AFB/PPRC.35/Inf.43
31 March 2025

Adaptation Fund Board
Project and Programme Review Committee
Thirty fifth Meeting
Bonn, Germany, 8-9 April 2025

Agenda item 14

REQUEST FOR CHANGE IN PROJECT TARGET SITES IN MALAYSIA: UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME (UN-HABITAT)

Background

1. During the intersessional period between the thirty-seventh and thirty-eighth meeting, the Adaptation Fund Board (the Board) approved through Decision B.37-38/10 a five-year project titled “Nature-based Climate Adaptation Programme for the Urban Areas of Penang Island” in Malaysia, submitted by the United Nations Human Settlements Programme (UN-Habitat), for a total amount of US$ 10,000,000.

2. The overall objective of the project is to enhance urban resilience and reduce human and ecosystem health vulnerability to climate change impacts and extreme weather events by implementing nature-based solutions. As mandated by the decision, an agreement was prepared and signed between the Board and UN-Habitat on 19 May 2022.

3. UN-Habitat submitted two project performance reports (PPR), of which one was cleared by the secretariat. As of 12 March 2025, a total project funding for an amount of US$ 3,000,000 including the project fees, has been disbursed by the trustee, which corresponds to 30% of the approved grant.

4. On 16 December 2024, UN-Habitat submitted to the secretariat a request for change in target sites (see annex 1) together with a justification note (see annex 2).

Suggested change in target sites

5. As described in the justification note, the initial proposal intended to target the neighborhood of Sungai Pinang and its tributaries. However, as stated in the project document approved by the Board, it was agreed jointly with the Department of Irrigation and Drainage (JPS Palau Pinang) and experts from the River Engineering and Urban Drainage Research Center (REDAC, USM), that flood mitigation projects in the pipeline for Sungai Pinang and its tributaries would be further assessed under the 12th Malaysia Plan. In 2020, the Federal Government decided to implement the Sungai Pinang Flood Mitigation project, making the proposed Adaptation Fund interventions in this neighborhood no longer needed.

6. The project, together with JPS Palau Pinang subsequently assessed alternative target sites for the Adaptation Fund interventions, including Solok Van Praagh, Sungai Bagan Jermal, Sungai Air Itam, Sungai Ara, as well as Sungai Keluang and Lintang Nibong (Parit Mox) in Bayan Baru. This assessment concluded that both Sungai Keluang and Lintang Nibong (Parit Mox) in the Bayan Baru neighborhood, Bayan Lepas suburb, were the most suitable sites for rolling out the interventions. Both sites are located within the City of George Town, in the Penang State, as in the project document approved by the Board. The adaptation investments planned in the project document, namely the blue-green corridor, retention ponds and the infiltration wells will remain the same, both in terms of nature and scope. This proposal was approved by the Chair of the Project Steering Committee, as evidenced by the letter included in the justification note (see annex 2).

7. Consultations with communities in the new target sites were carried out from July to November 2024. A summary of the main findings is provided in the justification note. Updates were made in both the Environmental and Social risk screening and measures for management of Environmental and Social risks sections of the project document (see annex 4).

Secretariat's review of the request

8. Following a review of the request by the secretariat and considering the explanation provided by UN-Habitat, the secretariat is of the view that this request for change in target sites is justified.

9. The secretariat acknowledges that this request has been endorsed by the Designated Authority in Malaysia (see annex 3).

Recommendation

10. Having considered the document AFB/PPRC.35/Inf.43 and its annexes, the Project and Programme Review Committee may want to consider and recommend the Board to approve the request for change in target sites for the project "Nature-based Climate Adaptation Programme for the Urban Areas of Penang Island" as requested by the United Nations Human Settlements Programme (UN-Habitat).

Annexes

1) Letter from UN-Habitat requesting a change in target sites
2) Justification note from UN-Habitat
3) Letter from the Designated Authority endorsing the change in target sites
4) Revised project document in track changes from UN-Habitat

Annex 1: Letter from UN-Habitat requesting a change in target sites

UN-HABITAT

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FOR A BETTER URBAN FUTURE

Nairobi, 26th February 2025

Subject: Request for revision of project location for *Component 2 Built projects for storm water and flood management* of the "Nature-based climate adaptation programme for the urban areas of Penang island"

Dear Sir or Madam,

UN-Habitat presents its compliments to the Adaptation Fund Board Secretariat, and in its capacity as the Multilateral Implementing Entity (MIE) for the "Nature-based climate adaptation programme for the urban areas of Penang Island" (AF00000232) has the honor to request the Board for the approval of change of the project location for *Component* **2** ***Built projects for storm water and flood management*** in the programme.

The proposed changes as specified in the attached justification note, with the endorsement letter from the National Designated Authority of Malaysia, confirm that the new project locations are within the focus areas of the programme (George Town and Bayan Lepas) and will not result in modifications of the outputs, outcomes, and targets of the project. Community engagement and stakeholder consultation have also been carried out for the project locations in Bayan Lepas and positive feedback and support have been received with no objections. It should be noted that there is no change in the risk assessment and the environmental and social management plan as a result of this change.

I appreciate your approval for the proposed changes. Thank you for your consideration.

Yours sincerely,

Rafael Tuts
Director, Global Solutions Division, UN-Habitat

The Adaptation Fund Board Secretariat
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Annex 2: Justification note from UN-Habitat

JUSTIFICATION NOTE

Request for a revision of the project sites for Component 2 Built projects for stormwater and flood management

Nature-based Climate Adaptation Programme for the Urban Areas of Penang Island

1. Justification for project site change

1.1 Change of project site from Sungai Pinang to Sungai Keluang and Lintang Nibong

In the AF programme, the Component 2, *Built project for stormwater and water management*, consists of three Outputs as below:

Output 1.1 Blue-green corridors developed

Output 1.2 New upstream retention ponds constructed

Output 1.3 Swales and infiltration wells restored and constructed

In the proposal, it was stated that for Component 2, the "*flood mitigation projects in the pipeline for **Sungai Pinang** and its tributaries will be further assessed and studied under the 12th Malaysia Plan to incorporate Nature-based Solutions. A team of consultants will be appointed by JPS Pulau Pinang to look into land status matters, suitability of specific sites, existing utilities as well as detailed design for its implementation. This will include operational costs and future maintenance*." (Pages 21-23 of the proposal)

However, as the Federal Government initiated the Sungai Pinang Flood Mitigation Project in 2020, Sungai Pinang was no longer available to implement the AF project. Thereafter, JPS Pulau Pinang has assessed several potential sites for the project implementation:

a. **Solok Van Praagh:** The Penang State Government commenced the Solok Van Praagh Flood Mitigation Project in 2021. Therefore, this site was no longer available to implement the AF project.

b. **Sungai Bagan Jermal, Sungai Air Itam, and Sungai Ara:** These areas involved private lands, which required JPS to apply for land acquisition. Therefore, these sites were deemed unsuitable for implementing the AF project.

c. **Sungai Keluang and Lintang Nibong (Parit Mox), Bayan Baru** (located within Bayan Lepas, one of the AF programme target areas): The communities in these areas have been experiencing frequent floods since 2017. **Figure 1.1** displays the flood area map, and **Figure 1.2** illustrates the project sites within that area.

The final assessment by the Penang State Department of Irrigation and Drainage (JPS Pulau Pinang) determined that **Sungai Keluang and Lintang Nibong (Parit Mox), Bayan Baru in Bayan Lepas** are the most suitable sites for implementing the AF programme's Component 2, including the blue-green corridor (Output 2.1), retention ponds (Output 2.2), and the swales and infiltration wells (Output 2.3).

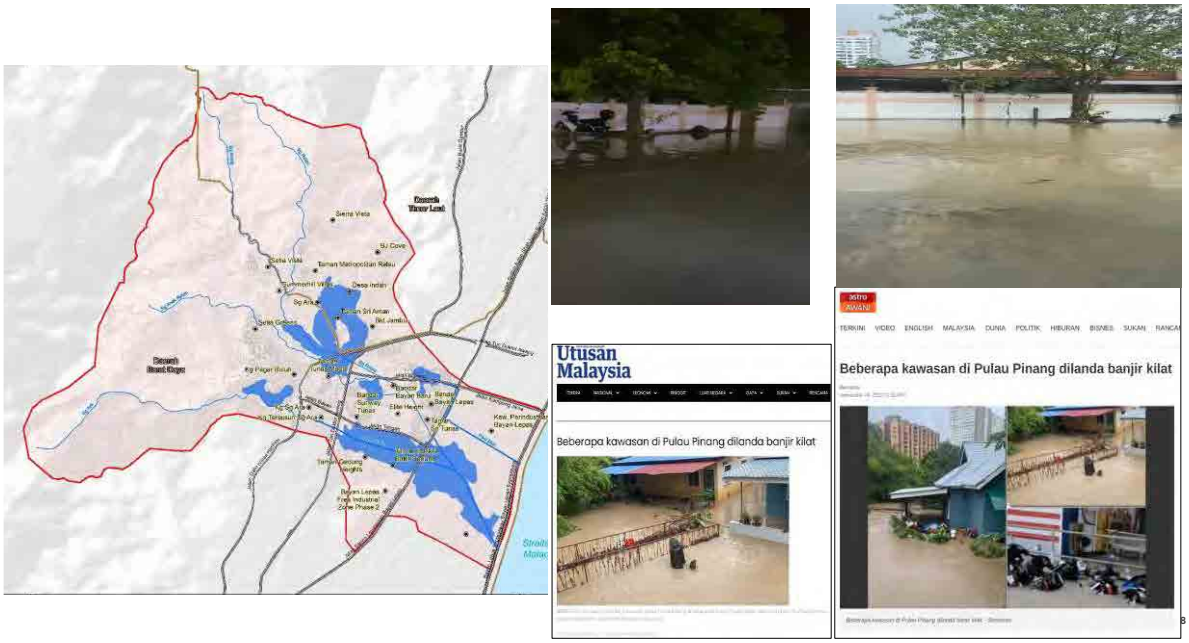


Figure 1.1 Map of frequently flooded area (in blue) in Bayan Baru, Bayan Lepas.

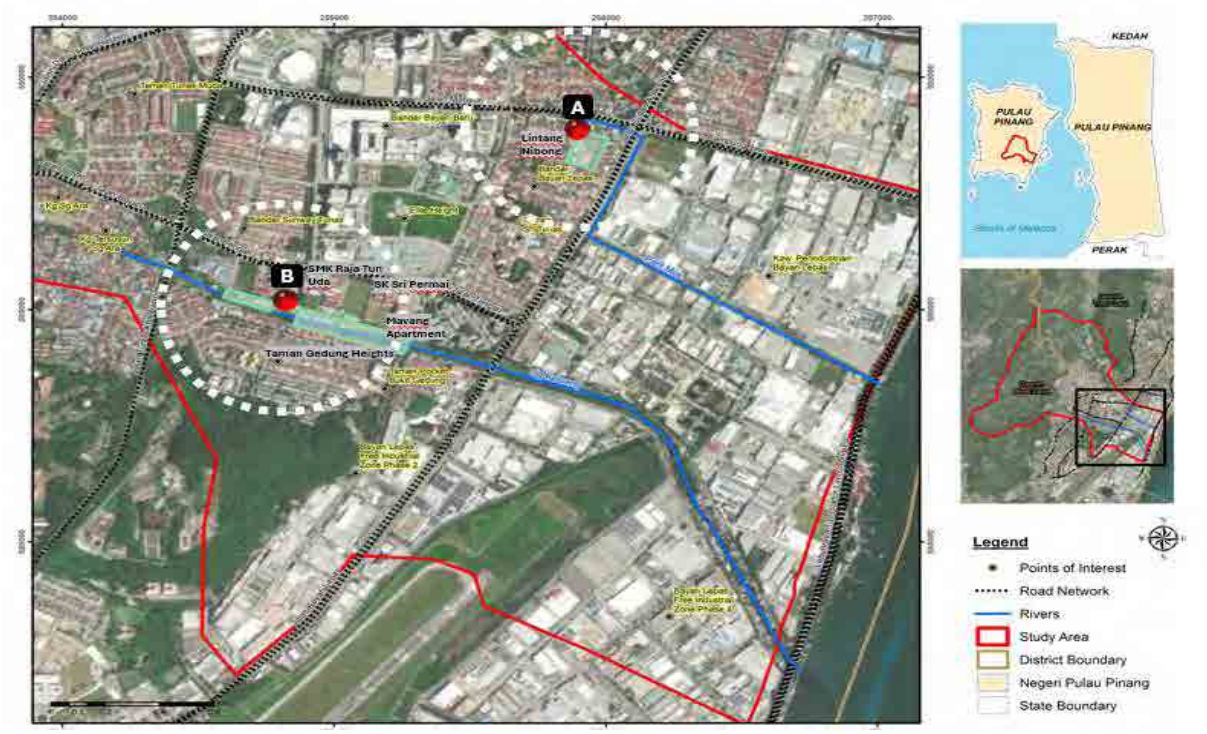


Figure 1.2 Sites of AF project within the frequently flooded area: (A) Lintang Nibong for the retention pond, swale and infiltration well; (B) Sungai Keluang for the blue-green corridor.

1.2 Removal of "upstream" in "retention pond"

The project site selected for implementing the retention pond, swale and infiltration well at site (A) as mentioned above based on the assessment by JPS Pulau Pinang is situated at midstream, which differs from the initial proposal of the "upstream" retention pond.

Nonetheless, the site change will result in similar target beneficiaries, project outputs, outcomes, and impacts as the initial proposal within the AF programme focus areas.

Based on the hydraulic modelling for 20 ARI (continuous rainfall of up to two days) (**Figure 1.3**), the project will reduce the flood area from the initial 11.45 ha to 0.03 ha. **Attachment 1** presents the design of the retention pond, swale and infiltration well, and the blue-green corridor.

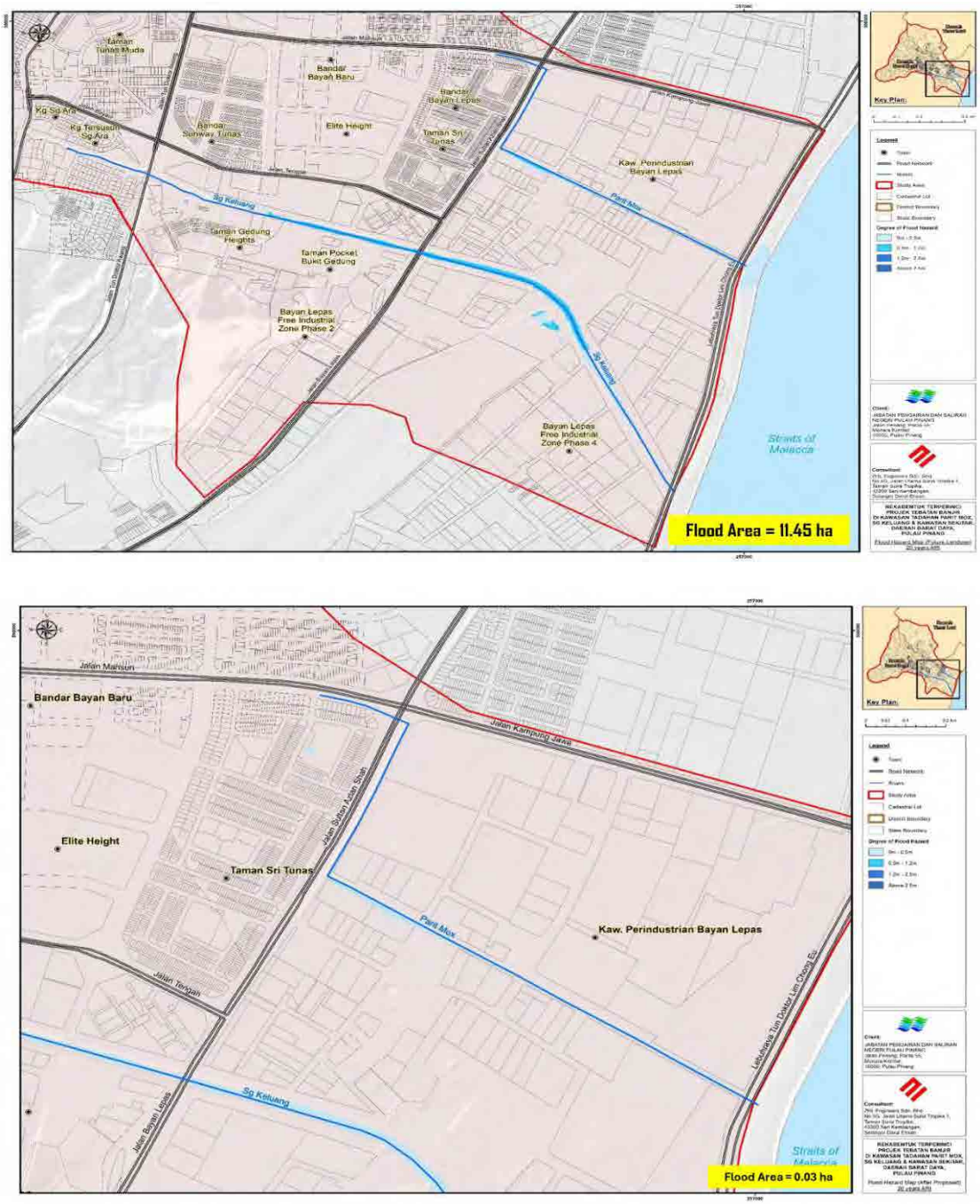


Figure 1.3 Hydraulic model before and after construction of the retention pond, swale and infiltration well for 20 ARI.

1.3 Implementation of blue-green corridor under the Local Council of Penang Island (MBPP)

In the Proposal, *Output 2.1: Blue Green Corridor* under Component 2 was parked under the Executing Entity - JPS Penang. Following further discussions, the Executing Entities agreed that both JPS Penang and the Local Council of Penang Island (MBPP) will work together to implement this initiative. This programmatic arrangement aims to integrate the blue-green corridor feature into Project *Component 1: Adaptation to the urban heat island effect through urban greening*, primarily implemented by MBPP. This integration aims to enhance the effectiveness of simultaneously reducing temperatures and minimizing flood risks. The blue-green corridor with MBPP will be implemented in the same area as Component 1 of the programme.

2. Risk Screening

According to the Law of Malaysia, the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 [1], the proposed project sites **are not required** to conduct an Environmental Impact Assessment (EIA).

Box 2.1 presents the Prescribed Activities for Drainage and Irrigation in the First Schedule and Second Schedule of the Order that require an EIA. Based on the Order, the proposed project area widths (**Table 2.1**) are below the stipulated surface areas requiring an EIA, and the project sites are not near to any environmentally sensitive areas.

Table 2.1 Area widths of the project

Project Outputs	**Area widths in the proposal (Page 24)**	**Current area widths**
2.1 Blue-green corridors	1,826 m^2 (0.18 hectares)	8,800 m^2 (0.88 hectares)
2.2 Retention Pond	2,200 m^2 (0.22 hectares)	8,800 m^2 (0.88 hectares)
2.3 Swales and infiltration wells	3,200 m^2 (0.32 hectares)	2,600 m^2 (0.26 hectares)

Box 2.1 Prescribed activities under the First Schedule and the Second Schedule for drainage and irrigation in the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015.

First Schedule

DRAINAGE AND IRRIGATION:

(a) Construction of man-made lakes and enlargement of artificial lakes with surface areas of 100 hectares or more.

(b) Irrigation schemes covering an area of 500 hectares or more.

Second Schedule

DRAINAGE AND IRRIGATION:

(a) Construction of man-made lakes and artificial enlargement of lakes with surface areas of 50 hectares or more in or adjacent or near environmentally sensitive areas.

(b) Any drainage of wetland, wild-life habitat or of dry inland forest covering an area of 20 hectares or more.

A risk screening exercise, including *Compliance with the Law*, was conducted for the Project's Component 2 with the proposed project sites based on *Table 18. ESP risks and possible mitigation measures for further analysis* in the original proposal (page 49). The risk screening is presented below in **Table 2.2**.

[1] https://www.doe.gov.my/en/eia-prescribed-activities-environmental-quality-order-2015/

Table 2.2 ESP risk screening for the project sites

	Original proposal		**Proposed JPS project sites**	
Adaptation Fund environmental and social principles	**Possible risks**	**Possible mitigation measures**	**Possible risks**	**Possible mitigation measures**
Compliance with the Law	None beyond the compliance issues identified in Part II Section E of this proposal document	No mitigation measures required	Same as original.	Same as original.
Access and Equity	Certain groups may have less access to training or to green infrastructure or urban agriculture or specific groups may have privileged access	Community management rules ensuring equal access is guaranteed, enforced through monitoring and legal agreements (where necessary)	Same as original.	Same as original.
Marginalised and Vulnerable Groups	There are some refugees in the Bayan Lepas area who are vulnerable to discrimination. Other forms of racial discrimination	Community management must ensure equal access extends to refugees and migrant population and equal treatment	Same as original.	Same as original.
Human Rights	None, other than those issues in Marginalised and Vulnerable Groups, Gender Equality and Women's Empowerment, Core Labour Rights and Involuntary Resettlement	No mitigation measures required	Same as original.	Same as original.

