Appendices

Waterlily (*Nymphaea violacea)* common to Northern Australia found in billabongs, waterholes and rivers

Photo: CSIRO - Nathan Dyer

Appendix A

Assessment products

More information about the Roper River Water Resource Assessment can be found at https://www.csiro.au/roperriver. The website provides readers with a communications suite including factsheets, multimedia content, FAQs, reports and links to other related sites, particularly about other research in northern Australia.

In order to meet the requirements specified in the contracted ‘Timetable for the Services’, the Assessment provided the following key deliverables:

- Technical reports present scientific work at a level of detail sufficient for technical and scientific experts to reproduce the work. Each of the activities of the Assessment has at least one corresponding technical report.
- The catchment report (this report) synthesises key material from the technical reports, providing well-informed but non-scientific readers with the information required to make decisions about the opportunities, costs and benefits associated with water resource development.
- A case study report that considers the regulatory processes and approval steps required for land and water development in the Roper catchment. The case study brings information about NT’s current land and water regulatory and approvals landscape together and structures it in an orderly way. It is intended to provide a useful introduction to the topic for proponents and others with an interest in advancing new developments in the NT (and the Roper catchment in particular).
- An overview report is provided for a general public audience.
- A factsheet provides key findings for a general public audience.

This appendix lists all such deliverables.

Please cite as they appear.

Methods report

CSIRO (2021) Proposed methods report for the Roper Catchment - updated. A report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Technical reports

Devlin K (2023) Pump stations for flood harvesting or irrigation downstream of a storage dam. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Duvert C, Hutley LB, Lamontagne S, Bourke AJ, Alvarez Cortes D, Irvine DJ and Taylor AR (2023) Tree water sourcing at the Mataranka Springs Complex. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Hughes J, Yang A, Marvanek S, Wang B, Petheram C and Philip S (2023) River model calibration and scenario analysis for the Roper catchment. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Kim S, Hughes J, Ticehurst C, Stratford D, Merrin L, Marvanek S and Petheram C (2023) Floodplain inundation mapping and modelling for the Roper catchment. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Knapton A, Taylor AR, Petheram C and Crosbie RS (2023) An investigation into the effects of climate change and groundwater development scenarios on the water resources of the Roper catchment using two finite element groundwater flow models. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Lyons P, Barber M, Fisher K and Braedon P (2023) Indigenous water values, rights, interests and development goals in the Roper catchment. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Petheram C, Yang A, Seo L, Rogers L, Baynes F, Devlin K, Marvanek S, Hughes J, Ponce Reyes R, Wilson P, Stratford D, Philip S (2022) Assessment of surface water storage options and reticulation infrastructure in the Roper catchment. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

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Stratford D, Kenyon R, Pritchard J, Merrin L, Linke S, Ponce Reyes R, Blamey L, Buckworth R, Castellazzi P, Costin B, Deng R, Gannon R, Gilbey S, King D, Kopf K, Kopf S, McGinness H, McInerney P, Perna C, Plaganyi E and Waltham N (2022) Ecological assets of northern Australia to inform water resource assessments. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

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Taylor AR, Crosbie RS, Turnadge C, Lamontagne S, Deslandes A, Davies PJ, Barry K, Suckow A, Knapton A, Marshall S, Hodgson G, Tickell S, Duvert C, Hutley L and Dooley K (2023) Hydrogeological assessment of the Cambrian Limestone Aquifer and the Dook Creek Aquifer in the Roper catchment, Northern Territory. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Thomas M, Philip S, Stockman U, Wilson PR, Searle, R, Hill J, Bui E, Gregory, L, Watson, I, Wilson PL and Gallant G (2022) Soils and land suitability for the Roper catchment, Northern Territory. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Vanderbyl T (2023) Case study for the Roper River Water Resource Assessment. A technical report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Catchment report

Watson I, Petheram C, Bruce C and Chilcott C (eds) (2023) Water resource assessment for the Roper catchment. A report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Overview report

CSIRO (2023) Water resource assessment for the Roper catchment. An overview report from the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Factsheet on key findings

CSIRO (2023) Water resource assessment for the Roper catchment. Key messages of reports to the CSIRO Roper River Water Resource Assessment for the National Water Grid. CSIRO, Australia.

