

# **The Marine Climate Change Science (MCCS) Programme**

2<sup>nd</sup> Grant Call Briefing (8th Apr 2024)

# MCCS – Launch of 2<sup>nd</sup> Grant Call

- The second grant call of the Marine Climate Change Science (MCCS) Programme has been launched as of **25 Mar 2024**.
- We invite interested researchers to submit suitable full proposals for potential funding support under **2 Call Topics**:
  - 1) Call Topic 7 – Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats
  - 2) Call Topic 8 – Assessing the effects of climate change on coastal water quality
- Interested parties are strongly encouraged to form research teams that collaborate across public research institutes and the private sector (including industry), and support translation of research outcomes to real-world applications.

2.00pm Overview of MCCS 2<sup>nd</sup> Grant Call – by **MCCS Programme Office**

- Background of Marine Climate Change Science (MCCS) programme
- Grant Call conditions and eligibility criteria
- Review process
- Instruction for submission of proposals
- Q&A on grant call processes

2.30pm Summary presentations of ongoing MCCS projects

- “A Blue Carbon Framework for Singapore’s national climate change policy (BlueCarbonSG)” – by **PI Prof Hao Tang (NUS)**
- “iNvestigation of wAve aTtenUation over mangRoves, sEagrasses and coral reefs (NATURE)” – by **PI Dr Harrif Santo (TCOMS)**
- “Assessing the long-term viability of nature-based climate solutions to future sea level rise and marine heatwaves in Singapore” – by **PI Prof Kyle Morgan (NTU)**
- “Enhancing urban coral reef resilience to climate change across biological scales” – by **MCCS Programme Office on behalf of PI Prof Huang Danwei (NUS)**

# Schedule

3:50pm Short Break

4.00pm Call Topic 7 – by **NParks**  
“Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats”

4.20pm Call Topic 8 – by **NEA and NParks**  
“Assessing the effects of climate change on coastal water quality”

4.40pm Final Q&A

*Note: A short Q&A timeslot will be allocated during the presentation of each MCCS project and Call Topic (strictly capped at 20mins each). This final Q&A session will be dedicated for any additional questions that have not yet been addressed earlier.*

5:00pm Refreshments & Networking

5:30pm End of Programme

# **Overview of the Marine Climate Change Science (MCCS) programme**

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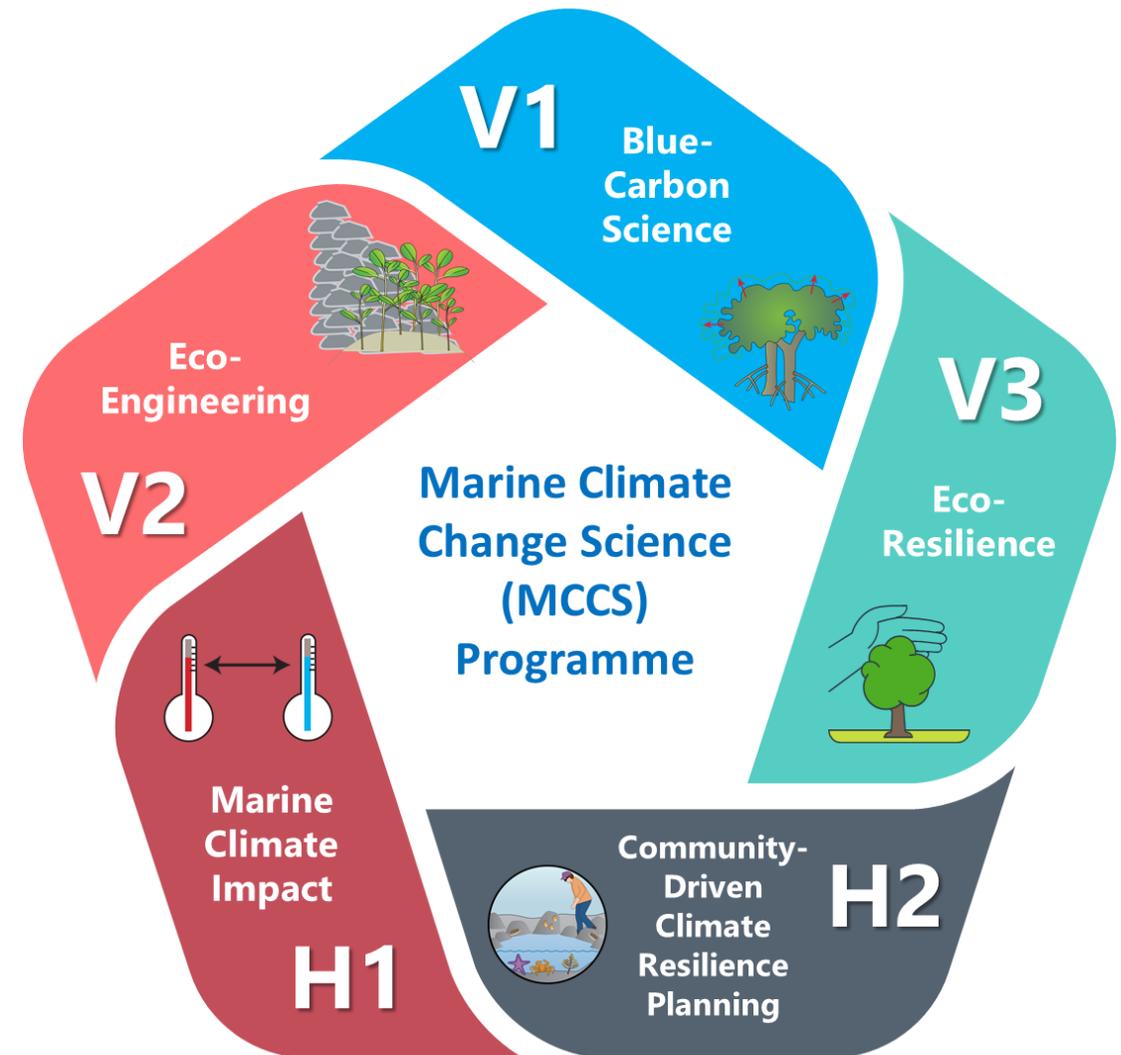
# The Marine Climate Change Science (MCCS) Programme

- New NRF-funded Funding Initiative (FI) totaling \$25.0M to support a 5-year programme under the Urban Solutions and Sustainability (USS) domain under RIE2025.
  - Led by NParks as Implementing Agency (IA)
- Multi-stakeholder research programme which seeks to advance the core sciences of marine climate change, and develop solutions to help address the challenges faced by our coastal and marine environment arising from climate change
  - Builds on the foundational science developed under past/ongoing programmes, including the Marine Science R&D Programme (MSRDP) (2016-2021)
  - Developed in response to the current challenge of future-proofing Singapore's marine environment, in the face of climate change
  - Part of overall efforts to transform Singapore into a City in Nature, as well as contribute towards a nationwide effort to build climate resilience under the Singapore Green Plan 2030.
- Entails important baseline and applied marine climate change research, to:
  - Address gaps in the climate science research landscape for the marine domain
  - Understand responses of marine ecosystems to increasing environmental and climate change pressures
  - Enable translatable actions that public/private practitioners – in Singapore and elsewhere – can adopt, apply and implement

