29th NSW Coastal Conference

Living with Uncertainty

31 May - 2 June 2022
Mantra on Salt Beach
Kingscliff

PROGRAM AND ABSTRACT BOOK

Co-Hosted by

Byron Shire Council

TWEED SHIRE COUNCIL

www.coastalconference.com

Contents

Cardno now Stantec

LET US REINTRODUCE OURSELVES:

CARDNO *IS NOW* STANTEC

Cardno, now Stantec understands the complexities of coastal and marine environments. With a global presence and world-class local expertise, we provide tailored solutions to assist our clients in managing, adapting and protecting natural and built assets that align with legislation frameworks.

Bringing together over 35 years of experience, Cardno, now Stantec specialises in coastal and marine engineering, hydrological and hydrodynamic modelling, floodplain management, environment, geomorphology, marine and freshwater ecology and GIS.

OUR CAPABILITIES:

- Coastal, marine and estuarine processes
- Numerical and empirical modelling (winds, waves, currents, sea level, erosion, water quality)
- Monitoring and instrumentation
- Coastal geomorphology
- Coastal hazard vulnerability
- Coastal protection
- Coastal asset design and condition assessment
- Beach nourishment
- Sediment transport
- Dredging
- Environmental impact assessments and environmental management plans
- Climate change impacts
- Environmental monitoring
- Approvals facilitation
- Benthic habitat mapping
- Sediment and water quality
- Data capture, analysis and presentation
- Data management and operating with large datasets (GIS)

View our recent projects: cardno.com/projects/

Welcome from the Host Councils

Welcome to the 29th NSW Coastal Conference.

It's a great honour for the Tweed and Byron Shire Councils to co-host this gathering of more than 250 delegates from a diverse range of fields, united by an interest in coastal, estuarine and marine science, research and management.

The Tweed and Byron Shires boast a combined 72 kilometres of coastline, 1 river, 7 estuaries and their catchments and some of the most famous beaches in the world.

Our beaches and waterways, along with our world-heritage listed rainforests, small villages and eclectic communities attract more than eight million visitors a year and this number is expected to grow as international travel resumes.

The natural beauty of the Tweed and Byron Shires underpins our tourism industries and our economies and we all have a role in protecting our magnificent and sensitive environment.

While the COVID-19 pandemic presented enormous economic challenges for our shires, this year we, along with our neighbouring Council areas, experienced floods with devastating impacts on our residents, businesses and the environment.

This conference could not have come at a better time as we come together to share knowledge, information, experience and ideas to empower and help us all better manage, protect and enhance our coastal areas in the face of climate change and uncertainty.

If this is your first time to our glorious part of the world we do hope you enjoy your stay and look forward to seeing you back here to explore everything the Byron and Tweed Shires have to offer.

Mayor Michael Lyon
Byron Shire Council

Mayor Chris Cherry
Tweed Shire Council

Message from the Major Sponsor

The Department of Planning and Environment is pleased to be the major sponsor of the 29th NSW Coastal Conference in Kingscliff.

The department brings together specialists in urban and regional planning, natural resources, industry, environment, heritage, Aboriginal and social housing, and Crown lands and water.

The Environment and Heritage Group is part of the department and our vision is for a thriving, sustainable and resilient New South Wales.

We work with communities, businesses, and governments to protect, preserve and strengthen the quality of our natural environment and heritage.

We are committed to creating thriving environments, communities and economies that benefit the people of New South Wales.

The department is pleased to provide its ongoing support to the NSW Coastal Conference as this annual event provides an opportunity for coastal managers and stakeholders to come together to share experiences and build strong working relationships to meet future challenges in managing the state's coastal and estuarine environments.

Sponsors

The Organising Committee for the 29th NSW Coastal Conference acknowledge with gratitude the support received from the conference sponsors and supporters.

Major Sponsor:

NSW GOVERNMENT | Planning & Environment

Silver Sponsor:

NSW GOVERNMENT | Local Land Services

Bronze Sponsor (Welcome Reception)

NSW GOVERNMENT | Planning & Environment Crown Lands

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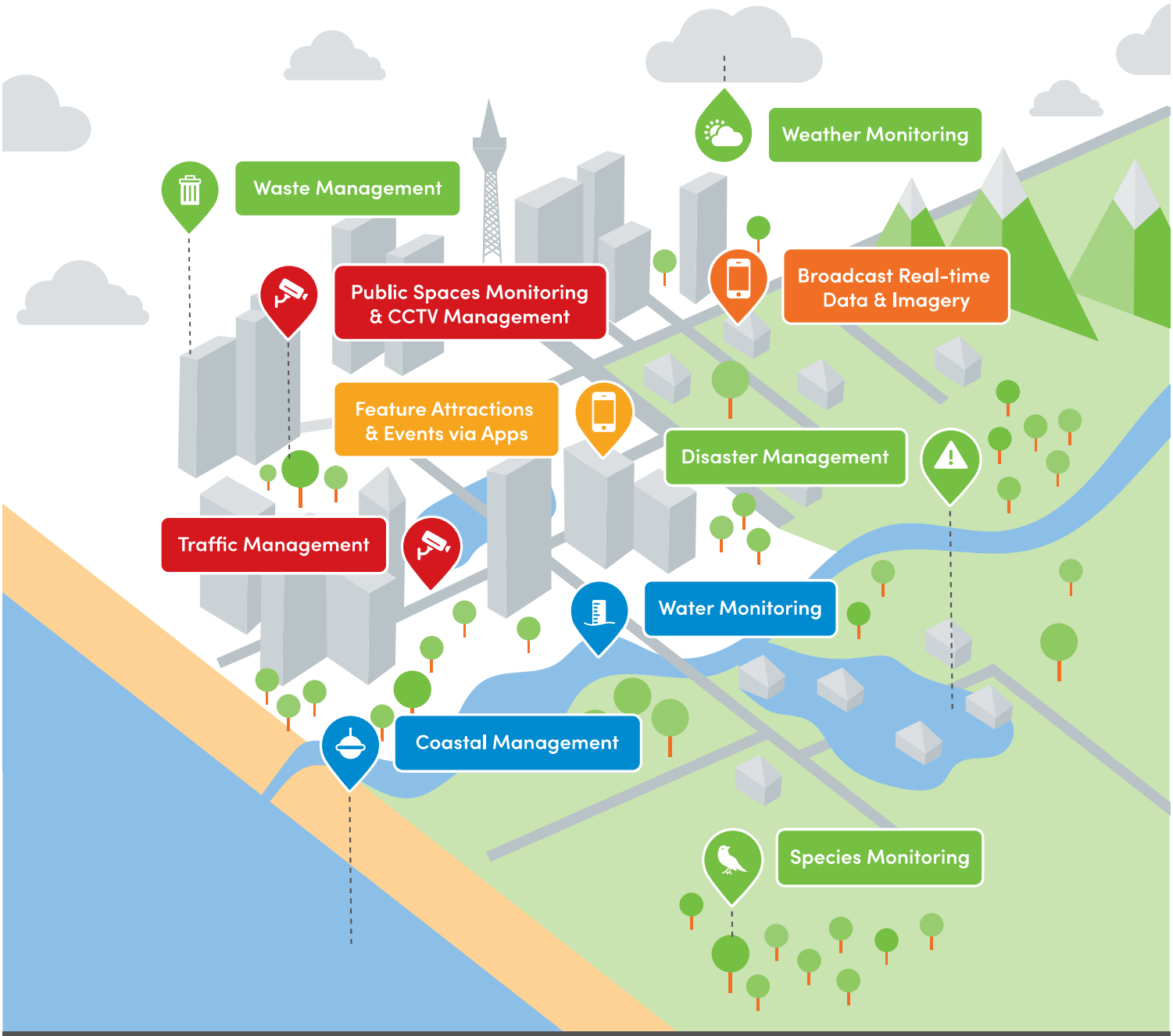
3CrownsTech

Solve environmental problems with real-time data and video automation.



Come and visit us in the exhibitor area to find out about our special offer for conference participants.

Trade Displays

Exhibiting organisations include:

- 3CrownsTech
- Australian Concrete Mats
- Australian Coastal Society
- Bluemont
- Bluecoast Consulting Engineers
- Department of Planning & Environment – Crown Lands
- Local Land Services
- Manly Hydraulics Laboratory
- Royal HaskoningDHV
- Soil Conservation Service
- Transport for NSW

Conference Committee

Melinda Cox	Local Land Services
Marc Daley	Department of Planning and Environment
Chloe Dowsett	Byron Shire Council
Zoe Immisch	Department of Planning and Environment
Jane Lofthouse	Tweed Shire Council
Malcolm Robertson	Department of Planning and Environment - Crown Lands
Orla Seccull	Byron Shire Council
Debra Stokes	Southern Cross University
Jonathan Yantsch	DPI Fisheries

General Information

Conference Managers
Please direct any enquiries to the NSW Coastal Conference Managers:

NSW Coastal Conference Managers - East Coast Conferences

Amy McIntosh, Jayne Hindle, Jasmine Durbidge
Mobile: 0408 220 188 Tel: (02) 6650 9800
amy@eastcoastconferences.com.au
www.coastalconference.com

Conference Venue
Mantra on Salt Beach
Gunnamatta Avenue, Kingscliff
P: (02) 6670 5000

Registration Desk
All delegates will need to check in at the Registration Desk to collect your name badge and conference materials. This will take place in the hotel foyer of the Mantra on Salt Beach at the following times:

Monday 30th May	5.00pm – 6.00pm
Tuesday 31st May	8.00am – 5.00pm
Wednesday 1st June	8.30am – 1.30pm
Thursday 2nd June	8.30am – 1.00pm

Catering
Morning and afternoon teas and lunches are included in the registration fee. Morning tea and afternoon tea will be served in the trade area and lunch will be poolside.

Special dietary requirements: All effort has been made to accommodate delegates who indicated special dietary requests when registering. Please identify yourself to venue catering staff, who will assist you.

Evaluation of the Conference
Following the conclusion of the Conference, all delegates who provided an email address will receive a link to the online conference evaluation form. Please take the time to complete the short survey, as your feedback is very important to us and will be used for future conferences.

Posters
Posters will be on display throughout the conference in the trade display area and can be viewed during the catering breaks. Authors will be available to discuss their posters during Wednesday Morning Tea Break from 10.35am – 11.05am.

Please return your voting slip for the best poster to the registration desk. Sponsored by BMT

Meeting Rooms for Sessions
Sessions will be held in the following rooms:

Plenary Sessions	-	Plantation Room
Concurrent Session 'A'	-	Plantation Room 1
Concurrent Session 'B'	-	Plantation Room 2
Concurrent Session 'C'	-	Plantation Room 3
Poster Display	-	Hotel Foyer
Trade Display	-	Hotel Foyer

Concurrent Sessions
Delegates are free to attend the concurrent session of their choice. Presentations are scheduled to start/finish at times given in the program. There will be a 5 minute 'changeover' period between presentations.

Name Badges
Name badges will be issued to all registered delegates on arrival at the registration desk. Please ensure you wear your name badge at all times, including social functions.

Annual NSW Coastal Management Awards
The NSW Coastal Conference Awards will be presented during the Conference Dinner on Wednesday 1st June 2022. These awards are presented to publicly recognise and acknowledge the contributions of individuals, groups, organisations and agencies toward the ecologically sustainable management of the NSW coastal zone.

Website and Conference Papers
Following the conference, copies of full papers will be available on the conference website www.coastalconference.com. For further information on any particular paper or presentation, please contact the author/presenter directly.

Security
The venue or Conference Managers accept no responsibility for loss of any items left in the function/meeting rooms, other venue areas or car park.

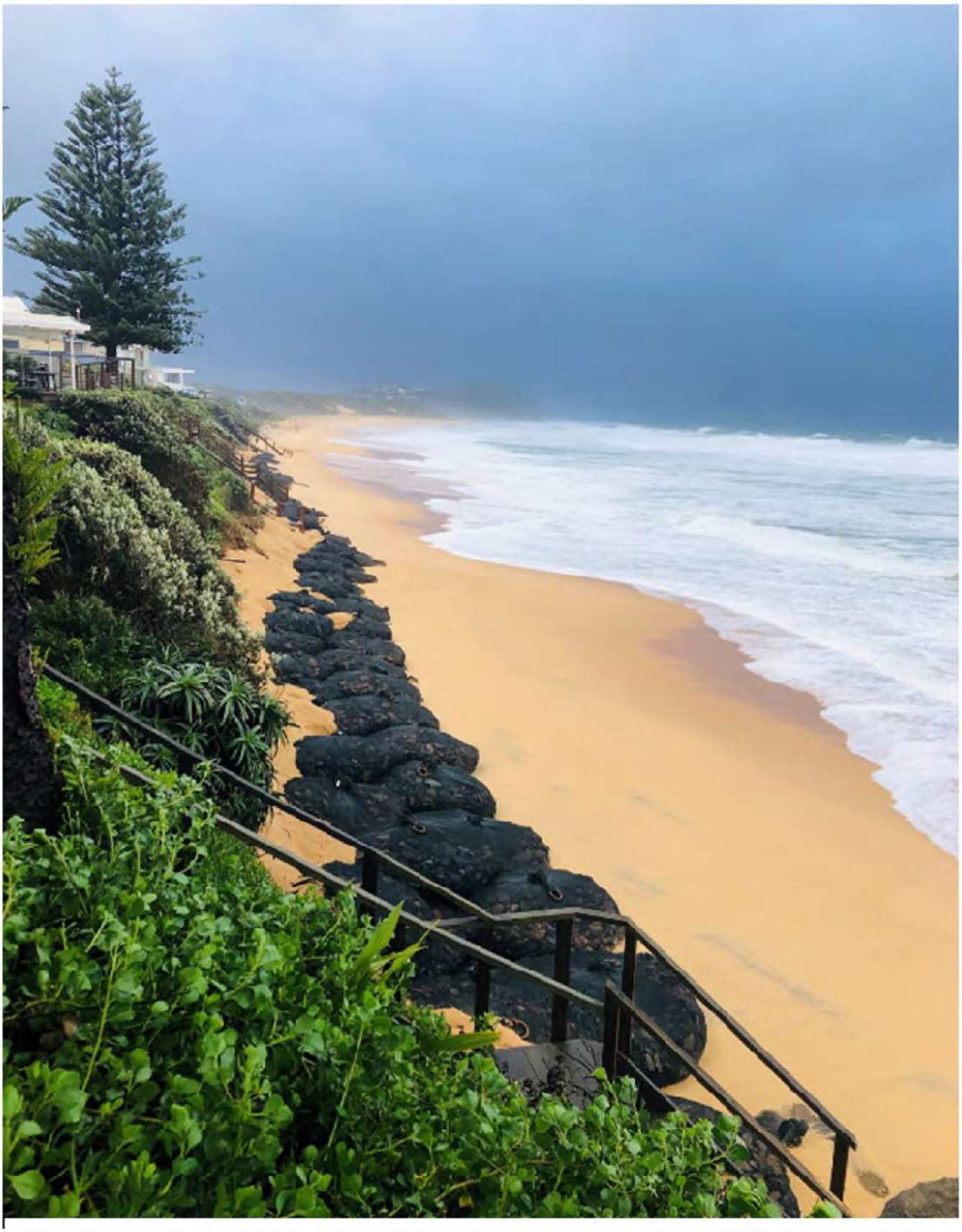
Mobile Phones
Out of respect to speakers and other attendees, please ensure your mobile phone is switched off or on silent mode during the conference sessions.

Conference App
The NSW Coastal Conference will have a Conference App, to keep you up to date on what is happening!!

You would have received an email with the link and information on how to install the app. If you are having any difficulty with the conference app, please see staff at the Registration Desk.

Official Conference Hashtag #nswcoastalconference

WIFI
Connect to Wi-Fi: **MantraOnSalt**
(note: if the log in page does not appear once a browser is open, enter mantraonsaltbeach.com.au into the address bar)
Select: **First Time User?**
Select: **I have an access code**
Enter Conference Code: **Coastal**
Tick to agree to the Terms and Conditions
Click: **Start Browsing**



BLUEMONT

–ROCK BAGS–

Social Functions

Welcome Reception – Tuesday 31st May 2022

Venue: Salt Bar, Kingscliff
Time: 7.00pm – 10.30pm
Dress: Casual
Address: 1 Bells Blvd, Kingscliff – short walk from the conference venue

Sponsored by:

NSW GOVERNMENT | Planning & Environment Crown Lands

Conference Dinner & Annual NSW Coastal Management Awards – Wednesday 1st June

Venue: Peppers Resort Ballroom
Time: 7.00pm until late
Dress: Smart
Address: Peppers Salt Resort & Spa – short walk from the conference venue

Sponsored by:

Royal HaskoningDHV
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Field Trips

Please ensure you dress appropriately for the weather – sunscreen, hats (or rain gear), appropriate footwear and light jackets. Please ensure you bring a drink bottle. Take away afternoon tea will be provided.

Field Trips Depart at 1.30pm and return 5.00pm, except for the Byron Bay Tour that will return at 5.30pm

FT1: Kingscliff Coastal Management and Tweed Sand Bypassing

Join us on a short bus trip to Kingscliff Beach foreshore to discuss the reinvigoration of the public foreshore area following the erosion events of 2009-2012. A combination of vertical-piled seawall (2010), stepped mass concrete wall (2018) and flexible rock seawall (1995 & 2018) provide protection for the foreshore and allowed for investment in public and Council managed holiday park facilities in this popular coastal town. The balancing of social, economic and environmental values for this major project will be discussed. Back on the bus to head north to Fingal Head, where the recent historic event took place with the Tweed Byron Local Aboriginal Land Council being named Crown Land Manager of Fingal Headland. We then visit the Tweed Sand Bypassing jetty, a joint initiative of the NSW and QLD Governments, which collects and transports sand from the northern most end of Letitia Spit, under the Tweed River and pumps it to outlets in Queensland to replenish the southern Gold Coast beaches and maintain a navigable entrance to the Tweed River.

FT2: Tweed River Cruise

This field trip will be hosted by Tweed Shire Council's Waterways Program. You will board a charter vessel at the Tweed Marina and travel up the Tweed River estuary from the lower reaches to Murwillumbah past Stotts Island Nature Reserve, a remnant lowland rainforest on floodplain and associated wetland habitats. On route are a number of fish friendly road embankment erosion stabilisation works undertaken by Council. The estuary and floodplain setting will provide opportunities to discuss Acid Sulfate Soil management and sustainable agriculture, tidal inundation, recreational use, floodgate management and preparation of the Tweed River Coastal Management Program.

FT 3: Bundjalung Cultural Tour

Tweed Shire lies within the Bundjalung Nation. It is home to the Traditional Owners and Custodians of the land – the Bundjalung People. The coastal landscape is extremely important and holds a cultural story, including cultural connections along the coastal zone and beyond. The relationship of Aboriginal People with this Country is more than just a place to live, it is the living, breathing source of all life, their spiritual home and home of their ancestors' spirits.

This field trip will cover local locations within the Bundjalung Nation where you will hear from local custodians about how to incorporate traditional knowledge and understanding in coastal planning and management to improve outcomes of Aboriginal People.

FT4: Beach walk from Cape Byron to Belongil Beach

Please ensure you pack comfortable walking shoes as there will be 1km of walking during this tour. This tour will also return at 5.30pm to the hotel

Byron Shire's coastal zone is renowned for its biological diversity and natural beauty. It is both a world-renowned tourist destination and an integral part of Byron Shire's urban landscape. The iconic Cape Byron is a dominant feature of the coastline and is the eastern most point of mainland Australia with sweeping views to the north and south. Our coastline is part of the broader regional beach system extending from the Clarence River to Moreton Bay in Queensland.

Coastal processes are complex and dynamic. Due to Byron's location, processes such as erosion and recession are occurring at a significant rate. The coastline is probably one of the most studied parts of eastern Australia, with five coastal plans prepared but not certified. Come take a walk with staff from Council and the Department who have intricate knowledge of the landscape, complexity of issues that face Byron and the contentious nature of coastal planning and management in this vocal community.
This tour will involve a small amount of walking.