Appendix B

Shortened forms

SHORT FORM	FULL FORM
AACo	Australian Agricultural Company
AAPA	Aboriginal Areas Protection Authority
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
AE	adult equivalent
AEP	annual exceedance probability
AHD	Australian Height Datum
ALRA	*Aboriginal Land Rights (Northern Territory) Act 1976*
APSIM	Agricultural Production Systems sIMulator
ASC	Australian Soil Classification
ASL	American serpentine leafminer
AWC	available water capacity
AWRA-R	Australian Water Resource Assessment – River
BCR	benefit–cost ratio
CBA	cost–benefit analysis
CIE	Centre for International Economics
CLA	Cambrian Limestone Aquifer
CMB	chloride mass balance
CMIP	Coupled Model Intercomparison project
CV	coefficient of variation
DAP	(CSIRO) Data Access Portal
DCA	Dook Creek Aquifer
DIDO	drive-in drive-out
DIWA	Directory of Important Wetlands in Australia
DKIS	*Darwin-Katherine Interconnected System*
DO	dissolved oxygen
DOI	Document Object Identifier
DRBWCD	Daly Roper Beetaloo Water Control District
DS	dry season
EB	embankment dams
EBITDA	earnings before interest, taxes, depreciation and amortisation

SHORT FORM	FULL FORM
EC	electrical conductivity
ENSO	El Niño – Southern Oscillation
FAW	Fall armyworm
FFA	flood frequency analysis
FIFO	fly-in fly-out
FMD	Foot-and-mouth disease
FRP	filterable reactive phosphorus
FSL	full supply level
FTE	full time equivalent
GCM	global climate model
GCM-PS	global climate model scaling technique
GDE	groundwater-dependent ecosystem
GM	gross margin
GVAP	gross value of agricultural production
GVIAP	gross value of irrigated agricultural production
GWWAP	Georgina Wiso Water Allocation Plan
HSD	Health Service District
I–O	input–output
IEO	Index of Education and Occupation
IER	Index of Economic Resources
ILUA	Indigenous Land Use Agreement
IRR	internal rate of return
IUCN	International Union for Conservation of Nature
JE	Japanese encephalitis
LSD	Lumpy skin disease
MAR	managed aquifer recharge
MDB	Murray–Darling Basin
MICE	Models of intermediate complexity
MODIS	global climate model scaling technique
MTLAWAP	Mataranka Tindall Limestone Aquifer Water Allocation Plan
NASY	Northern Australia Sustainable Yields project
NLC	Northern Land Council
NPF	Northern Prawn Fishery
NPV	net present value
NSW	New South Wales
NT	Northern Territory
NTU	nephelometric turbidity unit
O&M	operation and maintenance

SHORT FORM	FULL FORM
PAW	Plant available water
PAWC	plant available water capacity
PE	potential evaporation
PET	potential evapotranspiration
PHN	primary health network
PV	present value
RCC	roller compacted concrete
RCP	Representative Concentration Pathway
SA2	ABS Statistical Area Level 2
SA4	ABS Statistical Area Level 4
SAWR	Strategic Aboriginal Water Reserve
SEIFA	Socio-economic Indexes for Areas
SGG	soil generic group
SOI	Southern Oscillation Index
SILO	Scientific Information for Land Owners (database)
SSP	Shared Socio-economic Pathways
SST	sea surface temperature
TEU	twenty-foot equivalent unit
TDS	total dissolved solids
TLA	Tindall Limestone Aquifer
TN	total nitrogen
TP	total phosphorus
UNEP	United Nations Environment Program
VFD	variable frequency drive
WA	Western Australia
WAP	water allocation plan
WS	wet season
WSSV	White spot syndrome virus

Units

UNIT	DESCRIPTION
cm	centimetre
GL	gigalitre (1,000,000,000 litres)
GWh	gigawatt hour
km	kilometre (1000 metres)
L	litre
m	metre
mAHD	metres above Australian Height Datum
mg	milligrams
mm	millimetre
ML	megalitre (1,000,000 litres)
ppt	parts per trillion