	Original proposal		Proposed JPS project sites	
Gender Equity and Women's Empowerment	Women not having equal representation in decision making processes, women are excluded from activities under the programme, such as training and urban agriculture	Quotas for female participation and inclusion in decision making at all levels	Same as original.	Same as original.
Core Labour Rights	People working on the project may have improper contracts, working conditions, unsatisfactory occupational health and safety or there could be discrimination against women at work.	Proper contracts, in compliance with ILO standards and occupational health and safety standards in line with international best practices.	Same as original.	Same as original.
Indigenous Peoples	There are no indigenous people in Penang island	No mitigation measures required -	Same as original.	Same as original.
Involuntary Resettlement	Involuntary resettlement or disruption of access arising from construction	Proposed interventions only on state land	Same as original.	Same as original.
Protection of Natural Habitats	Damage to local ecosystems due to introduction of dangerous species of flora	Perhilitan and Perhutanan to review all projects to make sure no dangerous species is proposed	Same as original.	The Atlas of Climate Resilient Tree Species for Malaysia will be used for the project.
Conservation of Biological Diversity	Damage to local ecosystems due to introduction of dangerous species of flora	Perhilitan and Perhutanan to review all projects to make sure no dangerous species is proposed	Same as original.	The Atlas of Climate Resilient Tree Species for Malaysia will be used for the project.

	Original proposal		Proposed JPS project sites	
Climate Change	Inefficient sourcing of materials may generate emissions. Poor construction/planning may lead to "mal-adaptation"	Preferring local materials in the procurement process. Multi-stakeholder consultation and approval process for designs	Same as original.	Same as original.
Pollution Prevention and Resource Efficiency	Built projects will generate waste	Incorporate waste management and disposal into design	Same as original.	Same as original.
Public Health	Construction sites pose a risk to the public if not properly managed and demarcated. Water-related activities pose contamination risks	Zero-accident construction site management. Practices to ensure water sources are not contaminated	Same as original.	Same as original.
Physical and Cultural Heritage	Penang old town is a UNESCO World Heritage Site	Consultation with UNESCO, Department of Heritage Conservation (MBPP) and George Town World Heritage Incorporated about implementing the project in accordance with heritage preservation principles.	Same as original.	Same as original.
Lands and Soil Conservation	No risks identified beyond those highlighted in Protection of Natural Habitats	-	Same as original.	Same as original.

3. Endorsement

The choice of the project sites was discussed in the Project Steering Committee meetings held on 13 December 2023 and 21 March 2024 and attained endorsement from the Project Steering Committee. **Attachment 2** is the endorsement letter from the Chair of the Project Steering Committee.

4. Community consultations

Community consultation and stakeholder consultation sessions, alongside ongoing community surveys, have been conducted at the proposed project sites with strong support and positive feedback received. **Attachment 3** contains the report on the community survey examining the social, environmental and gender policies for the project areas.

5. Budget variation

Based on the above assessment, there have been budgetary deviations at the output level while the budget at the component level remains unchanged.

Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Original Budget (USD)	Actual Budget (USD)
Component 2. Built projects for storm water and flood management (Adaptation Fund Outcome 5: Increased ecosystem resilience in response to climate change and variability induced stress	Output 2.1 Blue-green corridors developed	2.1. Reduced exposure of Penang state to storm water and flooding	1,550,000	1,385,000
	Output 2.2. New retention ponds constructed	2.2. Reduced exposure of Penang state to storm water and flooding	725,000	1,195,000
	Output 2.3. Swales and infiltration wells restored and constructed	2.3. Reduced exposure of Penang state to storm water and flooding	450,000	145,000
Total			**2,725,000**	**2,725,000**

Attachment 1 Design of the retention pond, swale, and infiltration well, and the blue-green corridor.

Attachment 2 Endorsement letter from the PNBCAP Project Steering Committee.

Attachment 3 Community survey report.

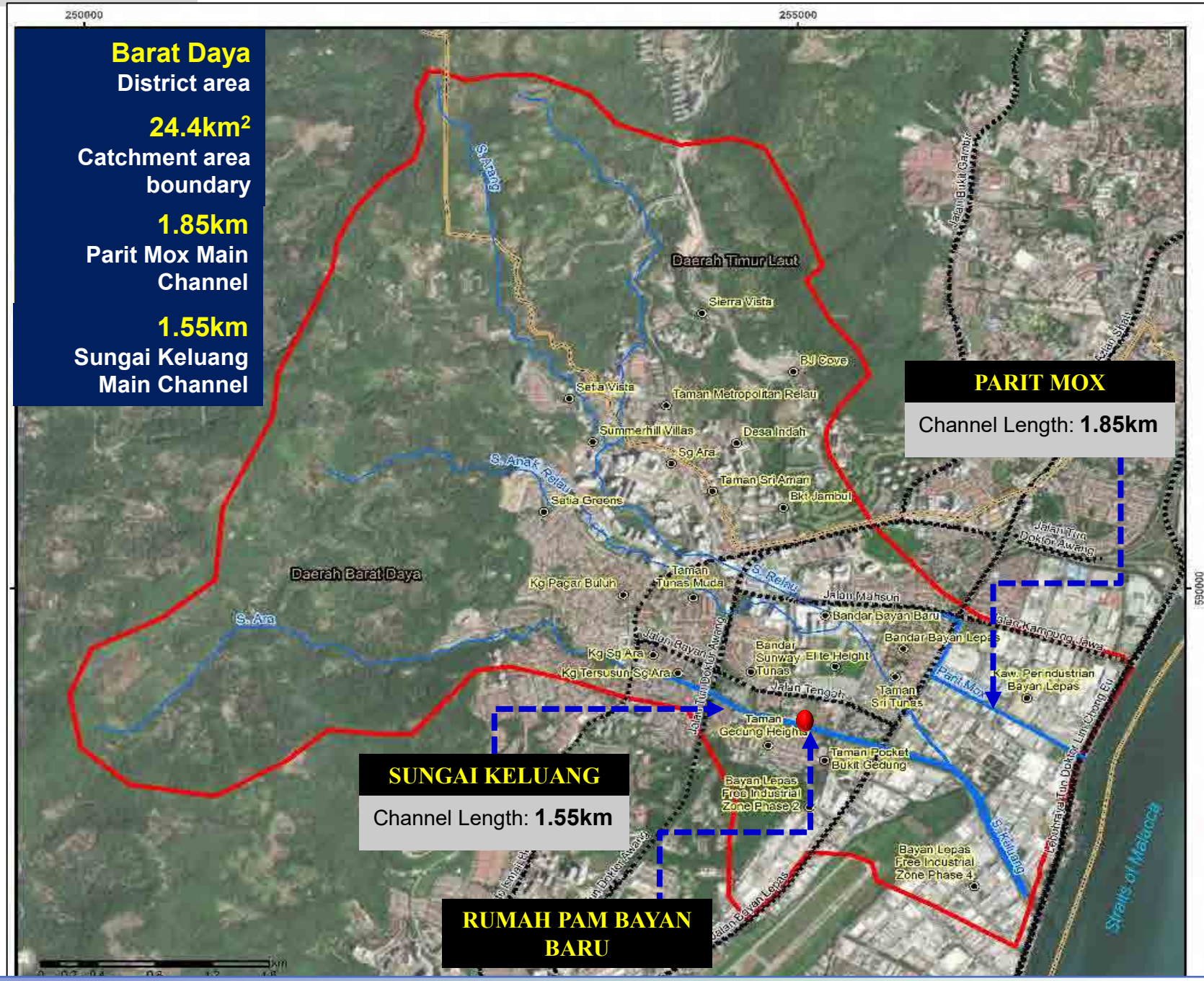
INTRODUCTION

PARIT MOX

- 1.85km stone pitching lined channel that runs through the center part of Free Trade Zone (FTZ) Phase 3
- Originates from the road junction of Jalan Kampung Jawa to Jalan Sultan Azlan Shah
- flows in the east direction before finally discharging into the Strait of Penang

SUNGAI KELUANG

- One of the catchment areas in Bayan Baru
- Earth-channel waterway is about 1.55km in length and runs through the FTZ Phase 3
- Middle stream and downstream of the river flow through the boundary area of FTZ Phase 3 and FTZ Phase 4 before it crosses under Lebuhraya Tun Dr. Lim Chong Eu and discharges into the Strait of Penang



Legend

- Points of Interest
- Road Network
- Rivers
- Study Area
- District Boundary
- Negeri Pulau Pinang

River System

- The main river Sungai Keluang with major tributaries being Sungai Ara and Sungai Relau.
- Sungai Ara and Sungai Relau flow in an eastward direction and discharge to the Penang Strait.

PARIT MOX

Channel Length: **1.85km**

SUNGAI KELUANG

Channel Length: **1.55km**

INTRODUCTION

Flooding event in Bayan Baru (2nd September 2016)

Flooding Event in Bayan Baru (24th August 2021)

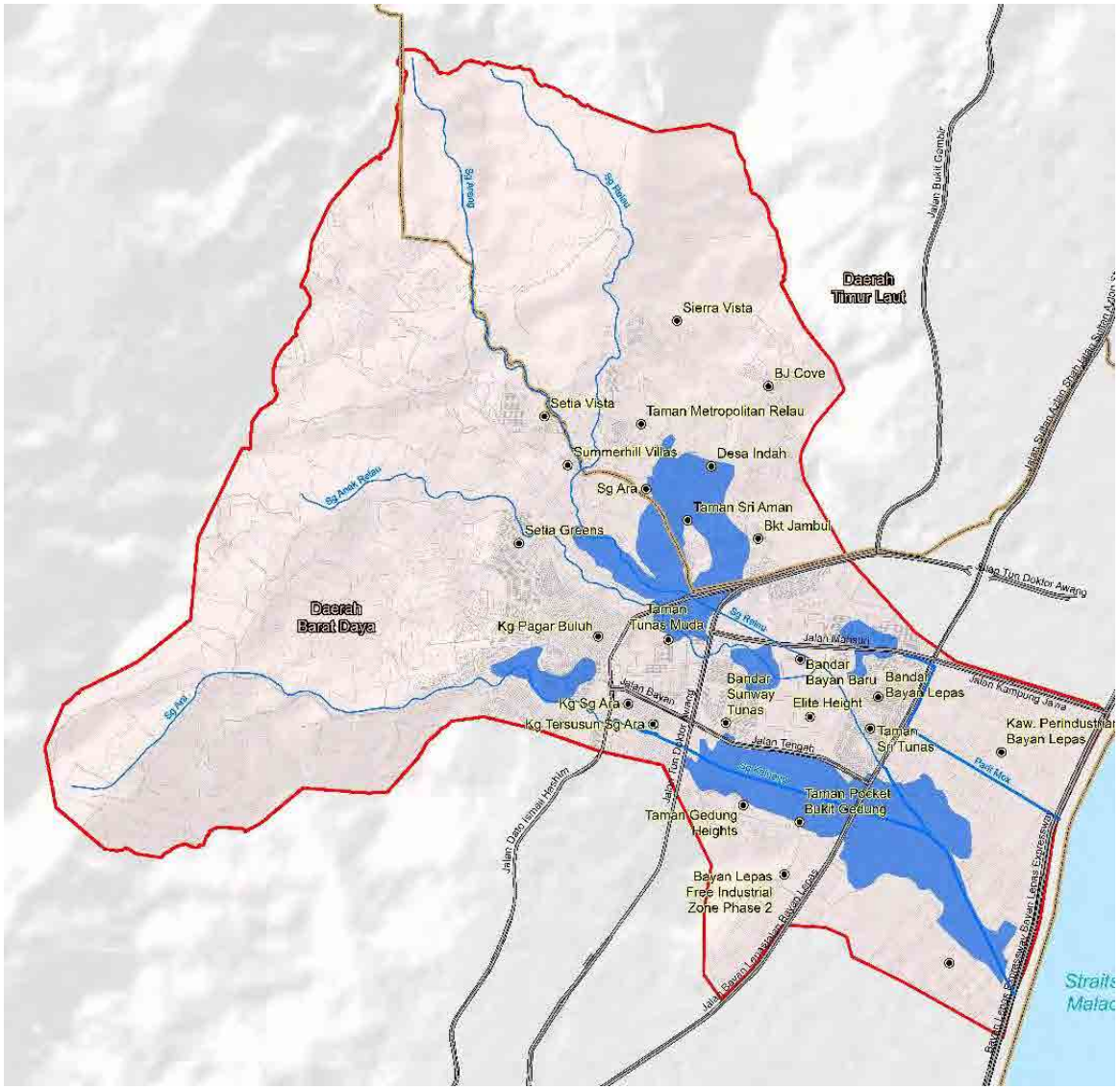
Flooding Event in Bayan Lepas Free Trade Zone (29th November 2015)

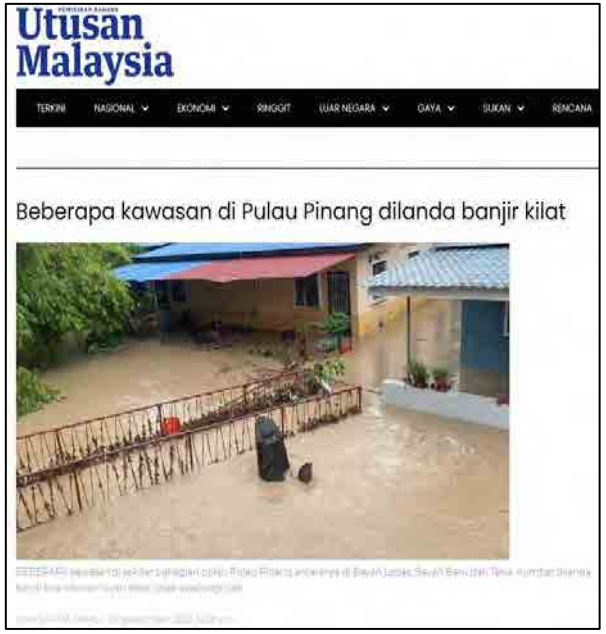
Flooding Event in Penang International Airport (24th September 2022)

FLOOD EVENTS IN THE STUDY AREA

Year	Date	Flood Area
2016	17 June 2016	Sunshine Bayan Baru, Masjid Bayan Baru
	2 September 2016	Jalan Mayang Pasir, Jalan Tengah, Persiaran Mahsuri dan Jalan Mahsuri
2017	24 January 2017	Jalan Sultan Azlan Shah, Bayan Baru, Kg Naran
	30 May 2017	Kg Naran
	14 July 2017	Jalan Sultan Azlan Shah, Bayan Baru, Kg Naran
2018	22 August 2018	Kg Bukit, Kg Seronok, Bayan Lepas, Sekolah Mutiara Perdana, Sungai Ara, Kem Tentera Sungai Ara, Pangsapuri Pahlawan Sungai Ara, OSRAM, GIANT, Lintang Pondok Upeh,
	7 September 2018	Jalan Sultan Azlan Shah, Jalan Dato Ismail Hashim, Sekolah Mutiara Perdana, Sungai Ara, Persiaran Relau, Jalan Mahsuri, GIANT Bayan Lepas
2019	9 May 2019	Jalan Persiaran Mayan Pasir, Jalan Dato Ismail Hashim, Jalan Sultan Azlan Shah, Bayan Baru, Kg Naran
	29 May 2019	Jalan Persiaran Mayang Pasir, Jalan Dato Ismail Hashim, Sunshine Bayan Baru, Giant Bayan Baru, Hotel Seri Malaysia
	24 July 2019	Jalan Persiaran Mayang Pasir, Jalan Dato Ismail Hashim, Pangsapuri Desa Pahlawan, Sunshine Bayan Baru, Giant Bayan Baru, Jalan Mahsuri, Hotel Seri Malaysia, Kg. Baru Sg. Ara, Jalan Sultan Azlan Shah
	3 September 2019	Jalan Persiaran Mayang Pasir, Jalan Dato Ismail Hashim, Sunshine Bayan Baru, Giant Bayan Baru, Jalan Mahsuri
2020	10 May 2020	Masjid Bayan Baru, Petronas Sg Ara, Pangsapuri Desa Pahlawan, Sek. Keb. Mutiara Perdana, Sunshine Bayan Baru, Giant Bayan Baru, Hotel Seri Malaysia
2021	15 June 2021	Jalan Persiaran Mayang Pasir
	24 August 2021	Jalan Persiaran Mayang Pasir
	21 October 2021	Jalan Mayang Pasir
2022	24 September 2022	Penang International Airport

INTRODUCTION




Utusan Malaysia

TERKINI NASIONAL EKONOMI RINGGIT LUAR NEGARA GAYA SUKAN RENCANA

Beberapa kawasan di Pulau Pinang dilanda banjir kilat


astro AWANI

TERKINI VIDEO ENGLISH MALAYSIA DUNIA POLITIK HIBURAN BISNES SUKAN RANCAN

Beberapa kawasan di Pulau Pinang dilanda banjir kilat

Bernama
September 24, 2022 12:36 MYT

Beberapa kawasan di Pulau Pinang dilanda banjir kilat. - Bernama

SOCIO-ENVIRONMENT

LOCAL COMMUNITIES & FDGs

Socio-Environment Study by using Community-Based Resilience Analysis (CoBRA)

Targeted Local Communities

CATCHMENT AREA	COMMUNITIES	TYPE
A) Parit MOX	- Taman Perumahan Bandar Bayan Baru -Kg Jawa -Surau Nurul Iman -Surau Desa Mayang -Masjid Umar Ibnu Al-Khattab	Residential Commercial Religious
B) Sg Keluang & Sg Ara	- Bukit Gedung Height - Mayang Apartment - Surau Bukit Gedung - SMK Raja Tun Uda - SK Sri Permai	Residential Commercial Institutional Religious

Focus Group Discussion (FGD)

Primary group

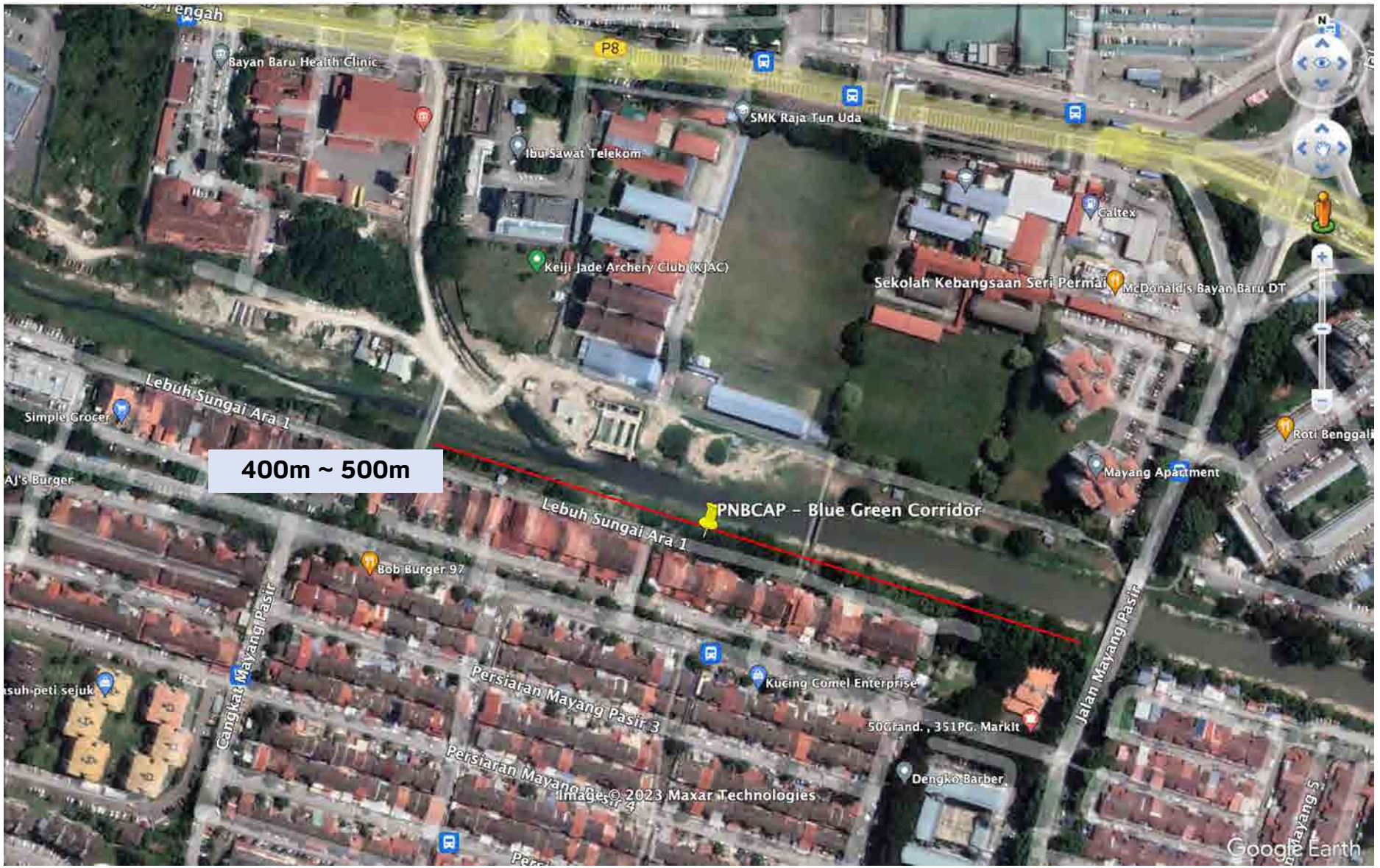
Represent of different occupation of the community

