and 80,101 ML/year, respectively. These data indicate a greater reliance on surface water than groundwater in the PAE. Table 13 shows the breakdown of water access entitlements (i.e. elements) for surface water and groundwater in the PAE of the Gippsland Basin bioregion.

Table 13 Breakdown of water access entitlements for surface water and groundwater in the preliminary assessment extent (PAE) of the Gippsland Basin bioregion

Water access entitlement type	Surface water	Groundwater
Basic water right (stock and domestic)	785	5,063
Water access right	2,537	6,075
Null (this class includes exploration and research, and monitoring bores)	291	19,867
Total share component (ML/y)	96,397	80,101

Data: Bioregional Assessment Programme (Dataset 1, Dataset 2)
NA=no data available

The Macalister Irrigation District was identified as a water-dependent economic asset at the Gippsland Basin asset workshop held in Traralgon, Victoria in December 2014. This information has been incorporated into the asset register and the areal coverage is depicted in Figure 4. The Landscape Priority Areas in Figure 4 are discussed in further detail in Section 1.3.4, and are defined as a sociocultural asset. These areas have significant natural values at most immediate risk from land use activities within the Gippsland Basin bioregion (WGCMA, 2012).

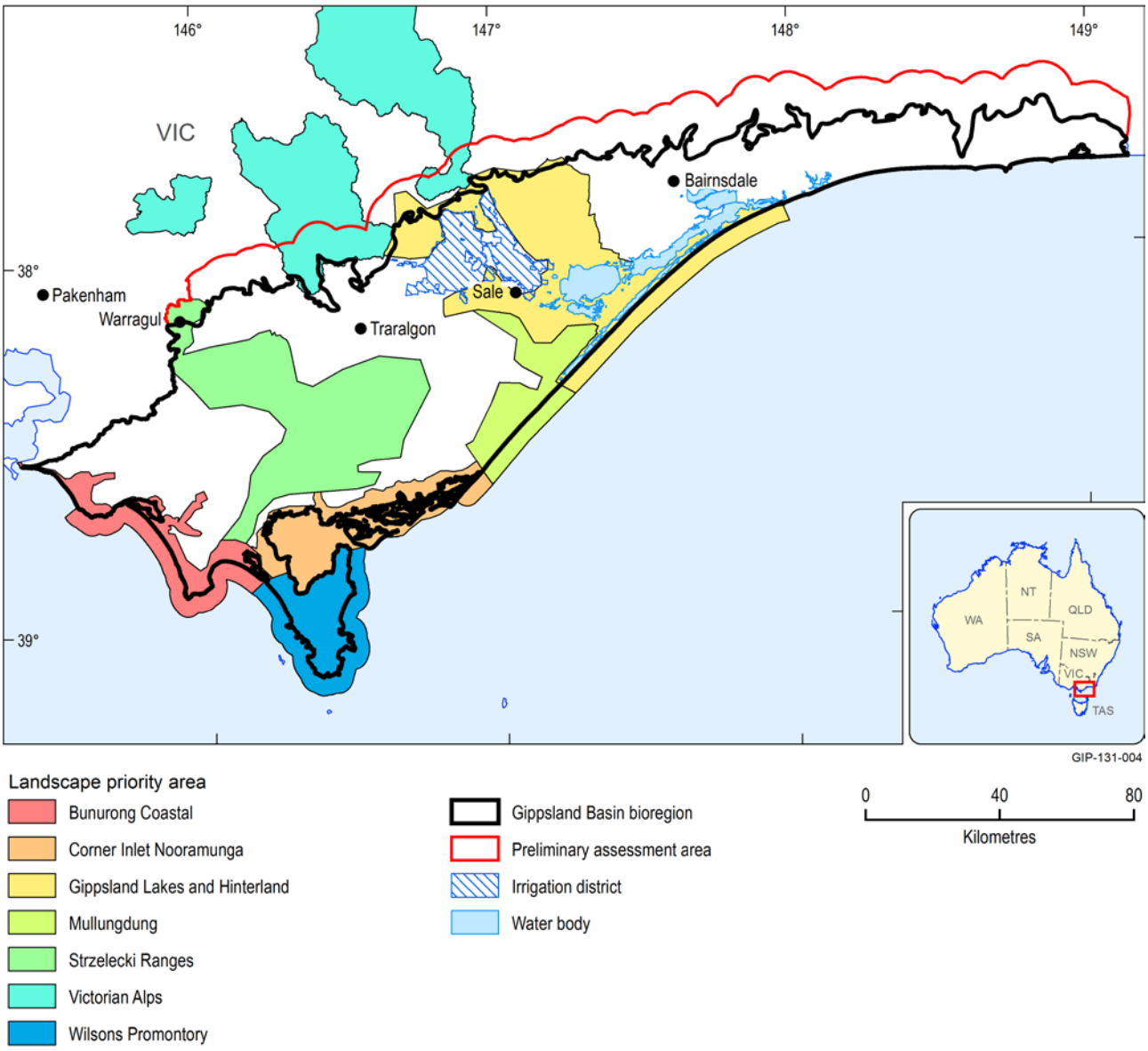

Figure 4 Irrigation district and Landscape Priority Areas that intersect or are contained by the Gippsland Basin preliminary assessment extent (PAE)

Data: Victorian Department of Environment and Primary Industries (Dataset 3), West Gippsland Catchment Management Authority (Dataset 4)

Regulated and unregulated river entitlements are grouped by river system and shown in Figure 5 along with the current surface water access entitlement distribution advised by Southern Rural Water at the Gippsland Basin asset workshop held in Traralgon, Victoria in December 2014. A large number of surface water access entitlements elements occur along the length of the Latrobe River and the Avon River (Figure 5).

