

Pristine Estuaries: Providing Basic Biophysical Information for Future Management

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Abstract

The Near-Pristine Estuaries project in the Coastal CRC aims to improve our understanding of near-pristine coastal waterways from a national perspective by collating and synthesising existing data, and mapping the habitats of these systems. During the NLWRA, the habitats of 537 coastal waterways around Australia were mapped. However, only 41 of those chosen for mapping were in near-pristine condition. This project will redress this gap by providing mapped habitat areas for ~130 near-pristine estuaries. The data obtained will be used to improve existing conceptual models, especially of tidal creeks, and to help elucidate the human imprint on Australia's coastal ecosystems.

Key Words:

Sedimentary habitats, OzEstuaries website, Tropical estuaries

Introduction

During the National Land and Water Resources Audit (NLWRA; 1), roughly half of Australia's estuaries were classified as "near-pristine". "Near-pristine" estuaries are those with relatively little or no apparent human impact. Little is known about these systems as they largely exist along the remotest and least explored parts of Australia's coastline, such as far northern Australia and southwest Tasmania (Figure 1). Much of what we know about estuaries comes from studies in more accessible areas of Australia, such as the southeast and southwest coasts, where estuaries are often quite altered by human activity.

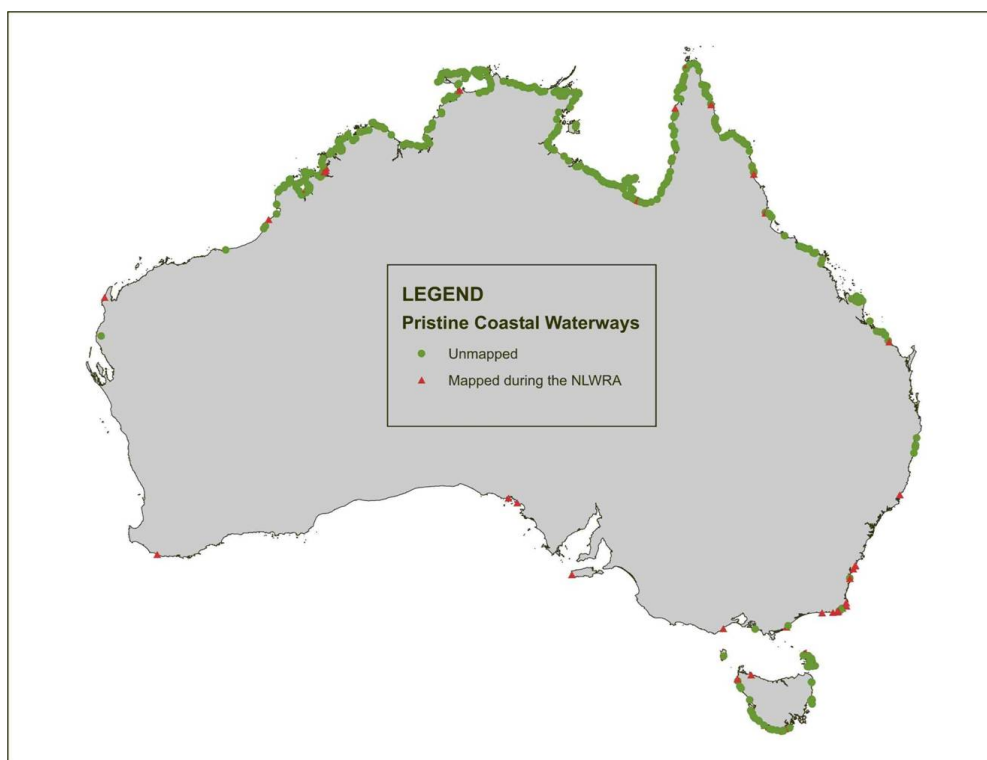


Figure 1. The locations of near-pristine coastal waterways in Australia.

There is a perceived need to learn more about pristine estuaries from both scientific and protective management perspectives. Near-pristine coastal waterways contain important baseline information for comparisons between regions and systems, in terms of water quality, ecology, and geomorphology.

The *Near-Pristine Estuaries Project* in the Coastal CRC aims to improve our understanding of Australia's near-pristine coastal waterways by collating and synthesising existing data and information, and by mapping habitat areas of a representative number of these systems. During the NLWRA, the habitats of 537 coastal waterways were mapped; however, only 41 of those chosen for mapping were in near-pristine condition. This project will redress this gap by providing mapped habitat areas for ~130 of the 424 currently unmapped near-pristine estuaries. The data obtained will be used to improve existing conceptual models (2), especially of tidal creeks, and to help elucidate the human imprint on Australia's coastal ecosystems.