Conference Program

(correct at time of printing, subject to change)

Tuesday 31st May 2022

8.00am	**Conference Registration** *Hotel Foyer, Mantra on Salt Beach*
9.00am – 11.00am	**Session 1 – Plenary**
9.00am	**Welcome to Country**
9.10am	**Welcome from Co-Hosts Byron Shire Council and Tweed Shire Council**
9.25am	**Conference Opening** **The Hon. Wendy Tuckerman, MP** *Minister for Local Government*
9.35am	**Address by Major Sponsor – Department of Planning and Environment** **Sharon Molloy,** *Executive Director, Biodiversity and Conservation, Department of Planning and Environment*
9.40am	**"Coastal risk impact on Australia property market"** **Dr Pierre Wiart,** *Head of Climate and Risk Management, CoreLogic International* ***Sponsored by Manly Hydraulics Laboratory***
10.20am	**"Coastal wetland restoration law – uncertainty, flexibility and adaptability"** **Dr Justine Bell-James,** *Associate Professor and Director of Higher Degree Research, The University of Queensland*
11.00am	**Address by Silver Sponsor Local Land Services**
11.05am – 11.30am	**Morning Tea**

Session 2 11.30am – 1.05pm	**2A: Holistic Coastal Management**	**2B: Knowledge, Science & Uncertainty**	**2C: Empowering People**
Location	Plantation Room 1	Plantation Room 2	Plantation Room 3
11.30am – 11.50am	Smart Cameras for coastal monitoring **Chris Drummond** *Water Research Laboratory UNSW Sydney*	The NSW Estuarine Habitat Dashboard: A web-based tool to assist estuarine management **Greg West** *NSW Department of Primary Industries - Fisheries*	Caring for Water Places: a community collaboration in regeneration **Cate Coorey** *Byron Shire Council*
5 min	***Changeover***	***Changeover***	***Changeover***
11.55am – 12.15pm	Managing Beach Accessways - A Rational Approach **Christopher Adamantidis** *Advisian*	Wetland morphology and its effect on sea-level rise modelling in barrier estuaries **Kristian Kumbier** *University Of Wollongong*	Drawing Landscape Narrative **Nathan Galluzzo** *University Of Technology Sydney* & **Norman Graham**, *NSW National Parks & Wildlife Service*
5 min	***Changeover***	***Changeover***	***Changeover***
12.20pm – 12.40pm	Shifting sands on Coastal Crown Land **Malcolm Robertson** *Department of Planning and Environment - Crown Lands* & **Jeremy Visser,** *BMT*	Holistic management of estuaries under climate change requires accurate numerical tools **Danial Khojasteh** *UNSW*	Empowering the tourism community to own it and act on visitor litter **Juliette Myers** *Take 3 for the Sea*

5 min	Changeover	Changeover	Changeover
12.45pm – 1.05pm	Lord Howe Island – From ad-hoc coastal protection to more holistic intervention **Marc Daley** *Department of Planning and Environment*	NSW estuaries webpages: an information tool for prioritising, planning and management **Aaron Wright** *Department of Planning and Environment*	Keeping Fingal Special: A case study of a coastal community working together **Leweena Williams,** *Tweed Byron Local Aboriginal Land Council &* **Kay Bolton**, *Fingal Head Coastcare.*
		Estuary foreshore management: waterfront structures and bank management strategies **Daniel Bucher** *Department Of Planning & Environment - Crown Lands*	Our Coast Our Waterways…turning opinion into activism! **Warren Brown & Vanessa McCann** *Central Coast Council*
1.05pm – 2.00pm	**Lunch**		
Session 3 2.00pm – 3.10pm	**3A: Policy, Decision Making & Funding**	**3B: Lessons from the Field**	**3C: Empowering People**
Location	Plantation Room 1	Plantation Room 2	Plantation Room 3
2.00pm – 2.20pm	Land value consequences of Coastal Hazards and Adaption. Who pays? **Ballanda Sack** *Beatty Hughes & Associates*	Managing coastal waterways after the Black summer Bushfires in South East NSW **Cherie Parmenter** *Department of Planning and Environment*	Connecting to culture – Engaging First Nations people on coastal management programs **Andrew Williams** *Department of Planning and Environment* **& Emma Maratea** *Rhelm*
5 min	**Changeover**	**Changeover**	**Changeover**
2.25pm – 2.45pm	The collective value of our ocean pools: developing a cost benefit framework **Nicole Larkin,** *NLarkin Design* **& Patrick Fensham,** *SGS Economics and Planning*	Seafood industry adapting to change on the Mid North Coast of NSW **Brian Hughes** *Hunter Local Land Services*	The Manning River Estuary and Catchment Management Program engagement strategy **Louise Duff** *MidCoast Council*
5 min	**Changeover**	**Changeover**	**Changeover**
2.50pm – 3.10pm	Planning for Uncertainty under the Coastal Management Framework: Deep water for decisions-makers? **Kirston Gerathy & Simon Hill** *HWL Ebsworth Lawyers*	Implementing the Lake Illawarra Coastal Management Program – A Year of Learning **Jessica Faustini,** *Wollongong City Council* & **Leslie Reid**, *Shellharbour City Council*	Effective engagement with indigenous communities for Coastal Country **Neil Dufty** *Molino Stewart*
3.10pm – 3.40pm	**Afternoon Tea**		
Session 4 3.40pm – 5.15pm	**4A: Holistic Coastal Management**	**4B: Lessons from the Field**	**4C: Knowledge, Science & Uncertainty**
Location	Plantation Room 1	Plantation Room 2	Plantation Room 3
3.40pm – 4.00pm	Climate Change Adaptation Case Study: Davistown Landform and Flood Management **Joel Fraleigh** *Rhelm*	Physical modelling of innovative rock bag applications **Dan Messiter**, Royal *HaskoningDHV*	Nutrient and organic matter removal efficiency of stormwater control measures **Chris Baiada** *Department of Planning and Environment*
5 min	**Changeover**	**Changeover**	**Changeover**

4.05pm – 4.25pm	Cooperation is the key to manage the Greater Sydney Harbour **Sarah Joyce** *Sydney Coastal Councils Group*	Stockton Beach Erosion, Causes and Solutions **Ron Boyd** *Stockton Community Group*	Prioritising catchment areas for the remediation of wetlands in coastal estuaries **Kate Waddington** *UNSW Sydney*
5 min	***Changeover***	***Changeover***	***Changeover***
4.30pm – 4.50pm	Marine Estate Management Strategy: reflection and adaption **Nicola Johnstone** *NSW Department of Primary Industries - Fisheries*	Adaptive risk management of erosion at Stockton Beach, Newcastle **Natalie Patterson** Royal *HaskoningDHV*	Scaling up coastal wetland rehabilitation with the return of the tide **Max Osborne** *NSW Department of Primary Industries - Fisheries*
5 min	***Changeover***	***Changeover***	***Changeover***
4.55pm – 5.15pm	Outside the (Fruit) Box: A Case Study in Big Picture Coastal Thinking **Neil Dufty**, *Molino Stewart*	Seawalls and sandy beaches - case study Wamberal Beach **Matthew Phillips** *Manly Hydraulics Laboratory*	Engaging Lake Macquarie's recreational users - lessons for managing a 'lifestyle' waterway **Pam Dean-Jones** *Umwelt*
5.15pm	**Close of Day One**		
7.00pm	**Welcome Reception -** *Salt Bar, Kingscliff* *Sponsored by Department of Planning and Environment - Crown Lands*		

Wednesday 1st June 2022

8.30am	**Conference Registration** *Foyer, Mantra on Salt Beach*		
9.00am – 10.35am	**5A:**	**5B: Knowledge, Science & Uncertainty**	**5C: Policy, Decision Making and Funding**
Location	Plantation Room 1	Plantation Room 2	Plantation Room 3
9.00am – 9.20am	Climate-Induced Headland Bypassing: Unravelling the Periodicity of Sand Pulses into Letitia Spit **Ana Paula Da Silva** *Griffith University*	Rocks provide better reef bases than shell for restoration **Victoria Cole** *NSW Department of Primary Industries - Fisheries*	Who Owns the Beach? The Impact of Uncertain Boundaries on Future Design of Protective Structures **Angus Gordon** *Coastal Zone Management and Planning*
5 min	***Changeover***	***Changeover***	***Changeover***
9.25am – 9.45am	Recent coastal change and emergency management in Byron Bay **James Carley** *Water Research Laboratory UNSW Sydney*	Historic shellfish reefs of NSW – gathering knowledge to build social licence **Charlotte Jenkins** *NSW Department of Primary Industries - Fisheries*	Planning for increasing local uncertainty **Ian McNicol** *Cities Research Institute - Griffith University*
		Mapping the distribution of snapper across Greater Sydney's coastline **Matt Rees** *NSW Department of Primary Industries - Fisheries*	
5 min	***Changeover***	***Changeover***	***Changeover***
9.50am – 10.10am	Sand budgets for coastal management in NSW **Heiko Loehr** *Bluecoast Consulting Engineers*	Monitoring and predicting change to NSW kelp forests **Tom Davis** *NSW Department of Primary Industries - Fisheries*	Coastal settlements, constant change and capitalising on complexity in New South Wales **Tom Rivard** *REALMstudios*
5 min	***Changeover***	***Changeover***	***Changeover***
10.15am – 10.35am	It's a Setup! **Rosanne Hart** *The University of Newcastle*	Monitoring change for managing uncertainty inherent to coastal systems… from space **Magnus Wettle** *Eomap Australia*	Risk Assessments for Coastal Water Sharing Plans **David Workman**, **Jon Sayers** & **Michael Healey** *NSW Department Of Planning and Environment - Water*
	Nearshore nourishment mound placement and temporary surfing outcomes **Tom Murray** *Griffith University*		
10.35am – 11.05am	**Morning Tea**		
Session 6 11.05am – 12.40pm	**6A:**	**6B: Lessons from the Field**	**6C: 10 Minute Presentations**
Location	Plantation Room 1	Plantation Room 2	Plantation Room 3
11.05am – 11.25am	Opportunities for beneficial reuse of natural material along the NSW coast **Evan Watterson,** *Bluecoast Consulting Engineers*	Drought, bushfire, flood- A tumultuous year in the life of an ICOLL **Rachel Duczynski** *Bega Valley Shire Council*	Assessing jetty features to reduce seagrass loss: Port Hacking case study **Nathan Knott** *NSW Department of Primary Industries - Fisheries*

			Aquatic recreational structures as ecologically important habitats **Troy Gaston** *University Of Newcastle*
5 min	***Changeover***	***Changeover***	***Changeover***
11.30am – 11.50am	Changing degraded sugar cane land into a carbon sink **Robert Quirk** *ACFA*	Drought-induced hysteresis in iron and sulfur cycling within Lake Cathie -Innes ICOLL **Thor Aaso,** *NSW Soil Conservation Service* & **Scott Johnston**, *Southern Cross University*	The role of morphodynamics in assessing flood hazard in tidally dominated estuaries **Michael Thomson** *JBPacific*
			Surfers' attitudes to sharks, perceptions of shark risk, and information needs **Carol Martin** *Nsw Department of Primary Industries - Fisheries*
5 min	***Changeover***	***Changeover***	***Changeover***
11.55am - 12.15pm	Kingscliff Seawall: Construction, Supplementary Works, and Design Life **Matthew Lee** *Tweed Shire Council*	InletTracker: 30+ years of entrance dynamics of NSW ICOLLs from satellite data **Valentin Heimhuber** *Water Research Laboratory, UNSW Sydney*	The effects of Australia's Black Summer fires on estuaries **Thayanne Barros** *University of NSW*
			A citizen science-based assessment of marine species redistributions in New South Wales **Troy Gaston** *University Of Newcastle*
5 min	***Changeover***	***Changeover***	***Changeover***
12.20pm – 12.40pm	Tweed Sand Bypassing Maintenance Dredging Program **Matthew Harry** *Tweed Sand Bypassing, Transport For NSW*	Opening that ICOLL: Are we managing flood risk? **Emma Maratea,** *Rhelm* & **Sean Garber** *Baird*	Delivering a riparian project - piece of cake? Or not **Suzanne Acret** *Department of Planning and Environment*
			There is no presentation in this time slot
12.40pm – 1.30pm	**Lunch**		
1.30pm – 5.00pm	**Field Trips (includes afternoon tea)**		
FT1: Kingscliff Coastal Management and Tweed Sand Bypassing			
FT2: Tweed River Cruise			
FT3: Bundjalung Cultural Tour			
FT4: Beach Walk from Cape Byron to Belongil Beach (returns to hotel at 5.30pm)			
5.00pm	**Close of Day Two**		
7.00pm	**Conference Dinner & Annual NSW Coastal Management Awards** Peppers Salt Resort & Spa Kingscliff *Sponsored by Royal HaskoningDHV*		

Thursday 2nd June 2022

8.30am	**Conference Registration** *Foyer, Mantra on Salt Beach*

Session 8 9.00am – 11.00am	**8A: Knowledge, Science & Uncertainty**	**8B: Lesson from the Field**	**8C: Holistic Coastal Management**
Location	Plantation Room 1	Plantation Room 2	Plantation Room 3
9.00am – 9.20am	How Much is it Worth? Estimating Recreational Values for Stockton Beach **Rhys Thomson** *Rhelm*	Where there's a WILS, there's a way! Innovative coastal management in action **Jillian Keating** *NSW Department of Primary Industries - Fisheries*	***There is no presentation in this time slot***
5 min	***Changeover***	***Changeover***	***Changeover***
9.25am – 9.45am	We've never been more certain about the seafloor: insights for coastal management **Tim Ingleton** *Department of Planning and Environment*	Holocene evolution and sediment budget at Tathra Beach, NSW **Tom Oliver** *UNSW Canberra* Investigation of dune profile changes at Park Beach, Coffs Harbour, NSW **Jayden Kachel** *Southern Cross University*	Improving water quality outcomes for coastal communities through revised NSW-Water Quality Objectives **Thomas Doyle** *Department of Planning and Environment*
5 min	***Changeover***	***Changeover***	***Changeover***
9.50am – 10.10am	'NSW TurtleWatch': how citizen science can help manage an uncertain future **Holly West** *Australian Seabird and Turtle Rescue*	Response of fish communities to eco-engineered seawalls in Sydney Harbour **Stephanie Bagala** *Macquarie University* Marine Parade, Manly Beach Wave Overtopping Early Warning System **Richard Platt,** *Northern Beaches Council &* **James Carley,** *Water Research Laboratory UNSW Sydney,*	Coast and Foreshore Protection Strategy for Trial Bay Gaol Visitor Precincts **Sophia Meehan** *NSW National Parks and Wildlife Service*
5 min	***Changeover***	***Changeover***	***Changeover***
10.15am – 10.35am	A snapshot of changing trends in digital consulting during certain times **Cassy Baxter** *Cardno now Stantec*	Construction of Seawalls at Collaroy-Narrabeen Beach – a Failure of Coastal Management? **Peter Horton** *Horton Coastal Engineering*	Meet the Friends of Cabbage Tree Bay Aquatic Reserve Volunteer Group **Robynne Millward** *Northern Beaches Council*
5 min	***Changeover***	***Changeover***	***Changeover***
10.40am – 11.00am	Assessing 65 Breakwaters Utilising Drones A Comparison of Techniques over 25 years **Indra Jayewardene & Eduardo Pombo Lavin** *MHL*	The Construction of the Shell Cove Boat Harbour Entrance and Beach Response **Ben Morgan** *Advisian*	Building capacity in communities to adapt to changing distribution of migratory wildlife **Susan Crocetti** *NSW National Parks And Wildlife Service*
11.00am – 11.30am	**Morning Tea**		

11.30am – 1.00pm	Session 9 – Plenary
	Keynote Address:
11.30am	**"Sustainable management or tragedy of the commons? Estuarine decision-making in 2050"**
	Dr Will Glamore, *Associate Professor Water Research Laboratory*
	Keynote Address:
12.15pm	**"Biophilia"**
	Sabyah White, *Girls for Future Documentary*
12.40pm	**Announcement for 2023 NSW Coastal Conference Host Council, Conference Closing and Wrap-up**
1.00pm – 2.00pm	**Lunch**

List of Poster Displays (alphabetical by presenting author)

Poster Session during Morning Tea on Wednesday from 10.35am – 11.05am

Poster Prize Sponsored by:

**** Electronic poster***

ID	Author	Poster Title
1	Dylan Laicher	The effect of bushfires on NSW estuaries, *Southern Cross University*
2	Helen Monks	You'll Get Away with That: There's no Money for Enforcement!, *Highlight Consulting*
3	Uthpala Pinto	Understanding legacy effects on ecosystem health through multiple-lines of evidence, *Department of Planning and Environment*
4	Uthpala Pinto	Engaging the disengaged: building community partnerships in environmental monitoring, *Department of Planning and Environment*
5	Kate Waddington *	Prioritising catchment areas for the remediation of wetlands in coastal estuaries, *UNSW Sydney*
6	David Workman, Jon Sayers & Michael Healey	Risk Assessments for Coastal Water Sharing Plans, *Department of Planning and Environment*

Keynote Speakers

Dr Justine Bell-James

Associate Professor and Director of Higher Degree Research, The University of Queensland

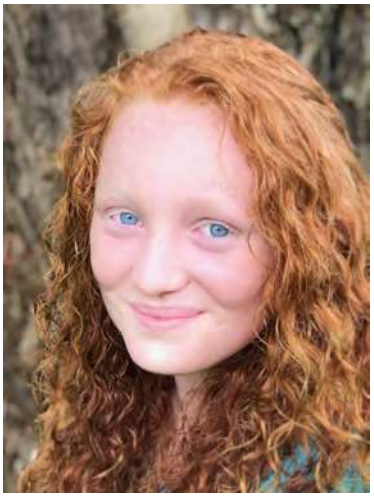
Justine Bell-James is an Associate Professor at the TC Beirne School of Law with expertise in environmental and climate change law and climate change litigation. She holds a PhD from QUT (2010) and was a postdoctoral research fellow at UQ's Global Change Institute from 2011-2013. Justine's research focuses on legal mechanisms for protection of the coast under climate change, incorporating both human settlements and coastal ecosystems. She currently leads an ARC Discovery Project (2019-2022) considering how coastal wetland ecosystem services can be integrated into legal frameworks. Justine is also an expert on legal mechanisms to facilitate blue carbon projects in Australia and internationally, and she was involved with the development of a blue carbon methodology under Australia's Emissions Reduction Fund. Justine's work is highly interdisciplinary and she is an affiliated researcher with UQ's Centre for Biodiversity and Conservation Science. Her recent collaborations and consultancies have involved colleagues from science, industry, NGOs, government and legal practice.

Justine also has expertise in climate change litigation, and her work on opportunities for litigation under Queensland's Human Rights Act 2019 has underpinned the first test case in this area.

Dr Will Glamore

Associate Professor, Water Research Laboratory

Assoc Professor Will Glamore is the leader of the EcoEng Research Group and Deputy Director at the Water Research Centre, UNSW Sydney. Dr Glamore is currently the Chairman of PIANC ANZ, the Chair of the Tuggerah Lakes Expert Panel, and a former member of the NSW Coastal Council, the Marine Estate Expert Knowledge Panel, and the PFAS Independent Expert Panel. Over the past 25+ years, Dr Glamore has led research programs on estuaries, including ecosystem response modelling and climate change, as well as the restoration of blue carbon habitats. Recent highlights include working with the Clean Energy Regulator to develop the Blue Carbon Method, and collaborating with the Australian Academy of Science on the 'Sustainable Oceans and Coasts National Strategy'. Throughout his career, Dr Glamore has been fortunate to work with many collaborative partners and talented research staff.



Sabyah White

Hi I am Sabyah White, I am 14 and my whole life I have had a close connection to nature and a strong will to look after it, from the age of 2 snorkelling the Great Barrier Reef to now still doing my best to protect it and preserve it for generations to come. At the age of 11 Sabyah was a subject in an environmental documentary called Girls for Future, this film went around the world and places like COP 26.

Dr Pierre Wiart

Head of Climate and Risk Management, CoreLogic International

Pierre is a senior global risk transfer director with two decades' experience in all aspects of risk transactions including (re)insurance underwriting, enterprise risk management, portfolio, structured risks and fund management.

Pierre leads CoreLogic's climate and risk management team in Australia and New Zealand with a focus on climate risk strategy execution and risk management solutions for the insurance, banking and government sectors. Pierre is a member of the Australian Institute of Company Directors, holds a PhD in Physical Geography from the University of Cambridge, UK and is also a senior associate of the Australian and New Zealand Institute of Insurance and Finance (ANZIIF – Snr Assoc CIP). Pierre is a regular guest speaker in the Insurance and Banking industry, such as the Australia and New Zealand Institute of Insurance and Finance (ANZIIF), the Insurance Council of New Zealand (ICNZ) or the New Zealand Banking Association.

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Drought-induced hysteresis in iron and sulfur cycling within Lake Cathie and Innes ICOLL

T Aaso[1], **S Johnston**[2], M Birch[3]
[1]NSW Soil Conservation Service, Port Macquarie, NSW
[2]Southern Cross University, Lismore, NSW
[3]Aquatic Science and Management, Bellingen, NSW

In 2018-2019, the eastern seaboard of NSW was subjected to an extreme drought event. This protracted drought, combined with an artificial lake entrance opening event lead to historically low water levels and the desiccation of over 1000ha of lakebed sediments, and bushfire susceptibility among wetland habitats in the Lake Cathie / Innes ICOLL. This resulted in widespread oxidation of sulfidic materials and mobilisation of large stores of both iron and sulfur.

After the drought, the lake was subsequently refilled by rainfall in mid-January 2020, leading to elevated lake levels for ~4 months. This reflooding was sufficient to initiate reductive mobilisation of iron (as Fe^{2+}) in lakebed and channel fringe porewaters. Subsequent artificial lake entrance opening in May 2020 caused a rapid draw-down in lake water levels (~1.5 m, 1 week). This combined sequence of events (extreme drought>flooding>artificial entrance opening) liberated and translocated large quantities of iron and acid from sulfidic lakebed / fringing sediments to the shallow and poorly flushed embayments within the ICOLL system, smothering benthic sediments and vegetative wetland habitats, leading to a major sustained iron floc event over 12 months.

This new hyper-abundance of meta-stable Fe(III) oxides in shallow benthic sediments has the potential to initiate a variety of important knock-on biogeochemical consequences. In particular, newly formed RIS in shallow sediments will likely be highly susceptible to future drought and lake opening events. Hence, the Acid Sulfate Soil (ASS) related risks and knock-on environmental and social impacts from ICOLL entrance management have significantly increased.

This event represents a hysteresis in the ICOLL Fe cycle, whereby re-flooding and current lake entrance management practices, will not readily re-establish the pre-existing state. Unfolding climate change is likely to see this 2018-19 drought event become more common and has implications for ongoing ICOLL water quality and management.

Delivering a riparian project - piece of cake? Or not….. what can go wrong will go wrong…and other tales from the frontline of project delivery

S Acret[1], R Jenner[2]
[1]NSW Department Planning and Environment, Alstonville, NSW
[2]Ballina Shire Council, Ballina, NSW

You've got funding and a project plan for your site - woohoo! Now, all you have to do is deliver the plantings, get some weeding done and your 'Riparian Revegetation 101' is complete, yes? Well, probably yes in the end but here are some tales on the road to getting a project done during bushfire season, drought, COVID, agency understaffing and flooding. There will be other tales which are worse and some which have rolled out much more smoothly. This is only one project.

This paper has been written to collate just some of the many and varied experiences project delivery can throw at you. It would be nice to have a straight line from 'go' to finish. Unfortunately, nature and global pandemics wait for no person, and every obstacle and happening changes your project. Often for the better, but not always. These challenges are as varied as the environment within which the projects take place.

Managing Beach Accessways – A Rational Approach

C Adamantidis[1], N Smith[2], D Wiecek[3]
[1]Advisian Pty. Ltd., Sydney, NSW
[2]Shoalhaven City Council, Nowra, NSW
[3]Department of Planning and Environment, Wollongong, NSW

Beach access is an important community asset provided to residents and tourists by coastal councils throughout NSW. The Coastal Dune Management Manual has guided the installation, ongoing repair and upgrade to these extensive assets which include fences, stairs, paths, signage and viewing areas along the coast. Councils face many common challenges in managing their coastal assets, which are exposed to the local coastal processes. In many areas, these assets are now approaching the end of their design life.