# MCCS – Objectives

The MCCS programme aims to serve as a **national focal point for multi-disciplinary marine climate change research**, that will:

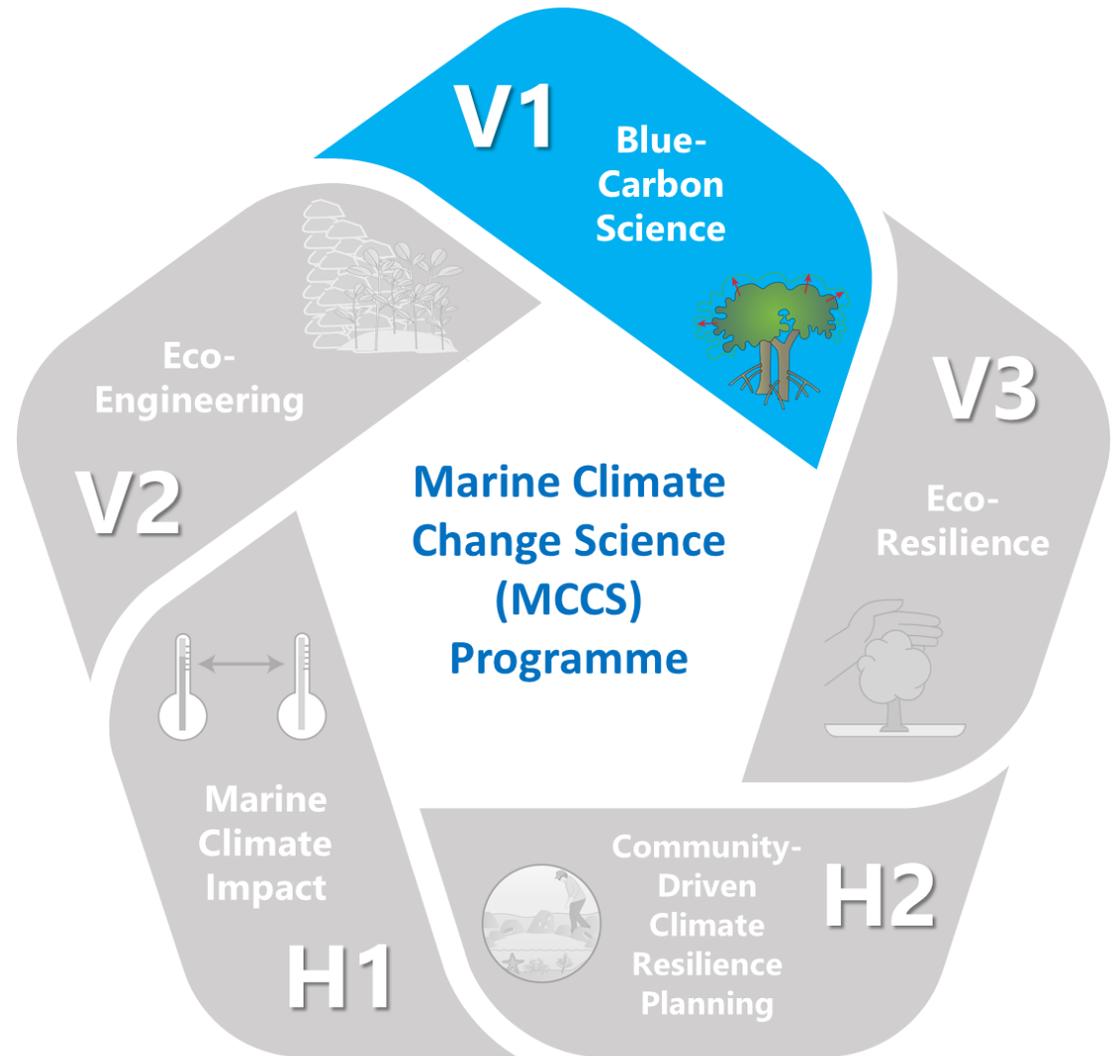
1. **Address current national needs and knowledge gaps** identified by agencies through core research verticals and enabling horizontals
2. **Leverage on synergies** across local IHLs, agencies and industry to strengthen and support national efforts to mitigate and manage climate change challenges
3. Create scientific insights and evidence to support the creation of **evidence-based interventions and solutions**



*Core domains and enablers of the MCCS programme*

## V1 Blue Carbon Science

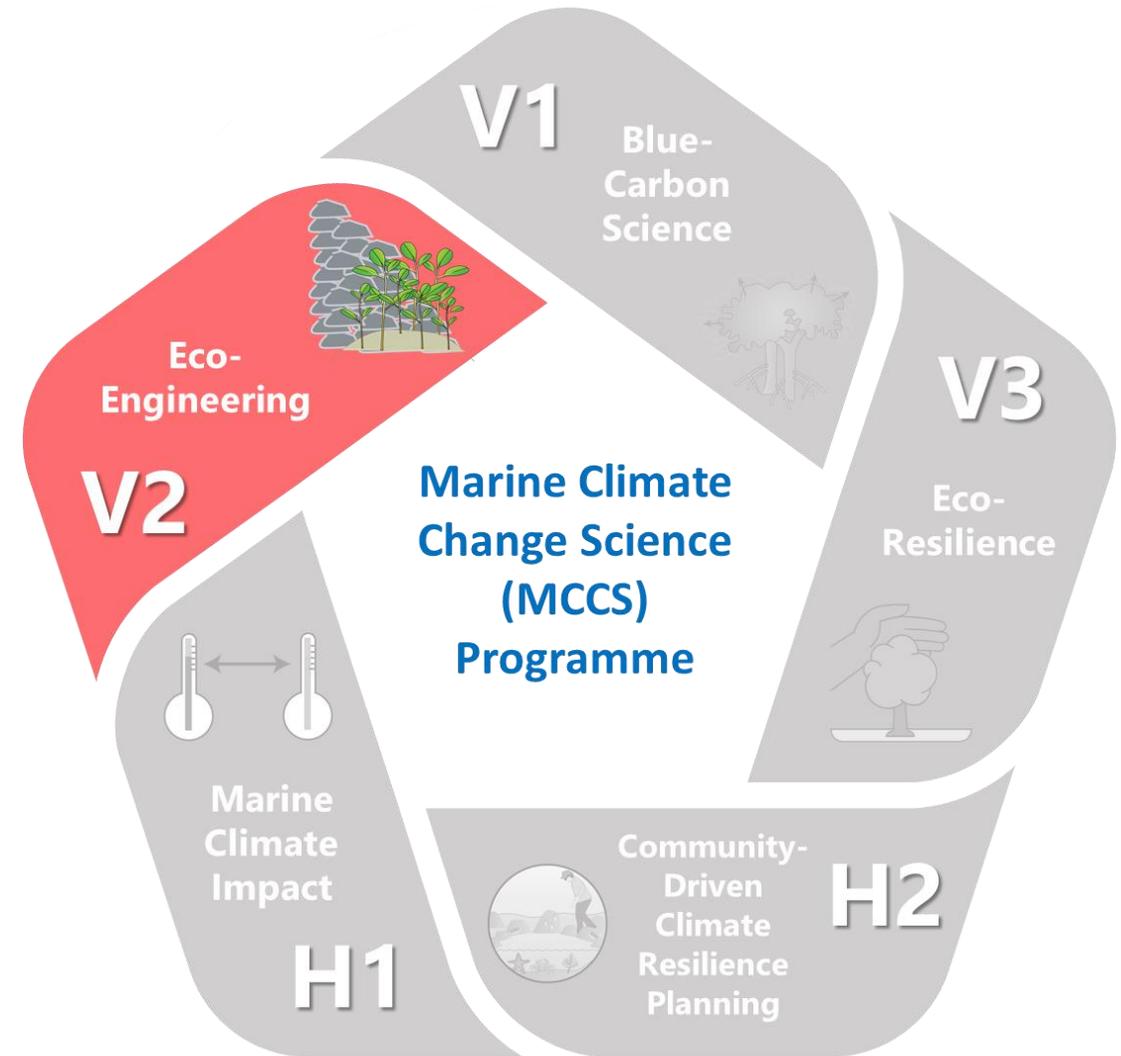
- Build foundational blue-carbon science in Singapore
- Assess blue carbon opportunities in Singapore
- Reduce Singapore's carbon footprint while mitigating climate change effects on coastal water quality, habitats and infrastructure