Secondary group

Relevant government officials

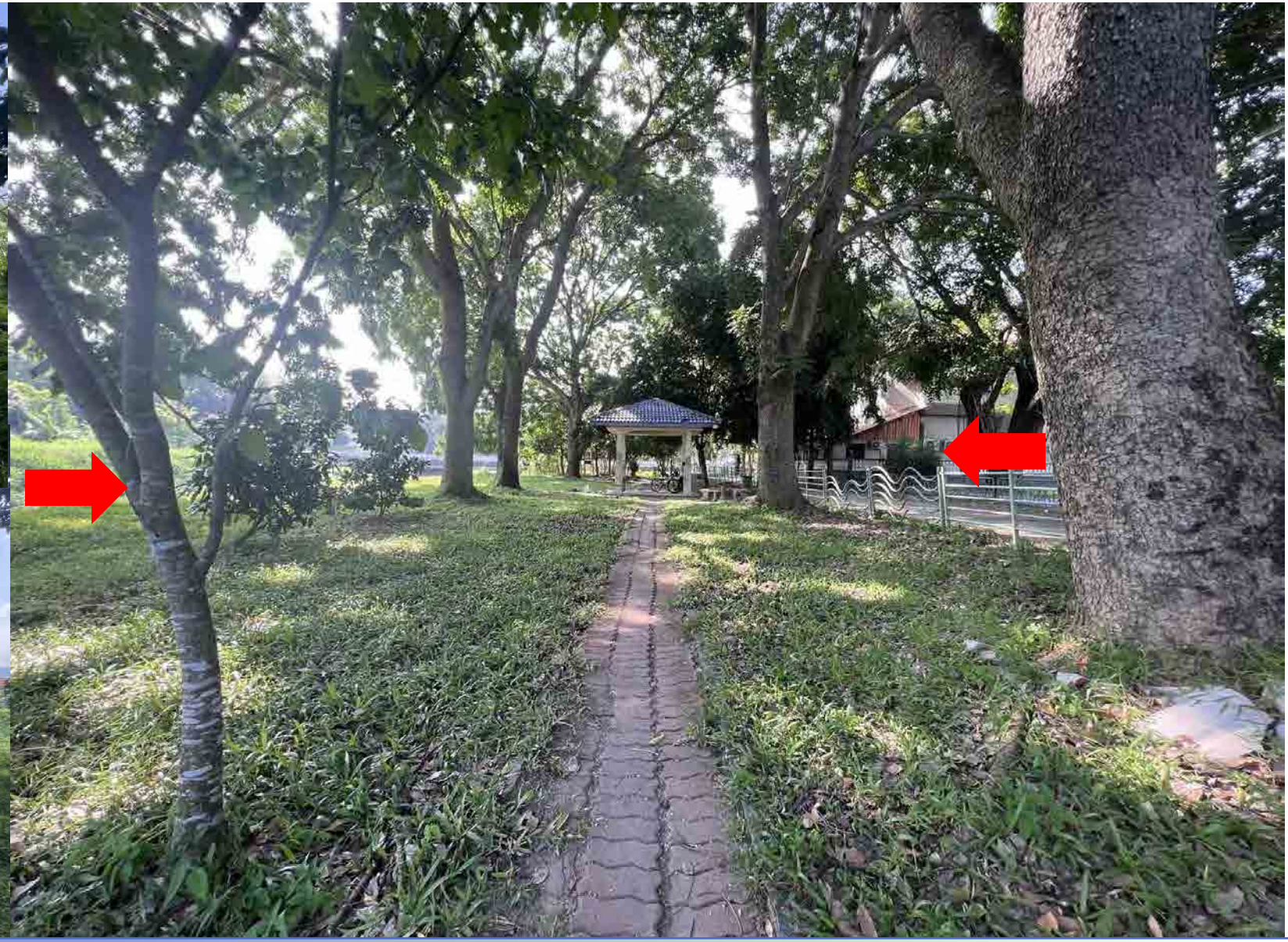
A. BLUE GREEN CORRIDORS – SUNGAI KELUANG

THE PENANG NATURE-BASED CLIMATE ADAPTATION PROGRAMME



A. BLUE GREEN CORRIDORS – SUNGAI KELUANG

THE PENANG NATURE-BASED CLIMATE ADAPTATION PROGRAMME



A. BLUE GREEN CORRIDORS – SUNGAI KELUANG

THE PENANG NATURE-BASED CLIMATE ADAPTATION PROGRAMME

URBAN BIOPHILLIA

The concept & Master Plan

"Biophilia describes the human drive to connect with nature and other living things. Nature's power for humanity can influence our mental health, our hobbies, our travels, and our homes and workplaces."

Gathering area/ Multipurpose area

Grass pathway

Nature canopy foodies

River Trail (Boardwalk)

Sitting area

Permeable parking area

Observation deck

Rattan& wooden archway

Welcoming area

Nature Resting

Glamping deck

Fishing deck

Gathering area/ Observation mound

Bioswale

Nature Resting

Rain Garden/ Dry pond

Green roof shelter & Toilet

Kids play area

Keluang foodies area

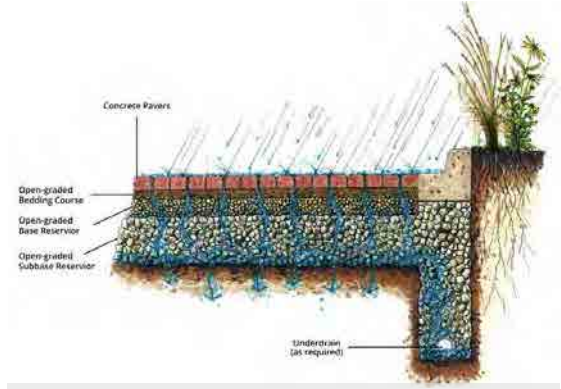
Nature stroll/ sport activities

Urban Farming

A. BLUE GREEN CORRIDORS – SUNGAI KELUANG

URBAN BIOPHILLIA

Permeable Parking area



Permeable pave Driveway

Grass pave

URBAN BIOPHILIA

Plant pallets

Samanea samans/
Hujan Hujan

Cinamomum Inners/
Kayu Manis

Filicium decipiens/
Kiara Payung

Ruellia simplex/
Mexican Petunia

Cyperus papyrus/
Umbrella plant

Typha angustifoilia/
Cattail

Hopea odorata/
Merawan Siput Jantan

Tabebuia spp./
Tabebuaia

Lagerstromia
indica/ Bungor

Loropetalum chinensis/
Chinese Fringe Flower

Alocasia spp./
Keladi Gajah

Hanguana malayana/
Hanguana

Euginia oleana/
Kelat paya

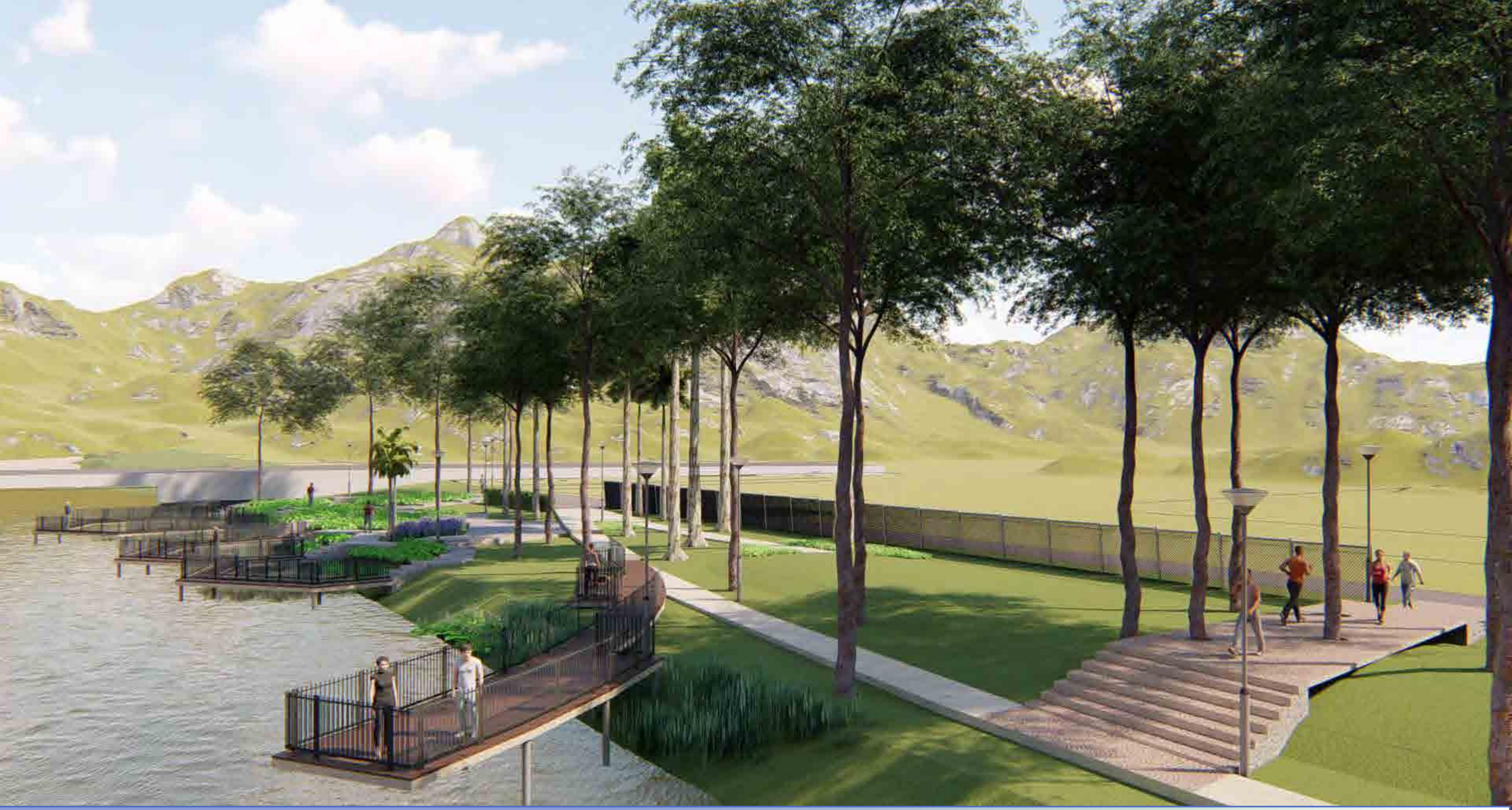
Tabebuia rosea/ Pink
Tabebuaia

Osmoxylon lineare yellow/
Golden Feather leaf

Water Lily

Eichhornia crassipes/
Keladi Bunting


Sungai Keluang



RETENTION POND & SWALE/ INFILTRATION WELLS

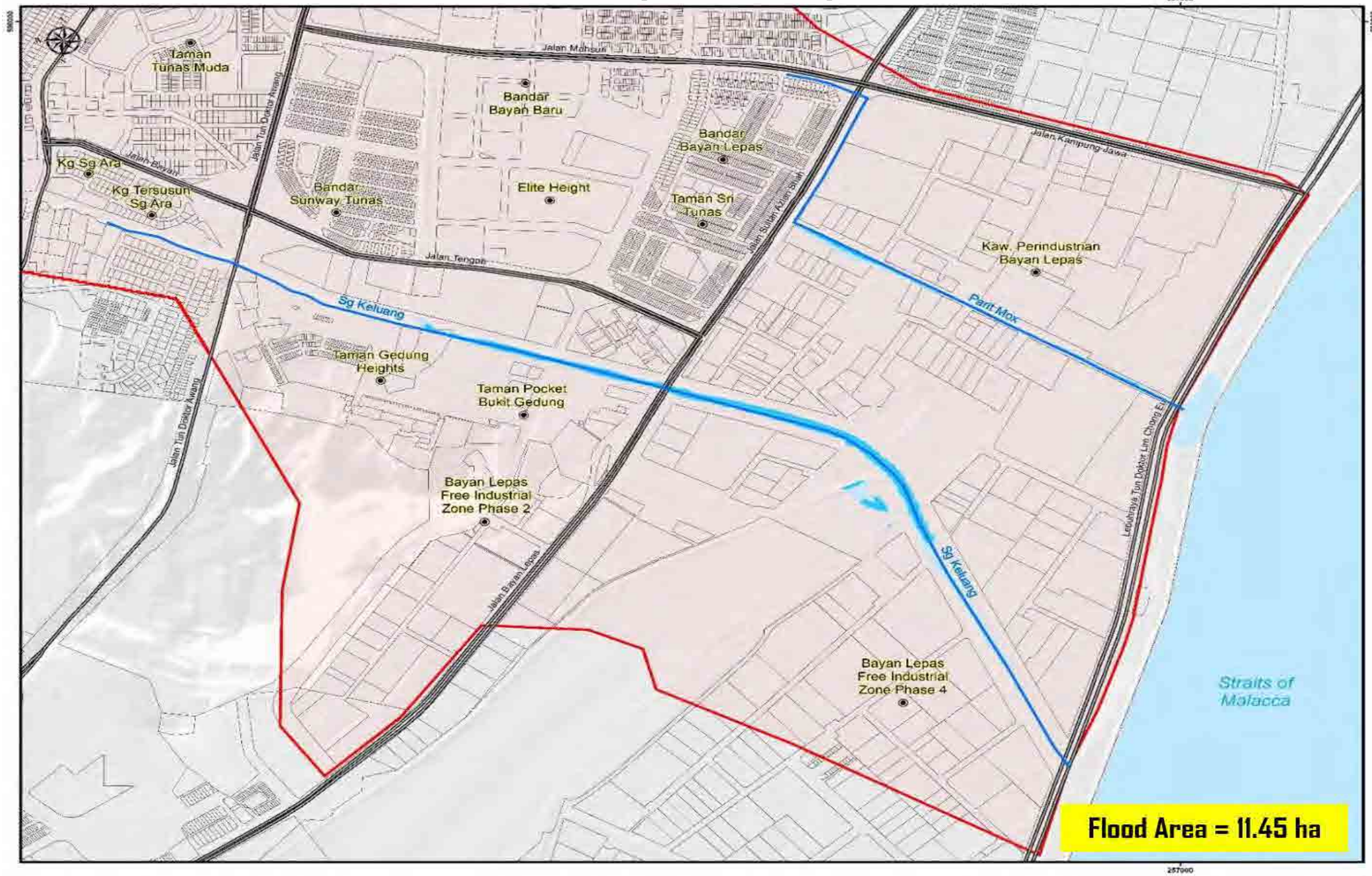
THE PENANG NATURE-BASED CLIMATE ADAPTATION PROGRAMME

RETENTION POND &SWALE/ INFILTRATION WELLS

THE PENANG NATURE-BASED CLIMATE ADAPTATION PROGRAMME

HYDRAULICS MODEL RESULT (BEFORE)

20 ARI



Legend

- Town
- Road Network
- Rivers
- Study Area
- Cadastral Lot
- District Boundary
- State Boundary

Degree of Flood Hazard

- 0m - 0.5m
- 0.5m - 1.2m
- 1.2m - 2.5m
- Above 2.5m

Client:
JABATAN PENGAIRAN DAN SALIRAN NEGERI PULAU PINANG
Jalan Hellang, Paras 5h,
Menara Komtar,
10000, Pulau Pinang

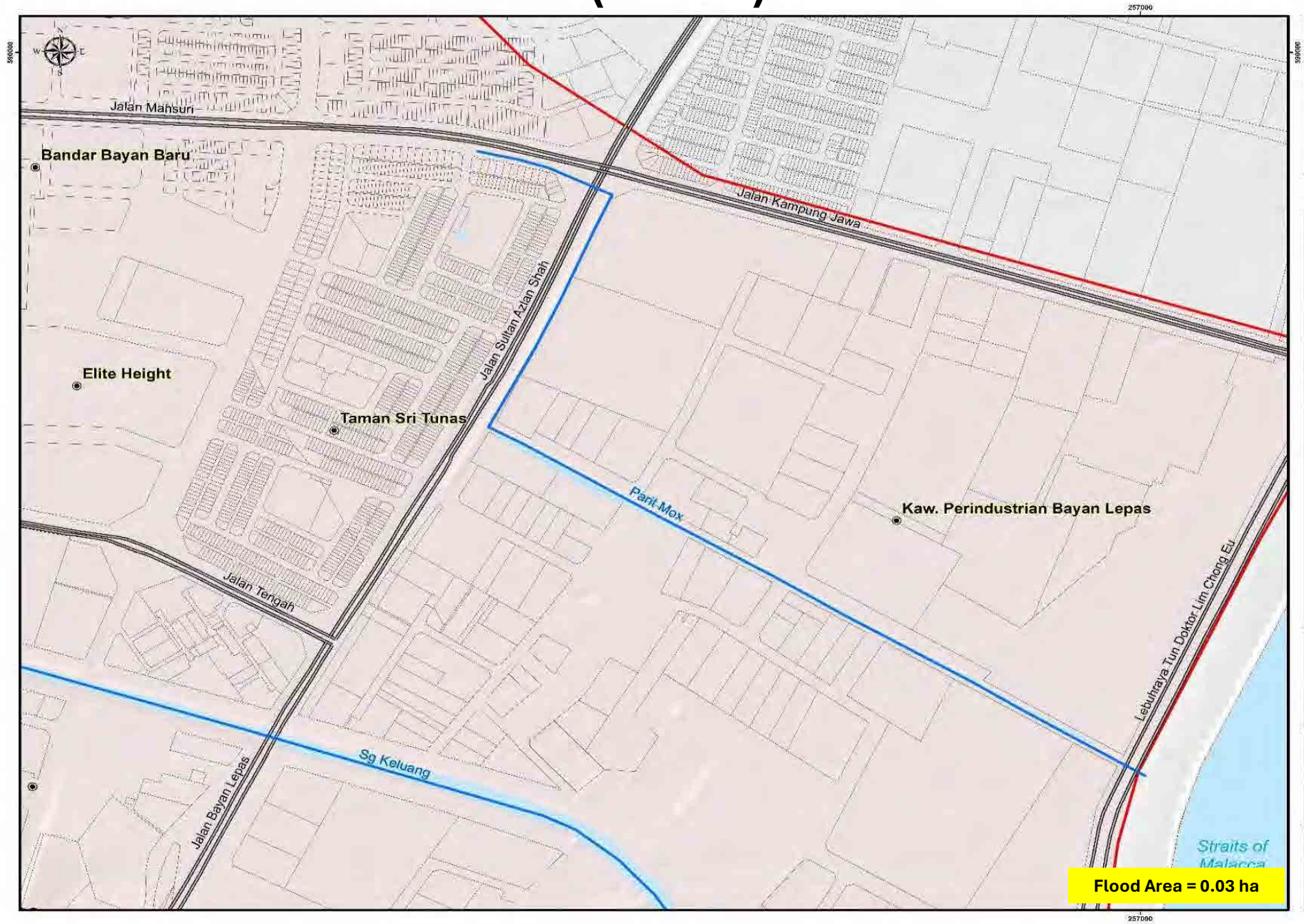
Consultant:
ZHL Engineers Sdn. Bhd.
No 5G1, Jalan Utama Suria Impiana 1
Taman Suria Tropika,
43300 Seri Kembangan,
Selangor Darul Ehsan