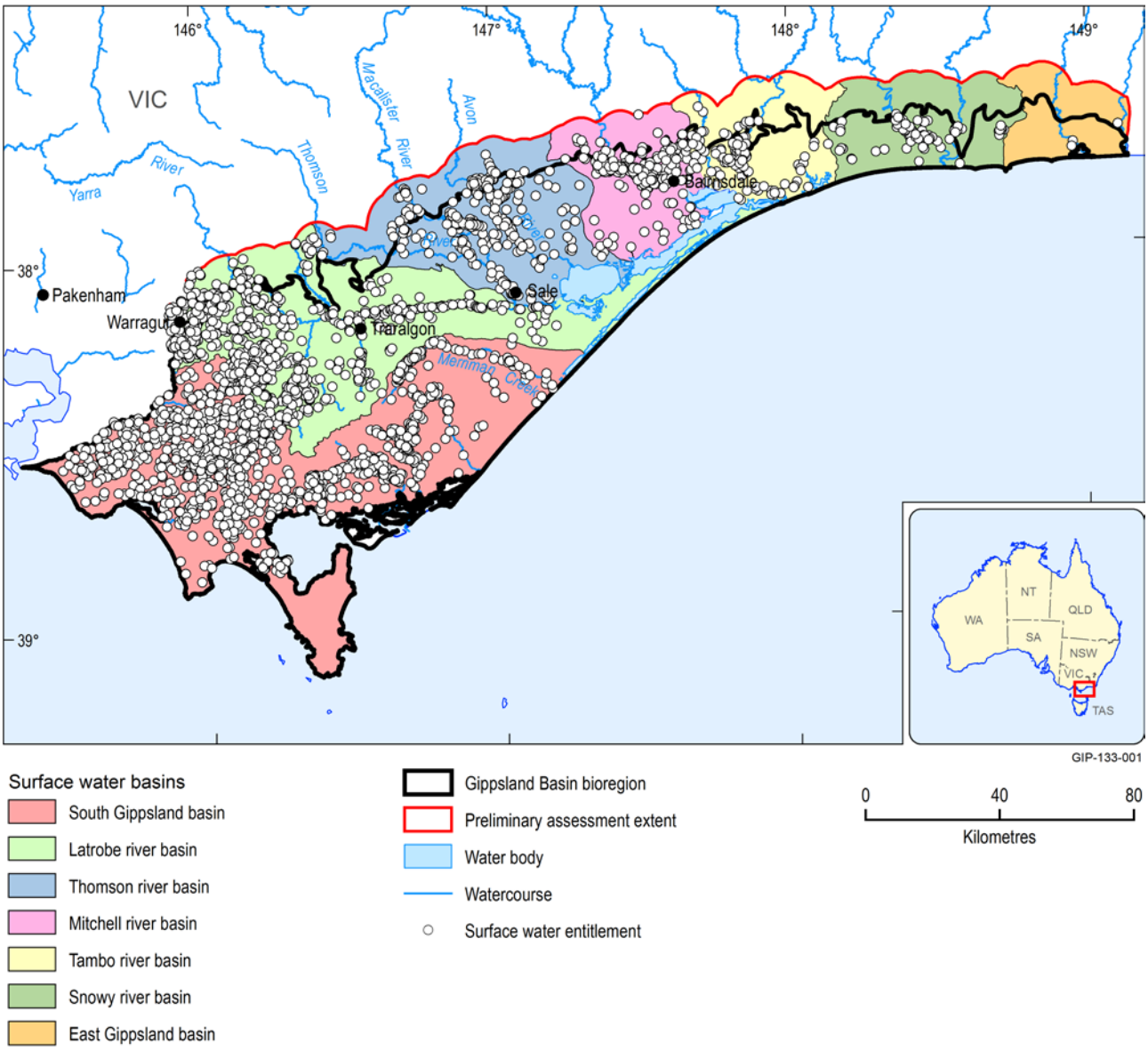

Figure 5 Regulated and unregulated river entitlements areas and surface water access entitlement spatial distribution

Data: Bioregional Assessment Programme (Dataset 1, Dataset 2)

A groundwater management area is an area where groundwater has been intensively developed or has the potential to be developed in the future (DELWP 2014). This area, defined by a line on a map and by depth or aquifer, is used to account entitlement such that Permissible Consumptive Volumes (PCVs) defined under Victoria's *Water Act 1989* may be enforced. A water supply protection area (WSPA) is an area declared under Victoria's *Water Act 1989* to protect the groundwater or surface water resources through the development of a statutory management plan. These are shown in Figure 6 along with the spatial distribution of groundwater access entitlements in the Gippsland Basin PAE.