*Core domains and enablers of the MCCS programme*

## V2 Eco-Engineering

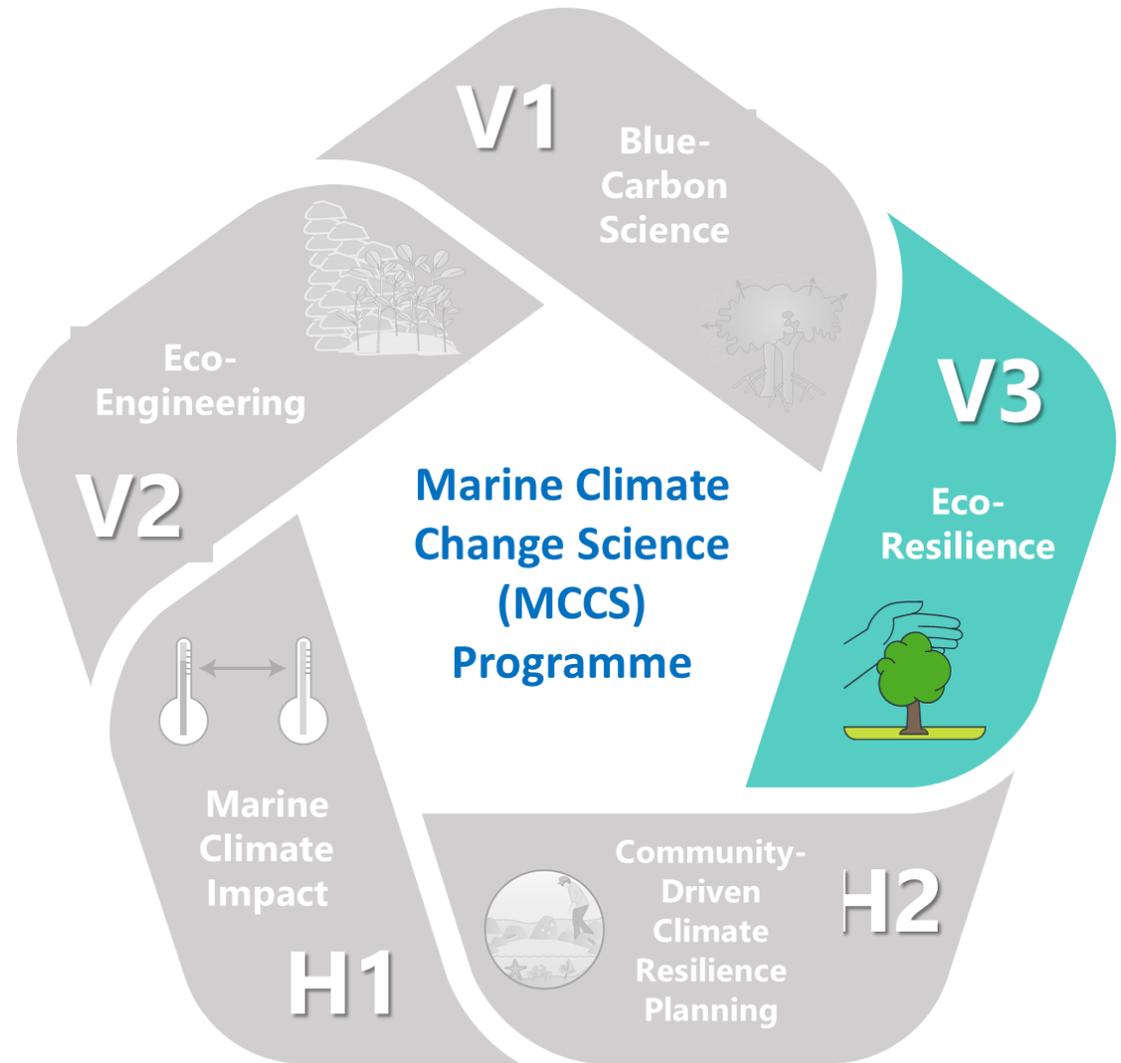
- Align engineering with nature-based solutions
- Mitigate sea-level rise, extreme storm events and flood protection, while enhancing and restoring marine environments and creating new habitats
- Provide sound basis for the sustainable development of Singapore's islands and coasts