Data sources and availability

The Roper River Water Resource Assessment obtained a range of data for use under licence from a number of organisations, including the following:

- Australian Government (Geoscience Australia)
  - GEODATA Topo 250K Series 3 – spatial data for mapping
    - Licence: Creative Commons Attribution 3.0 Australia, http://creativecommons.org/licenses/by/3.0/au/, (c) Commonwealth of Australia (Geoscience Australia) 2014
    - https://data.gov.au/dataset/ds-dga-c5c2d224-aa95-4b6b-9e0c-bd9f25301ffc/details?q=top%20250k%20series%203
  - SRTM-derived 3 Second Digital Elevation Models Version 1.0
    - Licence: The 3 second DEMs were released under Creative Commons attribution licensing in ESRI Grid format
    - https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search?node=srv#/metadata/69888
  - GEODATA 9 second DEM and D8: Digital Elevation Model Version 3
    - Licence: Creative Commons Attribution 4.0 International Licence
    - https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search?node=srv#/metadata/66006
- Esri
  - *World Imagery Map Service* – map service of satellite imagery for the world and high-resolution imagery for the United States and other areas around the world. Imagery is sourced from GeoEye IKONOS, Getmapping, AeroGRID, IGN Spain, IGP Portugal, i-cubed, USGS, AEX, Aerogrid, Swisstopo and by the GIS User Community.
    - https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9
- Atlas of Living Australia - a collaborative, national project that aggregates biodiversity data from multiple sources and is freely available and usable online.
  - https://www.ala.org.au/
- Australian Wetlands Database - online access to information on Australia's Ramsar wetlands and sites listed in the Directory of Important Wetlands of Australia, Australia's internationally and nationally important wetlands respectively.
  - http://www.environment.gov.au/water/wetlands/australian-wetlands-database

Glossary and terms

Anthropogenic: a human impact on the environment.

Aquifer: a permeable geological material that can transmit significant quantities of water to a bore, spring, or surface water body. Generally, 'significant' is defined based on human need, rather than on an absolute standard.

Aquitard (confining layers): a saturated geological unit that is less permeable than an aquifer, and incapable of transmitting useful quantities of water. Aquitards often form a confining layer over an artesian aquifer.

Artesian: a general term used when describing certain types of groundwater resources. Artesian water is underground water confined and pressurised within a porous and permeable geological formation. An artesian aquifer has enough natural pressure to allow water in a bore to rise to the ground surface. Subartesian water is water that occurs naturally in an aquifer, which if tapped by a bore, would not flow naturally to the surface. Artesian conditions refer to the characteristics of water under pressure.

Basement: the crust below the rocks of interest. In hydrogeology it means non-prospective rocks below accessible groundwater. Commonly refers to igneous and metamorphic rocks which are unconformably overlain by sedimentary beds or cover material, and sometimes used to indicate 'bedrock' (i.e. underlying or encasing palaeovalley sediments).

Benthic: the ecological region at the lowest level of a body of water such as an ocean or a lake, including the sediment surface and some sub-surface layers.

Current development: the level of surface water, groundwater and economic development in place as of 1 July 2013. The Assessment assumes that all current water entitlements are being fully used.

Development: see entries for 'current development' and 'future irrigation development'.

Discount rate: the percentage by which future cost and benefits are discounted each year (compounded) to convert them to their equivalent present value (PV)

Drainage division: the area of land where surface water drains to a common point. There are 12 major drainage divisions in Australia. At a smaller scale, surface water drainage areas are also referred to as river basins, catchments, or watersheds.

Drawdown: the lowering of groundwater level resulting from the extraction of water, oil or gas from an aquifer.

Ecosystem services: the contributions that ecosystems make to human wellbeing.

Eutrophication: the ecosystem response to the addition of artificial or natural substances, such as nitrates and phosphates, through fertilizers or sewage, to an aquatic system. One example is an 'algal bloom' or great increase of phytoplankton in a water body as a response to increased levels of nutrients.

Environmental flows: describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well being that depend on these ecosystems.

Flow regime: the entire pattern of flow in a river – from how long it lasts, to how frequently it flows and how large it is.