REKABENTUK TERPERINCI PROJEK TEBATAN BANJIR DI KAWASAN TADAHAN PARIT MOX, SG KELUANG & KAWASAN SEKITAR, DAERAH BARAT DAYA, PULAU PINANG

Flood Hazard Map (Future Landuse) 20 years ARI

HYDRAULICS MODEL RESULT (AFTER)

20 ARI



0 0.05 0.1 0.2 km

Legend

- Town
- Road Network
- Rivers
- Study Area
- Cadastral Lot
- District Boundary
- State Boundary

Degree of Flood Hazard

- 0m - 0.5m
- 0.5m - 1.2m
- 1.2m - 2.5m
- Above 2.5m

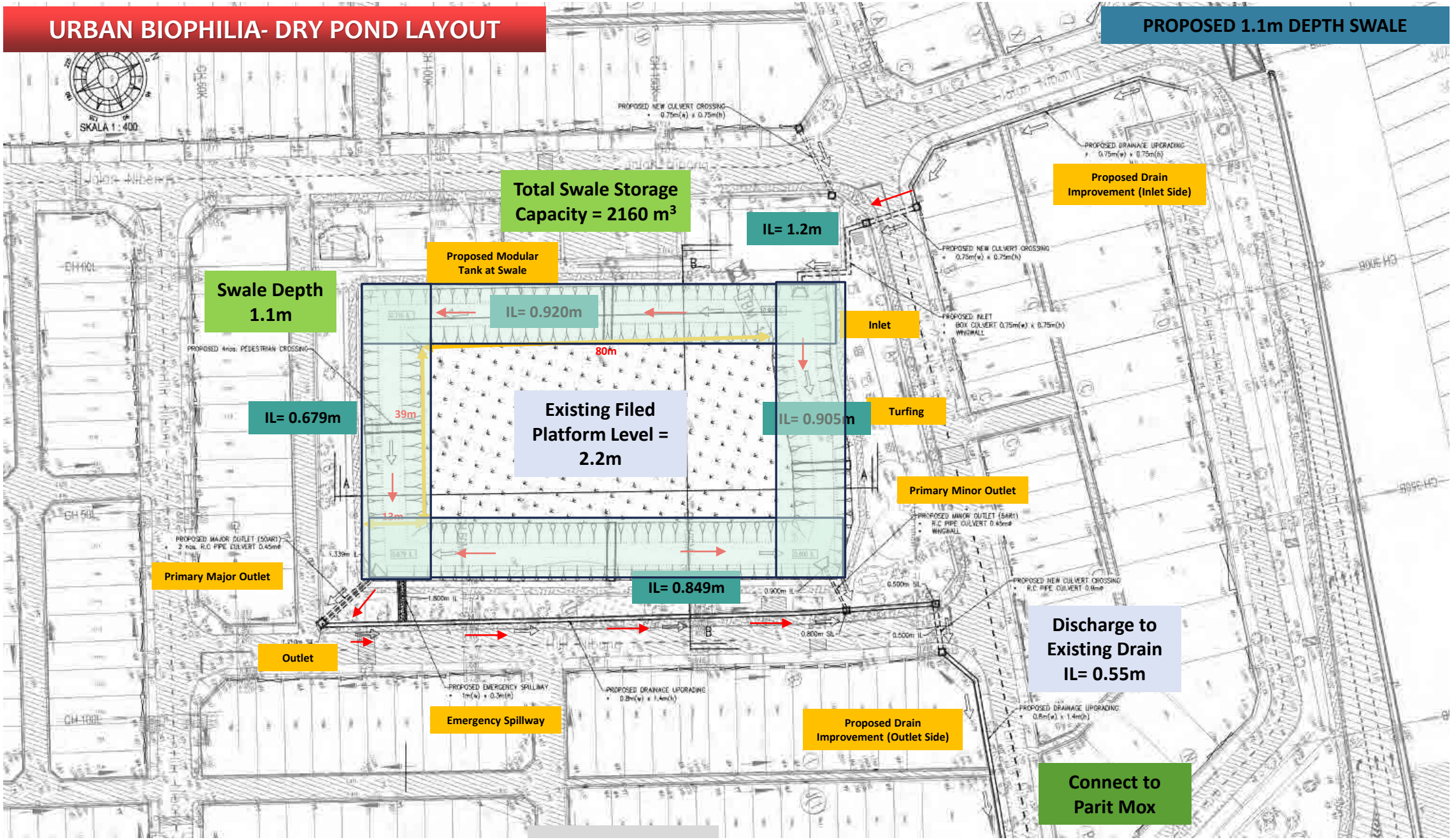
Client:
JABATAN PENGAIRAN DAN SALIRAN NEGERI PULAU PINANG
Jalan Penang, Paras 55,
Menara Komtar,
10000, Pulau Pinang

Consultant:
ZHL Engineers Sdn. Bhd.
No 5G, Jalan Utama Suria Tropika 1,
Taman Suria Tropika,
43300 Seri Kembangan,
Selangor Darul Ehsan.

REKABENTUK TERPERINCI PROJEK TEBATAN BANJIR DI KAWASAN TADAHAN PARIT MOX, SG KELUANG & KAWASAN SEKITAR, DAERAH BARAT DAYA, PULAU PINANG

Flood Hazard Map (After Proposed)
20 years ARI

RETENTION POND & SWALE/ INFILTRATION WELLS

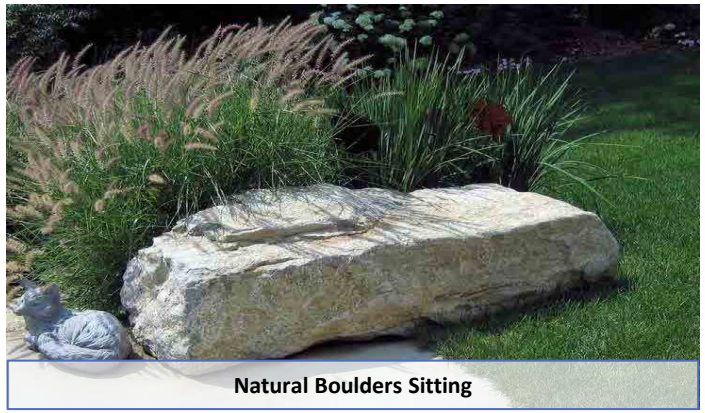


RETENTION POND & SWALE/ INFILTRATION WELLS

URBAN BIOPHILIA- DRY POND

Interlocking Grass Crete Walkway

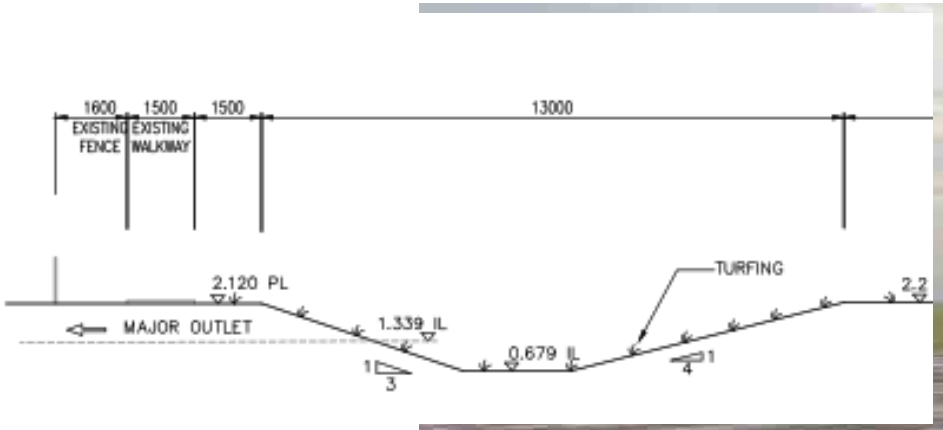
Thrash Bin



Natural Boulders Sitting

Arch Bridge

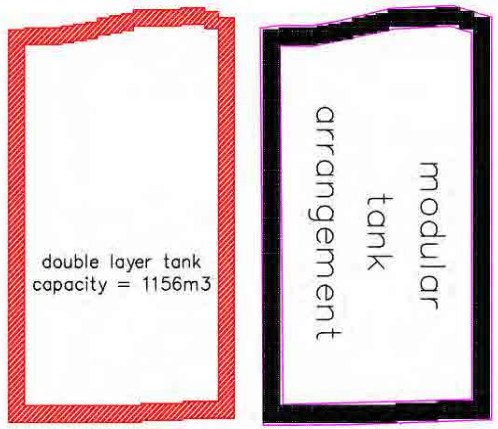
RETENTION POND & SWALE/ INFILTRATION WELLS



3D Perspective- for illustration purposes

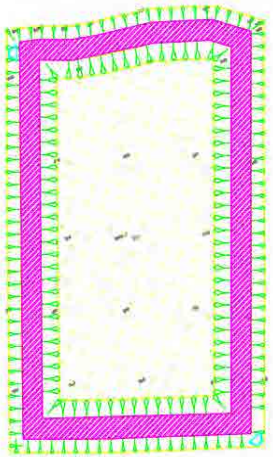
RETENTION POND & SWALE/ INFILTRATION WELLS

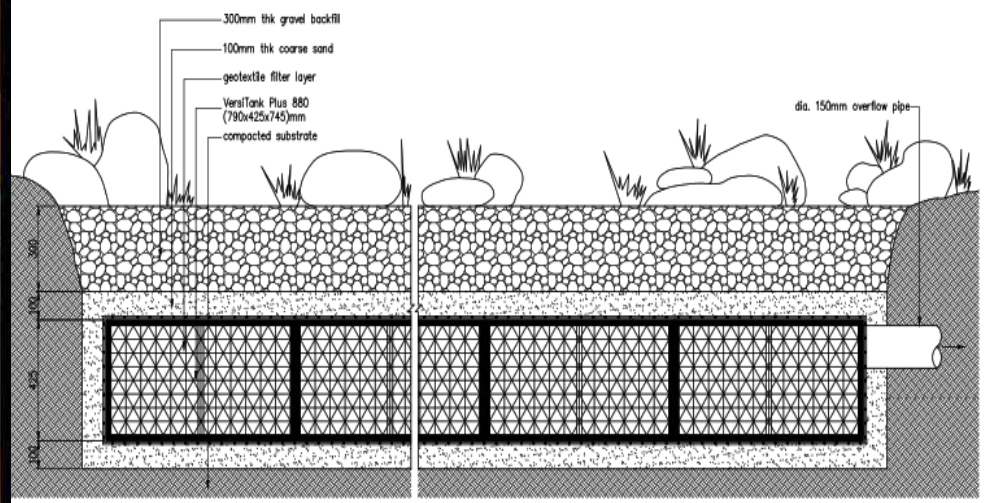
PROPOSED 1.0m DEPTH SWALE



depth 1.28m
water depth 1.00m
freeboard 0.28m

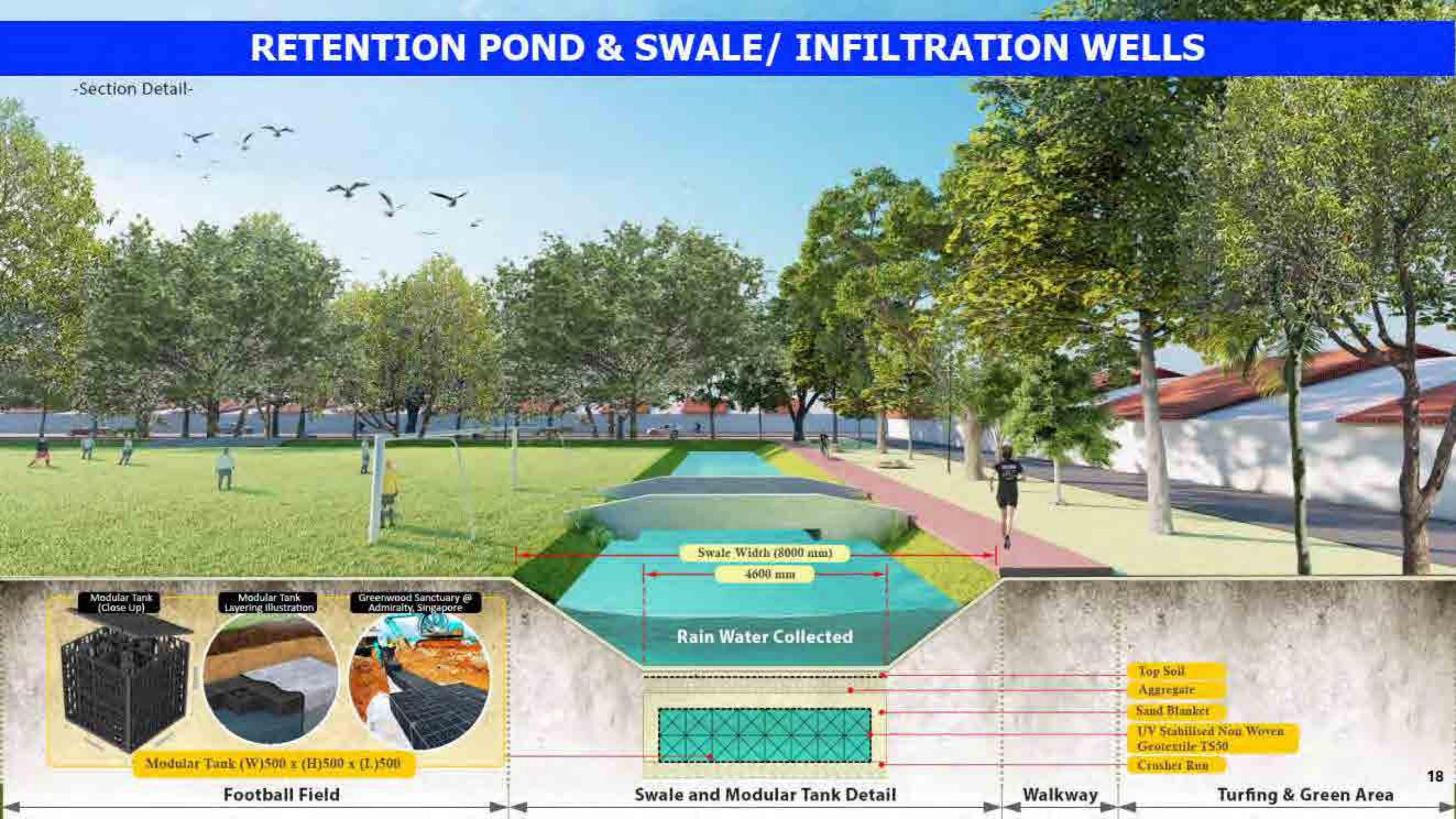
capacity
271.4 x 0.5 x 1 x 4
309.5 x 0.5 x 1 x 3
1454.30
existing capacity = 2461m3





RETENTION POND & SWALE/ INFILTRATION WELLS

-Section Detail-



Ahli Majlis Mesyuarat Kerajaan
Negeri Pulau Pinang
Infrastruktur, Pengangkutan dan Digital

Penang State
Executive Councillor
Infrastructure, Transport and Digital

Ref. No : PSUKPP.MMK.04.900-1/18 (18)
Date : 4th December 2024

Programme Manager
UN-Habitat Regional Office for Asia and the Pacific (ROAP)
8F, ACROS Fukuoka Building, 1-1-1
Tenjin, Chuo-ku, Fukuoka 810-0001
JAPAN.
(cc. PNBCAP Project Manager)

Dear Sir/Madam,

ENDORSEMENT FOR AMENDMENTS IN *COMPONENT 2 BUILT PROJECTS FOR STORMWATER AND FLOOD MANAGEMENT* IN THE "NATURE-BASED CLIMATE ADAPTATION PROGRAMME FOR THE URBAN AREAS OF PENANG ISLAND" (PNBCAP)

In my capacity as the Chair of the Steering Committee for the Penang Nature-Based and Climate Adaptation Programme (PNBCAP), I confirm that the following proposed changes for the abovementioned have gone through careful consideration and attained approval from the Steering Committee during the Steering Committee meetings held on 13 December 2023 and 21 March 2024.

i. Change of project location from Sg Pinang to Sg Keluang and Lintang Nibong; and
ii. Removal of 'upstream' in *Output 2.2. (New upstream retention ponds constructed)* due to the project location being in the midstream.

...2/-

Ref. No : PSUKPP.MMK.04.900-1/18 (18)

Based on the assessments done by the Department of Irrigation and Drainage, Penang State Government, the location change and associated adjustments will result in the same project beneficiaries, outputs, outcomes, and impacts. They will not result in a budget deviation. Community engagement and stakeholder consultations have also been conducted at the proposed project locations, and positive feedback and support from the local communities have been received.

Accordingly, this letter is to endorse the above amendments in *Component 2 Built projects for stormwater and flood management* in the "Nature-based climate adaptation programme for the urban areas of Penang Island" (PNBCAP) on behalf of the PNBCAP Steering Committee.

Sincerely,

(ZAIRIL KHIR JOHARI)
Chair of the Steering Committee for PNBCAP
Executive Counsellor for Infrastructure, Transport and Digital
Penang State Government

PENANG 2030

SOCIAL AND ENVIRONMENTAL & GENDER POLICY COMPLIANCE STUDY FOR PARIT MOX AND SUNGAI KELUANG CATCHMENT, PENANG

REPORT 2024

UN-HABITAT

ADAPTATION FUND

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FOREWORD

This project involves conducting thorough Social and Environmental Impact Assessments (SEIA) along with Gender Impact Assessments (GIA) for the Parit Mox and Sungai Keluang catchment area. The purpose of this study is to ensure that development efforts in the region are in line with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 5 (Gender Equality), SDG 10 (Reducing Inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). The study aims to evaluate the social and environmental effects of development while ensuring policy adherence and the incorporation of gender perspectives into both planning and decision-making. The results of this study will guide responsible and equitable development in the catchment area, balancing advancement with environmental sustainability, and supporting the broader global goal of meeting these SDGs.

SUSTAINABLE AGENDA

Penang Island has embarked on a collective journey to achieve the Sustainable Development Goals (SDGs) with a strong commitment to both people and the environment, ensuring that no one is left behind (Lim et el., 2021). This dedication is demonstrated through the detailed Social and Environmental Impact Assessment (SEIA) and Gender Impact Assessment (GIA) Policy Compliance Study. These frameworks steer Penang's initiatives toward fostering greater inclusivity, safety, resilience, and sustainability, especially in areas vulnerable to disasters such as flood zones. By incorporating these values, Penang Island seeks to create a more just and sustainable future for all its inhabitants, tackling both social and environmental challenges while advancing gender equality.

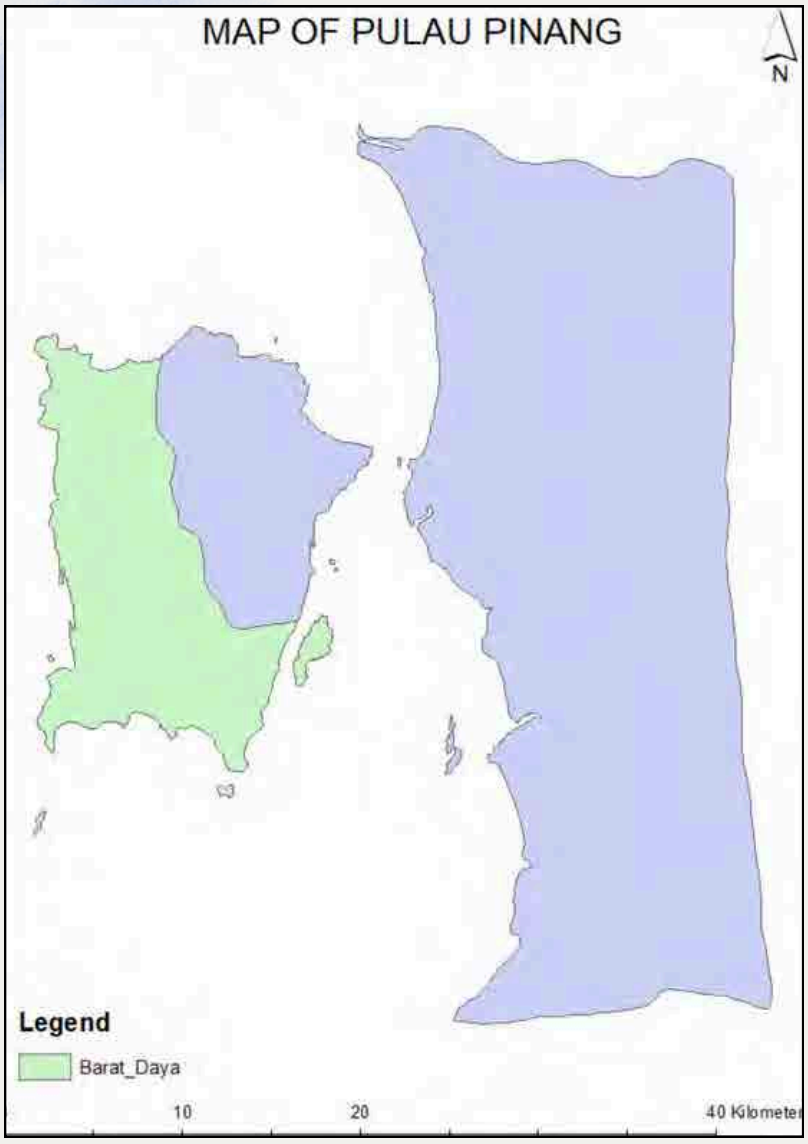
EXECUTIVE SUMMARY

The 2030 Development Agenda, introduced at the United Nations Sustainable Development Summit on September 25, 2015, outlines 17 Sustainable Development Goals (SDGs), accompanied by 169 targets and 232 indicators, providing a global framework for progress by 2030. In support of this initiative, the Department of Irrigation and Drainage Penang (JPS) has undertaken an evaluation to explore how these SDGs can be applied at the municipal level, ensuring their integration into the city's sustainable development strategies and urban planning. As part of this commitment, JPS intends to publish the "Sustainable Development Goals - Penang Island Voluntary Local Review," which will monitor and promote the city's advancement toward meeting the SDGs. Adhering to the guiding principle of "Think Globally, Act Locally – Leaving No One Behind," JPS is focused on addressing the specific needs of the local community while ensuring inclusivity. By fostering engagement and adopting a participatory approach, the department aims to facilitate the successful implementation of the SDGs within the local context.