*Core domains and enablers of the MCCS programme*

## V3 Ecological Resilience

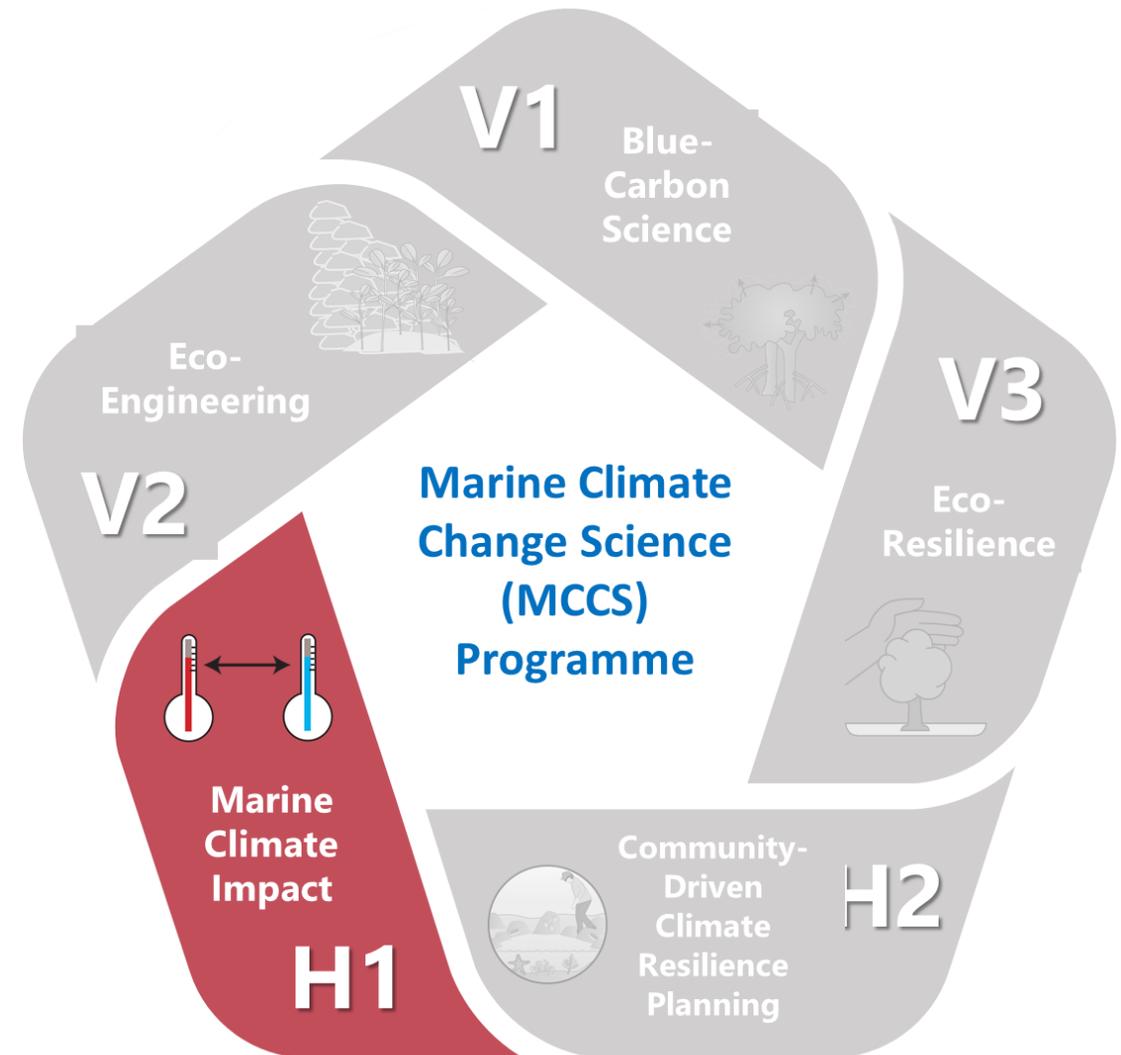
- Research to future-proof our coastal and marine ecosystems against increasing pressures from anthropogenic and climate change drivers
- Safeguard our natural marine capital through science-based management



*Core domains and enablers of the MCCS programme*

## H1 Marine Climate Impact

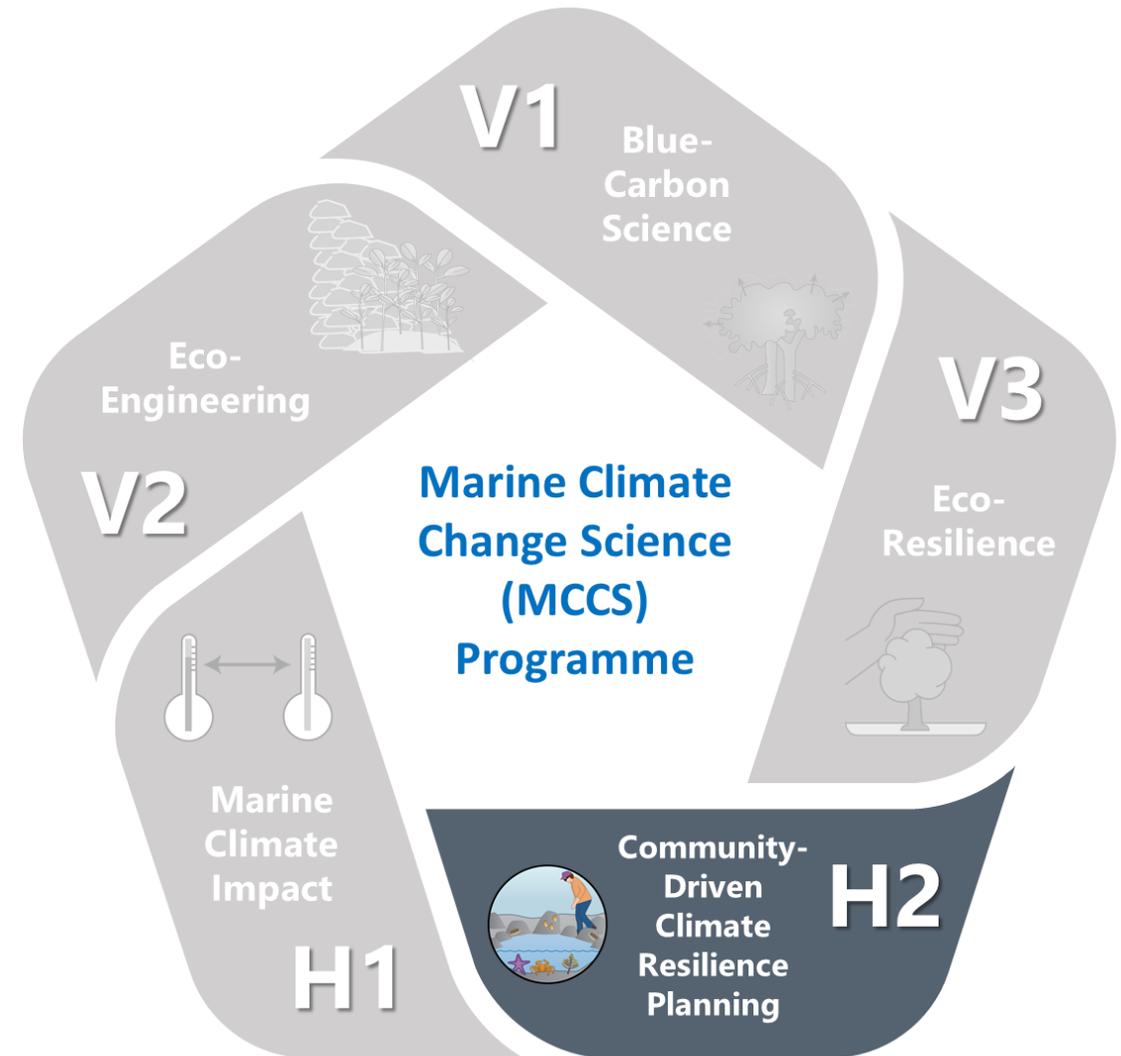
- Develop down-scaled global models for local climate change indicators relevant to the marine environment
- Benchmark MCCS research against relevant climate scenario projections and timescale horizons