Shoalhaven City Council manages 40 beach compartments with over 220 beach access points exposed to a wide variety of coastal impacts. As part of an update of Council's Coastal Asset Management Plan, a beach access strategy has been devised that includes a methodology for rationalisation of beach accesses based on environmental, social and economic risks. The methodology includes development of a pro-forma to allow rapid assessment of each asset in the field. A specialised multi-criteria analysis tool has been developed to provide a beach-by-beach rationalisation of accessways that can be adapted for use by any coastal council.

The criteria for rationalising the accessways on a beach-by-beach basis include:

- The number of accessways available per linear distance in each locality
- The location of accessways in relation to key local amenities and accessibility to high-use areas such as carparking or local urban areas
- Safety of accessways based on site assessments
- Environmental impacts of each accessway based on site observations and factors including the positioning of the accessway with respect to local winds, susceptibility to impacts from coastal processes, and the impact that the asset itself has on local coastal processes.

Response of fish communities to eco-engineered seawalls in Sydney Harbour

S Bagala[1], M Vozzo[2], K Dafforn[1], M Mayer-Pinto[3], M Bishop[1]
[1]Macquarie University, North Ryde, NSW
[2]Sydney Institute of Marine Science, Mosman, NSW
[3]University of New South Wales, Sydney, NSW

Urbanisation is not just a land-based problem. “Ocean sprawl” into coastal environments has replaced large amounts of complex near-shore habitat with relatively featureless structures such as seawalls, pontoons and pilings, resulting in losses of marine biodiversity. Eco-engineering seeks to mitigate biodiversity loss, by incorporating ecological values into the design of built structures. “Living Seawalls” provides a modular and scalable approach to enhancing habitat provision by new and existing structures through the incorporation or addition of complex panels to these. While the panels have been shown to have positive effects on invertebrate and algal biodiversity, the effects of Living Seawalls panels on fish communities is unknown. This study utilised remote underwater videos to assess whether through time Living Seawalls would develop resident and transient fish communities that are denser and more diverse than those of unmodified seawalls, and approach that of natural rocky shore habitats – the latter of which are considered hotspots of biodiversity. It also assessed whether there were certain panel designs that are more effective in facilitating certain species of fish. By two years post panel installation, Living Seawalls supported fish communities that were more abundant and species-rich than those of unmodified seawalls, and that were similar in community composition to rocky shores. At the patch-scale, however, fish utilisation of panels did not significantly vary with panel design. This study provides important information on how eco-engineering can mitigate effects of coastal urbanisation on fish communities.

Nutrient and organic matter removal efficiency of stormwater control measures

C Baiada[1], A Wright[1]
[1]NSW Department of Planning and Environment, Science Economics Insights, Lidcombe, NSW

The nearshore areas of Tuggerah Lake are prone to the build-up of black ooze; nutrient and organic matter (OM) rich deposits that impact the recreational and environmental values and visual amenity of the lake. It was perceived that seagrass wrack and decaying macroalage were the source of the OM in the ooze, however studies carried out by the Estuaries and Catchments Team (ECT) of NSW Department of Planning, Industry and Environment (DPIE) identified terrestrially derived OM made up a significant proportion.

To assist in optimising Central Coast Council's management of stormwater, ECT are undertaking a research project to identify the effectiveness of stormwater control measures (SCMs) in the Tuggerah Lakes catchment. This study aims at specifically assessing the performance of SCMs at removing traditional target pollutants (total sediment, total and dissolved nutrients) as well as OM from stormwater runoff.

Two constructed wetlands receiving urban stormwater runoff are being assessed during baseflow (dry weather conditions) and during a number of rainfall events over a minimum 18-month period. Samples will be collected at the inlet and outlet at each device, and analysed for total and dissolved nutrients, suspended sediment, and OM composition, source and lability. Removal efficiency will be determined by comparing the long-term event mean concentrations of target pollutants between the inlet and the outlet following national best practice guidelines as outlined in Stormwater Quality Improvement Device Evaluation Protocol (SQIDEP) 2018. The data will highlight whether constructed wetlands act as a source or sink of nutrients, sediment and OM over time and in response to rainfall events.

This information can be used to highlight how council's stormwater management approaches protect environmental values in the lake downstream, and also indicate whether conceptualised stormwater treatment targets are actually being met. This is highly valuable knowledge when planning future stormwater management.

References:
Stormwater Australia (2018) Stormwater Quality Improvement Device Evaluation Protocol. Version 1.2 December 2018.

The effects of Australia's Black Summer fires on estuaries

T Barros[1], S Bracewell[1], K Dafforn[2], S Simpson[3], M Mayer-Pinto[1], E Johnston[1]
[1]University of NSW, Sydney, NSW
[2]Macquarie University, Sydney, NSW
[3]CSIRO Land and Water, Sydney, NSW

Major bushfire events are predicted to become more frequent and of greater 'peak' magnitude over the next century. In addition to their impact on land-based fauna and flora, bushfires can also affect aquatic systems by increasing the inputs of fire-derived substances and sediment through increased post-fire soil erosion rates and atmospheric deposition of ash. However, there is little scientific information available describing the short- and long-term effects of bushfires on aquatic systems, particularly estuaries. This impedes our ability to take proactive management actions. Aiming to fill this knowledge gap, we conducted the first characterization, to our knowledge, of changes in estuarine sediment quality following major bushfires. We sampled six estuaries in New South Wales, Australia with different fire intensities, areas of catchment burnt and proximities of bushfire to the estuary. The estuaries were sampled before and after the 2019-2020 bushfire season. We looked at changes in nutrient concentrations (phosphorus (TP) and nitrogen (TN)), different forms of organic carbon (e.g. total carbon (TC), total organic carbon (TOC), resistant organic carbon (ROC), pyrogenic carbon), sediment silt content (<63 um), metals, and chlorophyll concentrations. We recorded an increase in TN, TP, TOC, and silt content in Clyde and Moruya River, the two estuaries that had the greatest percentage of their catchment burnt. In general, we observed consistent changes in the nutrients, carbon, and metal concentrations from pre to post-fire, particularly in the most heavily burnt catchments and in those where the burnt areas extended close to the edge of the waterways, suggesting an increased severity of bushfire impact in these circumstances. These results provide a baseline for the development of environmental indicators of bushfire impact in these systems. We suggest that TOC, ROC, TN, TP, metals, and silt content are useful indicators of bushfire impact and should be incorporated into any long-term study.

A snapshot of changing trends in digital consulting during certain times

A Steiger[1], **C Baxter[1]**
[1]Cardno now Stantec (NSW/ACT) Pty Ltd, Wollongong, NSW

Over the last two years the preferred consultation mode for community and stakeholders alike has shifted from a preference of in person to remote communication. This in turn has led to a growing challenge of how to meaningfully engage in a remote digital capacity.

Centralised data platforms are helping communities, councils and land management agencies to share information, collaborate and understand the world around them.

Digital tools such as web mapping, interactive portals, online forums, QR codes and digital twins are just some of the ways in which technology can help to engage people in new and exciting ways. With the last two year's challenges affecting traditional means of community consultation, Cardno drew on the power of spatial technology to conduct map-centric community and stakeholder workshops online.

Web mapping portals are also becoming common place for infrastructure projects as the central point of truth for data and a means of collaboration and communication across a geographically dispersed team.

There is power to be able to see assets or a plan on a map, to see how something relates to other environments, assets and features. And with a common operating picture, the community or stakeholder focus can be looking at and commenting on the same information.

This presentation draws on the advancing world of spatial consultation and through drawing on recent examples describes the values and challenges associated with the various methods available.

Stockton beach erosion, causes and solutions

R Boyd[1]
[1]Stockton Community Group and University of Newcastle, Newcastle, NSW

Stockton Beach, immediately north of Newcastle Harbour, is a “hotspot” of coastal erosion on the NSW coast. Over 12 million m^3 of sand has been lost from the southern end of this compartment. Harbour infrastructure and dredging are the two main causes of the erosion problem. Seaward breakwaters over 1000 m cut off the majority of northward longshore transport. The entrance channel was deepened from around 6 m to over 20 m, and widened from around 100 m to over 350 m. Over 130 million m^3 (Bluecoast, 2020) of sediment has been removed from the harbour and mostly dumped at sea. The flood tidal delta has been removed. The extensive ebb tidal delta has been starved of new sand supply from the south, while continuing to supply around 146,000 m^3 (Bluecoast, 2020) of sand annually to the northward longshore transport system. Changed wave refraction patterns from breakwaters and dredging have focussed wave energy on the central Stockton shoreline (Nielsen and Gordon, 2016). Three separate seawalls have been constructed on the southern 2 km of beach and a further rock bag wall is currently under construction. No sand has yet accumulated in front of any seawall. The overall result of these actions and processes has been to produce a coastal sand deficit, with shoreline erosion of up to 190 m. The NSW Government received over $1.75B for leasing the port in 2014, annually receives over $1.1B from coal royalties shipped through the Port of Newcastle and the Port of Newcastle profits exceed $20M annually. There is strong community support for restoring the lost Stockton Beach, primarily through sand replenishment from offshore and/or harbour sources. Current studies into the offshore source indicate that this is a viable option and a possible template for solution to many NSW coastal erosion problems.

Our Coast, Our Waterways…turning opinion into activism!

W Brown[1], V McCann[1] & R Brown-Mason[1]
[1]Central Coast Council, Gosford, NSW

The Central Coast is a region defined by its waterways and beaches with southern Lake Macquarie, Tuggerah Lakes, Brisbane Water, the Lower Hawkesbury River and our ICOLLs (Wamberal, Terrigal, Avoca and Cockrone Lagoon) combining for a total area of approximately 166km^2 (3 times the size of Sydney Harbour). Our diverse coastline stretches over 80km from Patonga in the south to Budgewoi in the north consisting of classic pocket beaches bounded by majestic Hawkesbury Sandstone headlands and cliff lines in the south, to brilliant, long stretches of white sandy beach in the north. These waterways and beaches are intrinsic to the lifestyle of our community providing recreational, social and cultural values which support our mental and physical wellbeing.

We recognise that for most of our residents, it is difficult to go more than 2km without coming into very close proximity of a waterway, meaning that most of our population play a role in the ongoing maintenance and health of our waterways. This was the driving factor behind the development of the *Our Coast, Our Waterways* campaign which sought to reach out across the entire region to develop a contemporary understanding of how the Central Coast community value and use our coastal environments.

This presentation provides an overview of the approaches we employed to ensure the campaign reached as many people (and age cohorts) as possible as well as a summary of the results of the survey.

References:
Our Coast. Our Waterways - https://www.yourvoiceourcoast.com/waterways

Estuary foreshore management: waterfront structures and bank management strategies

E Wilkie[1], P Dwyer[1], C Knight[2], **D Bucher[2]**
[1]NSW Department of Primary Industries, Wollongbar, NSW
[2]NSW Crown Lands & Water, Ballina NSW

Foreshore development, like installing jetties or undertaking bank protection works, is a key threat to coastal habitats, commercial and cultural activities, and public use and enjoyment of waterways. Despite being highly regulated, foreshore development is not generally assessed in the context of where other foreshore developments may occur. This is a problem because it results in ad-hoc assessments, double handling, ineffective outcomes and ongoing, cumulative threats to the marine estate.

Delivering healthy coastal habitats includes the development of estuary-wide foreshore strategies to improve regulation of such works on the foreshore.

Waterfront structures strategies map the foreshore with a 'traffic light' system to show locations that are suitable or not for development of domestic structures, and why. The maps integrate current policies with coastal habitat research findings. In doing so this new approach streamlines regulatory process by reducing the need for case-by-case assessments where outcomes are anticipated at the onset. This may result in up to a 90% reduction in possible development applications in unsuitable locations. The strategies have been endorsed by MEMA, and relevant local governments for roll out in estuaries statewide.

Estuary bank management strategies map foreshore erosion risk and recommended best practice erosion control. Mapping layers in this way will reduce ad-hoc assessments, and the cumulative impacts from the current 'patchy' distribution of control types. A decision support tool informs the mapping. Built by an independent consultant, the tool is designed to be robust and effective in assessment of estuarine geomorphologies found in NSW like ICOLLs, barrier estuaries, drowned-river valleys, and estuaries with anthropogenic channeling. This tool and the public interfacing map will provide a more efficient, integrated, defendable and consistent way of assessing bank protection proposals.

Other case-by-case decision making processes may also benefit from such integrated techniques for reducing cumulative impacts to the marine estate.

Recent coastal change and emergency management in Byron Bay

J Carley[1], C Knight[2], F Flocard[1], W Payne[3]
[1]Water Research Laboratory, School of Civil and Environmental Engineering, UNSW Sydney, Manly Vale, NSW
[2]Crown Lands | Department of Planning, Industry and Environment, Ballina, NSW
[3]Ardill Payne & Partners, Ballina, NSW

Clarkes Beach and Main Beach Byron Bay have experienced beach erosion in 2020 and 2021 that is "unprecedented". This has resulted in the loss of numerous trees, closure of many beach access ways, exposure of normally buried rocks and reefs, diminished beach amenity, unearthing of indigenous artefacts, and the potential collapse of built assets such as those within the Reflections Clarkes Beach Holiday Park and the Clarkes Beach Café.

The Clarkes Beach Café was determined by coastal, geotechnical and structural engineers to be at imminent risk of collapse onto the beach. Interim geobag seawalls were designed and constructed so as to prevent this collapse, while longer term management is being developed.

The paper presents all plausible contributors to the recent erosion and ranks their relative magnitude. These include storm wave erosion and waves emanating from less common directions, changes to the East Australian Current, underlying recession, sea level rise, incidental accidental human removal, end effects from recent interim geobag seawalls and stormwater erosion. The quantification of most of these parameters, including end effects from the geobag seawalls has been undertaken using direct measurements where possible, utilising aerial LIDAR surveys and satellite measurements of the vegetation line.

The most recent coastal hazard study mapped the coastal hazards relative to accreted 2007 beach conditions. Since that time, underlying recession has continued at 0.2 to 0.3 m/year, while sea level has continued to rise at approximately 2 mm/year. Byron Bay is now approximately one third of the way between the "immediate" hazard lines and the 2050 hazard lines.

Therefore, while the eroded beach state at Byron Bay in 2020 and 2021 is unprecedented, it is not unexpected.

Rocks provide better reef bases than shell for restoration

V Cole[1], D Harasti[1], K Russell[1]
[1]NSW DPI Fisheries, Port Stephens Fisheries Institute, Taylors Beach, NSW

NSW Department of Primary Industries undertook the State's first large-scale shellfish reef restoration project as an action under the Marine Estate Management Strategy. The first stage of the on-ground work for the Port Stephens Oyster Reef Restoration project was completed in March 2020. There were two restoration locations within Port Stephens, at the mouths of the Myall and Karuah Rivers. The areas were chosen for the high spatfall and many natural oyster reefs for the potential success of oyster reef restoration.

One hectare of locally sourced oyster shell (cultch) and rock were used as a reef base for the natural recruitment of intertidal Sydney rock oyster *Saccostrea glomerata*. With reefs made from rock and/or rock and shell, it was experimentally tested rock or shell substrata is a better reef base for naturally recruited oyster reef restoration and the associated ecological benefits.

More than 50 million Sydney rock oysters naturally recruited but the rock had significantly more oyster spat than shell, and it was consistent over time and at the Karuah and Myall sites. Reefs with a base of rock had more gastropods than reefs of rock and shell, but there was no difference in the diversity and relative abundance of key species of fishes.

Importantly, oysters are filtering >400,000 L/water/hour at the restoration sites. Over 2 million gastropods and other invertebrates also recruited to the newly created oyster reefs. Assemblages of fishes, including recreational and commercial fishes, associated with the new reefs and are similar to natural oyster reefs.

Caring for Water Places: a community collaboration in regeneration

C Coorey[1]
[1]Byron Community College, Byron Shire Council, NSW

How a community group, a community college and a local council combined to make scientists of citizens and build water resilience.

As Byron Shire councillor, I understand well the pressures on the Shire's water systems – both natural and man-made. Like many coastal shires, the cascading (literally) effects at the top of the catchment and the pressures of development on the coast are many but the resources and personnel to tackle them are few.

As a trainer in the VET sector, I decided to develop 'Caring for Water Places, a six-day course delivered through Byron Region Community College. Based on the work of marine scientist and writer, Mary Gardner PhD, it is a collaboration between the local organisation Water Places, Byron College, Byron Shire Council, and Delta Kay, a leader of the local Arakwal community. The course has been run twice so far by Byron Community College.

Community participants learned how to become citizen scientists and regenerators. They learned to conduct surveys and collect local knowledge, use digital multi-meters to measure water quality and to identify water indicators such as macroinvertebrates.

Each day of the course students went out in the field, from forest to farmland, along the Brunswick River, through the drains of Byron's towns and sewage treatment plant and to the estuaries and ICOLLS. I was the lead trainer but had specialist input, including from Arakwal leader Delta Kay and various staff members from Byron Council in the wastewater, bush regeneration and coastal management sections.

This presentation looks at the participants who came with a desire to do something with a forgotten or degraded local water body. This paper will share the outcomes for all those involved and for the water places of Byron Shire. The presentation will show that a collaborative model like this could be replicated in many places and generate a community of citizen scientists and water carers.

Building capacity in communities to adapt to changing distribution of migratory wildlife

S Crocetti[1], A Marshall[1], K Cooper[1]
[1]NSW National Parks and Wildlife Service, Coffs Harbour, NSW

NSW is the intersection between tropical waters to the north and temperate waters to the south. Consequently, the NSW coastline has an impressive diversity of marine species sighted from dugong and turtles to southern right whales and leopard seals. The distribution, frequency, and health of these animals, mostly listed threatened species, is changing each year and understanding the drivers of change is critical to help land managers build capacity in the landscape to allow this adaptation to occur and species to survive.

Sightings, strandings, haul outs, entanglements, nests and carcasses all provide an invaluable opportunity to gather important scientific information to improve welfare for the individual animal and also assist with species conservation now and into the future. On average, a marine wildlife event occurs every 1.3 days in NSW often requiring a coordinated response from National Parks and Wildlife Service, marine wildlife rescue groups like ORRCA, local government, Police, DPI Fisheries, Marine Rescue and veterinarians.

Initiative Five of the NSW Marine Estate Management Strategy identifies threats to threatened and protected marine species in NSW and builds a framework for conservation through collaboration. Improving land manager and stakeholder capacity to assist with responding to marine wildlife emergencies and resources and tools to maximise information collection are foundational to species conservation.

Tools to assist in response include: real time reporting by key partners into the marine wildlife emergency database Elements, training of vets, development of codes of practice for rescue and rehabilitation, cultural and carcass management protocols and citizen science programs like Right Whale ID.

Every marine animal on our beach provides an invaluable opportunity to learn about their conservation needs into the future.

Climate-Induced Headland Bypassing: Unravelling the Periodicity of Sand Pulses into Letitia Spit (NSW)

Ana da Silva[1,2], G da Silva[1], D Strauss[1], T Murray[1], R Tomlinson[1]
[1]Coastal and Marine Research Centre, Griffith University, Gold Coast campus – G51, QLD
[2]School of Engineering and Built Environment, Griffith University, Gold Coast Campus,QLD

Sediment transport around natural or man-made structures is a critical part of coastal zone dynamics since it may act as a valve that controls sand migration from one beach compartment to another. This study aims to characterize the headland bypassing system in a natural environment and investigate its short (months to years) and long-term (years to decades) variability while relating it to the potential weather types and climate indices that influence the regional wave climate. The research is focused on Fingal Head (NSW), where headland bypassing occurs naturally, and its variability is relevant for managing the sand volumes that are pumped by the Tweed Sand Bypassing (on the northern end of Letitia Spit) to the Gold Coast. Nine detailed topo-bathymetric surveys undertaken between June 2018 and January 2020 and over 30 years of satellite and aerial images were used to describe the headland bypassing process and frequency of variability. Hydrodynamic forcing (waves and currents) of the sand bypassing process including modal and extreme event conditions, the distinct atmospheric systems and associated climate indices were also considered to investigate the main physical drivers of the sand bypassing in the study area. Results indicate that the bypassing around Fingal Head is governed by two distinct processes and their dominance is controlled by waves and sediment availability. Headland bypassing cycles occur over multiple timescales, including seasonal – linked to the variability of the wave climate – to interannual and decadal cycles related to shifts in El Niño-Southern Oscillation, Pacific Decadal Oscillation and Interdecadal Pacific Oscillation. The understanding of the headland bypassing variability as a function of wave and climate systems explains some of the uncertainties related to the sand input into Letitia Spit, which is fundamental to predict cycles of beach accretion and erosion as well as to inform future management strategies for the region.

Lord Howe Island – From ad-hoc coastal protection to more holistic intervention

M Daley[1], P Watson[1], D Waterhouse[2], J Sauvage[2]
[1]NSW Department of Planning and Environment (DPE), Murwillumbah, NSW
[2]Lord Howe Island Board, Lord Howe, NSW

Lord Howe Island is recorded by UNESCO as a World Heritage Site and is Australia's (and the worlds) most southern coral reef. The island is located about 760km north-east of Sydney, within the Pacific Ocean and thus is exposed to waves from all directions. Windy Point and Lagoon beach situated on the western side of the island have been subject to ongoing coastal erosion, principally from natural processes and form the focus of this presentation. Significant coastal protection measures have been previously built to protect critical infrastructure (e.g. the airport and associated island access road). However, coastal erosion further north has continued, with erosion impacts also being exacerbated by a range of ad-hoc protection measures.

In 2019, owing to a worsening erosion situation placing both private and public assets at risk, additional coastal expertise was sought by the Lord Howe Island Board from the NSW Government. The nature of the advice sought to resolve the immediate issues whilst also developing a more holistic long-term management solution for the key precinct of Windy Point and Lagoon Beach. The developed strategy included the relocation of private assets threatened by erosion, the removal of existing ad-hoc coastal protection measures and the reinstatement of the beach and dune system through sand nourishment and associated monitoring.