Fecundity: the potential reproductive capacity of an individual or population.

Fertigation: application of crop nutrients through the irrigation system (i.e. liquid fertiliser)

Future irrigation development: is described by each case study storyline (see chapters 8 to 10); river inflow and agricultural productivity are modified accordingly.

Geological basin: layers of rock that have been deformed by mega-scale geological forces to become bowl-shaped. Often these are round or oblong with a depression in the middle of the basin.

Geological formation: geological formations consist of rock layers that have common physical characteristics (lithology) deposited during a specific period of geological time.

Groundwater (hydrogeology): water that occurs within the zone of saturation beneath the Earth's surface. The study of hydrogeology focuses on movement of fluids through geological materials (e.g. layers of rock).

Groundwater basin: a groundwater basin is a non-geological delineation for describing a region of groundwater flow. Within a groundwater basin, water enters through recharge areas and flows toward discharge areas.

Groundwater divide: a divide that is defined by groundwater flow directions that flow in opposite directions perpendicular to the location of the divide.

Groundwater flow (hydrodynamics): within a groundwater basin, the path from a recharge area to a discharge area is referred to as a groundwater flow system, where travel time may be as short as days or longer than centuries, depending on depth. The mechanics of groundwater flow – the hydrodynamics – are governed by the structure and nature of the sequence of aquifers.

Groundwater flow model: a computer simulation of groundwater conditions in an aquifer or entire groundwater basin. The simulations are representations based on the physical structure and nature of the sequence of aquifers and rates of inflow – from recharge areas – and outflow – through springs and bores. **Groundwater level:** in this report refers to the elevation of equivalent freshwater hydraulic head at 25 °C

Groundwater recharge and discharge: recharge occurs where rainfall or surface water drains downward and is added to groundwater (the zone of saturation). Discharge occurs where groundwater emerges from the Earth, such as through springs or seepage into rivers.

Hydrodynamics: the study of liquids in motion.

Internal rate of return (IRR): the discount rate at which the net present value (NPV) is zero.

Legume: pulse crop.

Lithology: the character of a rock; its composition, structure, texture, and hardness.

Net present value: a standard method for using the time value of money to appraise long-term projects by measuring the differences between costs and revenues in present value terms.

Palaeochannel: refers to the main channel of ancient rivers, sometimes called the 'thalweg', the lowest point of incision along the river bed where coarser sediments are commonly deposited. Former river channels that are recognised in the surface (from aerial or satellite images) or subsurface (typically in aerial electromagnetic surveys or drilling).

Permeability: a measurement describing the ability of any fluid (water, oil) to pass through a porous material. Values vary widely, with higher values corresponding to aquifers (i.e. highly permeable) and lower values corresponding to aquitards (i.e. less permeable).

Refugia: habitat for species to retreat to and persist in.

Regolith: weathered upper layer.

Residual value: calculated as the proportional asset life remaining multiplied by the original asset price.

Riparian: of, on, or relating to the banks of a watercourse. A riparian zone is the area of land immediately adjacent to a stream or river. Plants found within this zone are collectively known as riparian vegetation. This vegetation frequently contains large trees that stabilise the river bank and shade part of the river.

River reach: an extent or stretch of river between two bends.

Streamflow: is the flow of water in rivers and other channels (creeks, streams etc.). Water flowing in channels comes from surface runoff, from groundwater flow, and from water discharged from pipes. There are a variety of ways to measure streamflow – a gauge provides continuous flow over time at one location for water resource and environmental management or other purposes; it can be estimated by mathematical equations. The record of flow over time is called a hydrograph. Flooding occurs when the volume of water exceeds the capacity of the channel.

Triple-bottom-line: an accounting framework that incorporates three dimensions of performance: social, environmental and financial.

Watertable: the surface where the groundwater level is balanced against atmospheric pressure. Often, this is the shallowest water below the ground.