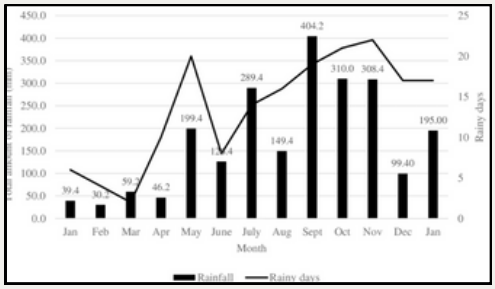
VISION AND MISSION

Penang, guided by the vision of the Department of Irrigation and Drainage Penang (JPS), is committed to fostering an intelligent, livable, and sustainable environment. JPS's mission focuses on managing water resources and providing efficient drainage systems to improve quality of life while protecting the environment. Through competitive and sustainable projects, JPS aims to combat climate change and safeguard Penang's natural resources. Technology plays a key role in transforming Penang into a smart state, enhancing urban planning and development. As a global region, Penang must embrace inclusive design that supports cultural diversity. JPS also leads environmental protection and climate adaptation efforts, reducing temperatures and protecting residents from climate impacts. By adopting nature-based solutions, JPS seeks to balance economic growth with environmental preservation. Its strategic roadmap envisions a world-class ecosystem centered on smart economic development and sustainability, achieved through collaboration with stakeholders, the private sector, and intergovernmental agencies.

STUDY AREA



FLOOD EVENT IN BAYAN BARU (2ND SEPTEMBER 2016)



Graph above shows total monthly rainfall and rainy days in Bayan Lepas, Penang from January 2016 to January 2017 (Source: Department of Meteorological Malaysia)

Urban resilience in Bayan Baru, Penang, is crucial in addressing the area's vulnerability to environmental challenges such as tidal forces, urban heat islands (UHI), floods, droughts, and water and air quality issues. Tidal fluctuations, especially during monsoon seasons, can lead to severe flooding and coastal erosion, threatening infrastructure and exacerbating the impact of rising sea levels. The UHI effect, caused by dense urban development and human activities, results in higher temperatures, which strain energy resources and contribute to health issues. Flooding remains a significant concern due to poor drainage and rapid urbanization, leading to frequent flash floods that disrupt daily life and economic activities. Conversely, droughts can lead to water shortages, stressing the area's water supply and affecting both residents and agriculture. Additionally, water quality is often compromised by pollution from industrial and agricultural sources, while air quality suffers from traffic and industrial emissions, posing health risks to the population. To enhance Bayan Baru's resilience, there is a need for improved infrastructure, sustainable urban planning, natural defenses, and robust disaster response systems.

INTRODUCTION

The "Social and Environmental & Gender Policy Compliance Study for Parit Mox and Sungai Keluang Catchment, Penang" is an essential initiative aimed at addressing the intricate challenges faced by the region, particularly within the context of George Town and Bayan Baru. As Penang grows and urbanizes, it is increasingly vulnerable to environmental pressures and socio-economic disparities. This study seeks to evaluate these challenges by conducting comprehensive surveys with residents, businesses, and stakeholders in Bayan Baru, capturing a wide range of data to understand the underlying issues. The primary objective is to develop targeted resilience strategies that address these environmental challenges while integrating feedback from the local population. By doing so, the study aims to create sustainable solutions that are effective and reflect the community's needs.

Beyond environmental and socio-economic concerns, this study also emphasizes the critical importance of gender equality in developing and implementing these resilience strategies. Recognizing that different gender groups experience and respond to environmental and socio-economic challenges in varied ways, the study ensures that all voices are heard and considered. This gender-sensitive approach is essential for fairness and inclusivity and for enhancing the proposed solutions' overall effectiveness. Additionally, the study promotes collaboration among government agencies, businesses, and local communities, fostering a united effort in implementing nature-based solutions and disaster preparedness initiatives. Aligning with the Sustainable Development Goals (SDGs), this study serves as a comprehensive framework for ensuring that Penang's growth is inclusive, resilient, and sustainable for all its inhabitants.

OVERVIEW OF PNBCAP

The PNBCAP takes on a comprehensive and collaborative approach, incorporating a diverse set of components addressing both the environmental and social dimensions of climate change in Penang's urban fabric. The programme is a pilot initiative that will serve as a municipal framework for climate adaptation with the potential for it to be scaled and adapted in other cities in Malaysia and elsewhere in the region.

OBJECTIVES OF THE REPORT

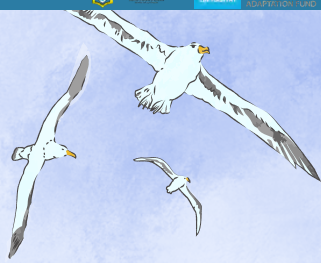
1. To evaluate the environmental and socio-economic challenges affecting George Town, Penang, with a particular focus on data collected from surveys conducted with residents, businesses, and stakeholders in Bayan Baru.

2. To develop resilience strategies that address the environmental challenges identified in Bayan Baru, incorporating feedback and data from the local population, businesses, and stakeholders.

3. To promote collaborative efforts among government agencies, businesses, and local communities in Bayan Baru for the implementation of nature-based solutions and disaster preparedness initiatives.

BACKGROUND OF PNBCAP

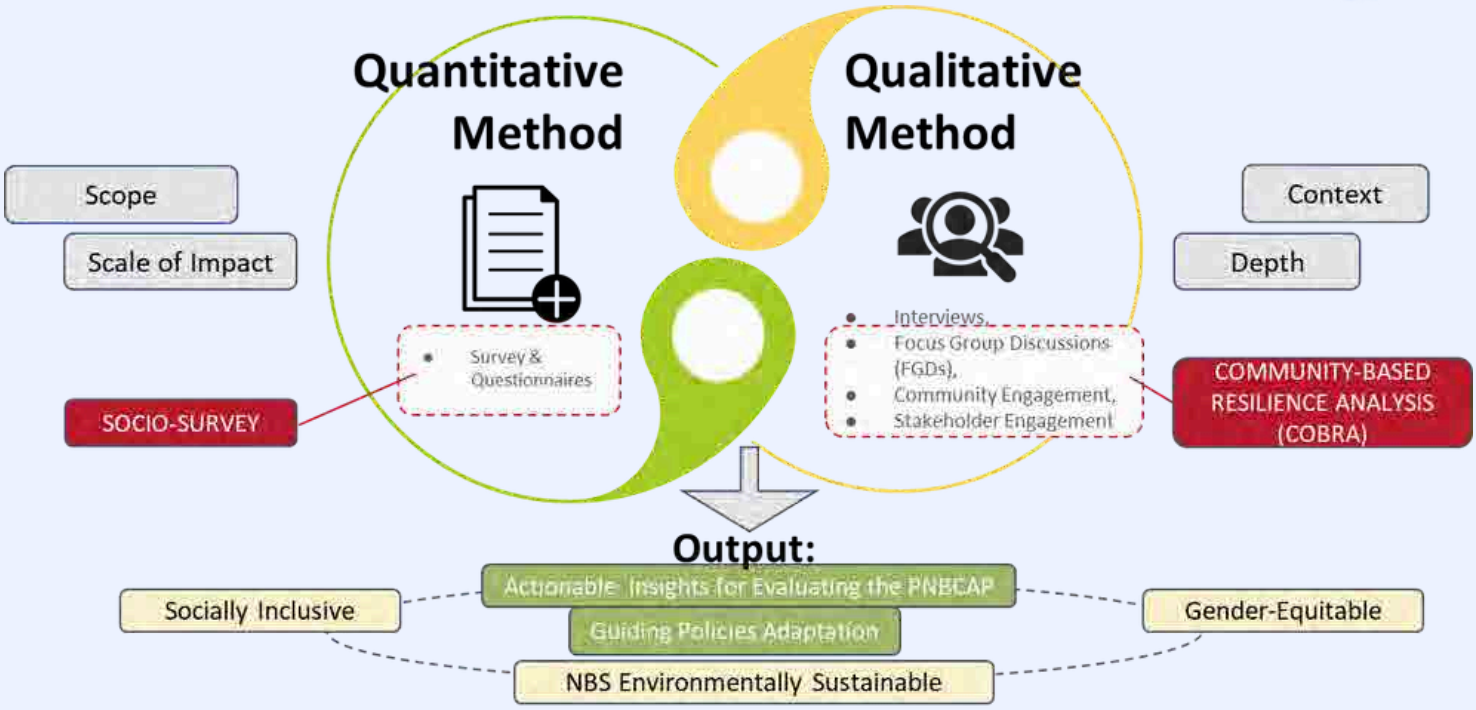
The Penang Nature-Based Climate Adaptation Programme (PNBCAP) is focused on enhancing Penang's resilience to climate change through nature-based solutions. It emphasizes sustainable urban development, ecosystem restoration, and collaboration with local communities and stakeholders to address climate challenges like flooding and coastal protection.



PURPOSE
OF THE SOCIAL & GENDER IMPACT ASSESSMENT

Gender Impact Assessment (GIA) evaluates the potential effects of a project, policy, or program on different genders. It aims to identify and address gender disparities, promote equality, and ensure that the benefits and burdens of development are distributed equitably, contributing to more inclusive and effective outcomes. Conducting SEIA and GIA is crucial for Penang Nature Based Climate Adaptation Program (PNBCAP), not only comply with regulatory requirements but also contribute to sustainable and inclusive development. These assessments help in understanding and mitigating the social, environmental, and gender-specific impacts of this project, leading to better outcomes for communities, the environment, and overall project success. SEIA and GIA outputs aim to provide actionable insights for evaluating the PNBCAP project and guiding policy adaptation in Penang, ensuring a socially inclusive, gender-equitable, and environmentally sustainable approach.

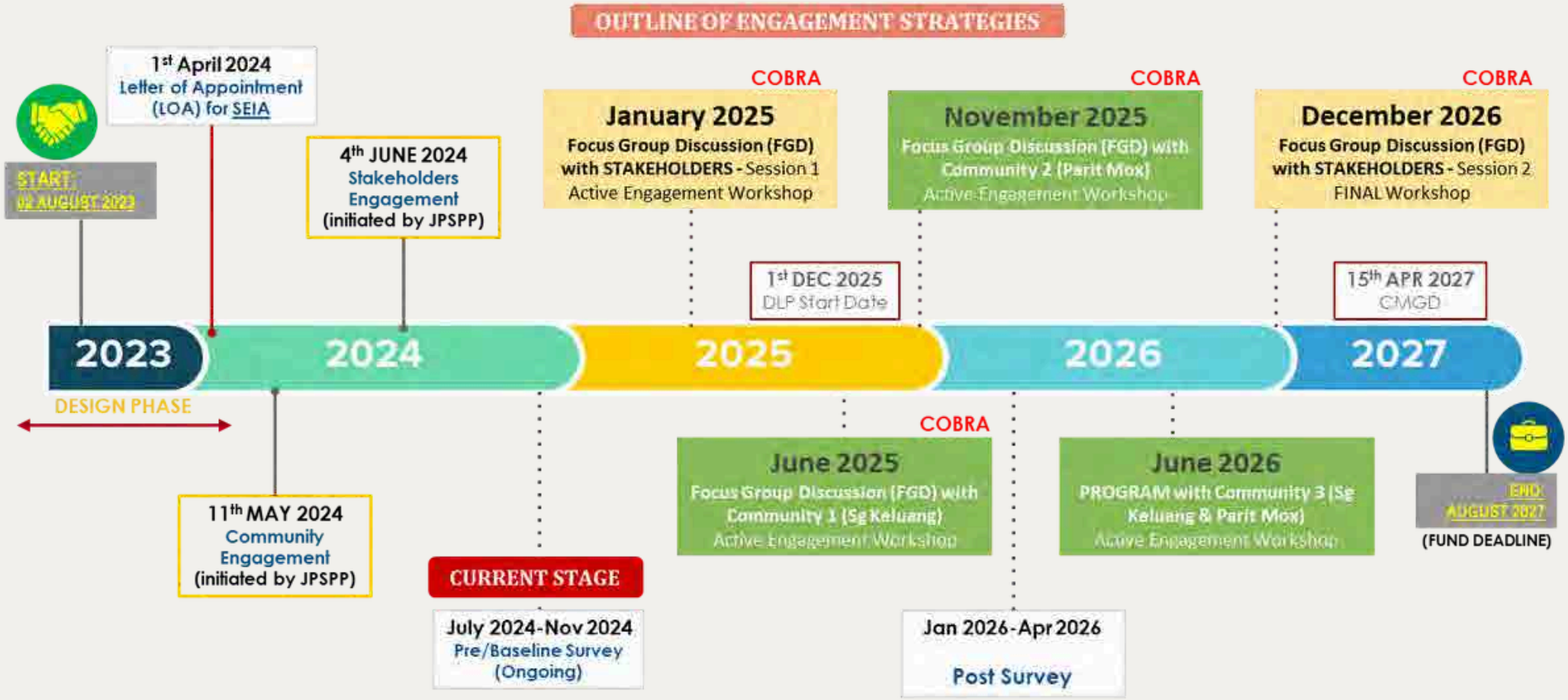
METHODOLOGY & APPROACH



The methodology presented integrates both quantitative and qualitative approaches to assess the impacts of specific interventions or policies, likely within the framework of Social, Environmental, and Gender Impact Assessments (SEIA & GIA). The quantitative method involves the use of surveys and questionnaires to measure variables and assess the scale of impact across different areas or groups. This data is gathered through socio-surveys, providing measurable and statistically analyzable information. On the other hand, the qualitative method employs interviews, focus group discussions (FGDs), and community and stakeholder engagement to delve deeper into the context and underlying factors influencing the study subjects. This approach, often termed Community-Based Resilience Analysis (COBRA), focuses on understanding community resilience and gathering rich, in-depth qualitative data. The combination of these methods aims to produce actionable insights that can guide the evaluation of the PNBACAP, ensuring that policies are adapted in ways that are socially inclusive, gender-equitable, and environmentally sustainable.

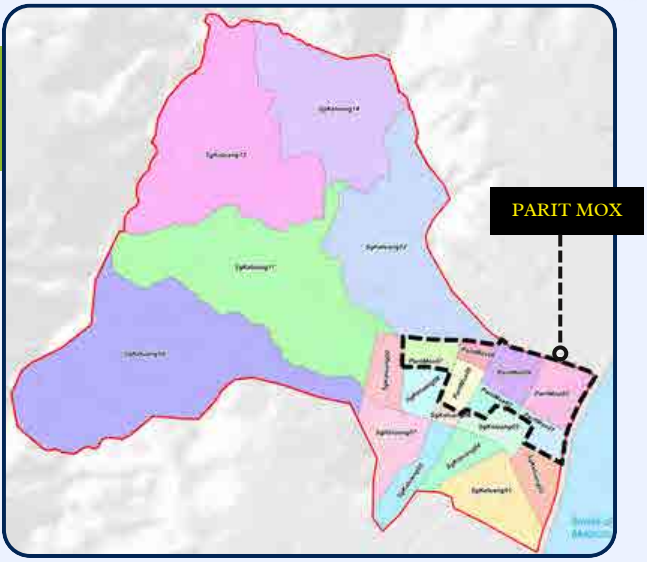
PROJECT OVERVIEW

Proposed Programme with Community and Stakeholder Engagement



DESCRIPTION OF THE PROJECT AREA (PARIT MOX, SUNGAI KELUANG, AND SURROUNDING AREAS)

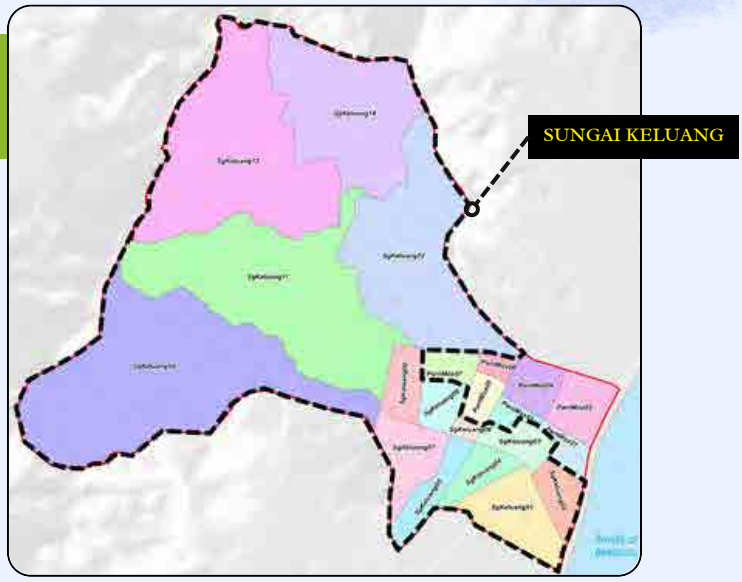
PARIT MOX



- 1.85km stone pitching lined channel that runs through the center part of Free Trade Zone (FTZ) Phase 3
- Originates from the road junction of Jalan Kampung Jawa to Jalan Sultan Azlan Shah
- Flows in the east direction before finally discharging into the Strait of Penang

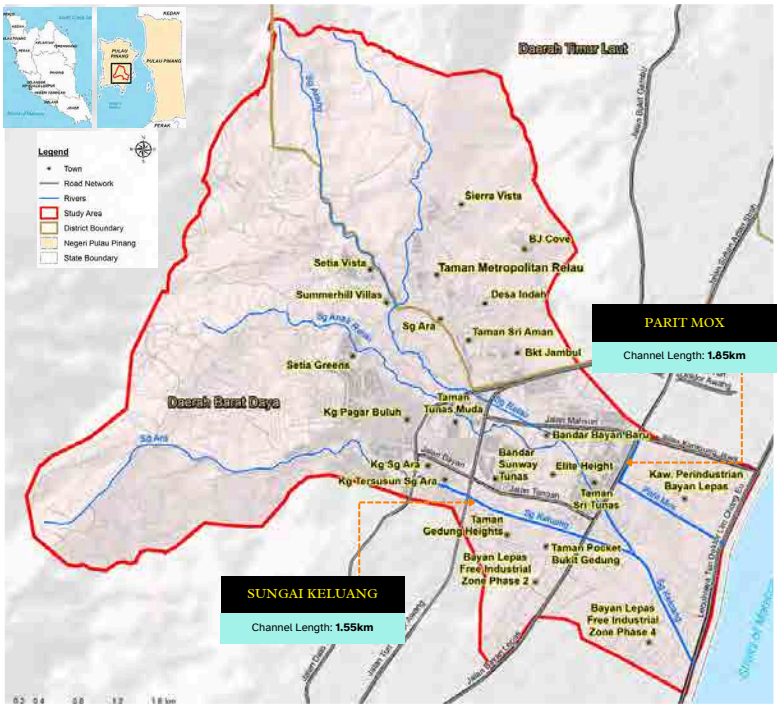
DESCRIPTION OF THE PROJECT AREA (PARIT MOX, SUNGAI KELUANG, AND SURROUNDING AREAS)

SUNGAI KELUANG



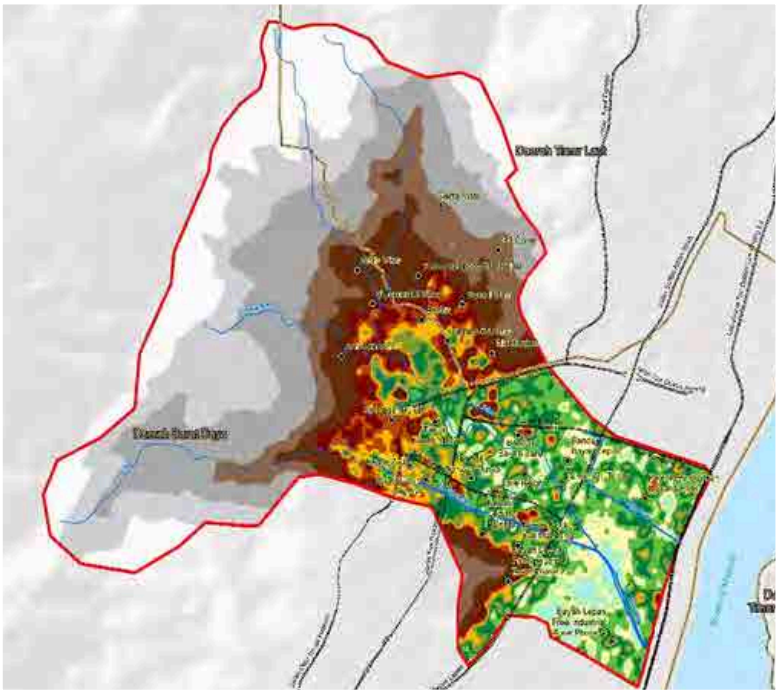
- One of the catchment areas in Bayan Baru
- Earth-channel waterway is about 1.55km in length and runs through the FTZ Phase 3
- Middle stream and downstream of the river flow through the boundary area of FTZ Phase 3 and FTZ Phase 4 before it crosses under Lebuhraya Tun Dr. Lim Chong Eu and discharges into the Strait of Penang

DESCRIPTION OF THE PROJECT AREA (PARIT MOX, SUNGAI KELUANG, AND SURROUNDING AREAS)



River System

- The main river Sungai Keluang with major tributaries being Sungai Ara and Sungai Relau.
- Sungai Ara and Sungai Relau flow in an eastward direction and discharge to the Penang Strait.



