The Global Water Institute

Welcome to the UNSW Global Water Institute

- a world leader in *multidisciplinary* water research, innovation and problem solving.

Global water issues have never been so prominent, and the demand for solutions never so high. With that in mind we are reaching across campus and forming new alliances to have a global impact.

We welcome you to join us on this global venture.

Our Vision

The vision of the Institute is to be *a world leading centre for research, capacity building and sharing of water knowledge, technologies and expertise, informing and connecting research to smart water policy and management, and facilitating sustainable outcomes from water use.*

Collaboration, the key to success

Opportunities abound through partnerships and collaborations with businesses, governments, development banks, NGOs, communities and other research providers. We offer our partners:

- Opportunities for enhanced collaboration
- Broader, more integrated water research
- Strategic international partnerships
- Stronger opportunities for research funding
- Easy access to top water expertise and facilities
- Long-term productive relationships
- Increased capacity through tailored education

The UNSW Global Water Institute (UNSW-GWI) will work with you to meet today's challenges and develop innovations to shape the future of water.

Solving global water issues together

We are working on:

- Water scarcity and access to good quality water
- Water and wastewater treatment and reuse
- Arresting the rapid loss of aquatic biodiversity and ecosystem decline
- Reducing health impacts of poor water quality
- Adapting to effects of climate change
- More efficient irrigation to meet growing demand for food
- Sourcing renewable hydropower sustainably
- Education and capacity building
- Smart policy, robust governance and resilient institutions

Multi-disciplinary powerhouse

Our university-wide institute will draw on the knowledge and expertise of over 400 academics, researchers and PhD students from a range of disciplines.

Plus we encompass individuals and groups in the UNSW faculties of Engineering, Science, Law, Business, Medicine, Built Environment and Arts and Social Sciences, in a truly multi-disciplinary approach.

These collaborative groups include:

UNSW Water Research Centre
UNSW Water Research Laboratory
UNESCO Centre for Membrane Science and Technology
Environmental Humanities Group
Cyanobacterial Research Group
UNSW Centre for Ecosystem Science
UNSW Centre for Marine Bioinnovation
UNSW Evolution and Ecology Research Centre
City Futures Research Centre
UNSW Climate Change Research Centre
Sino-Australian Research Centre for Coastal Management
Australian Centre for Sustainable Mining Practices
Connected Waters Initiative

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Market leaders in…

Water & wastewater management

Water and Wastewater Treatment: performance assessment and optimisation of key processes including activated sludge, membrane bioreactors, dissolved air flotation, microfiltration, ultrafiltration, nanofiltration, reverse osmosis, chlorine disinfection and advanced oxidation processes.

Water Recycling for Potable and Non-Potable Reuse: process assessment and validation; monitoring and critical control points; regulation and guidelines; public perception and community consultation.

Membranes: our UNESCO Centre for Membrane Science and Technology is the leading centre for membrane development in Australia, with facilities for characterisation of the structure, properties and transport mechanisms in synthetic membranes; sustainable membrane processes for environmental and industrial applications; membrane module design, operation and process control; novel membranes and membrane processes; methods to control membrane fouling.

Trace Organics: analytical method development and determination; assessment of chemical contaminant fate during engineered water treatment and environment process; organic contaminants including pharmaceuticals, hormones, disinfection byproducts, pesticides and algal toxins.

Physicochemical Processes in Natural and Engineered Systems: transformation and fate of contaminants; transport and 2haracterizati of radionuclides; algal growth and toxicity; generation of reactive oxygen species; advanced oxidation processes; electrochemical water treatment technologies; nucleation and aggregation phenomena; hydration and 2haracterizatio processes; mineral recovery and tailings management.

Odorous and Gaseous Emissions: the UNSW Odour Laboratory is a leading edge facility that provides specialist olfactory and chemical analysis for the 2haracterization of odorous and gaseous emissions from point and area sources.

Cyanobacteria and their toxins: the Neilan Laboratory of Microbial and Molecular Diversity has facilities to identify genes responsible for the production of toxins in several strains of cyanobacteria and investigate the mechanisms of toxin biosynthesis, regulation of toxin genes, and the evolutionary ecology of these aquatic microbes.