This presentation provides an overview into lessons learned through the course of developing and implementing the devised strategy. These include the risks associated with unplanned ad-hoc coastal management responses, the importance of (where possible) undertaking field inspections, the advantages in seeking flexibility in planning controls, and how direct and open engagement with key stakeholders proved critical for delivering successful and positive outcomes for all stakeholders and the greater coastal environment in this iconic location.

Monitoring and predicting change to NSW kelp forests

T Davis[1], M Coleman[1]
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Kelp forests underpin NSW's temperate marine ecosystems, providing vast economic, social, cultural and ecological values. Climate-induced ocean warming has caused poleward retractions of kelp in NSW, as temperatures exceed those which kelp can tolerate. These range shifts have generated profound impacts on the temperate ecosystems that rely on kelp. Consequently, greater understanding of future shifts in kelp distributions are needed, in order to facilitate the development of management and mitigation strategies.

We discuss how data from a state-wide monitoring program of sub-tidal habitats and species, plus satellite data on ocean temperatures and turbidity, were used to develop stacked-species distribution models for kelp in NSW. These models were then combined with projected future ocean temperature data to evaluate likely changes to kelp forests in NSW at a state-wide scale. Results indicate that kelp will retract southward in northern NSW by 2100, due to rising ocean temperatures. However, these losses will be offset by increased kelp cover in southern NSW due to temperatures enhancing kelp growth and reducing urchin abundances. Projecting future distributions of kelp forests, while accounting for species interactions, will enable NSW to "climate-proof" conservation and adaptation efforts within the NSW marine estate.

Engaging recreational users of Lake Macquarie – lessons for managing a 'lifestyle' waterway

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Sustainable recreational use values are important strategic context for managing urban coastal waterways.

Lake Macquarie, a large estuarine lake, is at the heart of Lake Macquarie City Council. In Council surveys over the last decade, the community has consistently identified the lake and foreshores as a key recreational and lifestyle asset for local families and visitors. Local and regional population growth and improved connectivity are expected to increase demand for opportunities for lake-based recreation.

Council is currently preparing a CMP and a Lake Activation Strategy (LAS) for its coastal zone. The LAS connects the estuary health focus of the CMP to Council's broader community well-being, destination management and sustainability goals. It is Council's first plan to apply a strategic lens to how best to support a healthy lifestyle for the community through use and enjoyment of the city's central natural feature, at the same time maintaining or improving the overall health of the lake system.

Quantitative information about how people use the lake and foreshores is essential for making investment decisions that strengthen recreation and tourism opportunities. It is currently an important gap in council's management knowledge. An extensive community and stakeholder engagement program during LAS development sought information about recreational use of the lake and foreshores, where people come from and their favourite places on the lake for different activities; their level of satisfaction with existing water access and aquatic infrastructure and what they would like changed or improved.

Survey and interview responses reveal both continuity and change in lake-based recreation preferences; and how environmental and access factors interact to influence perceptions of safety and amenity; helping to clarify the role of aquatic recreation in the city's lifestyle and economy. The engagement program has highlighted valuable ongoing data gathering initiatives to inform asset and place planning for lake activation.

Improving water quality outcomes for coastal communities through revised NSW-Water Quality Objectives

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In an uncertain world the intrinsic value of resilient and complex ecological systems has been further recognised for their important benefits to NSW communities. The ability to access and utilise diverse aquatic systems has been highlighted through COVID, as well as recent climatic extremes. The NSW Water Quality Objectives are the long-term goals and current standard for water quality across NSW and ensure that Local and State Government are working to maintain and improve water quality outcomes for the people of NSW. In keeping with the Australian Water Quality Guidelines, the Objectives are based on community environmental values and uses of waterways. As an action delivered under the Marine Estate Management Strategy 2018-2028, DPIE-EES has undertaken a review of the Objectives for coastal catchments within NSW, which were last updated in 1992. Contemporary community values and uses of waterways were identified, including a review of the existing Objectives, a desktop review of local planning documents, an online community survey, focused community engagement and consultation with key stakeholder groups. These findings were used to confirm the previously set Objectives and, where necessary update Objectives for both estuarine and freshwater sections of all 184 coastal catchments in NSW and developed into a publicly available website and interactive map. The revised Objectives will provide consistency across coastal catchments and provide line of sight for the management of water quality and protection of waterway values and uses. The revised Objectives will also fill gaps identified by Councils in Coastal Management Programs as well as in Community Strategic Planning.

Smart Cameras for coastal monitoring

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Coastal engineering practitioners are regularly faced with the difficulty of managing areas subject to beach erosion and inundation while having limited monitoring data. In most cases, coastal data is sporadic or outdated which often hinders the long-term success of coastal management decisions. While routine monitoring of the coast using camera-based systems is a well-established technique, these systems are traditionally expensive and beyond the resources available for most projects.

A low-cost smart camera system is presented here to overcome these challenges by combining start of the art machine learning algorithms with established image processing techniques to quantify beach usage and track shoreline change. The innovative system is completely self-contained and can be easily installed on existing beach infrastructure such as on lifeguard towers to provide long term continuous data that allows for analysis of coastal change in response to storm events and patterns of beach use to understand the value of beaches to our communities. This system transmits imagery in real time to an online dashboard to streamline access to live and archived imagery, timelapse videos, shoreline analysis and relevant environmental monitoring data.

This paper presents the capability of the system to monitor the coastal erosion crisis that occurred at Wamberal Beach in July 2020 as well its ability to support operational management of coastal lagoon entrances. Insights into 'the business of the beach' are also provided through analysis of patterns of beach usage including daily and seasonal trends in beach visitation.

The smart camera system detailed in this paper is shown to provide a cost-effective solution to unlock unprecedented information about shoreline change and beach visitation data. This information is becoming increasingly critical as we attempt to understand the value of beaches to our communities and develop sustainable future management strategies to protect our beaches for future generations.

Drought, bushfire, flood – a tumultuous year in the life of an ICOLL

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Wonboyn Lake, on the far south coast of NSW, is an Intermittently Closed and Open Lake and Lagoon (ICOLL). It has historically been open over 95% of the time supporting a valuable oyster industry with 52.8ha designated as priority oyster aquaculture area. In the last 20 years there has been three closures, 2004, 2009 and 2019. The most recent closure occurred after an extended period of drought with low water levels and hypersaline conditions experienced. Bushfires in the 2019/2020 summer impacted 90% of the catchment, successive high rainfall events since have contributed large amounts of ash and debris to the estuary.

These events posed a significant threat to the oyster industry due to both water quality and closed entrance. As no adopted entrance management policy was in place, Council responded to oyster industry concerns and undertook a trial 'reverse' opening in February 2020 in an attempt to flush bushfire debris and allow ocean water to enter the estuary. This had limited impact however in June 2020 following sufficient rainfall the lake was opened at a height 0.98mAHD which resulted in a sustained opening.

Whilst dealing with these extreme events, Council was in the process of developing a revised entrance management policy after a previous draft policy developed in 2016 was not supported by the community and oyster industry. Due to its mostly open state, foreshore infrastructure including jetties, private boat sheds and oyster sheds have been built extremely low. Oyster lease infrastructure is also limited in flexibility for varied water heights and requires a staged entrance management approach to allow time for adaptation.

This presentation follows the journey of Wonboyn Lake through drought, fire and flood and associated reactive management and explores the difficulties in developing a staged entrance management policy which requires adaptation in the short term.

The Manning River Estuary and Catchment Management Program engagement strategy

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Building local, scientific and Aboriginal knowledge into a whole-of-catchment and whole-of-community CMP

The Manning River (Djarii Bila) is the lifeblood of our community. From the mountains to the sea, (Balgarr-abirang-Gurrwa-gu), freshwater to saltwater (Bathu-garibang-Girambit-gu), the river connects our landscape and community. The estuary is important for oyster-growing, fishing, tourism and recreation. Up-river the Manning provides water for drinking and stock. Our community loves the cool water and beautiful scenery, feeling a cultural and spiritual connection to the river. These values all depend on healthy ecosystems and clean water.

MidCoast Council has worked together with stakeholders and our community to develop the Manning River Estuary and Catchment Management Program (ECMP). It sets out a long-term action program for Council, our community and partner organisations to improve the health and resilience of the Manning River and estuary. In response to a clear message from our community, the Manning River ECMP takes a whole-of-catchment approach.

Our goal was to meet the objects of the Coastal Management Act and mandatory requirements of the Coastal Management Manual, while using a grass-roots approach to meet the aspirations and needs of our community.

Through our governance structure and engagement process we gave weight to scientific research, local community knowledge and Aboriginal cultural knowledge. Scientists and NRM practitioners participated in a Technical Advisory Group which informed our research and issue analysis. Community representatives joined our Reference Group and provided valuable local knowledge. And the CEO of the Local Aboriginal Land Council was engaged to consult with Biripi Traditional Owners.

By leading the project in-house and ensuring strong community and stakeholder engagement, we have created a platform for ongoing implementation of the Manning River ECMP.

This presentation will provide a case-study on our governance structure and engagement strategy. It will cover the methods, results and benefits of the engagement program and lessons learned to inform future CMP development.

Effective engagement with indigenous communities for Coastal Country

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'Country is the places from which Ancestors originated and still exist within as life forces. Country cannot be owned or tamed, as Country is also a relationship that must be honoured and nurtured' (Hromek, 2020).

An effective approach to indigenous engagement encourages all working in coastal management 'to develop their own understanding of and relationship to Country and those First Peoples who relate to it' (Hromek, 2020). It firstly involves understanding the complexities of First Peoples in an area and asking each community if and how they wished to be engaged regarding Coastal Country. Listening, learning and respect are critical parts of the engagement process.

Lived experiences, corporeal activities and engaging the senses is a way of approaching Country (O'Brien, 2011). Where possible, Coastal Country should be interpreted and discussed in the field with First Peoples. 'It is the right of Knowledge Holders to hear and read Country, and it is not appropriate for others to do so unless given the appropriate training, guidance and authority by Custodians' (Hromek, 2020).

Based on these principles, this paper outlines the engagement with representatives from the Coffs Harbour and District Local Aboriginal Land Council, and Gumbaynggirr Cultural Knowledge Holders (including the Garby Elders) to inform the Woolgoolga Region Estuaries Coastal Management Program (CMP) Stages 2-4. As a result of the ongoing engagement, six CMP actions were identified for First Peoples to help manage Coastal Country of the area which includes the Solitary Islands Marine Park.

References:
Hromek, D 2020, *Aboriginal Cultural Values: An Approach for Engaging with Country,* Department of Planning, Industry and Environment.
O'Brien, K 2011, In Pursuit of an Architecture of Realism, *Monument 101* (March), pp. 35-36.

Outside the (fruit) box: a case study in big picture coastal thinking

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How ambitious should coastal management be in attempting to address catchment-based risks and threats? The difficultly often stems not just from the scale and nature of catchment-based risks, but also from the complexity involved in effectively engaging with the wide range of stakeholders that may exist across a catchment.

This presentation provides a case study in using coastal management to think big. It provides an overview of a management action developed in association with the Woolgoolga Region Estuaries Coastal Management Program (CMP) in the Coffs Harbour LGA.

A significant part of the small catchments draining into the study area catchments is used for Intensive Plant Agriculture (IPA), cucumber horticulture and banana plantations – and agricultural land use practices were identified as a significant risk to estuary health. A large-scale program of environmental improvement was developed for local growers through a specialised process of engagement and negotiation between local agricultural industry stakeholders, DPI-Agriculture, other State Government agencies, and Coffs Harbour City Council.

The planned and sensitive negotiation process was conducted with these stakeholders to develop the Coffs Harbour Intensive Horticulture Environmental Program (CHIEP). The CHIEP empowers local horticulture operators, not only in the study area but across the Coffs Harbour LGA, with financial and technical assistance to improve on-farm management practices, and in doing so, reduce the impacts of horticulture on downstream estuary health.

Implementing the Lake Illawarra Coastal Management Program – a year of learning

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The Lake Illawarra Coastal Management Program (CMP) was certified and gazetted in late 2020, making it the second certified CMP in the state and the first for an estuary. It was also the first CMP completed as a joint initiative between two Councils. Since certification both Wollongong and Shellharbour Councils, and other relevant stakeholders have been focused on implementing the actions outlined in the CMP.

The first year in any new strategy or program is often the toughest, it requires building and strengthening stakeholder networks, repairing strained relationships, finding the necessary extra budget, and most importantly building community trust and participation. This work is in additional to implementation of the 39 listed actions.

After a year of CMP implementation responsible stakeholders can reflect on successes and learn from struggles. Successes include the building of strong stakeholder relationships and obtaining the necessary budgets to implement many actions.

Stakeholder relationships have been enhanced and resulted in the formation of subgroups to coordinate implementation of complex actions. This enables efficient communication, opportunities to coordinate effort, pool resources, and share technical knowledge. The CMP's first year resulted in a boost in funding for Lake Illawarra across all organisations. Wollongong and Shellharbour Councils have worked together to secure grant funding for six actions.

The year hasn't been without struggles, especially when it comes to building community trust and enabling participation. COVID-19 has disrupted community programs and made the task of engagement very difficult. Established programs such as Bushcare have been put on hold, so it has been necessary to be adaptive in this space. More work is needed to build community trust in the CMP process.

Councils have learned a lot during the first year of CMP implementation and expect to improve even more over the years to come.

Climate Change Adaptation Case Study: Davistown landform and flood management

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Davistown is located within the Brisbane Water catchment, in the Central Coast Local Government Area. Previous studies of Brisbane Water have shown that the low-lying portions of Davistown will face difficulty in maintaining normal urban residential area functions under climate change projections for sea level rise.

Raising existing ground levels and associated infrastructure was identified in past studies as a potential solution provided there are no long-term detrimental effects as a result of maladaptation. By developing a regional adaptation masterplan, incremental filling could be achieved, albeit over the longer term on individual or multiple sites through development controls and urban renewal.

The suburb of Davistown is representative of a number of suburbs that are low lying and susceptible to the effects of climate change and the existing threat from flooding in and around Brisbane Water Estuary. A regional adaptation masterplan for Davistown will enable implementation of mitigation measures through developing adaption pathways such as development controls, levees and other measures over time in consultation with the community. The purpose of the Davistown climate change adaptation study is to inform these processes.

The Davistown climate change adaptation study focuses on the technical analysis of potential landforms and associated measures. These measures will provide flood protection against existing and future flood risk associated with both catchment and ocean flooding as a result of tidal or storm flooding mechanisms.
The outputs for the study include a concept design landform including civil design assessments such as. road and drainage design and flood modelling. The landform will inform development controls to require filling of individual lots as development occurs, along with regional filling to raise roads and public spaces and associated raising of infrastructure. Ultimately, the filling process would not only protect individual properties but provide ongoing viability to the suburb under rising sea levels.

This paper will explore the adaptation study process including collaborative options analysis, hydraulic modelling and civil design. The paper will also present the conceptual landform, drainage improvements and proposed management of ‘staging’ the landform development.

Drawing Landscape Narrative

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(Interfacing between the cultural, ecological and habitatat imperatives of Tallow Creek ICOLL watershed):

ICOLLs (intermittent closed and open lakes or lagoons) are extremely complex coastal environments, undergoing intense pressure with the acceleration of climate change impacts and increasing urban density along their margins. It is difficult when managing these environments to negotiate the competing interests of stakeholders. In the absence of alternatives, Councils tend to rely on methods of engagement such as surveys, websites and scientific reports which sometimes fail to identify the special qualities of a place or the values of community members and Indigenous owners of the land.

The work presented at this conference represents a yearlong investigation into a deep consultation process with stakeholders, incorporating the stories and wisdom of two people who have an intricate connection to Tallow Creek: Arakwal Elder Uncle Norm Graham and Suffolk Park Dune Care veteran Helen Brown.

The approach explores a participatory and integrative methodology that adopts the concept of 'drawing together', a highly iterative process that encourages and helps form deeper relationships among key stakeholders in order to gain a broader knowledge of site, its community and Indigenous heritage. This was achieved through fieldwork and various visual techniques such as on-site sketches, drawings, mind maps, collages, diagrams, pointcloud scans, physical and computer-generated models.

The co-creation of drawings to communicate unconscious/ intangible values, established deep and lasting connections with Indigenous peoples and customs in order to share, educate, and empower the wider community.

These non-traditional practices have the potential to aid Councils in their efforts to employ alternative strategies that better document, engage, promote, and respect the complex relationships that exists between place, stakeholder groups, ecosystems, belief systems, and values in these contested coastal landscapes.

Aquatic recreational structures as ecologically important habitats

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Artificial structures are becoming increasingly common within estuarine environments due to human population expansion along coastal zones. As such, identifying any effects associated with these structures on estuarine communities has the ability to help maintain and manage estuary habitats. This project assessed the effects of private jetties on fish assemblage and seagrass habitat within Lake Macquarie. Sampling was undertaken at four locations across the lake and contained three treatments: high density of jetties (≥10 in 150m shoreline length), low density of jetties (≤6 in 150m of shoreline length) and a control (no jetties). Seagrass was present at each location. Fish assemblages (abundance and diversity) were determined using Remote Underwater Video Systems (RUVS) and Remotely Operated Vehicle (ROV). All individual fish species observed were recorded and identified to the lowest taxonomic level possible and the abundance assessed as maxN – the maximum number of a single species within the video frame. Other parameters recorded from the video included: the time a species first appeared in a video (T1st) and the duration of time (in seconds) that a given species spent in view of the camera (TiV). Seagrass habitat was assessed by measuring percentage cover and mean canopy height. Relationships between jetty density (high, low and control) and habitat characteristics were quantified using statistical analyses. The presence of jetties had a significant positive influence on fish assemblages, indicating there are ecological benefits from the presence jetties in a seagrass dominated system. Furthermore, treatments containing jetties, regardless of density, had higher cumulative abundances (MaxN) and species richness, however, they also had a lower percentage cover of seagrass. This suggests that sites with jetties compared to sites with no jetties are providing additional habitat or structural complexity that has a positive influence on fish communities.

A citizen science-based assessment of marine species redistributions in New South Wales

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Climate-driven changes in species' distributions affect coastal ecosystem structure and function, impacting fisheries and conservation, presenting potential challenges for management. A recent review of the scientific literature [1] revealed 198 species shifting in Australian waters, but also substantial gaps in our knowledge. Over the past decade, several citizen science programs have collected large amounts of species observations that could be used to help address these gaps, but these databases have not yet been systematically searched and analysed to characterise species redistributions. We used a peer-reviewed qualitative decision tree analysis [2] to assess potential extensions of marine species distributions along the New South Wales coast, with data from three citizen science projects (Redmap; iNaturalist, especially the Australasian Fishes project; and Reef Life Survey). This analysis considers historical (i.e., recognised as of 2012) southern distribution limits, along with species traits (e.g., migratory behaviour, detectability) and evidence provided by citizen scientists' data (e.g., possible overwintering and/or multi-year observations) to assess overall confidence of potential species redistributions occurring. From an initial list of 93 marine species which have been tracked by Redmap over the past decade, we found evidence 23 are potentially undergoing range extensions, eleven with 'high', two with 'medium', and three with 'low' confidence. These findings provide an early indication of priority species and regions where targeted scientific research may be appropriate. Further, results of the assessment have been incorporated into the Redmap New South Wales Report Card, which provides a demonstration of the scientific value of citizen science and is being disseminated to engage with the broader public on climate change, using their own information.

1 Gervais, Connor R., Curtis Champion, and Gretta T. Pecl. "Species on the move around the Australian coastline: A continental-scale review of climate-driven species redistribution in marine systems." Global Change Biology 27.14 (2021): 3200-3217.
2 Robinson, L. M., et al. "Rapid assessment of an ocean warming hotspot reveals "high" confidence in potential species' range extensions." Global Environmental Change 31 (2015): 28-37.

Planning for uncertainty under the Coastal Management Framework: deep water for decisions-makers?

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The coastal zone is exposed to a variety of hazards that threaten human activities, amenity, development and infrastructure. Some hazards have a regional effect while others materialise locally. All will be exacerbated by climate change phenomena. Sea level rise, storm severity, cyclonic activity and increased flooding will have implications for sustainable management of the coastal zone.

The growing population on the coast and increasing tourism has resulted in rapid urban expansion and consequently increased pressure on the resources of the coastal zone and increased exposure to risk. The coast is a dynamic but fragile resource which supports communities, infrastructure, tourism and environmental assets. The present legislative and policy response to these challenges is principally found in the *Coastal Management Act 2016* and *Coastal Management SEPP*, operating within an existing legislative framework.

Risk management and resilience building does not occur in isolation. This paper explores the practical application of the current NSW Coastal Framework as an overlay to existing land use, development control and environmental protection legislation. Our analysis will focus on the current legislative toolkit and consider the implications and potential uncertainties within the broader scheme for holistic management of the coastal zone.

On analysis, clarity is required for practical responses under this broader framework. Are the flexibilities inherent in administrative decision making sufficiently balanced with management objectives or will the planning system present obstacles to meeting challenges ahead? A consideration of recent case law provides a detailed analysis of the legislative mechanics used to protect coastal regions.

Furthermore, coastal management in other jurisdictions, including the EU Code of Conduct for Coastal Zones and the US National Coastal Zone Management Program, provides a comparative touchstone. Both these international strategies prioritise integrated responses, and benefit from partnerships across government, to achieve holistic solutions that include forest management, tourism and water management.

Who owns the beach? The impact of uncertain boundaries on future design of protective structures

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With increases in coastal property prices, demand for coastal properties as populations increase, shoreline recession and sea level rise the boundary between private and public property is developing into a major issue. Coastal boundaries for private property are of two types; the high water mark line that has always been accepted as being an ambulatory boundary, and "fixed" surveyed boundaries often termed a "right-line" boundaries, which have traditionally been considered non-ambulatory. However neither of these boundary types is legally robust and the uncertainties should be of increasing concern for coastal engineers and coastal managers, particularly in regard to the location of works protecting private property. Issues include: planning approvals; on-going ownership and liability; impact on beach usage, including beach access both to, and along, the beach for the general public; the safety of protective works; and issues in regard to Aboriginal land rights and land claims.