What Exactly is a “Pristine Estuary”?

Defining what is meant by “pristine” can be problematic. Whether an estuary is classified as pristine or not really depends on the criteria used, which in turn is dependent on the available data. We use the classification of the NLWRA (Table 1), which was based on quantitative and qualitative information, and expert opinion on the part of State and the Territory governments (1).

Table 1. The criteria for near-pristine estuaries used by the NLWRA (1).

<i>Physical Characteristics</i>	<i>Condition</i>
Catchment natural cover	>90%
Land use	Limited roads and disturbance to natural conditions and processes
Catchment hydrology	No dams or impoundments, virtually nil abstraction
Tidal regime	No impediments to tidal flow, changes from natural morphology (e.g. Training walls, barrages, bridges and causeways)
Floodplain	Wetlands intact in vegetation and hydrology, no alterations to flood pattern
Estuary use	Extractive activities limited to indigenous or limited and sustainable commercial and recreational fishing, no aquaculture
Pests and weeds	Minimal impact on estuary from catchment weeds and limited pests and weeds within estuary
Estuarine ecology	Ecological systems and processes intact (e.g. benthic flora and fauna)

Habitat Mapping

As a measure of the spatial extent of different types of estuarine habitats, geomorphologically distinct areas of the estuaries (geomorphic habitats) will be mapped using aerial photographs and satellite images. The project will map approximately ~130 near-pristine estuaries, selected to achieve a representative sample in terms of: geomorphic classification (2) and coastal geomorphic regions (3). Where possible, ~30 estuaries will be mapped from each of the seven geomorphic classes (Table 2) and spread across the six geomorphic regions (Figure 2). These geomorphic regions divide the Australian coastline on the basis of tide, wave, and river characteristics. For example, the *North-East Coast* is characterised by high tidal energy, low wave energy, and high summer and low winter river energy, whereas the *South-East Coast* is characterised by high wave, low tide, and moderate year round river energy. State and Territory preferences will also be taken into account.

The final maps will comprise industry-standard ARC GIS files consisting of a base map of the estuary boundary, and vector layers showing a range of sub-aerial, tidal, and sub-tidal environments. The maps will add to those already mapped by the NLWRA, which are currently available for viewing and download in the Online GIS in OzEstuaries (www.ozestuaries.org; follow the OnLine GIS link).

Table 2. The seven geomorphic classes of coastal waterway (2).

Classification	Landward (Nearer to the river or catchment)	Middle (Centre or main water body)	Seaward (Entrance or mouth adjacent to the open ocean)	Comments
Embayment, (EMB) (Wave- or Tide-Dominated)	Highly variable river-derived sediment and freshwater input, unrestricted wave penetration.	Deep broad basin flanked by narrow intertidal zone, and exposed bedrock and rocky reef.	Wide, unconstricted entrance, large water exchange with the sea.	Marine conditions prevail throughout system. May evolve into an estuary with time.
Wave-dominated Estuary, (WDE)	River-derived sediment and freshwater input dominates. Fluvial-bayhead delta development	Broad, low energy central basin, flanked by small areas of intertidal environments.	Entrance constricted by a barrier, that attenuates tides within the estuary. Marine sediment dominates	Sediment is mostly trapped in the central basin. Limited oceanic water exchange
Wave-dominated Delta, (WDD)	Riverine sediment input. Floodplain/alluvial plain, shifting channel.	Channel(s) act as a conduit for transport of sediment offshore, flanked by thin intertidal areas.	Constricted entrance characterised by a barrier and tidal delta deposits, export of sediment to the sea.	Represents a WDE mostly infilled by sediment. River inputs are predominantly transported offshore.
Coastal Lagoon/ Strandplain, (CL/SP)	Very little (or no) freshwater and river-sediment input. No fluvial-bayhead delta	Low energy central basin dominates. Flanked by small areas of intertidal environments.	Intermittent entrance (often closed) characterised by barrier and tidal delta deposits. Tides attenuated/excluded.	Similar to a small WDE. Frequently isolated from the sea, and slow infilling.
Tide-dominated Estuary, (TDE)	Riverine sediment input. Floodplain/alluvial plain.	Wide tidal channel network, flanked by large areas of inter- & sub-tidal environments.	Wide funnel-shaped entrance containing tidal sand banks, large tidal exchange.	Shifting channels and sand banks, fine sediments trapped in inter- & sub-tidal environments.
Tide-dominated Delta, (TDD)	Riverine sediment input. Floodplain/alluvial plain, shifting channel.	Tidal channel network acts as conduit for sediments. Smaller intertidal area.	Wide funnel-shaped entrance containing tidal sand banks that may have merged with intertidal environments.	Represents a TDE mostly infilled by sediment. River inputs are predominantly transported offshore.
Tidal Creek, (TC)	Very little (or no) freshwater and river-sediment input. No fluvial-bayhead delta	Wide channel network flanked by large areas of inter- & sub-tidal environments.	Wide funnel-shaped entrance that does not contain tidal sand banks, large tidal exchange.	Similar to a TDE, contains sediment derived from marine sources only