*Core domains and enablers of the MCCS programme*

## H2 Community-Driven Climate Resilience Planning

- Harness social sciences to add important methods, perspectives, and data to climate change mitigation and adaptation efforts



*Core domains and enablers of the MCCS programme*

# **Grant Call Eligibility & Funding Criteria**

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# Grant Call Eligibility

- All Singapore-based public research institutes (RIs) (e.g., Institutions of Higher Learning (IHLs) and A\*STAR RIs), companies, company-affiliated research laboratories or institutions and not-for-profit entities are eligible to participate in the call.
- The Lead PI who leads the Research must be based in Singapore. Collaboration with Singapore-based and foreign organisations and experts, in the capacity of Co-Investigator (Co-I) or as Collaborator, is allowed.
- All funding awarded must be used to carry out the research work in Singapore, unless expressly approved by the grantor.
- Grant applicants are strongly encouraged to collaborate with industry partners to develop innovative solutions that can address the call objectives and demonstrate strong potential for real world application within and beyond Singapore.
- R&D proposals already funded by other government agencies will not be considered. R&D proposals with similar scope, which are currently under evaluation by other funding initiatives, will not be considered until the results from the other funding initiatives are finalised. Lead PIs, Co Is, and Collaborators will need to declare other funding sources and participation in other funding initiatives during application.

## Additional notes for private sector entities

- Funding for private sector entities would be conditional on collaboration with a public research performer for:
  - Research projects with a total project budget more than S\$500,000;
  - Test-bedding/demonstration/scale-up projects with a total project budget more than S\$2.0mil.
- For projects funding non-Singaporean entities (i.e., companies registered in Singapore with less than 30% local shareholding, determined by the ultimate individual ownership), a Singapore Technology Licensing Office (STLO) must be appointed regardless of the involvement of public research performer.

## Direct Costs\*

- Supportable direct costs are incremental cost required to execute the programme; can be classified into the following cost categories:-
  - Expenditure on manpower (EOM);
  - Equipment;
  - Other Operating Expenses (OOE); and
  - Overseas Travel

## Indirect Costs (i.e. “overheads”)

- Costs that are incurred for common or joint objectives and therefore cannot be identified readily and specifically with a particular sponsored research project, but;
- Contribute to the ability of the Institutions to support such research projects (e.g. providing research space, research administration and utilities, and not through the actual performance of activities under the sponsored projects).

\* Please refer to the Annex C of the Grant Call info sheets for the list of non-fundable direct costs of research.

# Funding Criteria

## Singapore-based IHLs/public research institutes

- Lead PI or Co-I will qualify for:
  - **[Direct costs] 100%** of the approved qualifying direct costs of a project;
  - **[Indirect costs] 30%** of the total qualifying approved direct costs of a project.

## Singapore-based private sector entities (incl. not-for-profit organisations)

- Lead PI or Co-I will qualify for:
  - **[Direct costs] Up to 70%** of the approved qualifying direct costs of a project
    - 30% for all non-Singapore entities (incl. non-Singapore not-for-profits);
    - 50% for Singapore Large Local Enterprises (LLEs);
    - 70% for Singapore Small Medium Enterprises (SMEs), start-ups and not-for-profits.

## Overseas organisations

- **Not** permitted to receive, directly or indirectly, any part of the funding, whether in cash or in the form of assets acquired using the funding or otherwise, unless expressly approved by the grantor.
  - Exception: **Travel expenses** for Visiting Professors/Experts (e.g., overseas based Co Is and Collaborators) **to come over to Singapore**, which should be identified and budgeted for upfront in the Other Operating Expenses vote to be incurred by the Host Institution.

## **Additional notes on Collaborators**

- Collaborators are **not** permitted to receive, directly or indirectly, any part of the funding, whether in cash or in the form of assets acquired using the funding or otherwise unless expressly approved by the grantor.

## **Additional notes on funded assets**

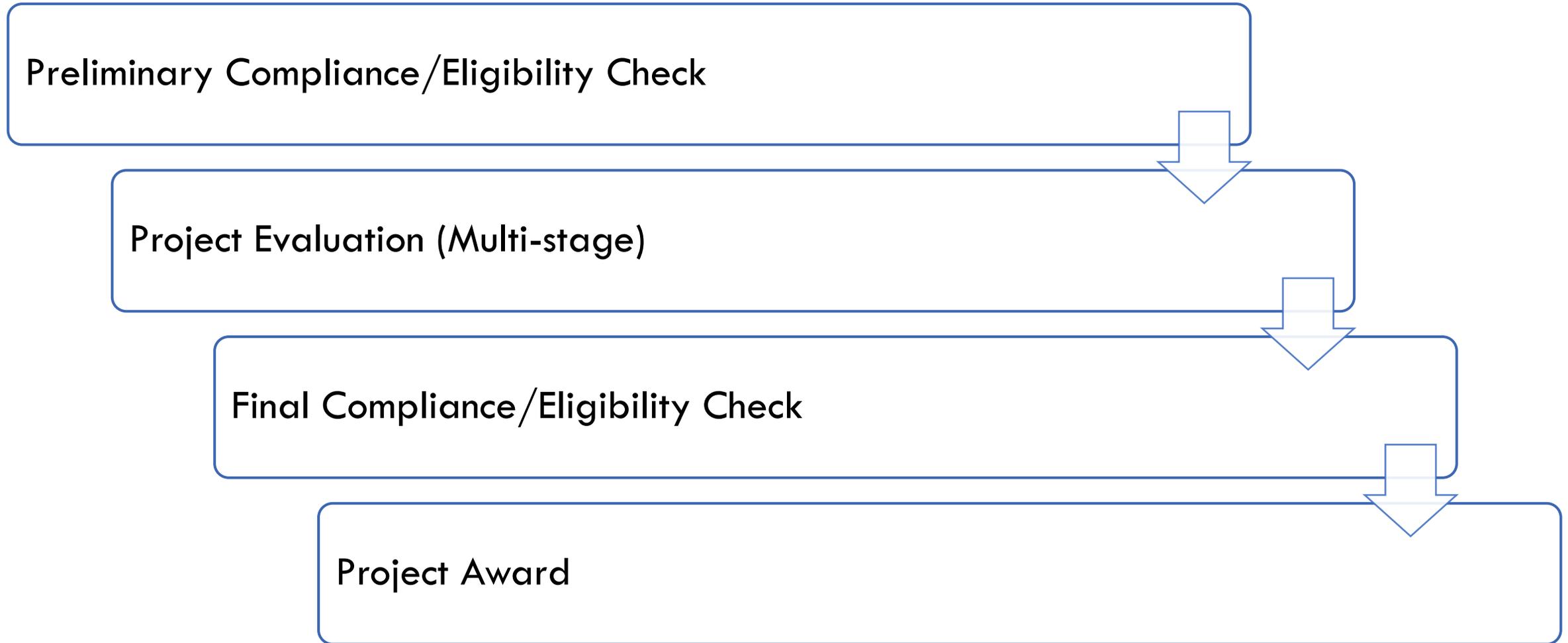
- All assets acquired using the funding must be located in Singapore and maintained within the control of the grantees.