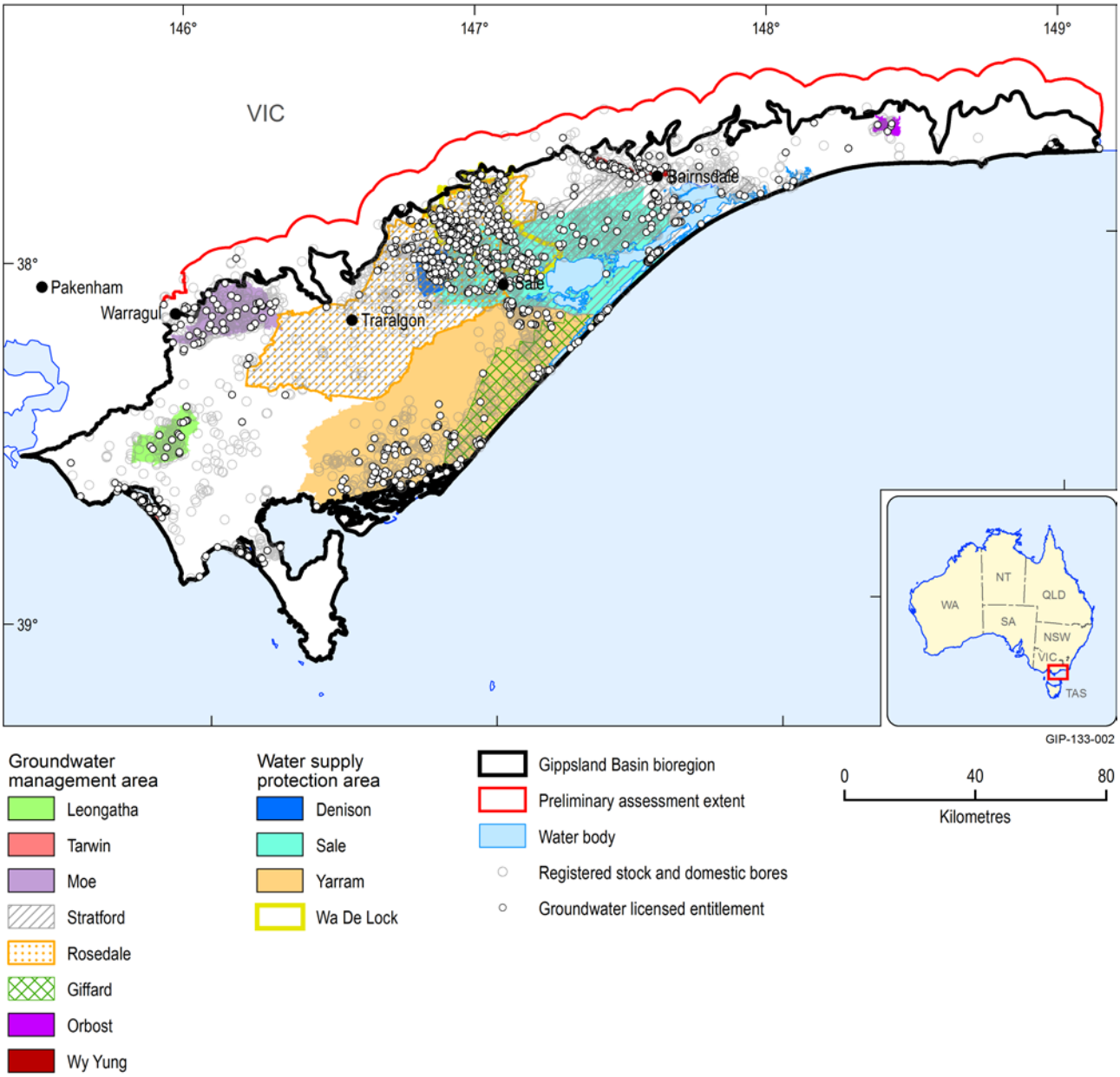

Figure 6 Groundwater management areas, water supply protection areas (WSPA) and the spatial distribution of groundwater access entitlement data in the Gippsland Basin preliminary assessment extent (PAE)

Data: Bioregional Assessment Programme (Dataset 2), Victorian Department of Environment and Primary Industries (Dataset 5), Victorian Department of Environment and Primary Industries (Dataset 6)

1.1.3.2 Gaps

The Bureau of Meteorology data (Bioregional Assessment Programme, Dataset 1) do not include details of the river reach (beyond the name of the waterway) where the offtake is located. However, the data do list the associated water system and trading zone that are associated with local management plans (LMP) administered and enforced by Southern Rural Water (Southern Rural Water, 2014). A water system and trading zone can be any set of rivers, lakes and the like that is defined by a gazetted LMP. Should further aggregation of elements into assets occur, care needs to be taken when assigning receptors to aggregated assets.

References

DELWP (2014) Managing groundwater. Department of Environment, Land Water & Planning, State Government of Victoria, Melbourne. Viewed 13 July 2015, http://www.depi.vic.gov.au/water/groundwater/managing-groundwater.

Southern Rural Water (2014) Gippsland River system restrictions. Southern Rural Water. Viewed 6 February 2015, http://www.srw.com.au/Page/Page.asp?Page_Id=369&h=0.

WGCMA (2012) West Gippsland regional catchment strategy 2013–2019. West Gippsland Catchment Management Authority, Traralgon.

Datasets