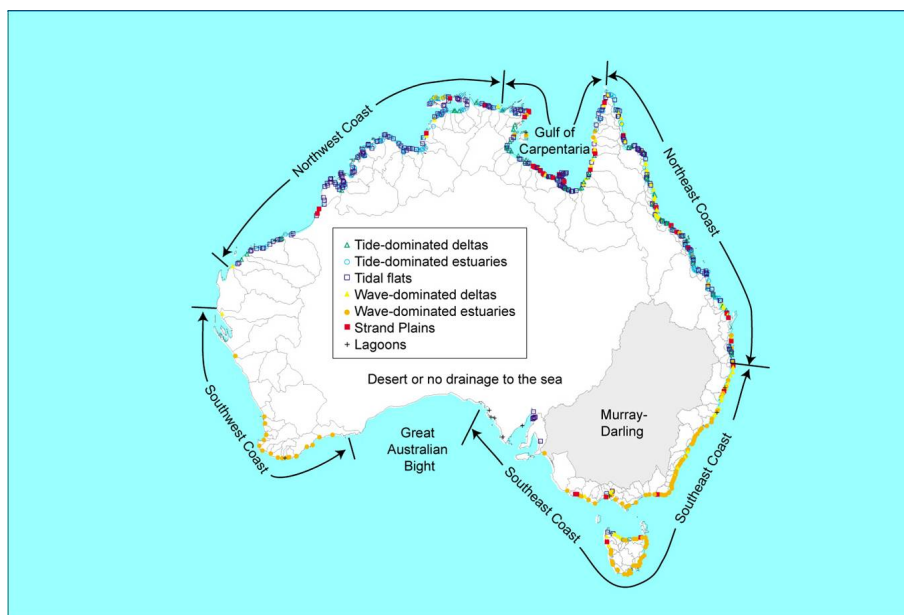


Figure 2. The six main coastal geomorphic regions in Australia (3).

Baseline Geomorphology

Information from near-pristine coastal waterways will be used to quantify the natural variability of geomorphic and sedimentary environments (geomorphic habitats) that comes about without the significant overprinting effects of human activities. These baseline data will be compared with data for modified systems to make an assessment of the relative effects of humans on the diversity and abundance of geomorphic habitats in Australia's coastal waterways. This is just one example of how basic biophysical information can help with the protective management of Australia's coastal waterways for better conservation values.

Collation and Synthesis of Existing Knowledge

A comprehensive literature review will collate and synthesise existing biological, chemical, and physical information on near-pristine estuaries. It will also summarise current management of near-pristine estuaries and identify information gaps, needs, and suggestions for management. In addition, it has become apparent, through talks with researchers and managers, that some near-pristine estuaries may need reclassification as they are currently being impacted by such things as aquaculture and grazing.

Information Wanted

If you have worked on or know of existing studies on any near-pristine coastal waterways, the project team would like to know about your experience or findings (see list below). Your thoughts on the concept or definition of pristine estuaries would also be appreciated.

References:

- (1) NLWRA 2002. *Australian Catchment, River and Estuary Assessment 2002*. Commonwealth Government, Canberra. www.audit.ea.gov.au/ANRA/atlas_home.cfm
- (2) Ryan, D. A., Heap, A. D., Radke, L., and Heggie, D. T., 2003. *Conceptual models of Australia's estuaries and coastal waterways: applications for coastal resource management*. Geoscience Australia, Record 2003/09, 127 pp. An online version of the information contained in this report is at: www.ozestuaries.org under the "Conceptual Models" link.
- (3) Harris, P.T., Heap, A.D., Bryce, S.M. Porter-Smith, R., Ryan, D.A., and Heggie, D.T. (2002). Classification of Australian Coastal depositional environments based upon a quantitative analysis of wave, tidal and fluvial power. *Journal of Sedimentary Research* **72** (6), 858-870.