*Please refer to the Grant Call info sheet for detailed information on the guidelines for the grant call.*

# Review Process

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# Review Process – at a glance



# Evaluation of Proposals

Evaluation of proposals will include:

## **1. Technical Peer Review**

Proposals will be subject to a round of technical peer review by domain experts\* with relevant expertise, to ensure excellent science in proposals.

## **2. Project Evaluation Panel**

Shortlisted applicants will be invited to present their proposals to a Project Evaluation Panel, consisting of relevant agency representatives, the Programme and Technical Directors, and other external experts (where relevant).

Successful applicants will be informed by the M CCS Programme Office on the award of the grant. The M CCS Programme Office's decision on project and funding support will be final.

*\* Research teams applying for the grant call are invited to recommend potential suitable peer reviewers for the M CCS Programme Office's consideration, as part of the proposal submission process. The final decision on the peer reviewers will be decided by the Programme Office.*

# Evaluation Criteria

## Criteria

### **Potential Contribution to MCCS Objectives**

- Relevance of proposed research in contributing to objectives/targets stated for the MCCS Call Topic.

### **Potential for Breakthrough and Innovation**

- Quality and significance of proposed research, including value for money, and the potential for breakthrough/innovation to advance knowledge and understanding within its own field or across different fields.

### **Potential for Application and Deployment in Singapore and Commercialisation/Export**

- Potential for application of research outcomes in Singapore by a public agency and potential for solutions to be replicated in Singapore beyond a single site/project.
- Feasibility for commercialisation/ export in areas where Singapore has a competitive advantage.

### **Execution Strength and Technical Competency of Research Team**

- Quality of plans for execution and delivery of the research programme and goals, including the appropriateness of the proposed milestones and deliverables (specific to evaluation of full proposal applications).
- Quality, significance, and relevance of the recent research record of the Lead PI and Co-Is and the strength of the applicant group, including likely synergy in delivering research and potential for international leadership.

# **Instructions for Submissions of Proposals**

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# Overview of Timeline

## FOR APPLICANTS & INTERESTED PARTIES (SGT, UTC +08:00)

Grant Call Opens (for 12 weeks)	25 March 2024, 2.00pm
Physical Briefing & Networking for MCCS 2 <sup>nd</sup> Grant Call	8 April 2024, 2.00pm
Grant Call Closes (Proposal Submission Deadline)	17 June 2024, 2.00pm

## FOR SHORTLISTED APPLICANTS ONLY

Notification of shortlisted applicants	August 2024*
Presentation to Project Evaluation Panel (2 or 3 days)	September 2024*

## FOR SUCCESSFUL AWARDEES ONLY

Approval and Letter of Award	Q4 2024 onwards*
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*\* Timings are indicative; shortlisted/successful applicants will be notified accordingly.*

# Grant Call Details

## Grant call information and relevant documents at:

- [MCCS 2<sup>nd</sup> Grant Call website](#)
- [IGMS](#)

## Application only through IGMS:

- See section on “Application Guidelines”. All funded proposals should follow the prevailing Terms and Conditions of Grant and NR Fund Guide.
- The application will only be considered valid if the submission of the full proposal is completed in IGMS, including endorsement by the Director of Research (also in IGMS) by the proposal submission deadline (**17 June 2024, 2.00pm**).
  - A copy of the application should also be sent via email to the MCCS Programme Office ([MCCS@nparks.gov.sg](mailto:MCCS@nparks.gov.sg)) after this.
- E-mail or walk-in applications will not be accepted.
- Late submissions will not be considered. Incomplete submissions may also be rejected. Applicants are advised not to submit their application at the last minute in case of technical errors with the IGMS website.
- The following slides outline steps for “Using IGMS” and “Full Proposal Submission”.

# Application Guidelines

Please choose one of the options below. It will direct you to the login type based on your choice.



## Host Institution Users

- Principal Investigator
- HI Administrator
- Office of Research/ Director of Research
- HI Finance/ HI Human Resource
- Data Administrator/ HI Audit



## Individual Users

- Singapore-based Applicants
- Overseas-based Applicants  
Eg. NRF Fellowship Applicants



## Reviewers

- Singapore-based Reviewers
- Overseas-based Reviewers

## Using IGMS:

### Key details for first time users

- Under the landing page, select the **“Host Institution Users”** option. This option will lead you to “Login with Singpass (Logging in as Business User)”. Login or register using your Singpass.
- **Authorise ORCID ID** before any grant application.
- Fill up mandatory fields.
- Update user profile.

# Application Guidelines

## **Full Proposal Submission:**

- Login to the system using the "Host Institution Users" option and subsequently, via "Login with Singpass (Logging in as Business User)".
- Click on grant call topic of interest under "Open Opportunities" and click "Apply".

## **For detailed steps, please refer to:**

- [Quick guide for Potential Applicants](#); and
- [Help guide for Potential Applicants](#)

(also available on the IGMS "Training Guides" page:

<https://www.researchgrant.gov.sg/Pages/TrainingGuides.aspx>)

# Contact Information

- For **general information**, please refer to the Grant Call FAQs document in either:
  - [MCCS 2<sup>nd</sup> Grant Call website](#)
  - Under “Related Documents” under the grant call topic of interest on [IGMS](#)
- For transparency, no verbal enquiries will be entertained. However, if you require clarification, please email the MCCS Programme Office at [MCCS@nparks.gov.sg](mailto:MCCS@nparks.gov.sg). Answers to all received queries will also be reflected in the Grant Call FAQs document (see above), which will be updated periodically to ensure that all applicants have equal access to additional information.
- For any queries on the **use of IGMS**, please contact the IGMS helpdesk.  
Tel No: (65) 6556 8807 or (65) 6556 6971  
E-mail: [helpdesk@researchgrant.gov.sg](mailto:helpdesk@researchgrant.gov.sg)

# **Q&A on Grant Call Processes**

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# **Call Topic 7: Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats**

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**V2 Eco-Engineering**

**2<sup>nd</sup> Grant Call: Topic 7**

**MCCS\_V2\_2024-2\_T7**

**Vertical 2 (Eco-Engineering),**

**Vertical 3 (Ecological Resilience)**

**Call Topic: Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats**

**Budget ceiling: S\$ 2.0mil**

**Duration of project: up to 4 years**

**Lead Agency: NParks**

# Project Details:

## Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

### Background

- Sediment dynamics is a key process that shapes coastal morphology and ecology and future development and climate change will likely impact this in the coming years.
  - Sea-level rise could drown intertidal habitats (seagrass, mangroves, mudflats etc.) that cannot accrete sustainably
  - Increasing wave energy or changes in coastal profiles could lead to erosion of coastlines and habitats
- We require a **better understanding of the current and future local sediment budgets** (sources and sinks) and understand how these might change based on various climate and coastal development scenarios.
- Climate change could lead to erosion and “drowning” of these habitats if they do not receive the necessary sediment supply to accrete. To address this challenge, the project will **explore the use of sediment nourishment, and other soft nature-based solutions** to enable soft-sediment habitats to accrete sustainably.