With shoreline recession due to sediment imbalances and sea level rise beaches can seem to progressively fall into private ownership, but this may not be the case. As recession threatens private property assets owners wish to build protective works, but who owns the land on which the works are to be built? This affects design considerations such as the type of protective structure, including whether the toe design encroaches across boundaries, any potential threat to public safety as a result of the protective work failing, or sheading material onto the beach or into the surf zone and how to manage beach access.

The paper will discuss the fallibility of both High Water mark and "right-line" boundaries and their implications for coastal structures protecting private property including the issues to be taken into account and the potential pitfalls for designers and coastal managers.

Tweed Sand Bypassing maintenance dredging program

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In recent years Tweed Sand Bypassing (TSB) has implemented a maintenance dredging and placement strategy to complement the ongoing sand bypass system operations. Dredge removal design has been driven by regular sand volume analysis of the Tweed River entrance and identification of shoaling and bar formation between dredge campaigns. Calculation of sediment infill rates has been undertaken to inform dredge designs that aim to provide longevity to entrance navigability whilst remaining cost-effective. Infill rates have been compared to longshore sediment transport model outputs across multiple dredging campaigns to determine corresponding trends. TSB's maintenance dredging strategy is proactive by design, although in practice retains the flexibility to respond to variable environmental conditions each year.

The placement strategy employs several tools to conceptualise and then detail the annual distribution of dredged sand to offshore locations between Fingal Head and Bilinga. A Decision Aid Tool provides TSB with placement options that aim to meet project objectives as well as beach and surf amenity criteria (DHI, 2018). The distribution of overall sand volumes is dependent on the analysis of receiving capacities at each location as per their respective approved placement envelopes. TSB has engaged QGHL to investigate the potential benefits of different placement designs on surf amenity. QGHL proposed the 2021 placement design based on combined physical and numerical modelling (Atkinson et al., 2021). The placed mound was monitored after placement, and additional fieldwork was undertaken. Impacts of nearshore wave processes are considered regarding the longevity of the placed sand mound and geometry that may enhance surf amenity.

The removal and placement areas continue to be monitored regularly to ensure improvements are identified and incorporated into the Tweed Sand Bypassing maintenance dredging program in the future.

References:
Atkinson, A., Naderi, N. & Ryan-Slinger, J. (2021). Investigating dredge placement optimisation to benefit surf amenity, 2021 Coast to Coast, July 2021, Cairns, QLD.
DHI (2018). Sand Transport Information System: Integrated Sand Delivery Management Plan

It's a setup!

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Natural, sandy beaches that surround Australia are under threat of erosion and dune overtopping from waves. Climate change induced increases in storm intensity, together with projected sea-level rise, will further exacerbate these threats to beaches and surrounding areas. To mitigate damage and be prepared for potentially hazardous conditions, coastal managers and engineers use wave run-up as a predictor for extreme water levels on natural beaches. Despite the importance of wave run-up in coastal management, empirical model predictions still result in errors in excess of 25% from even the best-performing models. There is therefore a need to thoroughly examine and understand the components of wave run-up on different beach types in order for progress to be made in developing more accurate models.

The two fundamental components of wave run-up are swash and wave setup. The contribution of run-up from swash has been well documented and investigated due to the relative ease of observations. Wave setup, however, is relatively more difficult to observe and measure in the field, specifically for short-term observations. The ability to accurately measure wave setup from short-term deployment of equipment is paramount in order to better understand how setup and therefore run-up varies on a spectrum of beach types. This research investigates and establishes a new method of measuring wave setup accurately using pressure transducers deployed in a shore-normal array within the swash zone of natural sandy beaches. The results of this research highlight the possibility to accurately measure both swash and setup simultaneously using an easy-to-deploy method that can be used under varying conditions and beach states.

InletTracker: 30+ years of entrance dynamics of NSW ICOLLs from satellite data

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Despite their high ecological and socio-economic significance, there is often a lack of knowledge on the long-term dynamics of ICOLL entrances. Australia alone is home to 305 of the 1477 globally mapped ICOLLs and for many of them, there are no long-term records of their time-evolving entrance state, which represents a challenge for coastal management. Here, we present results from InletTracker, a new tool for reconstructing the dynamics of ICOLL entrances from publicly available Landsat 5, 7 and 8 and Sentinel-2 satellite imagery (Heimhuber et al. 2021). InletTracker is a Google Earth Engine enabled python tool that uses a novel least cost path finding approach to trace inlet channels, and then analyses the resulting transects to infer the minimum channel width and whether an inlet is open or closed. The tool is easy to use and provides users with long-term time series data on the location and shape of entrance channels, the width of entrance channels at the bottleneck (i.e., at the throat) and the open vs. closed state of entrances for all sufficiently cloud-free satellite images. Here, we applied the tool to 15 ICOLLs along the NSW coast. Our results revealed large differences in the frequency, duration, size and seasonality of entrance openings across the analysed ICOLLs but also showed degrees of synchronization in entrance behaviour across geomorphologically similar sites. Further, the entrance closure index calculated over the satellite data period often deviated substantially from existing estimates. The data provided by this experiment will enable coastal managers and researchers to gain new insights into dynamics and drivers of ICOLL entrance behaviour in NSW and elsewhere. Further, the improved understanding of the long-term entrance dynamics will enable a more evidence-based approach to entrance management, in particular for sites for which this type of information did not yet exist.

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Construction of seawalls at Collaroy-Narrabeen Beach – a failure of coastal management?

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In June 2016, beach erosion damaged a number of beachfront properties at Collaroy-Narrabeen Beach in Sydney, Australia. This was the impetus for owners at 45 properties (including 10 multi-unit strata properties) to consider the necessity and cost benefit of constructing (generally upgrading) coastal protection works to reduce the risk to development.

Five years later, at June 2021, seawall construction has commenced at 16 properties, and there are 16 other properties that have obtained approval for works or have committed to proceed. Of the remaining 13, 10 are likely to proceed if some impediments can be overcome, and only 3 have not committed. In the paper, the process and reasoning of landowners in making these decisions and selecting a design are outlined, and the impediments are described.

Construction of the first of these private seawalls, at 10 adjacent properties, commenced in November 2020. Although no particular event had created news, the seawall became newsworthy in February 2021, with newspapers and television stations running stories, and related social media traffic. Some of the LinkedIn comments included “maladaptation”, “massive disconnect between the science, and management”, “people will be complaining within 6 months of its completion that there is no beach at high tide and its unsafe”, and “so many jurisdictions will take a 19th Century approach to a 21st century problem”.

These comments on LinkedIn were made by people who would claim to follow a scientific method based on evidence. In the paper, the evidence is presented that there was a robust assessment of coastal processes in the project, the outcome implemented was a better outcome for the beach than the status quo, that there will generally be a healthy beach width over the design life of the works, and how a ‘retreat’ outcome was not feasible.

Seafood industry adapting to change on the Mid North Coast of NSW

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Hunter Local Land Services (LLS) and MidCoast Council are helping local oyster and fishing industries adapt to change in estuaries through actions such as oyster reef restoration and riverbank stabilisation. A key driver for the work was a desire to understand the changing nature of Wallis Lake and develop practical adaptation responses. LLS assists oyster farmers across the Hunter region plan and implement changes to infrastructure and practices that improve their climate resilience, reduce waste generation and help protect seagrass habitats. However, fishers raised concerns that the newer infrastructure had lower habitat value and the Wallis Lake oyster industry agreed to help create new habitat including oyster reefs in the Wallamba River.

An active riverbank rehabilitation site on Gereeba Island was chosen for the initial project. Council had used coir logs and mangrove planting to protect the riverbank, but the coir logs disintegrated before the mangroves had become fully established. The project has trialled new ways of placing timber and oyster shells along the bank to reduce erosion from boat wash and protect young mangroves. Live oysters were also added to encourage the creation of a living structure. Survival and recruitment of oysters is being monitored as well as habitat values for fish, crabs and other marine life. Monitoring results have been positive with live oysters surviving, mangroves thriving and a positive impact on fish habitat values.

Prioritisation of future oyster reef restoration is underway for both Wallis Lake and the Manning River in partnership with the University of the Sunshine Coast. A broad partnership with the University of Newcastle and others has also been assessing habitat-fishery linkages, habitat values of different types of oyster infrastructure, non-lethal deterrents of ray predation on oysters and improving oyster over-catch management using a real-time environmental monitoring network.

Single line abstract summary: Hunter Local Land Services (LLS) and MidCoast Council are helping local oyster and fishing industries adapt to the changing nature of estuaries through actions such as oyster reef restoration and riverbank stabilisation.

We've never been more certain about the seafloor: insights for coastal management

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Over the past 5 years the NSW Coastal Seabed Mapping Program has revealed the coastal seafloor in unprecedented detail, including detailed bathymetry, the distribution temperate rocky reefs and sedimentary substrates, and the diversity of coastal sediments. Over 6,800 km^2 of coastal seabed has been mapped using airborne lidar with coverage extending to 30 m water depth on average and beyond 40 m in some areas. A further 800 km^2 was mapped with vessel-based multibeam echosounder (adding to more than 1500 km^2 previously mapped), completing high-resolution coverage in six priority sediment compartments with important sediment transport stories to tell. Critically, over 450 sediment grabs and 35 km of underwater video transects inform qualitative and quantitative interpretation of seabed types indicated by the remote sensing surveys. As a result, we are more certain about the nature of the NSW coastal seabed than we ever have been.

But what does that mean for reducing uncertainty in coastal management and planning in practice? We provide an update on NSW coastal seabed mapping datasets and demonstrate how they can be applied with other key data and tools, such as wave buoy records, to improve common methods for predicting coastal hazards caused by extreme events, process cycles and climate change. For example, how the high-resolution bathymetry and state-wide seabed substrate classification can be used to identify the submarine extent and dimensions of beach systems, and connectivity with adjacent beaches. We also present an analysis of the character and distribution of sediment bedforms identified from the high-resolution seabed mapping, and the implications for understanding sediment transport on the inner-continental shelf and coastal sediment budgets. While our picture of the NSW coastal seabed is more complete than ever, the new data raises additional questions about complex interactions between the sediment transport processes that shape our coastline.

Assessing 65 breakwaters utilising drones - a comparison of techniques over 25 years

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Since 1993, the Coastal Infrastructure Unit of Crown Lands (now the Maritime Infrastructure Delivery Office (MIDO) of Transport for NSW) along with Manly Hydraulics Laboratory (MHL) has been involved in the assessment of the 65 major training walls/breakwaters on the NSW coastline. Frequently the assessment has been commissioned after major wave events such as the May 1997 or the June 2016 storm. In 1993/94, 2012, 2014 and 2020/21 the assessments were commissioned to ascertain the current state of the structures in order to budget for ongoing maintenance.

The assessments have resulted in requirement for major repairs as in the case of Ballina South Head (1995), Forster Head (2004,2017), Iluka (2016-17), Yamba (2016-18) and Coffs Harbour Eastern (2002,2012-14) breakwater and the ongoing maintenance of crests in a large number of breakwaters. These repairs resulted in rapid increase in the use of these breakwater crests as important recreational areas used by an ever-increasing population. The requirements for major repair resulted often in numerical modelling, and the 2D and 3D physical modelling of successful repair strategies in MHL's wave flume and basin.

The paper will also briefly compare methodologies used internationally and provide examples of how MHL can take advantage of those methodologies using drone data to improve the accuracy and quality of the breakwater assessments.

This paper draws on the extensive combined experience of MIDO and MHL to trace the evolution of assessment and modelling of repair maintenance problems of breakwaters on the NSW coastline. The paper will also provide an insight into lessons that have been learnt and present successful investigations.

Overview-This paper will present advantages in utilising drone surveys for breakwater assessments and demonstrate the ability to integrate GIS software analysis to enhance the identification of field data that could be utilised in the modelling and maintenance requirements

Historic shellfish reefs of NSW – gathering knowledge to help build social licence

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Shellfish reefs/beds are complex three-dimensional living structures composed of live shellfish (oysters or mussels) and shell. Impressive in their water filtration abilities, these 'kidneys of our coastline' also play a key role in fixing nitrogen, shoreline protection and providing habitat for productive and diverse marine communities. Tragically, shellfish reefs have been decimated globally, with an estimated 99% 'functionally extinct' in Australia (Beck et al, 2011) due to the cumulative impacts of unsustainable harvesting, poor water quality, sedimentation and disease. Oyster beds were once a common element in estuaries along the NSW coast but are no longer.

NSW DPI (Fisheries) has started the restoration journey for this habitat type to reinstate the environmental services they provide. Engaging the NSW coastal community in shellfish reefs is a key activity of the project. Preliminary historical research revealed tantalising early colonial accounts of vast expanses of natural oyster beds. The non-indigenous settlers saw great value in these vast beds – as an easily accessible food source and in the production of lime mortar for the burgeoning construction industry.

The loss of the State's vast oyster beds is believed to have been extensive and occurred at such a pace, that the phenomenon of generational amnesia has taken place. This important estuarine feature is almost an entirely forgotten ecosystem. The Department contracted an Environmental Historian to dive deep into the NSW archives to research the historic extent and location of oyster beds.

This new knowledge is contributing to the story of NSW shellfish reefs, which is helping to better engage the NSW marine estate community and build social licence for restoration and empower the community to participate in and deliver restoration activities, whilst contributing to decision making about site selection for future restoration projects.

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Marine Estate Management Strategy: reflection and adaption

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The ten-year Marine Estate Management Strategy aims to improve how we holistically manage the NSW marine estate. After three years of implementation we reflect on achievements, lessons learnt and how we adapt into the future to achieve the vision of 'a healthy coast and sea, managed for the greatest welling of the community, now and into the future'.

Over 100 projects managed under nine interlinked initiatives are working towards improving water quality, reducing litter, reducing impacts to habitats and species, preparing for climate change, ensuring fishing and boating are managed sustainably and safely, and enhancing community wellbeing. Importantly, we are working with Aboriginal communities to protect cultural values and integrate traditional practices and knowledge of Sea Country into the contemporary management of NSW marine estate.

Two independent evaluations have rated our service delivery, sustainability, governance, project management and risk management as strong. The foundations laid in our early years will help us to focus delivery statewide over the next six years, with multiple partners, to reduce the greatest threats facing the marine estate. We have more work to do around stakeholder engagement, program outputs and their integration with coastal management programs, data collection to measure outcomes and report carding to the public on implementation progress.

These are our priorities moving forward. Our focus is on our partners, stakeholders and the broader community and the Strategy outcomes are centred on delivering multiple benefits to the NSW community, underpinned by a healthy marine estate. Our success will be monitored and measured, guided by the Marine Integrated Monitoring Program. A mid-term review of threats and risks will help us adapt management actions, to address the multiple drivers of change in these uncertain times.

Cooperation is the key to manage the Greater Sydney Harbour

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Greater Sydney Harbour is one of the world's greatest harbours, a magnet for tourists and a source of great ecological diversity. At the centre of Australia's largest city, the harbour is subject to intense human activity which presents coastal managers with many challenges.

There is unprecedented pressure from urban growth in Greater Sydney, particularly in areas where the water quality and health of the receiving waters are already rated as poor. Unless actions are undertaken, the threat will significantly increase with a further 1.3 million people expected in the catchment by 2040, a legacy of contaminated lands and waters, aging infrastructure, and climate change.

The Greater Sydney Harbour CMP Scoping Study completed in 2018 identified much of the pollution that poses a threat comes from stormwater discharge. It recommended a whole-of-system approach and identified opportunities for collaborative partnering with stakeholders from local and state government, DPIE, Sydney Water, Transport NSW-Maritime and the Sydney Institute of Marine Sciences.

Sydney Coastal Councils Group and Parramatta River Catchment Group have gained support from 20 Councils located in the catchment to work together to address the threats in seeking support under Stage 2 CMP Planning Grant. This is the next step in defining actions and capacities towards implementing a coordinated approach that allows for sharing of information and setting priorities for investment in the catchment.

By taking a coordinated catchment-based approach the aim is to generate cost savings and efficiencies in mitigating threats to waterway health. A partnership approach is critical to meeting community's long-term expectation of healthy waterways, a swimmable river and harbour waters and protection of our iconic natural asset as well as address water quality initiative under the Marine Estate Management Strategy.

The time is now to get on with the plan to conserve our iconic Greater Sydney Harbour.

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Investigation of dune profile changes at Park Beach, Coffs Harbour, NSW

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The Park Beach sand dunes at Coffs Harbour are located downdrift of a significant interruption of Longshore Sediment Transport. All coastal processes theory suggests this area should be experiencing a long-term recession as the beach moves into a new, dynamic equilibrium. However, on-ground observations have shown a significant increase in dune crest elevation over the last ten years. This process has been investigated using the NSW Shoreline Explorer, Geoscience Australia tools and historic nourishment records.

Each year, naturally occurring northern longshore sediment transport carries approximately 75,000m^3 of sand past Coffs Harbour, New South Wales (NSW). Since its construction in the early 1900s the harbour has become a sand sink, capturing up to 50,000m^3 of this sand which cannot escape through natural processes. Periodic dredging has been undertaken to keep the harbour navigable, with the removed sediment placed to the north of the harbour.

Analysis of the NSW Shoreline Explorer shows the dune had grown approximately 4m in height from 1969-2021, with the most rapid changes between 2018-2021, where the crest has increased by 2m. The volume of the profile has also increased, fluctuating between 50m^3/m and 100m^3/m. By reviewing historic dredge records, a trend can be seen between beach nourishment campaigns and the dune changes, which may have also benefitted from a period of less significant storms in recent history. The analysis showed the unexpected benefits to the harbour navigation dredging – which has increased the dune heights to Park Beach and led to a greater standard of protection of the coastline against extreme events.

Where there's a WILS, there's a way! Innovative coastal management in action

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It is well-established that coastal management is a complex intersection of social, economic, environmental, and cultural considerations, framed by a backdrop of regulations, increasing population pressure and escalating climate change impacts. Successful coastal habitat restoration projects increasingly require considered, integrative and adaptive solutions to meet these needs.

NSW DPI's Oyster Reef Restoration Team are leading the way with innovative projects focused on restoring shellfish reefs - long-forgotten ecosystems - to NSW's coastal landscape.

Natural oyster reefs were once an extensive habitat feature of NSW estuaries providing a range of ecosystem services and holding significant cultural value for coastal Aboriginal people. Within 100 years of European arrival most reefs were decimated by anthropogenic impacts and became part of our forgotten history.

Between 2018 and 2021 the team delivered the first large-scale intertidal Sydney Rock Oyster reef restoration project in NSW in the Port Stephens-Great Lakes Marine Park with project partners The Nature Conservancy (TNC). Nearly 7.5 Ha of new shellfish reef habitat was constructed. Over 55 million baby oysters naturally recruited to the reef bases and are starting to deliver the ecosystems services of a natural reef – providing habitat for marine life and filtering water.

An innovative project based in Narooma has recently joined the momentum for shellfish reef restoration. The Wagonga Inlet Living Shoreline (WILS) project will showcase how nature-based solutions to coastal management can protect foreshores, and enhance recreational opportunities, integrate cultural values, engage coastal communities and build the resilience of coastal habitats.

Stage 1 of WILS will restore the first intertidal Sydney Rock Oyster reef on the NSW South Coast and the first subtidal Native Flat oyster reef for NSW. WILS is a collaboration between Eurobodalla Shire Council, NSW DPI through the Marine Estate Management Strategy, TNC, and the Australian Government through its Reef Builder initiative.

Holistic management of estuaries under climate change requires accurate numerical tools

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Recent studies suggest a conservative global mean sea level rise (SLR) of 0.28-1.02 m by 2100, while a SLR of larger than 2 m is possible in case of unmitigated growth of emissions. This climate change induced SLR poses a growing threat to estuarine communities and surrounding ecosystems with often dense human population by bringing about more frequent inundation, shoreline recession, saltwater intrusion, changes in estuarine inlet dynamics, and loss of intertidal wetlands [1]. To sustainably manage these impacts, a thorough understanding is required regarding how an estuarine system – as an entire waterbody – will respond to accelerating SLR [2]. This response depends on energy drivers (e.g., tides and river inflows), geometry (e.g., length and depth), and boundary conditions (e.g., roughness).

Surprisingly, static ("bathtub") modelling tools are widely used to predict estuarine responses to SLR, though they fail to consider estuarine interconnected processes (e.g., spatial and temporal variations in tidal regimes, sediment transport, water quality, intertidal vegetation distribution) [1]. In contrast, hydrodynamic modelling tools can be applied to estimate the changes in estuarine tidal dynamics. However, knowledge gaps exist regarding how changes in estuarine hydrodynamics under SLR may influence sediment transport dynamics (geomorphology), ecology, and bio-geochemical processes. Therefore, a gap remains between the methods that are commonly used to estimate SLR impacts on estuarine interconnected processes and the knowledge required by policy makers to develop holistic, whole-of-system management plans for estuaries under climate change [2].

This study uses a large ensemble of hydrodynamic models to provide systematic insights into how hydrodynamics of various estuary types with different boundary conditions will alter under different SLR scenarios. The findings of this research can help decision makers in effectively managing estuaries at a catchment-wide scale in present-day and future conditions.