Major implication for Future Coastal Management

- (1) Providing baseline data for measuring change from 'natural' conditions and future change in pristine estuaries.

NEW SOUTH WALES

DURRAS LAKE
JERUSALEM CREEK
KHAPPINGHAT CREEK
LAKE ARRAGAN AND RIVER
LAKE BRUNDEREE
LAKE CAKORA/LAGOON
LAKE TAROURGA
MEROO LAKE
MERRICA RIVER
NADGEE LAKE AND INLET
SANDON RIVER
STATION CREEK
TERMEIL LAKE
WILLINGA LAKE

NORTHERN TERRITORY

ALL NIGHT CREEK
ANAMAYIRRA CREEK
ANDRANANGOO CREEK
ANGURUGUBIRA LAKE
ANGURUKI CREEK
APSLEY STRAIT
ARNHEM BAY
BARALMINAR RIVER
BARUNGBIRINUNG RIVER
BING BONG CREEK
BLUE MUD BAY
BLYTH RIVER
BONKALII CREEK
BUCKINGHAM RIVER
BYNOE HARBOUR
CALVERT RIVER
CATO RIVER
CORRAWARA CREEK
CULLALA CREEK
CURTIS HAVEN
DALY RIVER
DARWARUNGA RIVER
DE VERE CREEK
DJIGAGILA CREEK
DONGAU CREEK
DUDWELL CREEK
EAST ALLIGATOR
FAT FELLOWS CREEK
FITZMAURICE RIVER
FORSYTH CREEK
GIDDY RIVER
GLYDE RIVER
GOOMADEER RIVER
GOROMURU RIVER
GUDGERAMA CREEK
HABGOOD RIVER
HART RIVER
HUTCHINSON STRAIT
ILAMARYI RIVER
JESSIE RIVER
JOHNSTON RIVER
KEEP RIVER
KILU-IMPINI CREEK
KING CREEK
KING RIVER
KOOLATONG RIVER
KURALA RIVER
LATRAM RIVER
LEADERS CREEK
LIMMEN BIGHT RIVER
LITTLE LAGOON
LITTLE MOYLE INLET
LIVERPOOL RIVER
MAJARI CREEK
MARLIGUR CREEK
MCARTHUR RIVER
MINIMINI CREEK
MIRIKAU-YUNGA CREEK
MIYANGKALA CREEK
MOYLE RIVER
MULE CREEK
MUNTAK CREEK
MURGENELLA CREEK
NAYAMPI CREEK
NEW MOON INLET
NGANDADAUDA CREEK
NT001
NT007
NT009

NT014
NT037
NT038
NT039
NT055
NT079
NT080
NT082
NT093
NT096
NT104
NT106
NT111
NT112
NT113
NT114
NT115
NT117
NT118
NT128
NT130
NUNGBALGARRI CREEK
PERAKERY CREEK
PETER JOHN RIVER
POPHAM BAY
PORT BRADSHAW
PORT BREMER
PORT ESSINGTON
PORT HURD
PORT KEATS
RAFFLES BAY
REYNOLDS RIVER
ROBINSON INLET
ROBINSON RIVER
ROPER RIVER
ROSE RIVER
ROSIE CREEK
SALTWATER CREEK
SAUNDERS CREEK
SEVEN EMU CREEK
SHAMROCK BAY
SHARK CREEK
SILVIO BAY
SLIPPERY CREEK
SOUTH ALLIGATOR RIVER
SPILLEN CREEK
TOWNS RIVER
TREPANG BAY
TRIAL BAY
TUNGANAPU CREEK
VICTORIA RIVER
WALKER RIVER
WEARYAN RIVER
WEST ALLIGATOR RIVER
WEST ARM
WILDMAN RIVER
WOODS INLET
WOOLEN RIVER
WURUGOIJ CREEK