# Project Details:

## Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

### Key Research Questions

- a) What are the **sediment budgets** (sinks and sources, including mud, silt, sand, and suspended sediments) in **key soft-sediment coastal habitats** (e.g., mangroves, seagrass meadows, mudflats, sandy shores), and how will these sediment budgets be impacted by:
  - **Climate change** (e.g., sea level rise, increasing storm frequency) and;
  - **Man-made adaptations** to these impacts (e.g., installation of tidal gates and pumping stations, damming up of waterways, reclamation)?
- b) What **sediment nourishment or other nature-based solutions** (soft or hybrid) can be employed to alter existing or future sediment budgets to protect coastlines from climate-related impacts, and allow soft-sediment natural habitats to accrete?
- c) What are the **key environmental, physical, chemical, and ecological considerations**<sup>1</sup> when using sediment nourishment to mitigate erosion of soft-sediment coastal habitats, and what potential sediment sources can be tapped on?

<sup>1</sup> *These could include extrinsic considerations such as hydrodynamics, faunal or floral communities, or intrinsic considerations such as grain size distribution, microbiome, or mineral/chemical composition.*

## Project Details:

### Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

#### Research Objectives

- a) To **develop models to assess and predict how existing sediment budgets in key soft-sediment coastal habitats in Singapore will respond** to the sediment regimes under future **climate scenarios and land use plans** (including climate adaptation interventions).
- b) To **propose and design innovative nature-based solutions or designs** (soft or hybrid) that leverage on **sediment nourishment** or altering sediment regimes to improve coastal protection against storms and sea level rise, and to allow soft-sediment habitats to persist.
- c) To elucidate key environmental, physical, chemical, and ecological considerations<sup>1</sup> for the use of sediment nourishment in key local coastal habitats.

<sup>1</sup> *These could include extrinsic considerations such as hydrodynamics, faunal or floral communities, or intrinsic considerations such as grain size distribution, microbiome, or mineral/chemical composition.*

## Project Details:

### Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

#### Research Objectives (cont'd)

- d) To develop **recommendations for the use of sediment nourishment** (which has been historically used for beaches, but less so for other habitats like mangroves, seagrass meadows or mudflats) and other innovative nature-based solutions (soft or hybrid) in local soft-sediment habitats.
- e) To **test-bed these proposed nature-based solutions** at key local coastal habitats facing sediment-related issues (e.g., excessive erosion, burial etc.).

*Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.*

## Project Details:

### Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

#### Technical Deliverables

- a) Description and quantification (e.g., through numerical modelling, field sampling) of the sediment budgets in key soft-sediment coastal habitats like mudflats, mangroves, seagrass meadows and sandy shores in Singapore currently, including the relative contributions of different sources of sediment (e.g., inland and offshore) and their movement.
- b) Create models<sup>1</sup> and datasets to predict the changes of the sediment budgets to various climate change scenarios (e.g., sea level rise, increased wave energy) and future development plans. At least a long-term (i.e., end-of-century) projection should be included.
- c) Preparation of technical guidelines (including design parameters) for sediment nourishment and other nature-based solutions (soft or hybrid) that leverage on altering sediment regimes to improve coastal protection against storms and sea level rise, and to allow soft-sediment habitats to persist.

<sup>1</sup> *These may require first developing first-order models that predict climate change impacts on hydrodynamics before predicting impacts on sediment regimes.*

*Projects are encouraged to further build upon the above-mentioned deliverables, and/or propose additional deliverables.*

## Project Details:

### Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

#### Impact Outcomes

*In relation to the key-programme level deliverables of this vertical, this project should look towards contributing to the following impact outcomes:*

- a) The baseline characterisation of Singapore's coastal sediment budget and predictions for future responses to climate change can help inform strategies to protect soft-sediment habitats.
- b) The innovative nature-based solutions (including strategies for sediment nourishment) developed in the project can also potentially be implemented to protect the coast from erosion and to allow key natural habitats to persist under climate change. This will be especially useful in areas where more natural interventions would be preferred (e.g., biodiversity-rich areas, parkland and nature reserves).

## Project Details:

Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

**Proposed  
Study/  
Pilot  
Testbed  
Site(s)**

*Proposed projects may consider the following sites in Singapore for study and pilot test-bedding, including, but not limited to:*

- a) *Sungei Buloh Wetland Reserve and Mandai Mangroves and Mudflats (for mangroves and mudflats), Changi Beach Park (for sandy shores and seagrass meadows), and Chek Jawa (for seagrass meadows).*

## Project Details:

Sediment nourishment and other nature-based solutions for climate-resilient soft-sediment coastal habitats

Role	Agency
Lead	NParks
Member	HDB
	PUB

## **Q&A on Call Topic 7**

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# **Call Topic 8: Assessing the effects of climate change on coastal water quality**

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**H1 Marine Climate Impact & V3 Ecological Resilience**

**2<sup>nd</sup> Grant Call: Topic 8**  
**MCCS\_H1V3\_2024-2\_T8**

**H1 (Marine Climate Impact), Vertical 3 (Ecological Resilience)**

**Call Topic: Assessing the effects of climate change on coastal water quality**

**Budget ceiling:** S\$ 2.66mil

**Duration of project:** up to 3 years

**Lead Agency:** NEA & NParks

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Background

- Good water quality is crucial for the **health of coastal ecosystems, marine aquaculture, and the well-being of people who use coastal waters for recreational purposes**, but it is subject to compounded influences from both land and sea.
- **Climate change** is expected to alter environmental conditions in the sea (e.g. sea-level rise, acidification, and higher temperature), and likely pollutants loadings from the land (e.g. due to precipitation pattern changes). **Anthropogenic changes** (e.g. increases in population density and coastal development projects) can also affect levels of sediment, nutrients, harmful bacteria, and other pollutants. These changes can potentially cause significant changes in the physical, chemical, biological, and microbiological characteristics of coastal waters.
- Nonetheless, a knowledge gap exists regarding the **quantitative information** on the interactions between climate change, anthropogenic influences, and coastal water quality in the local context.

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Background (cont'd)

- The study aims to establish a **fundamental understanding of the relationships between water quality parameters, climate change-induced environmental stressors, and anthropogenic influences**. Potential benefits:
  1. Optimize monitoring programmes and prepare for future mitigation measures.
  2. Inform land-use planning and pollution control.
  3. Safeguard public health, coastal ecosystems, and marine aquaculture industries.
  4. Reduce potential socio-economic losses.

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Key Research Questions

- a) What are the **main drivers of the spatiotemporal heterogeneity in water quality** in Singapore's coastal water and how do these drivers affect the water quality?
- b) What will be the separate and combined **effects of projected climate changes and main anthropogenic activities** on coastal water quality?
- c) What are the effects of the changing coastal water quality on **microbial community diversity (including but not limited to enterococcus), harmful algal blooms (HABs) and coastal ecosystem (incl. key marine habitats and biodiversity)?**

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Research Objectives

- a) To identify and quantify the main drivers of the spatiotemporal heterogeneity of water quality parameters<sup>1</sup> in Singapore's coastal water in the 'present-day' scenario. There should be a clear differentiation among climatic<sup>2</sup> and other drivers<sup>3</sup>, where applicable.
- b) To evaluate quantitatively the effects of various IPCC climate-change scenarios, and potential main anthropogenic drivers, on Singapore's coastal water quality.