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Assessing jetty features to reduce seagrass loss: Port Hacking case study

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NSW Councils and Fisheries NSW are responsible for managing foreshore developments within estuaries and protecting seagrasses. With ever increasing development within NSW estuaries, there is the need to understand which features of anthropogenic structures, such as jetties, are leading to the loss of seagrass within our estuaries. Seagrass are important because of their intrinsic value, and also because of the ecosystem functions and services they provide. In several NSW estuaries, *Posidonia australis* populations are considered endangered with Port Hacking being one of those estuaries. In the current study, we used Port Hacking as a case study to determine whether there were clear features of jetties that influenced the presence or absence of seagrass (either *P. australis* or *Zostera* spp). Out of the 923 jetties within the estuary, we sampled 328 representatively across Port Hacking. Out of 186 jetties with seagrass adjacent 57 had seagrass below them (26%). Jetty width had a massive effect on the continued presence of seagrass under these structures going from 75% probability of seagrass being present at 1m width to only 25% at 2m width. The light measures inversely reflected this with 40% light loss at 1m compared to 60% at 2.5m. Mesh jetties had >50% probability of seagrass being present (n=11), whereas as timber plank jetties only had 25% (n=198). Strangely, jetty height was not found to be an important predictor of seagrass presence in the best explanatory models. However, jetty height was found to have a substantial influence on light reaching the seabed with a reduction of 75% of the light with jetties 0.5m above the water level compared to only 40% reduction when the jetty was 1.5m above the water level. Overall, this quantitative and well replicated study has indicated some interesting areas for potential innovative jetty design and research to conserve seagrass.

Wetland morphology and its effect on sea-level rise modelling in barrier estuaries

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Examining the effects of sea-level rise (SLR) on morphodynamic feedback between estuarine hydrodynamics and tidal wetlands is important for coastal management and general process understanding of estuarine-wetland systems. Traditional approaches for assessing SLR effects typically consider the two independently. This may bias our understanding of how estuaries behave under SLR, because wetland landscapes are assumed to be static rather than responding to SLR.

This study explores the inter-relationships between SLR, estuarine hydrodynamics and tidal wetlands by combining empirical observations of tidal dynamics and wetland inundation regime, and modelling of estuarine hydrodynamics under SLR. The analysis focussed on the SE coast of Australia which includes wetlands within estuaries at a range of infilling stages. Hydrodynamic modelling results show that changes in estuarine hydrodynamics under SLR are mainly controlled by the geomorphology and degree of estuarine infill. For example, tidal amplification was predicted in an immature estuary with steep channel banks, while predicted tidal range remained stable in a mature estuary with gently sloped banks displaying extensive wetlands. Preliminary results using a coupled hydrodynamic-wetland model indicates that predictions of tidal conditions under SLR differ when bio-physical feedbacks (e.g. changing wetland surface elevation) are considered. This supports our contention that SLR effects on estuarine hydrodynamics and tidal wetlands should be considered simultaneously to accurately represent the morphodynamic response.

Improved understanding of the estuarine-wetland system will support effective management of estuaries and tidal wetlands because important inter-relationships can be considered in planning for SLR. In addition, comparison of SLR modelling in different estuaries presented in this study may enable first-pass estimates of how hydrodynamics change in certain estuarine-wetland settings.

The collective value of our ocean pools: developing a cost benefit framework

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The NSW coastline has a preponderance of ocean pools with approximately 60 in active use today. Ocean pools frame some of Australia's most iconic coastal landscapes and are synonymous with our beach culture. They are unique structures providing protected access to our beaches and are highly valued assets serving as effective recreational infrastructure for the community. Today, climate change poses challenges to the future management and conservation of coastlines globally. Within this ocean pools are not only ageing assets; they are at risk of damage from east coast lows and inundation due to sea level rise.

The revitalisation and future proofing of our ocean pools will trigger significant investment collectively to ensure their continued existence along our coast. Within a 'cost-benefit' framework, this paper brings understanding to the value ocean pools contribute within NSW. Given the public nature of our state's ocean pools, commercial or financial measures are insufficient to assess this. Therefore, this paper applies alternative, 'non-traded' measures which document their recreational, environmental, wellbeing, tourism and even 'non-use' values. The analysis provided explores both the individual values of an ocean pool and their value as a collective necklace of assets along the state coastline.

These measures would quantify the net benefit contributed by ocean pools and equip the community, professionals and policy makers with a wholistic understanding of their value. The paper also builds on this to discuss where benefits could be expanded through the direction of systematic policies and resources towards their conservation, improvement and potential expansion.

Kingscliff Seawall: construction, supplementary works, and design life

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The construction of the various coastal defences along the Kingscliff foreshore was completed in 2018 and has generally been accepted by the community as a success providing surety against future erosion events such as occurred 2010. Further, they have allowed for the substantial redevelopment of the foreshore park and local holiday park. The stepped concrete seawall, located in close proximity to the Cudgen Headland SLSC, provides the community with relative ease of access to the beach and a location from which to appreciate the various competitions and events hosted by the club. The true extents and scale of the seawall and adjacent rubble mound structure have been obscured through significant natural accretion and the establishment of foredune vegetation.

While the works are sound it should be noted that there are construction and detailing issues specifically associated with the stepped concrete seawall that have the potential to reduce the longevity of the structure and increase the requirement for scheduled maintenance actions.

It is intended that this presentation will provide a brief overview of the entirety of the works prior to focusing on the aforementioned issues, the remedial works undertaken, and the resulting reduction in the design life of the structure.

Sand movement on NSW's longest beach

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Stockton Beach is located on a sand peninsula immediately north of one of NSW's largest coastal rivers, the Hunter River. It is a highly dynamic coastal environment and has experienced numerous coastal erosion events requiring, the construction of a range of temporary and permanent protection measures along Stockton's foreshore. While historical analysis of erosion at Stockton suggested a cyclic nature of beach erosion and recovery, in recent years erosion has progressed beyond the extents of historical cycles. Coastal management strategies are often expensive and robust scientific knowledge is essential for effective coastal planning. To appreciate the dynamics at the southern end of Stockton Beach, an understanding of the entire sediment compartment is needed.

A sand movement study of the entire Stockton Bight sediment compartment has been completed in accordance with the NSW *Coastal Management Act 2016*. The study adopts a data-driven approach. At its centre is an analysis of the Bight's sand budget, which maps historical sand volume changes in sediment cells used to infer the rates and directions of sand movements. Drivers for the observed sand volume changes are described based on observational data, previous literature, state-of-the-art numerical modelling and/or coastal processes knowledge. Multiple lines of evidence are used to cross-check, validate and provide greater confidence in the findings. The rate of sand loss from the southern end is significantly greater than previously estimated and has implications for the on-going management of the coastal erosion issue at Stockton Beach. The erosion increases the risk of failure of the existing seawalls, wave overtopping of these seawalls and continued downdrift erosion as well as an increased risk of breakthrough of the peninsula. The increased understanding of the Bight's contemporary sand budget and sand movements provides the basis for improved evidence-based decision-making in coastal risk management and planning along Stockton Beach.

Opening that ICOLL: Are we managing flood risk?

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Coastal waterways that alternate between being open or closed to the ocean are known as Intermittently Closed and Open Lakes and Lagoons (ICOLLs). The entrance condition depends on the movement and redistribution of marine and fluvial sands by waves, tides, flood flows and winds.

Many ICOLLs are artificially opened to the ocean by various authorities. The main reason for artificially opening an ICOLL entrance is to mitigate and reduce the impacts of flooding. Artificial opening of an ICOLL entrance is usually in response to a trigger level being reached, that often relates to the lowest asset that requires protection.

But how much does opening ICOLLs actually mitigate flooding? And what type of flooding is being mitigated?

If low lying assets are at risk of being inundated due to water levels being detained behind the berm, then opening the ICOLL will release the detained water and alleviate inundation. However, in a major flood, water levels are likely to rise well above the berm height over the duration of the storm, whether the ICOLL is opened artificially or not.

So, while we know that artificial opening of an ICOLL entrance can alleviate inundation, is it effective at mitigating flood risk during flood events.

This can be assessed through hydraulic and hydrodynamic modelling as part of Floodplain Risk Management Studies. Many of these studies completed to date have shown that artificially opening an ICOLL entrance before or at the beginning of a flood event, has very little impact on flood heights if the peak flood levels exceed berm heights when compared to natural ICOLL opening.

This paper leverages off several existing studies and models to assess the role and effectiveness of ICOLL entrance management in flood mitigation.

Surfers' attitudes to sharks, perceptions of shark risk, and information needs

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The ocean is a shared space: an essential habitat for marine animals, and a leisure/recreation zone for humans. Shark-human interactions often lead to conflict within communities. Generally, there are two prevailing views: those who favour coexistence, and those who believe human life should take precedence. Although the risk of shark bite to humans is small, it can have severe consequences for individuals and communities. Surfing is a popular leisure activity in Australia, motivated by the desire to be outdoors, enjoyment of nature, relaxation, solitude, and physical health benefits. The surfing experience is influenced by wave quality and frequency, and environmental and biophysical conditions (including marine predators). Surfers are most at risk of harm from sharks, especially White Sharks that are often observed parallel to the shoreline behind the surf break. While studies of beach and ocean users' attitudes to shark bite mitigation have included surfers, they have not specifically been targeted as a separate stakeholder group with distinct perspectives and information needs. Our study quantified surfers' attitudes to sharks, perceptions of risk, information needs and preferred channels for receiving information. A representative online survey was undertaken to assess attitudes and perceptions of surfers across six NSW coastal regions. A total of 448 surfers completed the survey. Results revealed sightings and close encounters with sharks was common among surfers (51%). Surfers generally accepted the presence of sharks and most recognised the important role of sharks in marine ecosystems. It was acknowledged that "zero risk" did not exist, and the risk was considered acceptable. Surfers know the risk factors and are unlikely to surf when risk is perceived as high. However, there was a proportion of surfers who surf even when risk is perceived as high. Findings can be used to inform the development of education and communication strategies aimed at surfers.

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Planning for increasing local uncertainty

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Local government planning is recognised as a climate change solution because of its strategic capacity and its local focus. However, the assumptions of stability that have underpinned strategic thinking about urban forms and landscapes aren't holding. Planning will have to adapt.

Under current planning systems there is already considerable uncertainty as to the efficacy of solutions. Features of complex control systems like local planning include adverse and unexpected reactions and underperformance. There is uncertainty about the broader social and environmental outcomes of planning even though the location and design of new development is tightly controlled. An example being the contributions of past development to the cumulative impacts that are squeezing and threatening natural systems.

To accommodate increasingly unstable contexts, local planning will need to become more adaptive which will require supportive governance, systemic changes and the adoption of very long-time horizons commensurate with known climate risks. Adaptation science has a considerable degree of convergence as to how such change should occur and indicates greater involvement of communities and greater use of local knowledge in forming solutions. But community agreement on adaptive action will have origins in, and apply within, complex social-ecological systems producing new uncertainties. Long-term adaptation goals are likely to be based on local values and be provisional, fuzzy, and clumsy. Community consultation anyone?

The future of local strategic planning is processes and practises that accommodate and embrace uncertainty. Potential solutions include community-based anticipation and its partner anticipatory governance. These are relatively recent concepts yet to be established in policy systems or put into local practice. Some of the characteristics of anticipatory local systems will be very long-term goals, adaptation pathways, policy experimentation, multi-disciplinarity, new strategic knowledges and new local learning practices.

Coast and Foreshore Protection Strategy for Trial Bay Gaol Visitor Precincts

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[2]NSW National Parks and Wildlife Service (NPWS)

Trial Bay, in Arakoon National Park on the NSW Mid North Coast, is often described as the 'jewel in the crown' for tourism within the Macleay Valley. Its key visitor precincts incorporate historic Trial Bay Gaol and Laggers Point Breakwater, and local Aboriginal people have an unbroken cultural association with Arakoon National Park extending over many thousands of years.

Trial Bay continues to have social, economic and cultural significance to the local community and visitors to the area who use its beach, foreshore and surrounding areas for a variety of activities. However, similar to other coastal locations, storm events, climate change and coastal geomorphic processes are contributing to coastal recession and erosion. This is resulting in the loss of coastal vegetation, changes to coastal lagoon ecology, damage to critical visitor facilities and the temporary closure of beach access points.

The NSW Coastal Management Manual (OEH, 2018) was used to inform the development of a coast and foreshore protection strategy for Trial Bay's key visitor precincts. This strategy provides the NPWS with a variety of options for managing the site's coastal assets and supports and compliment broader coastal planning activities being undertaken by the Kempsey Shire Council. The strategy also provides a blueprint and key reference document for the NPWS to manage similar low-energy coastal environments subject to high visitor use in the state's national parks and reserves.

Key elements of the strategy include:

- A coastal processes and hazards study.
- Targeted stakeholder engagement through the establishment of reference and technical advisory groups and the strategy's public exhibition.
- A coastal hazard risk assessment of the study area.
- Development of a coastal adaptation framework.
- Identification of realistic project objectives in line with community expectations.
- Preparation of concept designs and the identification of practical and cost-effective management options.
- Strategy integration/alignment with Kempsey Shire Council coastal planning processes and the NSW Coastal Manual.

This joint presentation by Alluvium and NPWS will provide insights and learnings from the development of the 'Coast and Foreshore Protection Strategy for Trial Bay Visitor Precincts', including the impacts of current and projected coastal processes on the management of this spectacular area of the NSW coast.

References: OEH (2018): NSW Coastal Management Manual Part B

Physical modelling of innovative rock bag coastal applications

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Often textbook solutions to coastal engineering challenges are not feasible due to: budgetary, construction and materials limitations; environmental and socio-political drivers; and project timing, including the need for an emergency or temporary response. Innovative solutions are required.

Emergency responses to storms in 2020 that caused significant erosion at numerous locations along the NSW coast included the deployment of a 250 tonne crane to lift 2 and 4 tonne Kyowa Rock Bags onto Wamberal Beach, which overcame significant emergency constructability constraints. This formed a protective toe and was the first use of this technique on the open coast of NSW. Furthermore, a 120 m, 4 tonne Rock Bag structure on the exposed coastline at Stockton Beach was constructed as an action within the certified Stockton CMP (2020) as an adaptive risk management structure. Consideration of the potential broader use of Rock Bags for temporary protection prompted more research into the engineering effectiveness of the technology in such applications.

The buzz word of today, "INNOVATION" in an increasingly risk averse society, requires significant effort in achieving acceptance among project stakeholders and industry. Physical modelling was undertaken at WRL on this previously untested technology, in this context. This gave confidence that the product could be effective as coastal protection whilst significantly reducing the volume and size requirements of rock required compared to traditional rip rap and layered armour. Furthermore, Rock Bags have a high degree of removability.

Physical model testing (approximately 1:20 scale) of the stability and overtopping risk of the Rock Bags in a back beach revetment arrangement typical to open coast are presented in this paper. Key outcomes were the quantified hydraulic stability of the pattern placed units and the development of generic stability design curves that can be used by engineers in applying this technology elsewhere.

Meet the Friends of Cabbage Tree Bay Aquatic Reserve Volunteer Group

R Millward[1]
[1]Northern Beaches Council, Dee Why, NSW

The essence of this presentation is to promote the benefits of environmental volunteer groups such as *Friends of Cabbage Tree Bay* - the benefits to the community and to the ocean -SDG14.
I will open with information and maps on the coastal area in NSW which this paper is referring to, the LGA which includes Northern Beaches Council and from which this group has stemmed.
The paper will cover a short history of the group, its origins, its purpose and the focus of the volunteers while on duty as well as a key aspect - the Enrichment Program.
It will outline the support and partnerships, community engagement, citizen science, cultural connections and collaborations, along with the celebrations and successes.
The power point presentation will be a mix of data, images and short videos.
And if we can work out the technology (?) a live cross to the volunteers while on duty in Manly.
https://www.northernbeaches.nsw.gov.au/environment/coast-and-waterways/aquatic-reserves/friends-cabbage-tree-bay

Construction of the Shell Cove Boat Harbour Entrance and the Beach Response

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The Shell Cove Boat Harbour Project is one of the most significant recreational boating facilities proposed for the NSW coast, located approximately 100km south of Sydney. The Project is being managed under a joint venture arrangement between Frasers Property Australia and Shellharbour City Council with Advisian as the lead engineering consultancy.

The multi-million dollar boat harbour development has involved digging out a harbour basin landward of Shellharbour South Beach and formalising the edge with varying rock and concrete foreshore structures.

A notable feature of the development is the harbour entrance off Shellharbour South Beach that provides open-ocean access to and from the sheltered boat harbour. The entrance is trained into the surf and deepwater zones by two rock walls (breakwater and groyne) that extend around 300 m seaward of the mean high water mark, and were constructed from around 400,000 t of basalt and granite rock.

Shellharbour South Beach has reacted to the introduction of the boat harbour entrance through rotation and profile changes, and has been monitored via ongoing beach surveys. A range of analyses have been carried out including graphical and volumetric comparison of historical surveys, interpretation of historical aerial photography, and consideration of known occurrences of storm events. Comparisons of the analysis have also been made with the outcomes of the first physical model undertaken in 1995 by AWACS to assess the physical impacts of construction of the harbour entrance.

This paper would outline the methodology and challenges experienced during the construction of the boat harbour entrance, and present the findings from the Shellharbour South Beach analysis of the entrance impacts.

References:
Advisian (2020), Coastal Engineering Analysis of Beach Survey, Technical Report November 2020
Miller, B.M and A.F. Nielsen (1995), Physical Modelling Study of Shell Cove Boat Harbour, Australian Conference on Coastal and Ocean Engineering, Melbourne

Nearshore nourishment mound placement and temporary surfing outcomes

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[1]Coastal and Marine Research Centre, Cities Research Institute, Griffith University, Gold Coast, QLD

Surfing and the surfing industry are of vital socio-economic importance to the Gold Coast, in both terms of lifestyle and economic benefit. In 2008 it was estimated that the Gold Coast surf industry output was around $3.3 billion (AEC, 2009). Increased population growth, particularly due to the COVID-19 migration, has increased pressures on the surfing amenity of the Gold Coast with over-crowding an issue at many of the region's world class surfing breaks. As such it is prudent to explore options for increasing the number of breaks available to surfers utilising working with nature approaches. The Tweed Sand Bypassing project (TSB) is a joint initiative between the New South Wales and Queensland state governments with the project's objectives to maintain a safe, navigable entrance to the Tweed River and restore and maintain the sand supply to the southern Gold Coast beaches. As a part of this program a targeted dredged sand deposit of around 30,000 m^3 from the Tweed River Entrance will be placed downdrift of the system at Bilinga Beach, Gold Coast, in July 2021. The targeted placement will potentially have positive temporary surfing outcomes (Atkinson et al., 2021). Two other targeted surf zone nourishment placements leading to improved surfing amenity were undertaken at Cronulla, NSW and Palm Beach, QLD in 2012 and 2017, respectively. Both of these placements had anecdotal evidence of increased surf quality. We present the results of an experiment that aims to inform future nearshore nourishment placements which consider surf quality. Monitoring of surfing characteristics over the sand mound placement for a range of swell conditions utilising in-situ measurements and remote sensing techniques will derive information on surfing parameters including: ride length, number of rides per hour, surfer counts, wave refraction and breaking characteristics.

References:
AEC (2009). GCCC surf industry review and economic contributions assessment: Gold Coast City Council. Gold Coast, 52 pp.
Atkinson, A., Naderi, N. & Ryan-Slinger, J. (2021). Investigating dredge placement optimisation to benefit surf amenity, *2021 Coast to Coast*, July 2021, Cairns, QLD.

Empowering the tourism community to own it and act on visitor litter

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[1]Take 3 for the Sea, Long Jetty, NSW

From first wave to ground swell

Although positive economic news for NSW tourism destinations and businesses the unfortunate downside to tourism success is 25,000 tonnes of visitor litter (NSW EPA 2022).

Take 3 for the Sea's pilot project First Wave began the visitor litter conversation with tourism operators in popular NSW holiday destinations and empowered 80 tourism business owners to take the lead in litter prevention and inspire others in the tourism community to own it and act.

Take 3 leveraged strategic network partnerships to create awareness and develop a shared vision and strategy for litter prevention in the visitor economy moving forward.

Tourism operators and strategic network partners participated in a series of activities, in-person and online workshops and an industry survey. Data was collected re litter sources, items, attitudes and behaviours and informed the creation of the NSW Visitor Economy Litter Prevention Strategy and the Litter Reduction Toolkit for NSW Tourism Operators.

The project inspired and educated participants from a broad cross section of the tourism community to join the journey, identify solutions and actions, share their suggestions, successes and impact whilst making a significant and sustained contribution to achieving the NSW target of a 40% reduction in litter.

March 2022 saw the launch of Ground Swell, a follow-on 3 stage program empowering all NSW tourism businesses state-wide to take next steps, develop and implement action plans to address litter and plastic waste in their own businesses and communities, and to work together to keep tourism destinations across NSW litter-free.

The project has demonstrated collaboration and partnership empowers people within a community to come together to make a difference, to map a future path and plan together to #Take3forNSW.

This project is a NSW Environment Protection Authority, Waste Less Recycle More initiative funded from the waste levy.

References:
NSW Environment Protection Authority, Accessed 12 May 2022
https://www.environment.nsw.gov.au/heytosser/

Holocene evolution and sediment budget at Tathra Beach, NSW

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[3]Graduate School of Frontier Sciences, The University of Tokyo, Chiba, Japan
[4]Land and Water, CSIRO, Canberra, ACT
[5]Bega Valley Shire Council, Bega, NSW

Sediment budgets seek to quantify sources, sinks and transport pathways in the coastal zone and inform our understanding of the sensitivity of sandy shorelines to change. Long-term (millennial) coastal evolution of sandy barriers and estuary systems provides an important framework to understand shorter-term (decadal to centennial) patterns of sediment transport. This study assembles a range of data sets from different timescales to reconstruct the long-term and short-term sediment budget of Tathra Beach on the south coast of New South Wales (NSW). Optically Stimulated Luminescence (OSL) dating of the foredune ridges behind the active beach combined with high-resolution topography and Ground Penetrating Radar (GPR) inform the Holocene deposition of this prograded barrier system and constrain the timing of changes in the position of the entrance to the Bega River. We reconstruct the position and impact of the 1974-78 storms and calculate the volume of sediment deposited since this event. We also make use of the ~30-year record of Landsat imagery to explore recent trends in shoreline movement and opening and closing patterns of the Bega River which result in destruction and re-formation of the river mouth sand spit. In so doing we test the conceptual model proposed in the *Tathra erosion study* (PWD, 1980) where post-storm shoreline recovery in the south of the embayment is slower as sand is preferentially sequestered northward to re-form the river mouth spit. Newly acquired marine LiDAR from the NSW Government also sheds light on the nature of sediment delivery from the Bega River to the inner shelf and cross-shore and alongshore sediment exchange within this broader secondary coastal compartment. The result of this multi-data, multi-timescale approach, is a wholistic picture of the millennial and historical sediment budget of Tathra Beach, which will inform management decisions considering future sea-level rise projections and other anthropogenic pressures.