Appendix C

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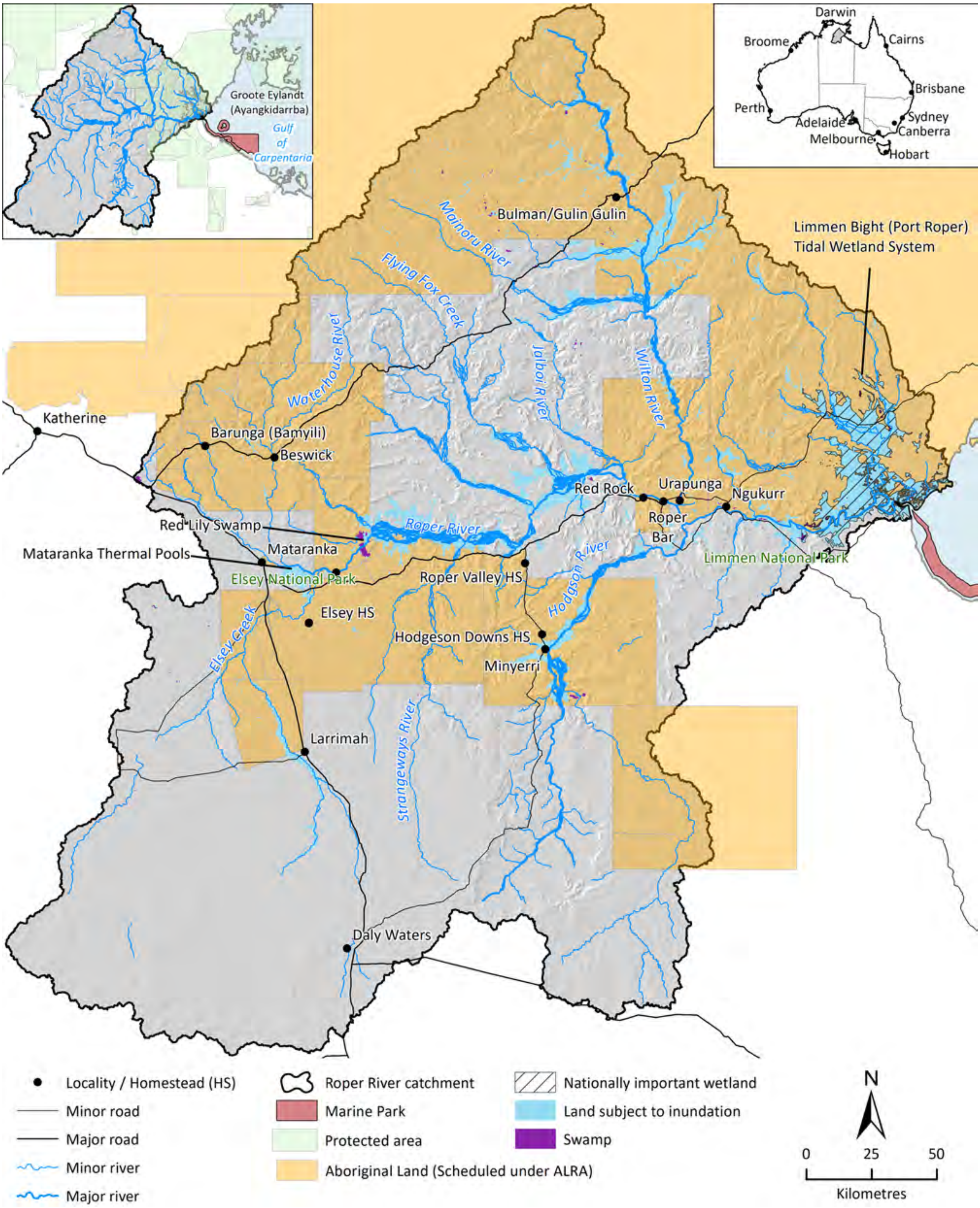
Appendix D

Detailed location map of the Roper catchment and surrounds



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Contact us

1300 363 400
+61 3 9545 2176
csiroenquiries@csiro.au
csiro.au

For further information

Environment
Dr Chris Chilcott
+61 8 8944 8422
chris.chilcott@csiro.au

Environment
Dr Cuan Petheram
+61 467 816 558
cuan.petheram@csiro.au

Agriculture and Food
Dr Ian Watson
+61 7 4753 8606
ian.watson@csiro.au