Topography

- Average elevation of approximately 15m
- Relatively flat with areas of higher altitude primarily located in the center of the island

SCOPE OF PNBCAP

1. Determine the impact zones at the surrounding area of PNBCAP's project

2. Design the survey questionnaire and reports to include:

   - Social environmental background and impact on PNBCAP's project
   - ESP Risk and Compliance Management (to refer UN-Habitat Template)
   - Gender Policy Compliance (to refer UN-Habitat Template)

3. Conduct Socio-environmental survey (>2,000 Samples)

4. Data Input;

5. Statistical data analysis to determine the effectiveness of PNBCAP"s project measures from the social environmental perspective

6. Study and determine the social impact of the environment (including the difference in temperature before and after the surrounding area and the temperature of the river water)

7. Prepare the social environmental report for DID level and UN-Habitat level on the effectiveness of PNBCAP's project (including the effectiveness of Nature-Based Solutions approach (NBs).

URBAN GREENING

STORMWATER MANAGEMENT

COMPONENTS OF PNBCAP

SOCIAL RESILIENCE

INSTITUTIONAL CAPACITY

URBAN GREENING

This component focuses on reducing the impacts of increasing temperatures by introducing green elements which help in the overall reduction of urban heat island effect and urban temperatures.

Existing Conditions

Urban Heat Island Effect

Warming areas within the George Town World Heritage Site and Bayan Lepas due to increased hard surfaces of built forms and bitumen roads.

Mean Temperature

Significant increase of 1.5°C in the mean temperature in Bayan Lepas between 1951 – 2018.
(Source: https://www.wunderground.com/history/daily/my/bayan-lepas/)

Surface temperatures

Sharp increase in maximum and minimum surface temperatures of 8.7 °C and 2.4 °C respectively between 1988 and 2019 in George Town.
(Source: https://thinkcity.com.my/)

Open spaces and recreational areas

Deficit of 1,203 hectares of green and open space in Penang Island. (based on population figures for 2017 and the national standard of 20m2 per capita)

Shading

Inadequate shading along the streets of George Town and Bayan Lepas

STORMWATER MANAGEMENT

Responding to the increasing rainfall and frequency of flooding events in Penang Island, the programme also sets out a comprehensive nature-based approach to stormwater management.

Blue-Green Corridors

The association of green spaces with rivers is essential as it allows for stormwater infiltration to the groundwater table through increased water retention capacity. This approach calls for rivers to be kept free from hard materials and its margins modelled in different levels /platforms to constrain and regulate the water path, protecting neighbouring urbanised areas.

Swales & Infiltration wells

Swales are vegetated open drains that collect stormwater whilst allowing for its infiltration to the groundwater table along its full extension. This approach reduces the accumulation of stormwater downstream, which in the case of heavy rainfall often leads to flooding. Infiltration wells are solutions used for heavily urbanised areas as they provide stormwater retention and fast infiltration to the groundwater table using several deep layers of aggregates of different dimensions.

Upstream retention ponds

Upstream retention ponds are areas used to retain stormwater and facilitate the process of infiltration into the groundwater table to avoid stormwater runoff to downstream areas. This approach is particularly crucial in Penang whereby the existing drainage system is threatened by high tides and storm surges.

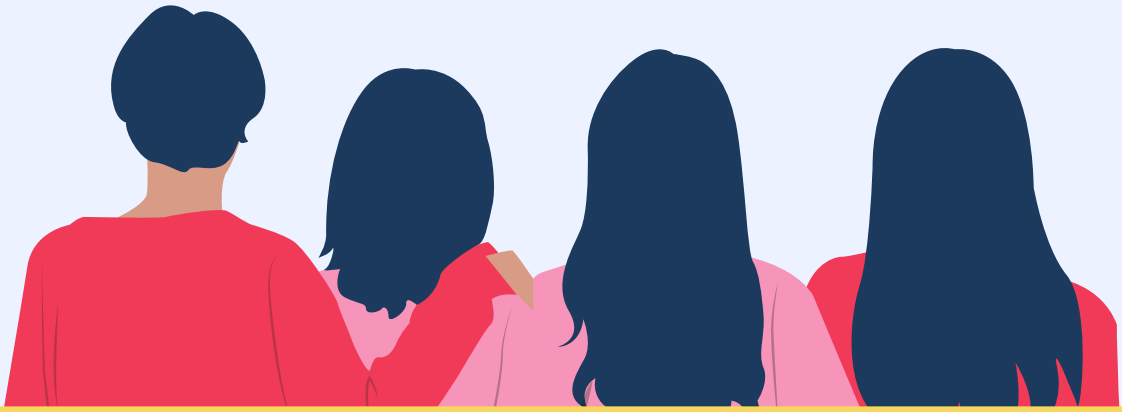
SOCIAL RESILIENCE

The social resilience component has a strong community-focused approach, engaging with the most vulnerable groups of society in order to assess vulnerabilities in a collaborative effort. Vulnerability assessments and targeted action plans for the communities of George Town and Bayan Lepas will be initiated in the early phase of the programme, laying the groundwork for enhancing climate change resilience.

The social resilience component comprises 2 specific programmes, which are the women and girls programme and the youth and schools programme.

A. Women and Girls Programme

The women and girls programme aims to reduce gender vulnerability asymmetry and strengthen capacity within existing agencies. It is structured around 4 sub-components which direct the flow of the programme.



B. Youth and Schools Programme

The youth and schools programme is focused on educating youth on climate change risks & mitigation strategies.

INSTITUTIONAL CAPACITY

As the programme will pioneer the use of nature based solutions in Malaysia, it is crucial that it includes a strong knowledge codification component. Institutional capacity will be built through a knowledge management platform, the creation of the Penang Climate Board and a public health programme.

KNOWLEDGE MANAGEMENT PLATFORM

Database Set-up
Create a database of the programme's scientific and technical framework

Monitoring
Collate and evaluate the results on the database

Dissemination
Create a website for collecting all programme's methodologies, assessments a
information for dissemination to other cities

PENANG CLIMATE BOARD

A unit to be integrated within MBPP's structure

- Climate-perspective coordinated approach
- Climate centralized policy at local level

Coordination
A coordinated response to climate-related risks is prioritised through the development of an operational framework

Policy Integration
A standard proceeding is developed, centralising all issues and responses related to climate change

STAKEHOLDERS INVOLVED

JABATAN PENGAIRAN DAN SALIRAN NEGERI PULAU PINANG

UN-HABITAT

ADAPTATION FUND

BERSATU DAN SETIA

BAHAGIAN PERANCANG EKONOMI NEGERI (BPEN)

MAJLIS BANDARAYA PULAU PINANG

BKSA

thinkCITY
REJUVENATING THE CITY TOGETHER

Penang Green Council

JKR PULAU PINANG

TENAGA NASIONAL

IndahWater

PWDC
Penang Women's Development Corporation

PBA
Perbadanan Bekalan Air Pulau Pinang Sdn Bhd

ZHL ENGINEERS SDN BHD

maxis

TM

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BASELINE CONDITIONS

SOCIAL ENVIRONMENT

The social environment in Barat Daya, Pulau Pinang, is characterized by a diverse community that faces unique challenges due to its geographical and socio-economic conditions. The region is particularly vulnerable to extreme weather events such as floods and heatwaves, which disproportionately affect its most vulnerable populations, including the poor, elderly, young, and disabled. These events exacerbate existing social issues, such as poverty, food insecurity, and inadequate access to essential services.

Flooding in Barat Daya often leads to significant damage to infrastructure, resulting in long-term displacement and loss of property for many residents. The physical and mental health of the community is also impacted by prolonged heat stress, which can lead to an increase in heat-related illnesses and mental health issues such as anxiety and depression.

Despite these challenges, efforts are being made to enhance the community's resilience through targeted interventions, such as improving infrastructure, strengthening community networks, and providing better access to health and social services. By addressing these social vulnerabilities, Barat Daya can better withstand and recover from the adverse effects of extreme weather events, leading to a more resilient and sustainable future for its residents.

DEMOGRAPHICS

Name	Status	Population Census 2000-07-05	Population Census 2010-07-06	Population Census 2020-07-07	Population Estimate 2023-07-01
Barat Daya [Southwest Penang]	District	169,442	202,142	237,738	244,000

Barat Daya [Southwest Penang]

244,000 Population [2023] – *Estimate*

173.0 km² Area

1,410/km² Population Density [2023]

0.88% Annual Population Change [2020 → 2023]

South-West Penang Island: district of Malaysia in Penang

Malaysia	Federation	23,274,690	28,334,135	32,447,385	33,379,500			

(Source: https://www.wunderground.com/history/daily/my/bayan-lepas/)

Barat Daya, or Southwest Penang, is a district with an estimated population of 244,000 as of 2023. Covering an area of 173.0 square kilometers, it has a population density of approximately 1,410 people per square kilometer. The district has experienced a modest annual population growth rate of 0.88% from 2020 to 2023.

The population here is a blend of different ethnic groups, including Malays, Chinese, and Indians, reflecting the multicultural fabric of Penang as a whole. The area is home to a mix of urban and rural communities, with some parts more developed and others maintaining a more traditional, village-like atmosphere.

Regarding age distribution, Barat Daya has a reasonably balanced population, with many families, young adults, and elderly residents. The district has a mix of income levels. Still, it's important to note that some communities face economic challenges, particularly in rural areas where opportunities for high-income jobs are more limited.

The area also has a growing population due to urbanization, with new housing developments attracting people from other parts of Penang and beyond. This influx has increased demand for infrastructure, services, and amenities, creating opportunities and challenges for the district. Education and healthcare services are available, but access can vary depending on where people live within the district. Overall, Barat Daya is a dynamic area with a rich cultural heritage, but like many places, it faces the task of balancing development with the needs of its diverse population.

LIVELIHOODS AND ECONOMIC ACTIVITIES

Barat Daya's economy is a blend of traditional and modern activities. Agriculture remains a key livelihood, with many engaged in small-scale farming, fishing, and livestock rearing. The district also hosts small manufacturing units, particularly food processing and electronics. Tourism is vital, capitalizing on the area's natural beauty and cultural heritage through homestays and eco-tourism initiatives. The service sector is growing, with local markets, retail, education, and healthcare providing jobs. Construction is booming due to ongoing housing developments and infrastructure projects. Additionally, the informal sector thrives with street vendors, small businesses, and craftspeople contributing to the local economy.

Sector	Economic Activities
Agriculture	Small-scale farming, fishing, livestock rearing
Manufacturing	Small industries, food processing, electronics
Tourism	Homestays, cultural tourism, eco-tourism
Services	Retail, education, healthcare, local markets
Construction	Housing development infrastructure projects
Informal Sector	Street vending, small businesses, crafts

SOCIAL INFRASTRUCTURE AND SERVICES

SECTOR	INFRASTRUCTURE AND SERVICES
Education	Primary and secondary schools, vocational training centers
Healthcare	Clinics, health centers, pharmacies
Transportation	Local bus services, taxis, road networks
Housing	Public housing, private developments, traditional homes
Public Utilities	Water supply, electricity, waste management
Community Services	Community centers, places of worship, recreational facilities

Barat Daya, Pulau Pinang, is supported by a range of social infrastructure and services that cater to the needs of its diverse population. The district has several primary and secondary schools, along with vocational training centers that provide educational opportunities. Healthcare is accessible through clinics, health centers, and pharmacies scattered across the region. Transportation options include local buses, taxis, and a network of roads connecting different parts of the district. Housing varies from public housing projects and private developments to traditional homes. Public utilities such as water supply, electricity, and waste management are in place, though their quality and availability may vary in different areas. Community services like centers, places of worship, and recreational facilities play a crucial role in fostering social cohesion and providing spaces for communal activities.

GENDER DYNAMICS

Aspect	Gender Dynamics
Employment	**Men** predominantly in manufacturing and construction; women in services, retail, and agriculture
Education	**Equal** access to primary and secondary education; fewer women in higher education and vocational training
Household Roles	**Traditional gender roles**; women often responsible for domestic duties and caregiving
Community Participation	**Men** more involved in formal decision-making; women active in community-based organizations
Healthcare Access	**Women** generally have better access to healthcare services, especially maternal health
Income Disparity	**Gender wage gap** exists, with men generally earning more than women

In Barat Daya, Pulau Pinang, gender dynamics reflect a mix of traditional roles and evolving opportunities. Men are predominantly employed in sectors like manufacturing and construction, while women are more active in services, retail, and agriculture. Educational opportunities are relatively equal at the primary and secondary levels, but women are underrepresented in higher education and vocational training. Traditional gender roles persist, with women often managing household duties and caregiving. In community life, men typically dominate formal decision-making processes, though women are increasingly active in community-based organizations. Women generally have better access to healthcare, particularly in maternal health services, yet a gender wage gap remains, with men typically earning more than women.

GENDER ROLES AND RESPONSIBILITIES

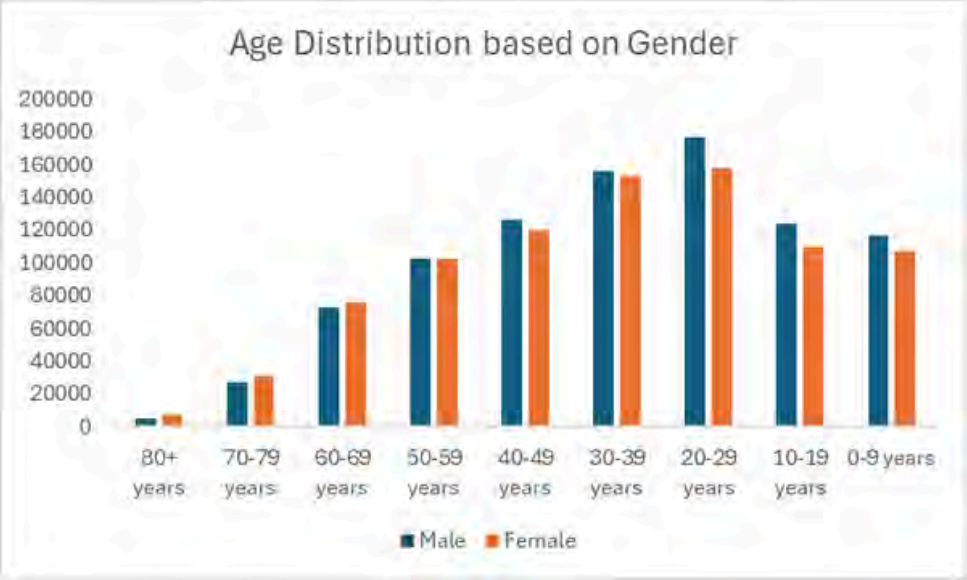
Domain	Men	Women
Household Duties	Primary income earners, occasional household repairs	Principal caregivers, responsible for cooking, cleaning, and child-rearing
Employment	Dominant in construction, manufacturing, and fishing	Predominantly in services, retail, agriculture, and informal sector
Decision-Making	Head of household, primary decision-makers in financial matters	Manage daily household decisions, increasingly involved in community decisions
Community Involvement	Active in formal leadership roles, community councils	Active in informal community networks, social support roles
Education	Encouraged to pursue higher education and vocational training	Encouraged to complete schooling, with fewer pursuing higher education
Healthcare	Seek healthcare for work-related injuries or chronic conditions	Primary focus on maternal and child health, responsible for family healthcare decisions

In Barat Daya, Pulau Pinang, traditional gender roles and responsibilities are still prominent, though they are gradually evolving. Men are typically seen as the primary income earners, working in sectors like construction, manufacturing, and fishing. They often take on the role of head of the household, making major financial and family decisions. Women, on the other hand, are primarily responsible for household duties, including cooking, cleaning, and caring for children. While men are more visible in formal leadership roles within the community, women are active in informal networks and play crucial roles in social support systems. In terms of education, men are generally encouraged to pursue higher education and vocational training, while women are more likely to complete basic schooling, with fewer advancing to higher education. Healthcare responsibilities often fall on women, who manage the family's health needs, focusing particularly on maternal and child health. Despite these traditional roles, there is a growing trend of women participating in community decision-making and taking on more diverse roles outside the home.

ACCESS TO RESOURCES AND OPPORTUNITIES

In Pulau Pinang, especially in Bayan Lepas, access to resources and opportunities varies between men and women, reflecting traditional gender roles and socio-economic structures. Men generally have greater access to formal education, particularly in vocational training and higher education, which opens up more opportunities for formal employment in sectors like construction and manufacturing. They are also more likely to own land and property and find it easier to access financial services such as loans and credit. Women, while having equal access to primary and secondary education, face barriers to pursuing higher education and formal employment. They are more likely to work in informal sectors like agriculture and retail, with limited access to high-paying jobs. Women also have lower rates of land ownership and often rely on male family members for property-related decisions. However, a growing trend of women participating in microfinance initiatives is slowly increasing their access to financial resources. In terms of healthcare, women have broad access, especially in maternal and child health services, and are gradually becoming more involved in household decision-making, though their representation in formal community leadership remains limited.

GENDER-BASED CONSTRAINTS



The bar chart illustrates the gender-based age distribution of the population in Bayan Baru, Penang, based on 2023 data from CityPopulation.de. In the younger age groups (0-9 to 20-29 years), males consistently outnumber females, with the 20-29 age group showing the highest overall population. This indicates a significant concentration of young adult males in Bayan Baru. As the population ages, the gender gap begins to narrow, particularly in the 30-39 and 40-49 age groups, where the difference between male and female populations is minimal.

In the older age groups (50-59 years and above), the population continues to decline, with females gradually outnumbering males. This trend becomes more pronounced in the 70-79 years and 80+ years age groups, reflecting higher female longevity in Bayan Baru. The chart overall highlights a demographic shift from a male-dominated younger population to a more female-dominated older population, which is typical of many urban areas as people age.

IMPACT ASSESSMENT

Bayan Baru, a key township within the Barat Daya district of Pulau Pinang, is an area where urban development meets rich cultural traditions and diverse communities. As a significant hub in the southwest region, Bayan Baru continues to grow and modernize, making it essential to understand the potential social, environmental, and gender impacts of various projects and policies. This impact assessment seeks to explore how these changes might affect the livelihoods, ecosystems, and gender dynamics within the community, ensuring that development is both sustainable and inclusive for all residents.