QUEENSLAND

ACCIDENT INLET
ALBERT RIVER
ARCHER BAY
BAFFLE CREEK
BAUER INLET
BEEBER CREEK
BIZANT RIVER
BLACKWATER/MITCHELL CREEK
BLOOMFIELD RIVER
BOYORUNGA INLET
BRANCH CREEK
BRANNIGAN CREEK
BREAKFAST CREEK
CANOE PASSAGE
CHANNON CREEK
CHAPMAN RIVER
CHESTER RIVER
CLAUDIE RIVER
CLIFFDALE CREEK
COLLOSEUM INLET
COOPER CREEK
CORAL CREEK
COWAL CREEK
CROCODILE CREEK
CRYSTAL CREEK

CURTIS ISLAND CREEK
DAINTREE RIVER
DALLACHY CREEK
DALMUMEAH CREEK
DEAD DOG CREEK
DEEP CREEK
DEMPSTER CREEK
DISASTER INLET
DOUGHBOY RIVER
DUCIE RIVER
DUCK CREEK
EAST CREEK
EDWARD RIVER
EIGHT MILE CREEK
ELIZABETH RIVER
ELLIOT RIVER
ESCAPE RIVER
EURI CREEK
EURIMBULA CREEK
FIVE-MILE CREEK
FLINDERS RIVER/BYNOE RIVER
GEORGES CREEK
GILBERT RIVER
GIN ARM CREEK
GLENNIE INLET
GREGORY RIVER
GUM CREEK
HARMER CREEK
HEAD CREEK
HERSEY CREEK
HORSE CREEK
HORSE PLACE CREEK
HOWICK RIVER
HUMMOCK CREEK
HUNTER INLET
ISLAND HEAD CREEK
JACKSON RIVER
JANIE CREEK
JARDINE RIVER
JEANNIE RIVER
JOHN'S CREEK
KANGAROO RIVER
KENDALL RIVER
KENNEDY INLET
KIRKE RIVER
KUNGUNMEAH CREEK
LAGOON CREEK
LEICHHARDT CREEK
LEICHHARDT RIVER
LOCKHARDT RIVER
LOGAN JACK CREEK
LONGFORD CREEK
LOVE RIVER
MACDONALD RIVER
MACKENZIE CREEK
MACMILLAN RIVER
MALAMAN CREEK
MARLESS CREEK
MARRETT RIVER
MASSACRE INLET
MASSEY CREEK
MCIVOR RIVER
MCKENZIE CREEK
MIRALDA CREEK
MISSION RIVER
MISSIONARY BAY
MOONKAN CREEK
MOONLIGHT CREEK
MORNING INLET
NAMALETA CREEK
NESBIT RIVER
NGULWONMEAH RIVER
NOAH CREEK
NOBBIES INLET
NORMAN CREEK
NORMANBY RIVER
NORTH KENNEDY RIVER
OLIVE RIVER
OYSTER CREEK
PANCAKE CREEK/JENNY LIND CREEK
PASCOE INLET
PASCOE RIVER
PASSMORE CREEK
PENNEFATHER RIVER
PINE RIVER BAY

QUEENSLAND CONT.

PORT CLINTON
PORT MUSGRAVE
Q001
Q003
Q006
Q008
Q010
Q013
Q029
Q030
Q031
Q033
Q034
Q037
Q039
Q040
Q045
Q047
Q048
Q049
Q061
Q062
Q093
Q100
Q102
Q105
Q113
Q124
Q125
Q128
Q134
Q136
Q137
Q138
Q139
Q140
Q171
Q256
Q257
Q259
RASPBERRY CREEK
REPULSE CREEK
ROCKY CREEK
ROCKY PONDS CREEK
ROCKY RIVER
RODD'S HARBOUR
ROSS CREEK
ROUND HILL CREEK
SALT ARM CREEK
SALTWATER CREEK
SANDALWOOD RIVER
SHOALWATER CREEK
SKARDON RIVER
SMITHBURNE RIVER
SNAKE CREEK
SPRING CREEK
STAATEN RIVER
STARKE RIVER
STEWART RIVER
SYRELL CREEK
TOONGOOWAHGUN INLET
TOPSY CREEK
TOWBULBULAN RIVER
TULLY INLET
WADALLAH CREEK
WAKOOKA CREEK
WALBOR INLET
WENLOCK RIVER
WILLIAMS INLET
WRECK CREEK
YEATES CREEK
ZOE BAY