<sup>1</sup> The water quality parameters should include, but not limited to, water temperature, salinity, pH, dissolved oxygen, total suspended solids and/or turbidity, nutrients, chlorophyll-a, organic materials, and inorganic pollutants.

<sup>2</sup> Climatic drivers include, but not limited to, temperature, precipitation patterns, wind patterns, sea level, and solar radiation.

<sup>3</sup> Examples of other potential drivers include anthropogenic influences such as land-use changes, population increase, wastewater treatment effluents, industrial effluents, land reclamation, coastal developments, aquaculture, shipping, and potential pollution management measures (e.g. nature-based solutions), as well as geomorphology, tidal processes, biogeochemical processes, transboundary loads and internal loads (e.g. from bottom sediment or submarine groundwater).

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Research Objectives (cont'd)

- c) To evaluate quantitatively the projected synergistic impact of these water quality changes to microbial community diversity, including but not limited to the occurrences and fates of enterococci (as the faecal indicator bacteria) and HABs in the coastal water.
- d) To evaluate quantitatively the projected synergistic impact of these water quality changes to key marine habitats (e.g. seagrass meadows, mangroves, coral reefs) and biodiversity.

*Projects are encouraged to further build upon the above-mentioned objectives, and/or propose additional research objectives.*

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Technical Deliverables

- a) Identification and quantification of **potential drivers that affect the water quality processes** and levels of coastal water quality parameters, based on historical data, literature review, and field survey if applicable. It should include scientific understanding and analysis of how the identified drivers interact and affect levels of various water quality parameters in the 'present day' scenario.
- b) Scientific understanding and analysis of the **projected changes of the identified drivers** over different time horizons consistent with IPCC climate-change scenarios. At least a long-term (i.e. end-of-century) projection should be included.
- c) A **water quality model**<sup>1</sup> with sufficient spatial and temporal resolution and accuracy<sup>2</sup> for various water quality parameters. The baseline 'present-day' scenario should be calibrated and validated using historical data and additional data that may be required<sup>3</sup>.

<sup>1</sup> The model, baseline and future scenarios, including the software, model setups, model inputs, model outputs (in spatial maps and time series at sensitive marine receptors), data transformation scripts and any related scripts to run the model, and a handbook and training for agencies, shall be transferred to agencies as part of the project deliverables. The model shall comply with government agencies' security requirements, where applicable, and be integrable with NEA's existing operational system if required. Inputs for model development should account for regional and local hydrodynamics, regional and local meteorological influences, main anthropogenic drivers, local and transboundary pollutant loadings, and pertinent physical and biogeochemical processes.

<sup>2</sup> Rationales for the selection of model resolution and quantitative evaluation method and criteria on model performance (calibration and validation) should be clearly indicated in the proposal.

<sup>3</sup> NEA's historical water quality monitoring data for Singapore's coastal water and non-catchment rivers will be provided, while other relevant data can be requested from other agencies.

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Technical Deliverables (cont'd)

- d) Assessment and quantification of the **projected water quality changes**. The assessment should include their significance in local context (incl. benchmarking with either projected or experienced climate-change/anthropogenic impacts in other countries).
- e) Assessment and quantification of the projected synergistic impact of these water quality changes to **microbial community diversity**, including but not limited to the occurrences and fates of enterococci, and HABs (incl. speciation and algal toxins) in coastal water.
- f) Identification of **environmental conditions that may result in increased risk of enterococcal contamination** under various IPCC climate-change scenarios as well as combined scenarios with projected anthropogenic impacts.
- g) Assessment and quantification of the projected synergistic impact of these water quality changes to **key marine habitats** (e.g. seagrass meadows, mangroves, coral reefs) and biodiversity.
- h) Recommendations on **future monitoring strategy**, including key parameters to be monitored and monitoring locations, and frequency. These recommendations should consider the projected impacts under climate-change scenarios and the main anthropogenic drivers. Additionally, they should outline how future monitoring data could be leveraged to enhance future modelling scenarios.

*Projects are encouraged to further build upon the above-mentioned deliverables, and/or propose additional deliverables.*

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Impact Outcomes

*In relation to the key programme-level deliverables of this vertical and horizontal, this project should look towards contributing to the following impact outcomes:*

- a) Information on drivers of temporal and spatial distributions of water quality parameters can guide policy on effluent quality control, such as trade effluent regulations under Environmental Protection and Management Act, from relevant industries to minimize discharges to vulnerable receptors in the coastal water.
- b) Model results on the projected changes in coastal water quality parameters under various IPCC climate change scenarios and/or with anthropogenic influences can help to enhance the understanding of local coastal marine environment and contribute to its future preservation and sustainability.
- c) Quantifying the effect of climate change can help to support the review of monitoring campaigns with respect to the changing environmental conditions and improve their adaptiveness and robustness.
- d) The relationships between environmental factors, anthropogenic influences, and the occurrence and fate of enterococcus will facilitate an understanding on the changes in enterococcus under different conditions which will then enable differentiated/site-specific management of recreational beaches for the public (i.e. monitoring, determining suitability for recreational activities, and public communications) and their future planning.

# Project Details:

## Assessing the effects of climate change on coastal water quality

### Impact Outcomes (cont'd)

- e) Data and/or model results on the spatial distribution of water quality parameters during different environmental conditions in the coastal water and subject to various anthropogenic influences can be used to plan future aquaculture sites and reduce their vulnerability to HABs. Therefore, promoting a sustainable and resilient aquaculture industry.
- f) Projections of climate-driven changes and main human influences on water quality and their impacts on coastal ecosystems (incl. key marine habitats and biodiversity) can help inform nature conservation and management strategies.
- g) Promote Singapore as a climate-resilient country with proactive and adaptive catchment and coastal management.

# Project Details:

## Assessing the effects of climate change on coastal water quality

**Proposed  
Study/  
Pilot  
Testbed  
Site(s)**

*Proposed projects may consider the following sites in Singapore for study and pilot test-bedding, including, but not limited to:*

N.A.

*(Note: In the event that bacteria (enterococcus) or harmful algal species need to be tested, controlled environments such as laboratory setups should be used. It is only recommended to test their growth and proliferation in the natural environment if the tested subjects are strictly confined and pose no threat to the health of public or aquatic ecosystems, due to the potentially pathogenic or toxic nature of the study subjects.)*

# Project Details:

Assessing the effects of climate change on coastal water quality

Role	Agency
<b>Lead</b>	NEA
	NParks
<b>Member</b>	SFA
	PUB

## **Q&A on Call Topic 8**

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# Final Q&A

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# Thank You

For further enquiries, please contact: [MCCS@nparks.gov.sg](mailto:MCCS@nparks.gov.sg)