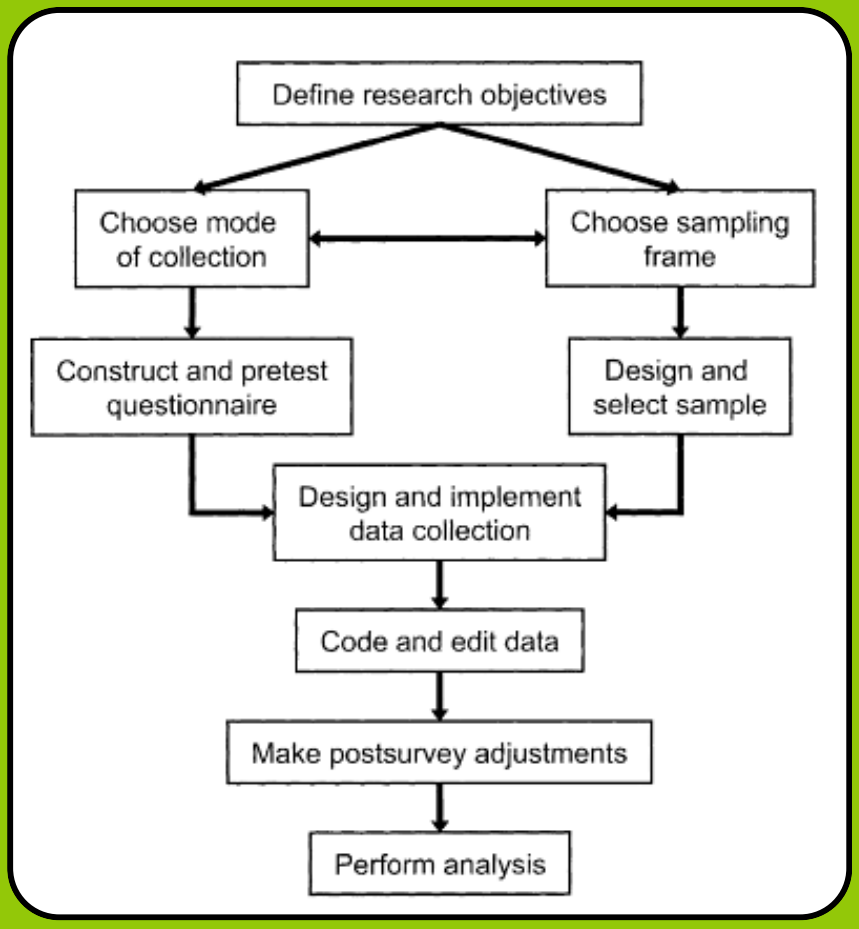
SOCIAL & ENVIRONMENTAL IMPACT ASSESSMENT

The **Social & Environment Impact Assessment** for Bayan Baru focuses on understanding how various projects or developments might affect the local communities. In this region, key social concerns include the displacement of communities due to infrastructure projects, access to essential services like healthcare and education, and changes in the quality of life. For example, the construction of new housing developments or industrial sites might lead to the displacement of families, disruption of local social structures, and increased pressure on existing services. Additionally, the influx of new populations could strain local resources, leading to potential conflicts and changes in community dynamics. On the positive side, new developments could also improve access to services, job opportunities, and better infrastructure, thereby enhancing residents' overall quality of life.

GENDER IMPACT ASSESSMENT

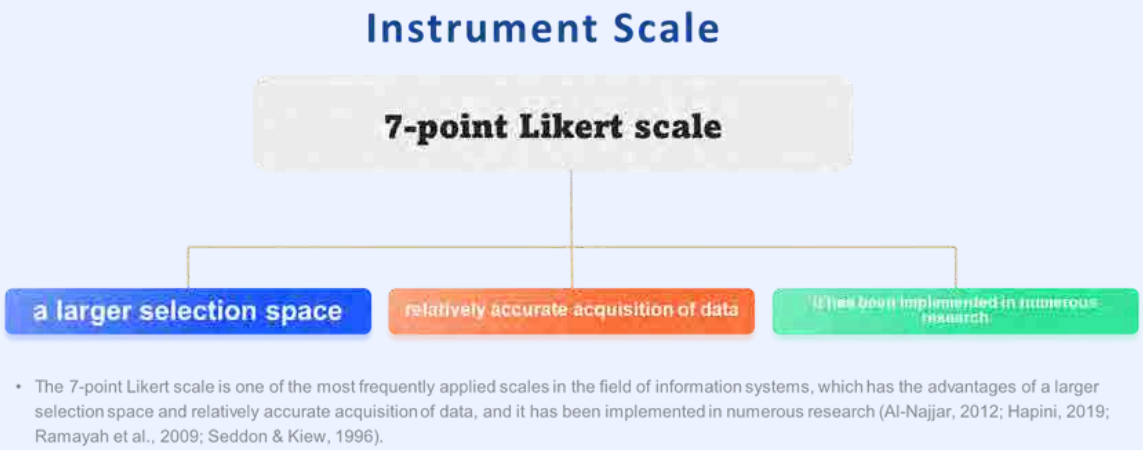
The **Gender Impact Assessment** for Bayan Baru examines how various projects or developments might differently impact men, women, and gender-diverse individuals within local communities. Key concerns include equitable access to employment, safety, representation in decision-making, and access to essential resources like healthcare and education. Infrastructure projects could affect mobility and access to economic opportunities, with potential impacts on women's safety and employment, particularly in informal sectors. By considering these factors, the assessment aims to promote gender-sensitive policies that ensure inclusive participation, safer public spaces, and equitable resource access, fostering a supportive community for all.

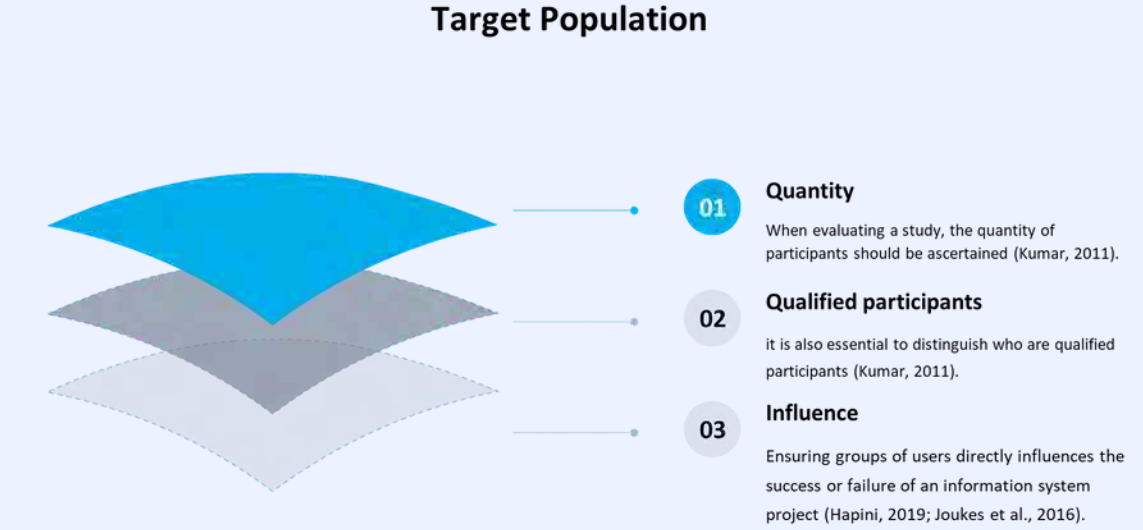
SURVEY AND DATA COLLECTION STRATEGY



The diagram presents a structured approach to survey and data collection. The process begins by defining the research objectives, which serve as the foundation for the subsequent steps. Following this, two parallel activities are undertaken: determining the appropriate mode of data collection and selecting the sampling frame. After these decisions, a questionnaire is constructed and pretested to ensure its validity and reliability. Concurrently, the sample is designed and selected. The next phase involves the implementation of the data collection process, after which the data is coded and edited for accuracy. Post-survey adjustments are then made to address any potential biases or inconsistencies. Finally, the data is subjected to analysis to derive insights that align with the initial research objectives.

INSTRUMENT DEVELOPMENT





The process of instrument development, specifically focusing on the use of a 7-point Likert scale. This scale is highlighted for its benefits, including a larger selection space, relatively accurate data acquisition, and widespread use in research. Additionally, the image emphasizes the importance of identifying the target population for the study, noting three key factors: the quantity of participants, the need to distinguish qualified participants, and the influence that these groups have on the success or failure of information system projects.

SAMPLE SIZE

The formula provided is a widely used method for determining the sample size needed in survey research. Here's a more detailed explanation:

$$s = X^2NP(1 - P) \div d^2(N - 1) + X^2P(1 - P).$$

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

The formula is used to determine how large a sample should be taken from a given population to ensure that the results are statistically significant, taking into account the confidence level, population size, and desired precision.

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

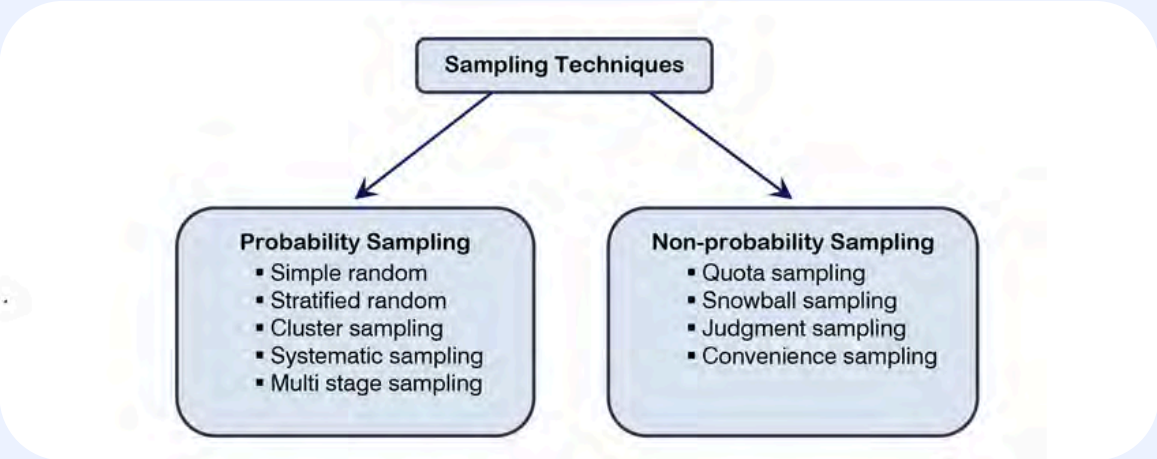
Note.—N is population size.
S is sample size.

SAMPLING METHOD

Kumar (2011) categorizes sampling strategies into three main types: Probability, Non-Probability, and Mixed.

- Probability Sampling involves selecting samples so that each member of the population has a known, non-zero chance of being included. This approach enhances the sample's representativeness, allowing for generalization of the results to the broader population.
- Non-probability sampling does not give every member of the population a known chance of being selected. This method is often used when random sampling is impractical, though it may introduce bias, making it harder to generalize findings.
- Mixed Sampling combines elements of probability and non-probability sampling, aiming to balance the strengths and weaknesses of each approach. This balance provides a sense of reassurance in the research process.

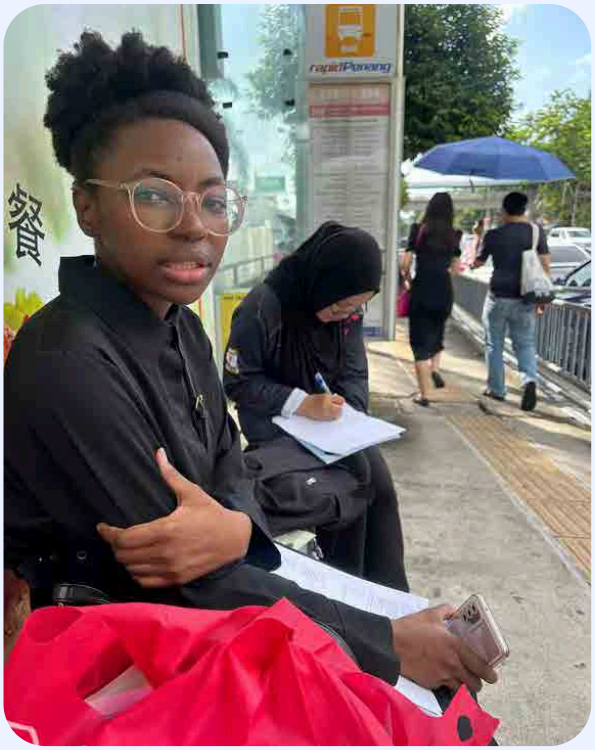
Building on this, Taherdoost (2016) discusses a variety of specific sampling techniques within these broad categories and provides guidance on how to choose the appropriate technique based on the research objectives, population characteristics, and other practical considerations. This emphasizes the researcher's role in ensuring the sample is representative and the research findings are valid and reliable.



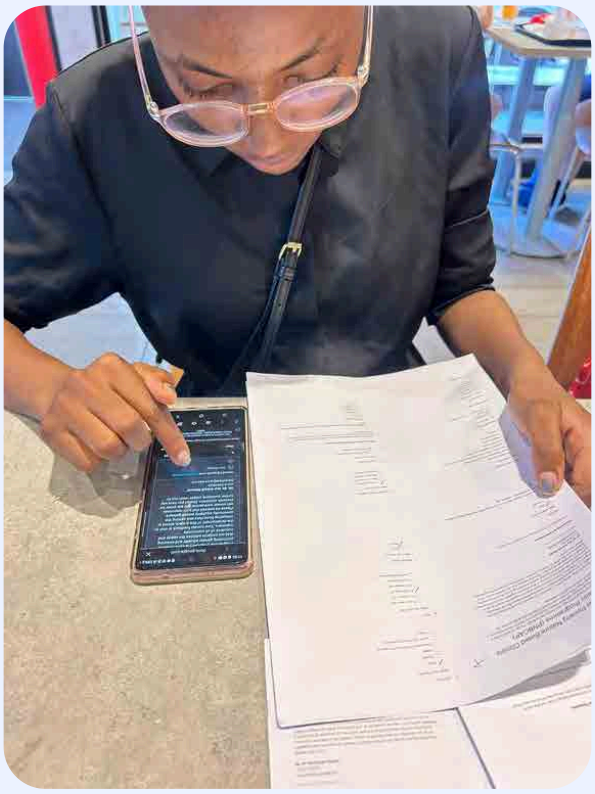
SURVEY FINDINGS

The survey findings offer a comprehensive overview of the data collected, highlighting key trends, patterns, and insights that emerged from the responses. This analysis provides a detailed understanding of the demographic characteristics of the respondents, their behaviors, attitudes, and opinions on the subject matter. By examining these results, the findings reveal significant relationships and differences among various groups, contributing to a deeper understanding of the research questions. The insights gained from these findings are crucial for drawing conclusions and making informed decisions based on the data collected.

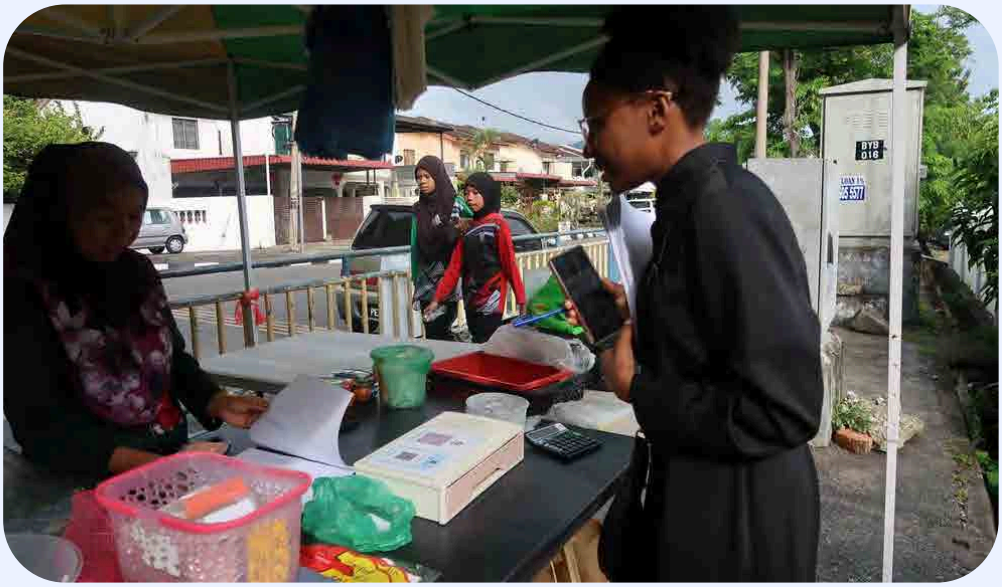
INCLUSION OF PICTURES FROM SURVEY SESSIONS



Conducting survey physically onsite at Bayan Baru area



INCLUSION OF PICTURES FROM SURVEY SESSIONS



Conducting survey physically onsite at Bayan Baru area

INCLUSION OF PICTURES FROM SURVEY SESSIONS

Stakeholder Engagement session at Amari Hotel,Penang Including Online Survey Participation through Google Form platform

INCLUSION OF PICTURES FROM SURVEY SESSIONS

Interview location at Taman Lintang Nibong a day prior to community engagement session

INCLUSION OF PICTURES FROM COMMUNITY ENGAGEMENT SESSION

Community engagement session at Dewan Persatuan Penduduk-Penduduk Bayan Baru, Pulau Pinang

SURVEY INSTRUMENTS AND QUESTIONNAIRES

RESPONDENT'S INFORMATION

Question	Answer
Gender	Male / Female
Total number of people residing in your household, including relatives, siblings, parents, grandparents, children, etc.	Short answer
Ethnicity	Malay, Chinese, Indian, Others
Age	Option
Academic Qualification	Option
Employment Sector	Option
Average Monthly Income	Option
Residential Area	Short Answer

SURVEY INSTRUMENTS AND QUESTIONNAIRES

NATURAL DISASTER AND FLOOD RISK PERCEPTION

Question	Answer
What are the common natural disasters due to climate change in this and nearby area?	Flood, Heatwaves, Landslide, Air Pollution, Others
In the past five (5) years, how frequently has your neighborhood experienced flooding?	About once every 2 or 3 years, About once a year, About twice a year, Approximately 3 times a year or more
What is the estimated average flood depth that has ever been faced?	Less than 1 foot, Between 1 to 2 feet, Between 3 to 4 feet, More than 4 feet
How concerned are you about the risk of future flooding in your neighborhood?	Likert Scale 1 - 7
During the most recent flood event, how severe was the economic impact (loss of income, property damage, etc.?	Likert Scale 1 - 7

SURVEY INSTRUMENTS AND QUESTIONNAIRES

NATURAL DISASTER AND FLOOD RISK PERCEPTION

Question	Answer
If your property is affected by flooding, can you estimate the property damage from the flood?	Less than RM1000, RM1001 to RM5000, RM5001 to RM10000, More than RM10000
How has flooding affected your health impact (illnesses, injuries, access to healthcare, etc.)?	Likert Scale 1 - 7
How has flooding affected your access to essential services such as water supply, electricity, and transportation?	Likert Scale 1 - 7
How has flooding affected your security and safety (risk of violence, theft, etc.)	Likert Scale 1 - 7

SURVEY INSTRUMENTS AND QUESTIONNAIRES

EXISTING COPING MECHANISMS

Question	Answer
Rate the importance of the following measures to prepare for a flood: • Store important documents and valuables in waterproof containers. • Store clean water. • Identify the location of the nearest evacuation center and assistance center. • Prepare sufficient emergency supplies. • Prepare power banks. • Always be prepared to relocate.	Likert Scale 1 - 7
Have you ever relied on emergency services (e.g., fire department, JPAM, etc.) for assistance during a flood event?	Yes, No
Do you have flood insurance for your property?	Yes, No
Do you currently implement any strategies to manage rainwater runoff in your home?	Yes, No

SURVEY INSTRUMENTS AND QUESTIONNAIRES

RAINWATER RUNOFF MANAGEMENT

Question	Answer
Do you currently implement any strategies to manage rainwater runoff in your home?	Yes, No
Please specify the strategies. • Rain garden • Rainwater harvesting • Others	Yes, No