Dataset 1 Bioregional Assessment Programme (2015) Surface Water Economic Entitlements GIP 20141219. Bioregional Assessment Derived Dataset. Viewed 11 March 2015, http://data.bioregionalassessments.gov.au/dataset/e52eb72a-46c9-40d8-b4c3-986d0f02600b.

Dataset 2 Bioregional Assessment Programme (2015) Asset database for the Gippsland Basin bioregion on 18 September 2015. Bioregional Assessment Derived Dataset. Viewed 23 September 2015, http://data.bioregionalassessments.gov.au/dataset/f67fbe66-2e36-4444-8575-2b0370ad7398.

Dataset 3 Victorian Department of Environment and Primary Industries (2006) Irrigation District Department of Environment and Primary Industries GIP. Bioregional Assessment Source Dataset. Viewed 11 March 2015, http://data.bioregionalassessments.gov.au/dataset/880d9042-abe7-4669-be3a-e0fbe096b66a.

Dataset 4 West Gippsland Catchment Management Authority (2012) West Gippsland Regional Catchment Strategy Landscape Priorities WGCMA GIP 201205. Bioregional Assessment Source Dataset. Viewed 11 March 2015, http://data.bioregionalassessments.gov.au/dataset/6c8c0a81-ba76-4a8a-b11a-1c943e744f00.

Dataset 5 Victorian Department of Environment and Primary Industries (2014) Victorian Groundwater Management Areas. Bioregional Assessment Source Dataset. Viewed 11 March 2015, http://data.bioregionalassessments.gov.au/dataset/df25175d-0dff-43e7-ada5-4c0ec0569e88.

Dataset 6 Victorian Department of Environment and Primary Industries (2014) Victorian Water Supply Protection Areas. Bioregional Assessment Source Dataset. Viewed 11 March 2015, http://data.bioregionalassessments.gov.au/dataset/2138f7eb-468e-4522-b214-f1bd0b440ba8.