Public Works Department (1980). Tathra Erosion Study; Report No. PWD 79015; Department of Public Works Coastal Engineering Branch: Sydney, Australia.

Scaling up coastal wetland rehabilitation with the return of the tide

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Farm-scale drainage of the coastal floodplain began during 1870-80s. However, to achieve the desired level of drainage, works were scaled-up with drainage efforts peaking in 1950-70 with regional-scale works funded by local, state and national government collaborations. Works included straightening and deepening creeks, digging drains, and, installing floodgates, barrages, weirs and levees. These drainage schemes severely altered hydrology, resulting in wide-spread habitat and biodiversity loss due to the degradation of backswamps, intertidal wetlands, estuarine and marine ecosystems. Hydroperiods in many drained freshwater wetlands changed from 100+ days to <10. This has allowed flood intolerant pasture species to dominate. Remnant wetland vegetation has also shifted to areas with hydroperiods that matched their need, so some areas that were formerly open water have become *Melaluca* or *Casuarina* wetlands. The ground surface of these drained landscapes acidified and slumped, exacerbating poor water-quality flows from parts of the coastal floodplain resulting in estuary-wide aquatic organism mortality events.

Some of the first coastal wetland rehabilitation efforts occurred during the 1970s at the farm-scale in response to environmental impacts, loss of wetland birds and fish kills. The Marine Estate Management Strategy 2018-2028 and its Threat And Risk Assessment identified environmental, social, cultural and economic assets as still being under threat and risk from coastal wetland drainage. Addressing these key threats and risks to improve the quality of water that discharges into estuaries from coastal floodplains involves working at wetland and landscape scale as a multi-agency collaboration, with local government, key landholders and stakeholders. The Australian Government's proposed release of the blue carbon methodology at the end of the year may see more partners participate in coastal wetland rehabilitation because the outcomes align so tightly with the blue carbon co-benefits. Perhaps in several ways the upscaling of coastal wetland rehabilitation will reflect the evolution of drainage activities.

Managing coastal waterways after the Black Summer 2019-20 Bushfires in South East NSW

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[2]Eurobodalla Shire Council, NSW
[3]Shoalhaven City Council, NSW
[4]Bega Valley Shire Council, NSW

The 2019-20 landscape scale fires in New South Wales were enormous in their extent and severity, with the fire grounds covering approximately 5.4 million hectares.

Across the South East region, which includes the Shoalhaven, Eurobodalla and Bega Valley local government areas, the fires burnt over 1 million hectares directly impacting and affecting our communities and the environment. A diverse range of landscapes and ecosystems were affected including rainforests, wet sclerophyll forests, heathlands, sensitive waterways and aquatic ecosystems. The fires were so intense and widespread that some estuary foreshores including mangroves and coastal dunes were burnt.

Some 47 estuaries and catchments within the south east region of NSW were fire affected to some extent, substantially impacting the intrinsic environmental, social and cultural values, biological diversity and ecosystem integrity. This has tested the resilience of the coastal waterways, estuaries and their catchments to bushfire hazards.

Following the bushfires, the NSW Government provided technical and financial support to the three Councils via its Coastal Management Program to undertake on-ground restoration works, recovery planning and monitoring projects.

This presentation aims to share some of the learnings from these projects including:

- Initial impacts, concerns and actions that were undertaken following the bushfires;
- Lessons learnt to date about what has worked well and what could be done differently next time; and
- The ongoing riparian rehabilitation works that are being implemented to aid recovery and increase the resilience of south east coastal waterways.

References: Alluvium Consulting 2021, *South East Catchments and Waterways Bushfire Recovery Plan.* Report prepared for Shoalhaven City Council, Eurobodalla Shire Council, Bega Valley Shire Council and the Department of Planning Industry and Environment (November 2021). https://www.shoalhaven.nsw.gov.au/Projects-Engagement/Major-Projects-Works/Bushfire-Affected-Coastal-Waters

Adaptive risk management of erosion, Stockton Beach, Newcastle - Lessons from the field

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As developed coastlines in NSW come under increasing pressure from erosion, Councils require adaptive risk management strategies to protect assets in the short-term whilst long-term strategies are investigated, approved, designed and funded through the formal processes. Presently sand or sand-filled geocontainers are the only construction materials approved under NSW legislation for temporary coastal protection works. The short comings of these options however have been apparent in Stockton where they have been used extensively in recent years for emergency works. Kyowa Rock Bags provide an alternative construction material with advantageous hydraulic stability, constructability, reusability, safety, and durability. These mesh bags filled with cobble sized rock can be 1t, 2t or 4t and crane or excavator lifted into place using a built-in lifting ring. Rock Bags have been used in Japan for many decades but are relatively new to Australia.

In similar circumstances to the coastal hazards observed at Stockton, the July 2020 erosion at Wamberal Beach saw houses threatened and evacuation orders given. Only sand-filled geocontainers were permitted for use under the existing Coastal Erosion Emergency Action Subplan, but were considered impractical for the situation by local experts. Use of Rock Bags was only permitted through the Local Emergency Operations Controller (LEOCON) issuing orders for subsequent successful emergency works under section 61(1)(c) of the *State Emergency and Rescue Management Act 1989*.

This paper outlines the lessons learnt through the design and construction of a 205m long, 4t Rock Bag planned temporary protection structure on the exposed coastline at Stockton Beach and the consideration of the potential broader use of Rock Bags for temporary coastal protection. The use of Rock Bags at Stockton for adaptive risk mitigation was included in the certified Stockton CMP (2020).

Seawalls and sandy beaches - case study Wamberal Beach

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[1]Manly Hydraulics Laboratory, Department of Planning and Environment, NSW
[2]University of NSW Water Research Laboratory, Sydney, NSW
[3]Balmoral Group, Australia, Sydney NSW
[4]Central Coast Council, Gosford, NSW

Wamberal Beach is within Darkinjung land. Over the past 50 years, foredune development at Wamberal has experienced damage and loss from coastal erosion. Managing public safety and built assets, pressures on coastal ecosystems and community uses of the coastal zone are priority issues in the certified Gosford Beaches Coastal Zone Management Plan (CZMP, 2017). Undertaking a review of seawall design for Wamberal Beach, coupled with beach nourishment (supporting Section 27 of the CZMA, 2016), was a key recommended action.

An integrated multidisciplinary team was formed to undertake:

1. Review of previous studies;
2. Coastal protection amenity assessment;
3. Seawall concept design options development;
4. Sand nourishment investigation;
5. Additional coastal monitoring (online webpage);
6. Cost benefit analysis and distributional analysis of options; and
7. Community consultation.

Prior studies and community sentiments highlighted the need for strong integration between different disciplines of coastal engineering, geomorphology, science, economics and community involvement. This has ensured completed studies for Wamberal Beach utilise best information, valid and defensible assumptions and a good understanding of all key benefits and costs from all interested parties.

Each of the studies provide valuable information and evidence to aid selecting a preferred option. The preferred option will be selected from a balance between economic/funding, engineering, scientific and management considerations as seen by key interested parties within the NSW legislative framework.

The studies demonstrated that all seawall options provide benefits to foreshore property owners, but that conventional rock structures present adverse non-stormy beach width amenity impacts compared with the present situation. Vertical seawall options enhance non-stormy beach width amenity compared with the present and by incorporating a well-considered promenade, have the potential to greatly enhance the area for all interested parties.

Marine Parade, Manly Beach Wave Overtopping Early Warning System

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[2]University of NSW Water Research Laboratory, Manly Vale, NSW

The Marine Parade Wave Overtopping Early Warning System and Response Project has been implemented along the historic Marine Parade coastal promenade. This promenade, also known as the Shelly Beach walkway, was built in 1890 and is a popular tourist destination between Sydney's iconic Manly and Shelly Beaches and provides access to Cabbage Tree Bay Aquatic Reserve.

During storm events the promenade is impacted by large waves making the 1km walkway potentially unsafe. The project has benefited Council and the community through improved safety and preparedness through:

- Increased Council knowledge of coastal hazards through the installation of a camera and development of a warning system.
- Improved public safety and awareness through implementing a pedestrian risk management system.
- Improved stakeholder relationships and ability for future strategic planning joint asset owner Sydney Water.

This project has been undertaken in collaboration with University of NSW Water Research Laboratory, Sydney Water, cross Council teams, community groups, local businesses and members of the coastal engineering and insurance community. Our early warning and pedestrian safety system is now being considered for other NSW locations.

Changing degraded sugar cane land into a carbon sink

R Quirk[1]
[1]NSW Cane Growers Association, Duranbah NSW

Soil on my 100ha sugarcane farm was developed over the last 10,000 years through the deposition of marine sediments during sea level rise. During the development of the Tweed Valley in the 1920's into pastureland, much of the peat was burned, while the drains were the conduit to take the acid to river from the fields the oxidation front is 30cm lower than the depth of the drains. Acid scalds were common, and many areas only grow salt-water weeds. Potential mineral acidity in the soils has been measured at over 50t H2S04/ha. During the 1960's, floodgate, levees and dewatering pumps were installed to improve drainage, discharging the fresh water from the surface of the soil before it mixed with the acidic water draining through the soil profile. This has reduced the amount of acid discharging to the river by 85%.
In conjunction with 12 PHD candidates and researchers we developed a BMP. This are now accepted as world's best practice for growing sugar cane in acid sulphate soil landscapes. These include laser leveling, infilling 50 % of the field drains, cutting the cane without pre-harvest burning, retaining the residue, controlled traffic, reducing the inputs of chemical fertilizers used well below the recommended rates. Maintaining the water table, at minus 60cm AHD with automatic pumps.
The results have been excellent. Soil Ph has improved from 2ph to 5ph, soil organic carbon has improved,80 carbon tests taken on the farm showed there were 17,000 tons in CO2 equivalents accumulated in the 100-ha farm over the last 20 years.
The results have been good. Increased Ph in discharge water, increased organic carbon levels, reduction in chemical inputs and 75% increase in in production.

Mapping the distribution of snapper across Greater Sydney's coastline

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[3]Marine Planning, NSW Department of Primary Industries, Wollongong, NSW

Information on the distribution of fishes and their critical habitats, such as nursery areas, is essential for the effective management of fisheries resources. Currently, there is limited information on the distribution of pink snapper across the NSW coastline and specifically the Greater Sydney region. In this study, we assessed the distribution of snapper on rocky reefs from 308 baited underwater video samples along Greater Sydney's coastline (Newcastle – Sydney – Wollongong). We found that juvenile snapper (< 25 cm total length) preferred small flat patch reefs adjacent to large estuaries. In contrast, adult snapper (> 32 cm total length) were influenced more strongly by nearby human population size than habitat features. Lower occurrences of adult snapper adjacent to large metropolitan centres suggest human threats (e.g. water pollution, noise and fishing) may be having a negative impact in these areas. Further research is required to better understand the relationship between multiple human threats and snapper populations in the region. Overall, our results highlight the essential habitats for snapper, particularly the importance of large estuaries, which are nurseries for juveniles. Knowledge of these habitat relationships and the distribution of snapper across Greater Sydney's coastline will support the ongoing management and monitoring of snapper and their critical habitats by NSW Fisheries.

Coastal settlements, constant change and capitalising on complexity in New South Wales

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Infrastructure delivery as civic amenity

This presentation will explore how the recently completed NSW Coastal Design Guidelines can be used by coastal councils to capitalise on essential infrastructure to realise public domain improvements.

Meandering for nearly 2000 kilometres from Eden in the south to Tweed Heads in the north, the New South Wales coastline is a physical, cultural and poetic landscape with few parallels in the world. With unspoiled landscapes ranging from beaches and wetlands to forests and cliffs, dozens of reserves, parks and sanctuaries protect the coastal lands, waters and habitats.

Woven through this territory are the human habitats of NSW's regional cities, holiday towns, beach suburbs, fishing villages and coastal resorts – settlements with long and varied histories and relationships with the coast and its ecologies. This mutually beneficial co-existence between settlement and the natural environment was the basis for the NSW Coastal Design Guidelines, which REALMstudios authored in 2020.

The dynamic and highly sensitive coastal environment has increasingly become the preferred location for a growing range of uses and the desired destination for swelling numbers of visitors, as the State's urban and rural populations migrate to the coast, and its iconic places. In this context, it was clear that the Guidelines required an approach based on understanding essential considerations and developing fundamental principles in response.

The Guidelines provide clear directions to consider urban design and architectural challenges in response to pressures posed by population growth and climate change. It outlines effective practices to protect the character and quality of the coastline while managing land and infrastructure, maintaining public access and enhancing visitor experience.

Central to the Guidelines utility are the methodologies developed to analyse coastal sites, frame critical issues, and reveal opportunities for design solutions in coastal infrastructure that can also deliver significant outcomes in environmental, social, cultural and economic performance.

Shifting sands on Coastal Crown Land

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[2]BMT Commercial Australia, QLD

Audit of Commercial dredging and extraction:

Commercial dredging and extraction on coastal Crown land provides economic benefits to the New South Wales (NSW) economy and supports the current and increasing construction demands of the state. However, these operations can pose significant threats to the environmental, social and recreational values of the marine estate, as recognised in the NSW Marine Estate Threat and Risk Assessment (TARA). Key stressors and risks identified were physical disturbance, wildlife disturbance, water pollution and changes to tidal flow velocity and patterns.

The Marine Estate Management Strategy 2018-2028 (MEMS) provides a framework to address the key threats and risks identified in the TARA. Initiative Two of the MEMS includes an action to audit and assess the current commercial dredging and extraction operations across coastal Crown land in NSW and analyse the framework for licensing and compliance under the *Crown Land Management Act 2016*.

The audit identified 26 licensed operations on coastal Crown Land in 2019, 14 of which were 'active' and 12 of which were latent. The total extraction volume associated with the active licences was approximately 1,500,000 m3 of material, across the Tweed River, Bellinger, Nambucca and Shoalhaven rivers as well as at South West Rocks, Oyster Cove, Anna Bay and Boambee Beach.

The audit identified that responsibilities are shared between development consent and approval authorities for the assessment and oversight of commercial dredging and extraction operations. Approval and compliance functions are spread across several different legislative instruments, and across the various government agencies.

Through benchmarking the approval and licensing arrangements for each active operation, it was evident this current framework does not consistently address key risks and threats to the marine estate. Importantly, the benchmarking found that risks associated with dredging plumes and morphological and hydrodynamic changes to estuaries were not consistently assessed or managed through current approval and licencing arrangements.

References:
BMT WBM (2017), New South Wales Marine Estate Threat and Risk Assessment Report, Version 12, prepared for Marine Estate Management Authority, Newcastle.
Natural Resources Access Regulatory (2020), Guide to completing and submitting a new or amended controlled activity approval, Publication 19/500, Department of Planning, Industry and Environment, State of New South Wales, Parramatta.

Land value consequences of Coastal Hazards and Adaption. Who pays?

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In NSW the premium value attached to coastal land and perceived impacts on property values provide the setting for decision making on coastal risk and coastal adaption. Tensions within and between stakeholder groups make this a politically difficult arena for Local Government to navigate. Impacts on the unimproved capital value of land have implications for local Councils and their rate base as well as landowners. Changes in land value and risk may also impact on insurance premiums and coverage as well as mortgage risk (including for banks). This paper explores the tensions between stakeholders through case studies.

Private landowners are often vocal objectors of coastal hazard assessment due to concerns about impacts on land values. They are also frequently the first to assign blame when coastal hazards eventuate and benefit from inflated property values when at risk land is acquired. The broader **community** is often expected to bear the cost of coastal adaption, by way of funding for works, acquisition of at risk land, and/or through loss of access to public land set aside for works. Through acquisition or works they may also gain access to and use of coastal land. The **State Government** values land for land tax assessment, collects stamp duties, funds certain coastal works or adaption measures, can through legislation or SEPPs impose new planning constraints and through the Valuer General is the government's final arbiter of property value in the event of acquisition. **Local Government** relies on higher land values to set their rate base, is required to undertake coast risk assessments and implement measures (as economically justified), can acquire land for public purposes, can be compelled to purchase land designated for future acquisition and will forgo rates where land is set aside for environmental purposes rather than being or remaining developed.

The role of morphodynamics in assessing flood hazard in tidally dominated estuaries

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Tide dominated estuaries typically feature extensive tidal sand banks in their downstream reaches. These can be mobile, shifting under the actions of tides, residual wave energy, and floods. These dynamic conditions mean that bathymetry information can become outdated after a single extreme weather event, let alone the actions occurring over multiple years. This offers a challenge when undertaking coastal, estuarine and flood hazard modelling assessments, which requires a detailed understanding of bed levels to accurately simulate hydrodynamic processes.

New data collection and morphologic modelling has been used to support the Wooli Flood Study, in northern NSW. This has included jetski-based field survey to supplement the 2018 'clear day' LiDAR which penetrated to depths of around 1-2m, and GPS drifters to record new tidal current speeds in the lower estuary. A Delft3D morphodynamic model was established using the new bathymetry, calibrated to local tide conditions, and used to estimate the potential changes in bed elevation during a large catchment flood event. The pre- and post-storm estuary bed levels have been applied to detailed Tuflow hydraulic model to simulate flooding and estimate the potential variation in water levels under different bathymetry conditions. This approach has been developed to meet the recommendations within the NSW Office of Environment and Heritage (OEH – now DPIE) Floodplain Risk Management Guide, that a detailed hydrodynamic study use an "unsteady" morphologic model to represent changes to the downstream bathymetry during a storm event. The results of this study will bring more insight into the effect of bathymetry conditions on inundation level and eventually improve the community resilience to flooding.

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NSW OEH (2015), Floodplain Risk Management Guide: Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways. Available at: https://www.environment.nsw.gov.au/~/media/B6CE9A5D9B8043BCAC62D97486FF1B6C.ashx

How Much is it Worth? Estimating Recreational Values for Stockton Beach

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Economic assessment is required to support development of Coastal Management Program (CMP), as per the NSW Coastal Management Manual. The majority of such assessments typically adopt beach values from the available literature derived from studies undertaken elsewhere. However, existing literature may not provide specific understanding of the beach values for a particular area. Locally derived beach values provide greater certainty and robustness in the economic results and as a result, an improved business case for subsequent funding.

The Stockton CMP investigates coastal management schemes to manage coastal erosion and inundation. The study used a combination of online surveys, on-the-ground surveys and business surveys. The online surveys provided information across the Newcastle LGA on beach visitation, not only for Stockton but for all beaches within the LGA. Information gathered included beach preference, frequency and duration of visits, and mode of transport. Due to a strong support and awareness program from Council nearly 900 responses were received across the LGA. This provides valuable information for Council on their wider beach use and preferences.

On-the-ground beach user surveys were undertaken over a number of days, for a 12-hour period. The surveys counted the number of beach users, and the types of activities that were being undertaken on the beach and allowed an understanding of beach demand patterns.

The combination of these two surveys, together with information collected from local businesses, was used to undertake an economic Travel-Cost Method for estimating the recreational beach value for Stockton Beach. The estimated recreational values provide locally verified estimates of economic values for use in the CMP and allow for a more detailed understanding of the distribution of these values across society. The methods used in this study provide a relatively efficient method for undertaking a Travel Cost estimate and could be adapted to other study areas.

Prioritising catchment areas for the remediation of wetlands in coastal estuaries

K Waddington[1]
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Flood mitigation and drainage schemes have been constructed within many of the estuarine catchments of NSW. These schemes generally incorporate floodgates that have been installed to prevent inundation from high tides and floods, providing the opportunity to drain the floodplains to the lowest tide level in the adjacent estuary and reclaim extensive tracts of land for harbours, industry and agriculture. Unfortunately, the reduction in surface and groundwater levels accompanying this development has facilitated the oxidation of acid-sulphate soils, and the drainage channels provide an efficient conduit for transferring acidic, deoxygenated and contaminated waters to the estuary, resulting in widespread environmental degradation and episodic fish kills.

While it has been widely recognised that sea level rise (SLR) will lead to increased marine inundation and exacerbate coastal flooding at high and even moderate tide levels, there has been limited consideration of how changes to the low tide will compromise drainage of estuarine floodplains. This research has developed the concept of the *drainage window* to assess how existing and future tidal regimes may influence floodplain drainage. Analysis of the drainage window describes how changes to the tidal range and symmetry that occur throughout estuarine waters vary the window of opportunity for gravity discharge within and between different catchments and how these changes may be affected by SLR.

The results indicate that SLR may substantially limit the window of opportunity for discharging many estuarine floodplain drainage systems. Lands that are protected from inundation by higher high tide and flood levels will become increasingly vulnerable to reduced drainage and chronic waterlogging, adversely affecting productivity and amenity. Additionally, some measures that have been proposed to mitigate flood risks may exacerbate drainage risks.

These findings suggest that SLR is likely to necessitate changes to future land management or use, presenting the opportunity to engage nature-based solutions to restore coastal wetlands. A multi-criteria assessment methodology has been developed to objectively prioritise the strategic restoration of estuarine floodplain wetlands based on catchment susceptibility to reduced drainage under SLR, and potential for generation and export of poor quality water resulting from acid sulphate soils and low oxygen ‘blackwater’.

Opportunities for beneficial reuse of natural material along the NSW coast

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Along the NSW coast there are locations with a need for coastal management interventions that promote more resilient beaches that everyone can enjoy. In addition to capital and maintenance dredging there are infrastructure projects that generate excess natural material that, where suitable, could be reused beneficially on the coast.

This presentation examines two case studies to provide insights on identifying opportunities, the barriers and measures that assist in realising beneficial reuse opportunities in NSW. The first case study examines the tunnelling component of a major Sydney rail project expected to generate large quantities of clean sand and crushed sandstone. The second looks at maximising beneficial reuse of material dredged from Newcastle Harbour as an alternative to disposal at sea.