Risk Assessment and Management: exposure assessment, reliability assessment, hazardous events and failure modes, quantitative microbial risk assessment, quantitative chemical risk assessment, risk management protocols.

Water resource management & climate change

Hydrology & flooding: catchment hydrology and quality of runoff, water budgeting, reservoir operations, desalination, sedimentation, geomorphology, salinization, and floodplain management.

Groundwater resource and quality: water quality and biogeochemical processes; interconnectivity of surface water and groundwater; environmental and isotopic tracers; groundwater resource impacts from changing climate and landuse, including agriculture, coal seam gas and mining; hydraulics and chemistry of aquitards; coastal zone groundwater connectivity; fractured rock systems and preferential flow; cave and karst hydrogeology; Managed Aquifer Recharge; heat as a groundwater tracer; fate of hydraulic fracturing fluids; contaminated land remediation; subsurface contaminant and heat transport; fate of engineered nanoparticles; 3D geological models; site characterisation, resource assessment - bore design, aquifer testing, core-testing, flow through sorption testing, water level and quality monitoring, geophysical survey, groundwater flow and transport modelling and conceptual model development; solutions for effluent re-use and disposal.

***Climate change and climate variability impacts on water*:** El Nino - Southern Oscillation (ENSO) and related phenomena in the Tropics and their impacts on regional climate and water security; temperature and rainfall variability and extremes - and how these are affected by land processes at regional scales; the present and future impact of global warming and carbon dioxide/ocean acidification on life in the oceans and on land; key ocean processes that affect the climate system, including processes such as ENSO, the Indian Ocean Dipole (IOD), and Southern Ocean circulation; better models for weather and climate prediction for water management; factors that control rainfall and drought; extremes such as heat waves and heavy precipitation events; regional modeling of the climate system for water and catchment managers; land surface models to reproduce ecosystem carbon and water dynamics; understanding marine impacts and responses to elevated CO_2 concentrations and ocean acidification; paleoclimatological understanding of droughts, floods and ecological tipping points.

Hydroclimatology: Modelling changes in flood and drought characteristics resulting from climate change; using principles of uncertainty (including Bayesian and stochastic techniques) to model natural systems; understanding changes in ecology or eco-hydrology resulting from land-use change and rising global temperatures; formulating better approaches for quantifying surface soil moisture and precipitation using remote sensing techniques such as satellites and weather radars; improving the basis for seasonal to interannual to decadal forecasting of rainfall and streamflow to better manage water availability in a sustainable manner.

Coastal and estuarine management

Estuarine management: estuarine and river processes; estuarine process studies; tidal and wetland restoration; broad-based multidisciplinary research to identify, preserve and enhance the resilience of species and habitats in urban rivers, estuaries and harbours that have high ecosystem and conservation value, enhancing the capacity of relevant government departments to make key management decisions.

***Coastal Engineering and Management*:** our hydraulic research station addresses coastal processes; coastal hazard definition and inundation; foreshore revetment design and testing; dredging and beach nourishment; design optimisation of coastal structures, harbours, ports and marinas; surfing reefs; optimal methods for coastal climate change adaptation; remediation of historic seawalls; innovative and traditional coastal structures; 'real time' coastal monitoring and measurement; impact assessment of near shore coastal structures on beach planform and forensic coastal engineering.

***Environmental Engineering*:** Port and harbour hydrodynamics; fate and transport of contaminants; riverbank and boating assessments; sediment transport; acid sulphate soils; impacts of sewage outfalls on the marine environment; dredge plume management; environmental fluid mechanics including multiphase flow, stratification and re-aeration.

Eco-engineering for coastal developments: baseline ecological assessments; biodiversity enhancements; multi-functional enhancements; pre-seeding for new developments; retrofitting; intertidal and subtidal. Land reclamation and hardening of the coastlines, ecohydrology, ecosystem dynamics modelling.