1.1.4 Sociocultural assets

Summary

A total of 235 sociocultural water-dependent assets were identified in the Gippsland Basin bioregion preliminary assessment extent (PAE). The Gippsland Basin asset workshop held in December 2014 identified recreational playing field and ovals as being sociocultural assets; however this information was not uniformly available.

Meetings are planned with Indigenous knowledge holders in the Gippsland Basin bioregion to discuss Indigenous cultural water-dependent assets.

1.1.4.1 Description

Of the total 235 water-dependent assets within the Gippsland Basin bioregion PAE, a total of 228 sociocultural assets were sourced from the Australian Heritage Database (Department of the Environment, 2014; Australian Government Department of the Environment, Dataset 1; Dataset 2; Dataset 3; Dataset 4): 225 from the Register of the National Estate, 2 from the Commonwealth Heritage List and 1 from the National Heritage List. Additionally the West Gippsland Catchment Management Authority has identified seven areas known as landscape priority areas (LPAs). These areas represent regions with significant natural values at most immediate risk from land use developments in the Gippsland Basin bioregion and are grouped together as a priority for attention by the West Gippsland CMA (WGCMA, 2012). These are shown in Figure 4 in Section 1.3.3 and are classified as cultural heritage assets.

Twelve Indigenous sociocultural water-dependent assets sourced from existing Commonwealth heritage databases were included for assessment.

Table 14 shows the breakdown of assets by subgroup and class. Many of the sociocultural assets were derived from geographically intersecting the Australian Heritage Database within the PAE of the Gippsland Basin bioregion.

These 235 assets are considered water dependent since they were located within the maximum flood extent or are within an area where the groundwater was less than 10 m below the ground surface.

1.1.4.2 Gaps

The Gippsland Basin Asset workshop, held in December 2014, identified ovals and playing fields as a potential dataset for inclusion. As these data are held by local councils, information about water sources used for irrigation of ovals and playing fields is likely to be of variable coverage and quality. This data will require review prior to inclusion in the asset register and are currently not included in this assessment.

Meetings have been held with Indigenous knowledge holders in the Gippsland Basin bioregion to gain further understanding of Indigenous cultural water-dependent assets. Where possible and appropriate, and with the agreement of Indigenous knowledge holders, these additional Indigenous water-related values will be published in a separate report. Identified assets will be

incorporated into an updated water-dependent asset register (available at http://data.bioregionalassessments.gov.au/product/GIP/GIP/1.3) and/or incorporated into later technical products.

Table 14 Number of sociocultural assets according to subgroup and class in the preliminary assessment extent (PAE) of the Gippsland Basin bioregion

Subgroup	Asset class	Number of assets
Cultural	Heritage site	132
	Indigenous site	11
Social	Recreation site	92

Data: Bioregional Assessment Programme (Dataset 5)

References

Department of the Environment (2014) The Australian Heritage Database online. Viewed 9 September 2014, http://www.environment.gov.au/heritage.

WGCMA (2012) West Gippsland Regional Catchment Strategy 2013–2019. In: West Gippsland Catchment Management Authority, Traralgon.

Datasets

Dataset 1 Australian Government Department of the Environment (2000) Australia World Heritage Areas. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/4927789b-7ba7-4a77-b6fc-be1b29b6590c.

Dataset 2 Australian Government Department of the Environment (2004) National Heritage List Spatial Database (NHL) (v2.1). Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/26daa8d7-a90e-47f3-982b-0df362414e65.

Dataset 3 Australian Government Department of the Environment (2004) Commonwealth Heritage List Spatial Database (CHL). Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/57720684-4948-45db-a2c8-37259d531d87.

Dataset 4 Australian Government Department of the Environment (2004) Australia, Register of the National Estate (RNE) - Spatial Database (RNESDB) Internal. Bioregional Assessment Source Dataset. Viewed 13 April 2015, http://data.bioregionalassessments.gov.au/dataset/878f6780-be97-469b-8517-54bd12a407d0.

Dataset 5 Bioregional Assessment Programme (2015) Asset database for the Gippsland Basin bioregion on 18 September 2015. Bioregional Assessment Derived Dataset. Viewed 23 September 2015, http://data.bioregionalassessments.gov.au/dataset/f67fbe66-2e36-4444-8575-2b0370ad7398.

www.bioregionalassessments.gov.au

Australian Government
Department of the Environment
Bureau of Meteorology
Geoscience Australia

CSIRO