‘NSW TurtleWatch’: how citizen science can help manage an uncertain future

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[3]Australian Seabird Rescue Inc., Ballina, NSW
[4]Australian Seabird and Turtle Rescue

Marine turtles have been reported to nest in low numbers along the NSW coastline, with nesting and hatchlings recorded since the early 1990s. Although nesting events are relatively infrequent, it is predicted that increasing global temperatures will see beaches in NSW playing a more important role as refugia, offering nesting sites with cooler sand temperatures and coastlines with relatively less disturbance from urban development.

A partnership between the NSW Saving Our Species (SoS) program, Australian Seabird Rescue Inc (ASR) and local Councils is engaging citizen scientists in northern NSW to record marine turtle nesting activity. ‘*NSW TurtleWatch’* is supporting the recovery and conservation of the endangered loggerhead turtle (*Caretta caretta*) and vulnerable green turtle (*Chelonia mydas*) in particular. However, the program is also increasing public awareness around marine turtle conservation and is linked with established programs to monitor and record the impacts of marine debris and light pollution on nesting turtles and their habitat.

This paper will report findings from the program, along with a vision for how to link outcomes more effectively with decision making, to ensure nesting habitat for marine turtles in NSW is identified and protected into the future.

The NSW Estuarine Habitat Dashboard: A web-based tool to assist estuarine management

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Estuarine macrophytes including; seagrass, mangrove and saltmarsh are recognised as important ecological habitats within the estuaries of NSW. Effective management of these habitats requires knowledge not only of the current extent but also how these habitats change through time, where these changes are occurring and the potential impacts affecting them. NSW DPI Fisheries has a long history of mapping and monitoring these habitats and via the Fisheries data portal has made the latest mapped extent available for public access.

Understanding changes through time however requires more than a simple one-off snapshot of mapped extent and while NSW DPI has had several long-term programs mapping these habitats over time, the complete historic data set has never been compiled and presented in any one location. Here we present the NSW Estuarine Habitat Dashboard new data visualisation tool that allows for the viewing and analysis of the complete historic estuarine macrophyte data set captured by NSW DPI. This tool presents for the first-time mapped seagrass, mangrove and saltmarsh in the estuaries in NSW with data going back to the 1980s. The allows for the temporal analysis of change in these habitats over time as well as provides updates to the latest mapping. The tool also shows the location of oyster leases in estuaries and other in-water structures such as seawalls, pontoons and jetties and extent of wetlands impacted by the 2019/2020 bushfires.

The outcome of this project is the delivery of a web-based tool that depicts changes in mapped estuarine habitats over time. The Dashboard will provide planners and decision makers with data that will facilitate the sustainable management of NSW natural resources.

Monitoring change for managing uncertainty inherent to coastal systems… from space

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The nearshore aquatic environment is highly dynamic and subject to ongoing change, and this inherent uncertainty can impact a broad range of stakeholders. Being able to monitor this dynamic environment both spatially and temporally is a critical component in understanding, managing and adapting to this future uncertainty.

Recent advances in satellite imaging technology and processing algorithms now make it possible to monitor a range of important aquatic environment parameters, including: water turbidity, algal blooms, sediment load in the water column, sediment erosion and accumulation on the seafloor, and seafloor habitat change (e.g. changes in seagrass cover extent).

There are several advantages to deploying satellite-based aquatic monitoring systems. Traditional methods for monitoring the water column are often limited to station-based sampling, whereas satellite data gives a near real time, synoptic view of the entire area of interest. Monitoring the seafloor using traditional fieldwork methods is furthermore relatively costly since it requires deployment of equipment and personnel, something which is not required during satellite-based mapping.

Another important aspect of satellite-based monitoring is that environmental parameters can be mapped going back in time by accessing historical satellite imagery archives. This can yield significant statistical baseline information, a key input for successful understanding and management of environmental change.

Here we will share real world examples of using satellite-based monitoring systems to understand and manage dynamic coastal environments. This will include: mapping seafloor morphology as input to hydrodynamic-, wave- and biogeochemical models for climate change resilience development of the Vanuatu Archipelago; environmental baseline mapping for Norfolk Island and Arafura marine Park, benthic habitat mapping of the entire Great Barrier Reef, monitoring water column turbidity caused by dredging, seagrass change mapping of Gold Coast waterways, and quarterly monitoring of navigationally hazardous sand bar movements in Queensland.

Connecting to culture – Engaging First Nations people on coastal management programs

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Under the NSW Coastal Management Framework, the development of coastal management programs (CMPs) provides an opportunity to work closely with our communities, including First Nations people. The intrinsic relationship, and knowledge First Nations people hold about the coast, provides insights on how to manage and adapt to the dynamic environment of our coastline. The participation of First Nations people in CMPs, provides opportunities for Aboriginal communities, organisations and Traditional Custodians to share their perspectives and influence how cultural values are understood and maintained. Engaging with First Nations people in a culturally safe way that is inclusive and acknowledges, and respects cultural values, perspectives and protocols should be foundational to our approach.

Inadequate consultation can ultimately lead to missed opportunities - to connect meaningfully with First Nations people and develop respectful partnerships. Where reciprocal relationships are developed with Aboriginal communities, organisations and Traditional Custodians based on mutual trust and respect, there are significant opportunities to integrate First Nations peoples' values and priorities in CMPs to support how the coast is valued and managed and shared decisions.

The Future Directions Statement for the NSW Coastal and Estuary Management Program (FDS) includes commitments that aspire to facilitate improved engagement with First Nations people when preparing and implementing CMPs. As an outcome, a project team was established by the NSW Department of Planning and Environment (the Department) to evaluate the effectiveness of existing engagement approaches, challenges, knowledge gaps and First Nations peoples' perspectives about engaging on coastal management. During December 2021 the project team released a survey to coastal councils and the Department's staff involved in preparing CMPs. The purpose of the survey was to establish a broader understating of the current situation of how First Nations people are engaged about CMPs.

This presentation presents the evaluation undertaken by the project team and feedback received through the 2021 survey and explores the recent experiences in engagement with First Nations people as part of the preparation of the Eurobodalla LGA Open Coast CMP and the Southern Byron LGA CMP.

The Eurobodalla Open Coast CMP covers over 140km of beaches headland and shorelines of which the Yuin Nation are the Traditional Custodians. Council recognised the need to engage with Traditional Custodians early in the CMP process, however, they faced challenges engaging meaningfully across such a diverse and widespread community. Engagement was hindered further by the lack of existing strong relationships between Council and the Aboriginal community. Taking on input received during early engagement, Council modified its approach to engagement, incorporating internal staff training and co-design methodologies.

A key focus in designing the CMP Scoping Study for the Southern Byron Shire Coastline and Belongil Estuary was the need to better understand, value and respect the Byron Shire's significant cultural heritage and knowledge held by the Arakwal Bumberlin People of the Bundjalung Nation (the Traditional Custodians). A deeper level of engagement was required to ensure the best possible outcome for the scoping study and future CMP. This included: early and consistent consultation; creating an atmosphere of open communication that enabled Traditional Custodians to honestly express their concerns, needs and aspirations for the land; undertaking field days with Elders; and one on one engagement activities.

Keeping Fingal Special: A case study of a coastal community working together

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[1]Tweed Byron Local Aboriginal Land Council, Tweed Heads, NSW
[2] Fingal Head CoastCare, Fingal Head, NSW

Ten years ago the Tweed Byron Local Aboriginal Land Council (TBLALC), Fingal CoastCare (FCC) and the Fingal Head Community Association (FHCA) presented at the 19th NSW Coastal Conference on an important community initiative to protect a cultural and environmentally significant coastal strip at Fingal Head. Today's paper is an opportunity to revisit this successful community action, share its learnings and celebrate its lasting and ongoing success.

Fingal Head is in Northern NSW and home to migratory birds, endangered flora, protected marine life, littoral rainforests and protected wetlands. TBLALC and the wider community have a history of protecting this area from inappropriate development and unsustainable over-use.

In 2011, a number of vulnerable green turtles (Chelonia mydas) laid their eggs at Fingal Head resulting in the birth of sixty-seven (67) live baby turtles. This event energised TBLALC and the community to take a stand against illegal off road 4WD'ers who were destroying the turtle nesting sites by driving on the beach and parking in the dunes. The campaign was successful and resulted in stopping all illegal 4WD activity on TBLALC land. This has allowed TBLALC to clean up and revegetate the area and begin a successful program of cultural immersion training for its community on Country. This program includes an Aboriginal language program, cultural immersion workshops for youth at risk and the establishment of a healthy eating program and kitchen garden. Due to successful clean-up and regeneration grants, the environment has also recovered and the endangered Loggerhead turtle (Caretta caretta) has joined the Green turtles in nesting safely on the Fingal Peninsular.

This case study revisits the Fingal Head community campaign to save Letitia Spit from illegal 4WD's and the resulting positive developments ten years on, for both the community and the environment.

Risk Assessments for Coastal Water Sharing Plans

D Workman[1], J Sayers[1], M Healey[1]
[1]NSW Department of Planning and Environment, Surface Water Science, NSW

The *Water Management Act, 2000,* requires water sources to be managed sustainably both now and for future generations. A significant part of this is that in sharing water, a Water Sharing Plan must protect the water source and its dependent ecosystems. Department of Planning, Industry and Environment (DPIE) Water has developed processes for rating the risk to the environmental values of water sources that are attributable to water sharing. The latest assessments assist in prioritizing and directing effort to mitigate risks. This approach aligns with Australian Standards for rating risk by evaluating consequence and likelihood of a threat.

Our rating of consequence is based on the national guideline for rating ecologic value, the High Ecological Value Aquatic Ecosystems (HEVAE) guideline. We are using the HEVAE framework for freshwater, estuarine, and groundwater dependent ecosystems. We consider the sensitivity of the ecology to extraction to rate the potential loss of ecological values, or consequence.

In freshwater rivers we are scoring at river reach scale using a range of data sets to indicate Distinctiveness, Diversity and Naturalness components. These are combined to create an overall HEVAE score. Similarly, our method for rating consequence to estuaries is aligned with HEVAE in evaluating the risk of loss of inflows required to maintain estuary functions, particularly tidal pool ecology. Importantly, it considers sensitivity to inflows, based on estuary character and structure.

Likelihood of impacts to the key ecosystem functions of freshwater and estuarine reaches is based on modelling of flow. The likelihood of impacting on the ecosystem is rated by comparing two scenarios - full water development (by extraction and infrastructure) compared to a without development (analogous to natural flows). Risk Assessments are being published to align with Water Sharing Plan stakeholder engagement. A summary of data sources, limitations, and some selected findings are presented here.

NSW estuaries webpages: an information tool for prioritising, planning and management

A Wright[1], M Orr[1], E Rayner[1]
[1]Estuaries and Catchments Team, NSW Department of Planning and Environment, Sydney, NSW

As part of the NSW Marine Estate Management Strategy the NSW Department of Planning, Industry and Environment has updated the estuaries webpages on the NSW environment website, as a commitment to improve access to data and information on the NSW marine estate.

The update was carried out following a survey of users from state government, local government, relevant citizen science and community groups, and educators. The updated content addresses information needs of the different user groups, while remaining focused on the science of estuary monitoring.

Updates include an interactive map, and 189 individual pages covering almost all NSW estuaries and major tributaries. On each page there is both general and estuary-specific information, and links to available data, nearby national and marine parks, and local citizen science or community groups that have a focus on the environment.

An important feature of the update is the inclusion of a report card grade for ecological health which is provided for each estuary sampled as part of the ongoing NSW state-wide estuarine water quality monitoring program. The report card grades highlight estuary condition for each year sampled and brings these evaluations together at a state-wide scale following consistent protocols.

Using report card grades to communicate waterway condition has previously enabled prioritisation of management efforts through coastal management programs and has assisted planning and implementation of remediation and rehabilitation programs in both urban and rural settings. The release of state-wide report card grades will be highly valuable for local government and environmental managers when planning strategic, long-term management of estuaries.

As part of the ongoing estuaries monitoring program the webpages will be regularly updated with relevant content to communicate issues and respond to user feedback.

The effect of bushfires on NSW estuaries

D Laicher [1], D Maher [1], S Johnston [1], K Benkendorff [2], A Ferguson [3], A Wethered [3]
[1] Southern Cross University, Lismore, NSW
[2] National Marine Science Centre, Southern Cross University, Coffs Harbour, NSW
[3] New South Wales Department of Planning and Environment, Lidcombe, NSW

Global climate change presents an ever-growing threat and challenge to humanity and the environment. Wildfires have become an obvious manifestation of a warming climate, and are likely to increase in intensity, duration, and frequency, leading to a range of impacts to the economy, infrastructure, human and environmental health. Parts of Australia are projected to endure increased drought conditions and consequential wildfire as global warming increases. The 2019/2020 bushfire crisis of Australia hit the south coast of New South Wales (NSW) particularly hard, burning approximately 97,000 km^2 of vegetation. While the impacts to the terrestrial environment were immediate and noticeable, potential impacts to aquatic systems in burnt catchments is less understood. Along the bushfire-impacted south coast of NSW there is a number of delicate estuarine systems that are highly productive and supportive of fisheries and coastal biodiversity, as well as having high recreational and cultural value. Existing studies have investigated some wildfire impacts to inland aquatic systems, such as rivers, lakes and reservoirs, but there is little to no understanding about the potential impacts to coastal aquatic systems such coastal creeks and estuaries. Estuaries vary widely in their geomorphology, entrance opening regimes, and residence times, all of which can greatly impact an estuary's resilience to disturbance, such as wildfire. The estuaries along the NSW coast include a number of Intermittently Closed and Open Lake or Lagoons (ICOLLs), which often have limited flushing and residence times, making them susceptible to disturbance. This study assesses possible bushfire impacts to estuaries, and particularly ICOLLs, by combining routine monitoring of a range of fire-impacted estuaries on the south-coast with targeted experimental, analytical and interpretive analysis to take an in-depth look at specific ecosystem response questions over varying timescales.

You'll get away with that: there's no money for enforcement!

H Monks[1]
[1]Highlight Consulting, Wagstaffe, NSW

State Environmental Planning Policy (Exempt and Complying Development) 2008 (Part 1 Division 1) distinguishes between land to which the Policy does and does not apply. Housing is not exempt development, but conditionally may be complying development. Part 3 Housing Code covers new houses. Part 4 Housing Alterations Code is being unlawfully used where demolition occurs followed by a new house. Part 3 does not permit housing on sensitive lands, where Part 4 often does. Cl. 1.19 is specific about coastal hazards. But houses are being built on land where they are prohibited without a Development Application, with some certifiers, designers and builders specialising in this rort.

1.19 Land on which complying development may not be carried out
(1) **Specific land exemptions for Housing Code, Inland Code, Low Rise Housing Diversity Code, Rural Housing Code and Greenfield Housing Code** To be complying development …, the development must not be carried out on—
(a) land within a heritage conservation area or a draft heritage conservation area, .., or
(b) land that is reserved for a public purpose by an environmental planning instrument, or
(c) land identified on an Acid Sulfate Soils Map as being Class 1 or Class 2, or
(c1) land that is significantly contaminated land within the meaning of the *Contaminated Land Management Act 1997*, or
(d) land that is subject to a biobanking agreement under Part 7A of the *Threatened Species Conservation Act 1995* or a property vegetation plan approved under the *Native Vegetation Act 2003*, or
(d1) land that is subject to a private land conservation agreement under the *Biodiversity Conservation Act 2016* or that is a set aside area under section 60ZC of the *Local Land Services Act 2013*, or
(e) land identified by an environmental planning instrument as being—
(i) within a buffer area, or (ii) within a river front area, or (iii) within an ecologically sensitive area, or (iv) environmentally sensitive land, or (v) within a protected area, or
(f) land … identified by an [adopted] EPI, a DCP or a policy as being or affected by—
(i) a coastline hazard, or (ii) a coastal hazard, or (iii) a coastal erosion hazard, or
(g) land in a foreshore area, or
(h) land that is in the 25 ANEF contour or a higher ANEF contour, [conditionally] …
(i) land that is declared to be a special area under the *Water NSW Act 2014*, or
(j) unsewered land …

Councils are the principal organisations with SEPP enforcement powers but the State does not fund nor undertake enforcement of its own SEPP. As a result, Councils make decisions to enforce the SEPP, **or not,** with public safety being one criterion – not simple legal standing: is the development compliant with the SEPP or not? Should that house be built within a coastal hazard area? At >$50,000/matter/party in Land & Environment Court yet no awarding of costs, Councils are hamstrung by the State's expectation that they enforce a State policy, **without funding**. Delivery of this policy is failing in coastal areas.

Engaging the disengaged: building community partnerships in environmental monitoring

U Pinto[1], M Powell[1], J Ling[1], J Potts[1], A Wright[1], S Bozzaco[2], P Scanes[1]

[1]Department of Planning and Environment, Science Economic Insights Division, Sydney, NSW
[2]South East Local Land Services

Long-term ecosystem health monitoring programs provide important information on the condition of the environment and any change in condition over time. Regular data collection is important to the success of such programs although is resource and time intensive, especially when implementing projects in remote NSW locations. Harnessing the skills and interests of local community is one way to effectively manage human and financial resources while empowering locals to become stewards of environmental management activities. In this poster, we share some lessons learnt by working with the local community in Tilba Tilba NSW, establishing a long-term ecosystem health monitoring program.

We started the engagement process by delivering a workshop highlighting the rationale behind the monitoring program. The interested community members were then invited to a field demonstration which was followed by a series of one-to-one sessions with scientists from the department. These sessions occurred over three months and allowed community members to be trained on data collection and sample handling processes. They were also provided with field equipment and ongoing remote support during the life of the project. At the end of phase-1 of the program, another workshop was delivered to share the results with local community. This increased interest and encouraged more volunteers to sign-up for the program.

We worked with community members over two years with varying levels of success. About 35% of the water samples were collected and stored by volunteers. From our experience, volunteers engaged better when they were provided with a simplified workflow, regular feedback and assurance that trained scientists are reviewing the quality of their data. Ongoing engagement of volunteers is promoted by additional training to ensure success of the program. Training and supervising volunteers requires extra effort, however in the longer term it is a win-win situation for all parties involved.

Understanding legacy effects on ecosystem health through multiple-lines of evidence

U Pinto[1], M Powell[1], J Ling[1], J Potts[1], A Wright[1], A Dickson[1], C Johnson[1], Z Larkin[1], S Bazzacco[2], P Scanes[1]
[1]Department of Planning and Environment, Science Economic Insights Division
[2]South East Local Land Services

Our legacy of changing our landscape to make it more suitable for our immediate urban, agricultural and industrial uses has led to potentially irreversible changes to our waterways. A deeper understanding of the spatial and temporal variation of this legacy must have an integral role in the management and restoration of ecosystem health (Foster et al., 2003, Martin et al., 2011). Over the last century, the Tilba Tilba Lake catchment in NSW has been cleared for timber, housing, roads, dairy and grazing. Despite their social and economic benefits these changes have resulted in poor and declining aquatic ecosystem health in the Tilba Tilba Lake system.

We collaborated with a range of stakeholders to develop a scientifically rigorous monitoring program to better understand the condition of the lake ecosystem as a result of human legacy impacts. We used a wide range of water quality indicators (i.e., physico-chemical, biological and microbiological), stream bank and riparian vegetation health indicators, and also various weather-related indicators in the monitoring program. Our results showed symptoms of nutrient enrichment, algal blooms, faecal bacteria contamination, deoxygenated conditions and poor macroinvertebrate community structure in the system. However, we found three species of frogs and twelve species of fish suggesting the ecosystem has a lot of potential to recover given the right conditions.

Results from the 2-year Marine Estate Management Strategy funded study characterized and confirmed the current ecosystem health that is related to land management practices. The implementation of a government-funded stream rehabilitation program aims to improve aquatic ecosystem health. The data collected through this project will primarily be used as baseline condition to demonstrate future improvements in the Tilba Tilba Lake system due to on ground works. In addition, this data will help to inform development of a report card for coastal freshwater systems in NSW.

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Prioritising catchment areas for the remediation of wetlands in coastal estuaries

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[1]UNSW Sydney, School of Civil and Environmental Engineering, Sydney, NSW

Flood mitigation and drainage schemes have been constructed within many of the estuarine catchments of NSW. These schemes generally incorporate floodgates that have been installed to prevent inundation from high tides and floods, providing the opportunity to drain the floodplains to the lowest tide level in the adjacent estuary and reclaim extensive tracts of land for harbours, industry and agriculture. Unfortunately, the reduction in surface and groundwater levels accompanying this development has facilitated the oxidation of acid-sulphate soils, and the drainage channels provide an efficient conduit for transferring acidic, deoxygenated and contaminated waters to the estuary, resulting in widespread environmental degradation and episodic fish kills.

While it has been widely recognised that sea level rise (SLR) will lead to increased marine inundation and exacerbate coastal flooding at high and even moderate tide levels, there has been limited consideration of how changes to the low tide will compromise drainage of estuarine floodplains. This research has developed the concept of the *drainage window* to assess how existing and future tidal regimes may influence floodplain drainage. Analysis of the drainage window describes how changes to the tidal range and symmetry that occur throughout estuarine waters vary the window of opportunity for gravity discharge within and between different catchments and how these changes may be affected by SLR.

The results indicate that SLR may substantially limit the window of opportunity for discharging many estuarine floodplain drainage systems. Lands that are protected from inundation by higher high tide and flood levels will become increasingly vulnerable to reduced drainage and chronic waterlogging, adversely affecting productivity and amenity. Additionally, some measures that have been proposed to mitigate flood risks may exacerbate drainage risks.

These findings suggest that SLR is likely to necessitate changes to future land management or use, presenting the opportunity to engage nature-based solutions to restore coastal wetlands. A multi-criteria assessment methodology has been developed to objectively prioritise the strategic restoration of estuarine floodplain wetlands based on catchment susceptibility to reduced drainage under SLR, and potential for generation and export of poor quality water resulting from acid sulphate soils and low oxygen ‘blackwater’.

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[1]NSW Department of Planning and Environment, Surface Water Science, NSW

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