***Civil Engineering Hydraulics*:** Design optimisation and performance assessment of hydraulic structures in urban and rural environments such as stormwater systems, dam outlet works, energy dissipaters, ocean outfalls, spillways, levees, fish passages and flood control structures; hydraulics in industrial applications such as pump stations, hydro and thermal power stations, and water and wastewater treatment plants; physical and numerical modelling of turbulent flows including fluid-structure interactions, air-water flows as well as in stationary and transitional flows.

Aquatic ecosystems & biodiversity

River and wetland management: risks to biodiversity (invertebrates, vegetation, frogs, waterbirds) of wetlands, rivers, estuaries and groundwater systems; linking hydrological patterns to floodplains and wetlands to restore environmental flows and rivers; understanding anthropogenic drivers of aquatic ecosystems including river regulation; protection of minimally impacted biodiversity hotspots.

Conservation practice: practices and processes of rigorous adaptive management; identification of ecological values of rivers; policy, conservation tools and strategies.

Marine bioinnovation: disease in marine seaweeds; microbial process in aquaculture, ecology and function of biofilms; restoration of underwater forests; ecology of invasive species; microbial symbiosis; biogenic habitats and biodiversity; bio-prospecting marine microbial diversity for new drugs and bioactives; microbial interactions with biochar.

Biomonitoring of aquatic ecosystems: identification and application of biomonitors to investigate environmental impacts; bioaccumulation studies; development of codes of practice, regulatory standards and guidelines; environmental, ecotoxicology and ecological analysis; environmental risk assessment and modelling.

Development of novel biomonitoring tools: ARISA DNA fingerprinting tools; targeted gene sequencing; metatranscriptomics for functional assessments; targeted qPCR for pathogens of interest; cellular biomarkers.

Pollution research: lab and field-based mesocosms; ecotoxicology testing; multiple stressor assessments; application of remote sensing tools to pollution monitoring; compliance for water and sediment quality guidelines.

Public health and social science

Public health and health services: infectious diseases control and prevention, epidemiology of infectious disease outbreaks with particular focus in health services and patient safety.

Environmental humanities: Social histories of rivers and water; social aspects of urban and rural water use; social aspects of novel water technologies; resource use and conflict; water and international development; social aspects of climate change.

Policy, planning, governance, institutions and sustainability

***Water governance and planning*:** water allocation planning; water metering policy; co-regulation; agricultural self-management; community engagement; collaborative water governance; water regulation; bore driller regulation; market based instruments; compliance and enforcement of water extraction; groundwater law and governance.

Sustainability assessment: triple bottom line reporting, life cycle assessment, environmental foot-printing, multi-criteria analysis.

Industry specialisations

Aquaculture and fisheries: improving income and food security for rural communities by increasing farm yields, reducing environmental degradation, controlling disease outbreaks, managing resource competition, developing sustainable farming practices, building local capacity and increasing benefits to farmers.

Agriculture and horticulture: GWI is working with several agricultural, pastoral and horticultural industries to solve their water problems. This ranges across improving irrigation water use efficiency, understanding biochemical interactions in the root zone, methods to adapt to climate change, novel technologies and sustainability assessments for new enterprises.

***Mine water productivity and waste management*:** water productivity-footprint in coal and uranium mining; in situ recovery of metals for future mines; groundwater-geomechanical processes for underground roof stability; hydraulics and geochemistry of low permeability barriers; dewatering of excavations; mine water balance and aquifer interference; mine subsidence impacts on shallow aquifers and peat swamps; long term water quality of mine voids and beneficial use options; underground disposal of mine tailings and wastes.

***Coal Seam Gas*:** Water resource impact assessment, mapping aquifer connectivity, geological mapping, geological fault analysis, 3D geological models, groundwater chemical analyses, gas characterisation, gas leak detection, and fugitive emission estimations.

Water utilities: collaboration with water utilities; identifying solutions to water shortages, water quality problems and preparing for adaptation to climate change. Improve water quality characterisation, enhance treatment process performance, develop new water quality monitoring techniques and refine stakeholder communication strategies. Undertaking risk assessment activities that have been required of utilities from regulators. Significant contributions to water industry guidelines such as the Australian Drinking Water Guidelines and Australian Guidelines for Water Recycling.

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