SOUTH AUSTRALIA

BREAKNECK RIVER
SMOKEY BAY
TOURVILLE BAY

TASMANIA

ARTHUR RIVER
BATHURST HARBOUR
BIG LAGOON
BLACK RIVER
BRYANS LAGOON
CAMERON INLET
CATAMARAN RIVER
CLOUDY BAY LAGOON
COCKLE CREEK
DOVER RIVER
FOOCHOW INLET
FRENEY LAGOON
FRESHWATER LAGOON
GIBLIN RIVER
GREAT SWANPORT
HENTY RIVER
HIBBS LAGOON
LAGOON RIVER
LEE RIVER
LEWIS RIVER
LOGAN LAGOON
LOUISA CREEK
LOUISA RIVER
MAINWARING RIVER
MIDDLE INLET
MINES CREEK
MODDER RIVER
MULCAHY RIVER
NELSON BAY RIVER
NEW RIVER
NORTH EAST RIVER
PATRIARCH RIVER
PAYNE BAY
PEDDER RIVER
RICES RIVER
ROCKY HEAD RIVULET
SALTWATER LAGOON
SEA ELEPHANT RIVER
SELLARS LAGOON
SHAG LAGOON
SLOOP LAGOON
SOUTH CAPE RIVULET
SOUTHPORT LAGOON
SPERO RIVER
THIRSTY LAGOON
WANDERER RIVER

VICTORIA

BENEDORE RIVER
BETKA RIVER
EASBY CREEK
JACK SMITH LAKE
MALLACOOTA INLET
MERRIMAN CREEK
POWLETT RIVER
RED RIVER
SAINT GEORGE RIVER
SHIPWRECK CREEK
THURRA RIVER
WINGAN INLET
YEERUNG RIVER

WESTERN AUSTRALIA

BALDWIN CREEK
BANNINGARRA CREEK
BEAGLE BAY
BERKELEY RIVER
BOONGAREE ISLAND CREEK
BROKE INLET
CAPE LONDONDERRY CREEKS
CAPE LONDONDERRY CREEKS
CAPE LONDONDERRY CREEKS
CAPE LONDONDERRY CREEKS
CAPE TORRENS EMBAYMENT
CAPE WHISKEY CREEK
CARNOT BAY
CASCADE BAY
CHILE CREEK

CONE BAY
COPPERMINE CREEK
DECEPTION BAY
DISASTER BAY
DOCTORS CREEK
DOUBTFUL BAY EAST
DOUBTFUL BAY SOUTH
EAGLE POINT
FALSE MOUTH OF ORD
FRASER RIVER
GEORGE WATER
GOODENOUGH BAY
HANOVER BAY
HIGH BLUFF CREEK
HOON CREEK
HUNTER RIVER
JAUBERT CREEK
JINUNGA RIVER
KAMMARGOORH RIVER
KELK CREEK
KING GEORGE RIVER
KING SOUND (GOODENOUGH TO CASCADE)
LAKE MACLEOD/CARDABIA
CRK/LYNDON/MINILYA
LAWLEY RIVER
LOMBADINA CREEK
MAY RIVER
MCKELSON CREEK
MEDA RIVER
MISSION COVE
MONTAGUE SOUND CREEKS
MONTAGUE SOUND CREEKS
MONTAGUE SOUND CREEKS
MONTAGUE SOUND CREEKS
MT CONNOR CREEK
MT WATERLOO CREEKS
MUDGE BAY
MYRIDI BAY
NINGBING RANGE CREEKS
NINGBING RANGE CREEKS
NINGBING RANGE CREEKS
PAULINE BAY
POINT TORMENT CREEKS
POINT TORMENT CREEKS
PORT SMITH
PRINCE REGENT RIVER
PRIOR POINT CREEK
ROBINSON RIVER
ROCKY COVE
ROE RIVER
SADDLE HILL CREEKS
SADDLE HILL CREEKS
SADDLE HILL CREEKS
SALE RIVER
SAMPSON INLET
SCOTT STRAIGHT CREEKS
SCOTT STRAIGHT CREEKS
SCOTT STRAIGHT CREEKS
SCOTT STRAIGHT CREEKS
SCOTT STRAIGHT CREEKS
SECURE BAY
SHOAL BAY
TALBOT BAY
TAPPERS INLET
THOMPSON RIVER
UNNAMED EAST OF ROE
UNNAMED NORTH OF ROE
WADE CREEK
WALCOTT INLET
WEDGE HILL CREEKS
WILLIES CREEK
WOPPINBIE CREEK
YARDIE CREEK
YARDOOGARRA CREEK
YURADDAGI RIVER