SURVEY INSTRUMENTS AND QUESTIONNAIRES

FLOOD MITIGATION STRATEGY

Question	Answer
Do you have any mitigation plan for your household for the flooding incident in the future?	Yes, No
If yes, please specify the strategies. • Raise up the ground in your property by using concrete floor./ Menaikkan aras kawasan harta benda anda dengan menggunakan lantai konkrit. • Install the flood prevention wall around the property./ Pasang dinding pencegahan banjir di sekeliling harta benda. • Keep the sandbags in the storage./ Simpan beg pasir di dalam stor. • Keep the food and drinking supplies in the storage./ Simpan bekalan makanan dan minuman di dalam stor. • Participate in the community group for flooding mitigation plan./ Menyertai kumpulan komuniti untuk pelan mitigasi banjir.	Yes, No

SURVEY INSTRUMENTS AND QUESTIONNAIRES

EQUITY AND SOCIAL COHESION

Question	Answer
Do you think that all members of your community have equal access to the benefits of nature-based flood mitigation measures?	Yes, No
Have you observed any disparities in the distribution of flood mitigation resources or assistance among different socio-economic groups in our community?	Yes, No
How often do you engage in community activities or events within your neighborhood?	Likert Scale 1 - 7
Do you feel a sense of solidarity and support within your community during times of flooding or other emergencies?	Yes, No

SURVEY INSTRUMENTS AND QUESTIONNAIRES

GENDER-SPECIFIC NEEDS AND CAPACITIES & GENDER-RESPONSIVE PROJECT IMPLEMENTATION

Question	Answer
Do you believe that flooding affects men and women differently in your community?	Yes, No
What measures do you think should be implemented to address these gender-specific challenges? (e.g., Safe shelter, healthcare access, livelihood support, economic diversification, inclusive decision-making, education & awareness, etc.)	Open-ended
Do you think the current flood management and climate adaptation measures in your community adequately address the needs of both men and women?	Yes, No
What additional measures do you think should be taken to ensure gender equality in flood management and climate adaptation projects?	Open-ended
Would you be willing to participate in further consultations or focus groups to discuss gender-responsive strategies for flood management and climate adaptation?	Yes, No

SURVEY INSTRUMENTS AND QUESTIONNAIRES

GENDER-SPECIFIC NEEDS AND CAPACITIES & GENDER-RESPONSIVE PROJECT IMPLEMENTATION

Question	Answer
Which gender is more affected by the following challenges during flood incidents in your area: men, women, or both equally?/ • *Lack of access to safe shelter.* • *Increased risk of gender-based violence.* • *Limited access to healthcare and sanitation.* • *Loss of livelihood opportunities/incomes.* • *Increased responsibilities for providing to the family.* • *Physical health issues or injuries.* • *Mental health issues.* • *Limited privacy, e.g., shared or open sleeping area.* • *Limited safety, e.g., dark path.* • *Limited sanitary facilities or disrupted access to toilets and bathing facilities.* • *Limited access to menstrual products and facilities.* • *High risk of mortality (death).*	Men/Women/ Equally Affected

SURVEY INSTRUMENTS AND QUESTIONNAIRES

FEEDBACK AND SUGGESTIONS

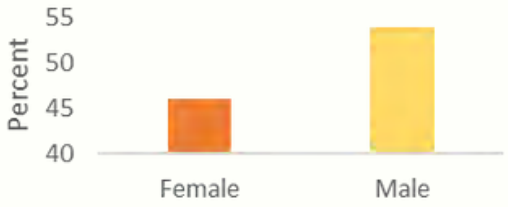
Question	Answer
Do you have any other comments or suggestions on how the Penang Nature-Based Climate Adaptation Programme can improve its effectiveness in flood reduction?/	Open-ended
Do you have any other comments or suggestions on how the Penang Nature-Based Climate Adaptation Programme can improve its gender responsiveness?	Open-ended

RESULT & DISCUSSIONS

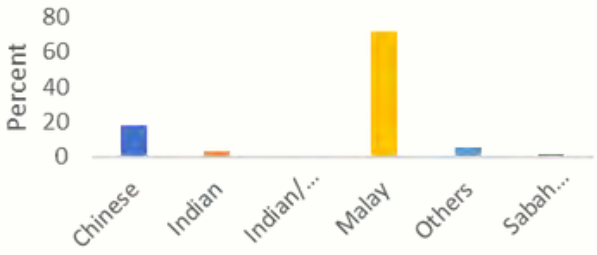
The data analysis process begins with a descriptive analysis in which SPSS is used to import data and generate descriptive statistics for respondents' demographic characteristics. During this stage, the response rate is assessed, and non-response bias tests are conducted. In the second stage, the focus shifts to data screening and preparation, including evaluating missing data, processing outliers, analyzing linearity, and conducting multicollinearity tests.

DESCRIPTIVE ANALYSIS

- **GENDER**

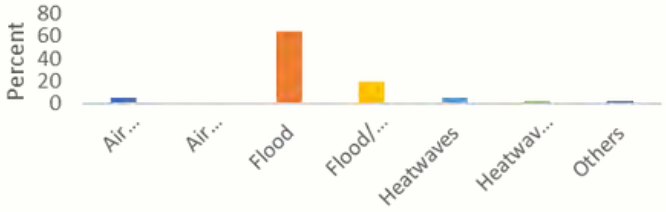


- **ETHNICITY**



•**Demographics**: Most respondents in the PNBCAP survey are male (55%) and predominantly Malay (75%).

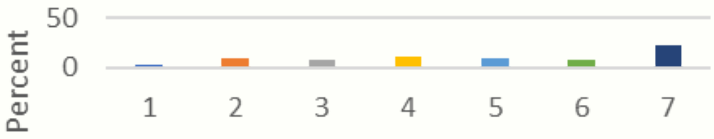
- **NATURAL DISASTER**



•**Common Natural Disasters**: Flooding is the most commonly identified climate change-related natural disaster, noted by about 60% of respondents.

•**Additional Identified Issues**: Heat waves and air pollution are also identified as concerns, with 10% and less than 5% of respondents highlighting them, respectively.

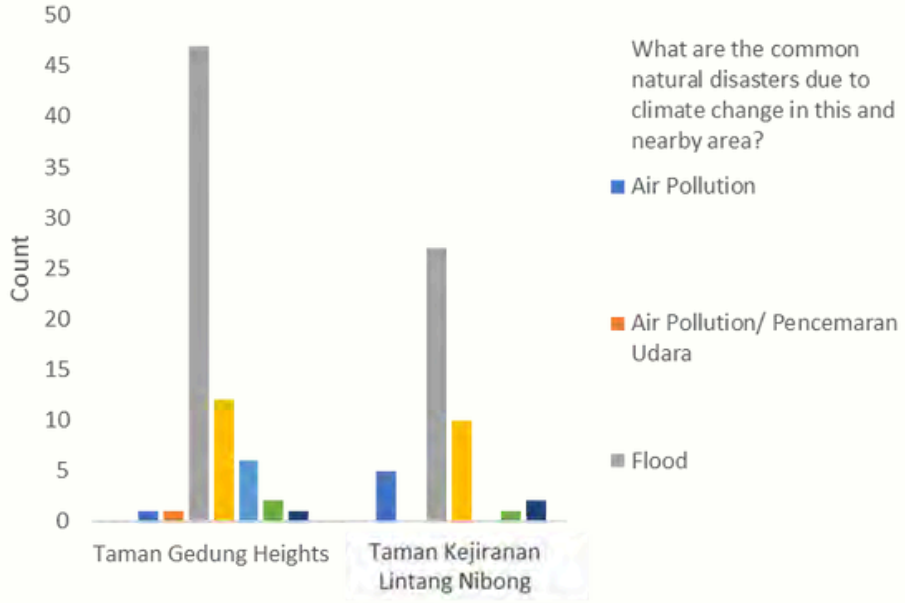
- **CONCERNED FOR FUTURE RISK OF FLOODING**



•**Concern About Flooding**: There is significant concern about future flooding, with 20% of respondents expressing the highest concern (rating 7 out of 7).

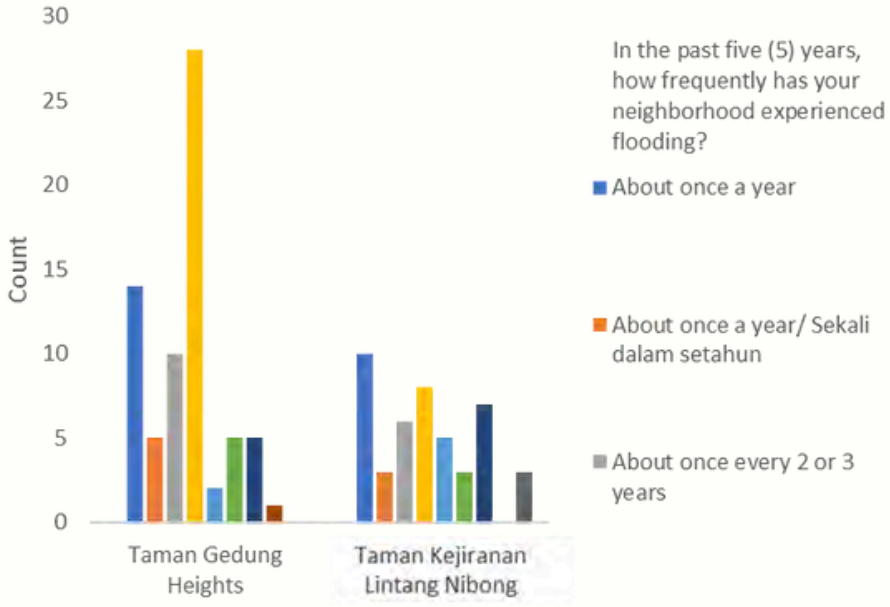
NATURAL DISASTER AND FLOOD RISK PERCEPTION

- ## COMMON NATURAL DISASTERS



•Flooding is the most commonly identified natural disaster in Taman Gedung Heights and Taman Kejiranan Lintang Nibong, overshadowing air pollution and heat waves.

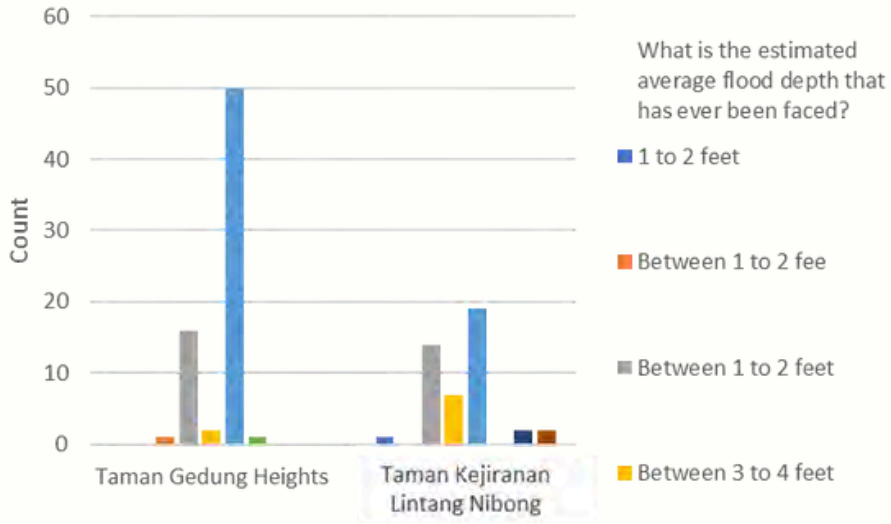
- ## FLOODING'S EXPERIENCE



•Most respondents experience flooding approximately once a year or every two to three years, underscoring the need for effective flood risk management and mitigation strategies.

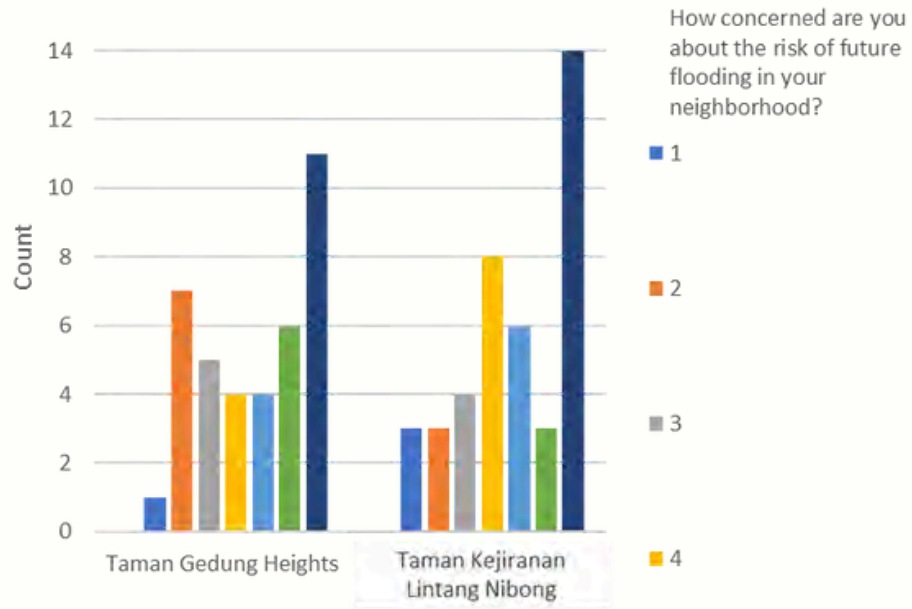
NATURAL DISASTER AND FLOOD RISK PERCEPTION

- **FLOOD DEPTH**



•Taman Gedung Heights predominantly experiences flood depths of 3 to 4 feet, while Taman Kejiranan Lintang Nibong often has flood depths below 1 foot.

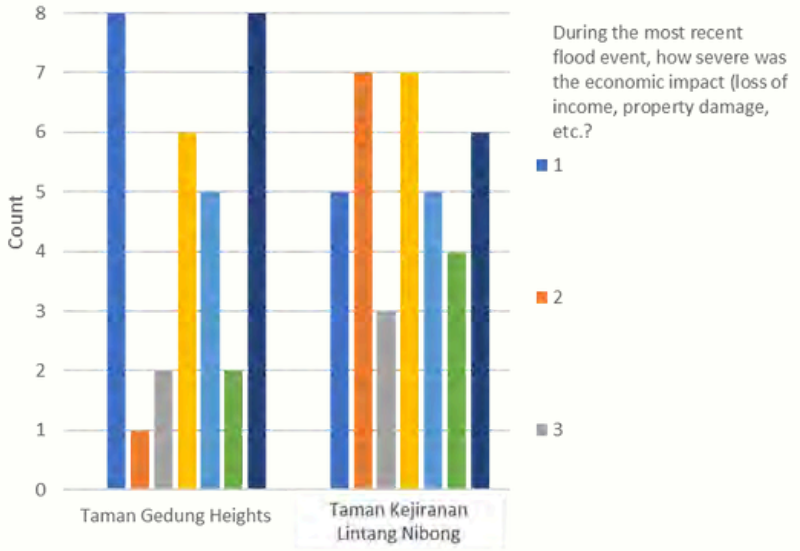
- **CONCERNED ON RISK OF FLOODING**



•Taman Kejiranan Lintang Nibong shows higher concern about future flooding (levels 6 and 7), whereas Taman Gedung Heights shows more moderate concern (levels 3 and 4).

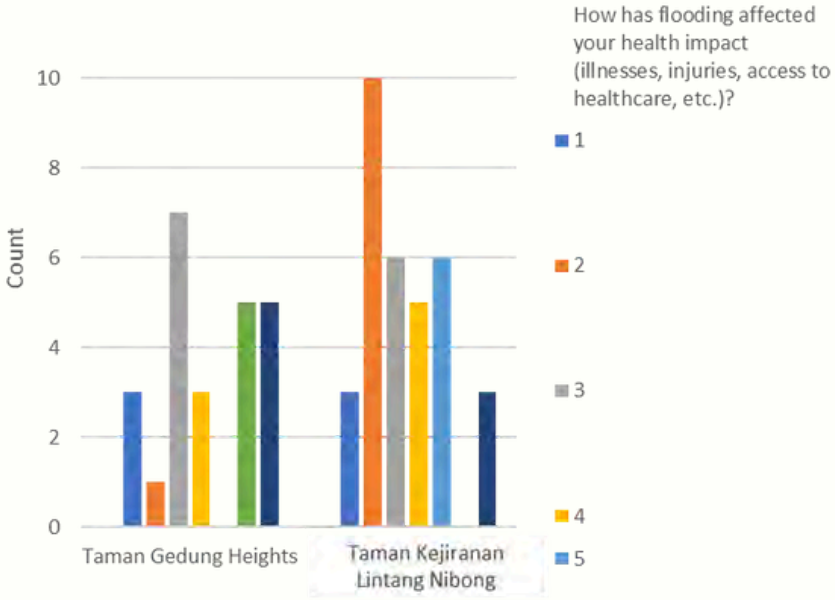
NATURAL DISASTER AND FLOOD RISK PERCEPTION

- ## ECONOMIC IMPACT



•Taman Gedung Heights has a higher frequency of respondents rating the economic impact of the most recent flood as least severe (level 1), with significant counts at more severe levels (6 and 7), while Taman Kejiranan Lintang Nibong shows varied economic impacts across all severity levels.

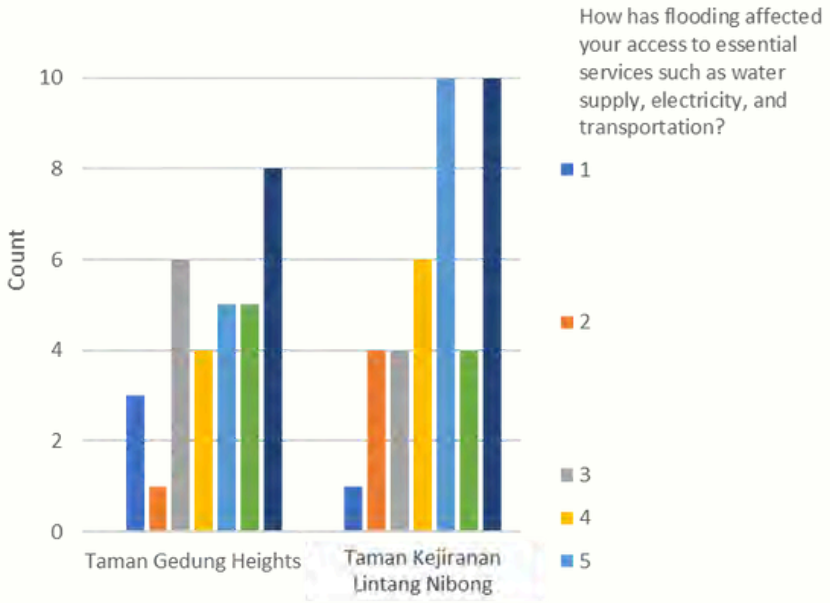
- ## HEALTH IMPACT



•Taman Gedung Heights residents mostly report low to moderate health impacts from flooding (levels 2 and 4).
•In contrast, Taman Kejiranan Lintang Nibong shows notable responses at levels 1, 3, and 4, indicating some higher concern for health impacts.

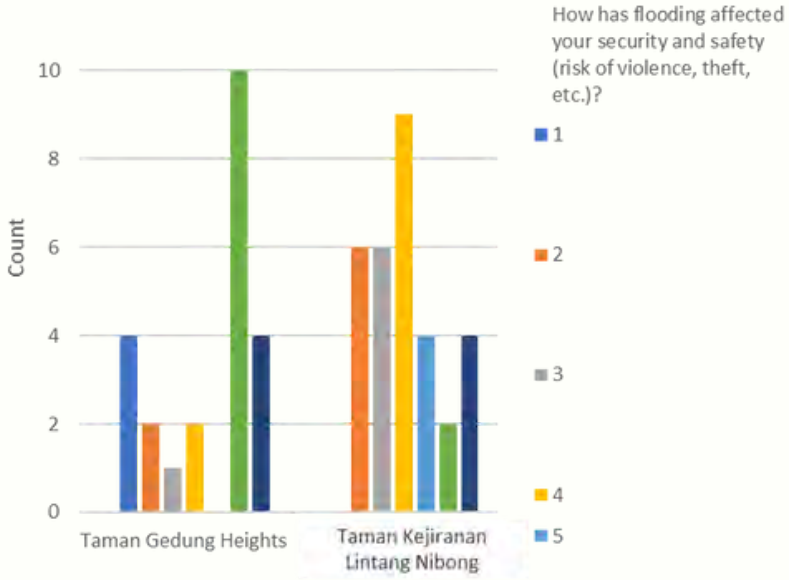
NATURAL DISASTER AND FLOOD RISK PERCEPTION

- ## IMPACT ON ESSENTIAL SERVICES



•Flooding has significantly impacted essential services like water supply, electricity, and transportation in Taman Gedung Heights and Taman Kejiranan Lintang Nibong, with many ratings at levels 4 and 5.

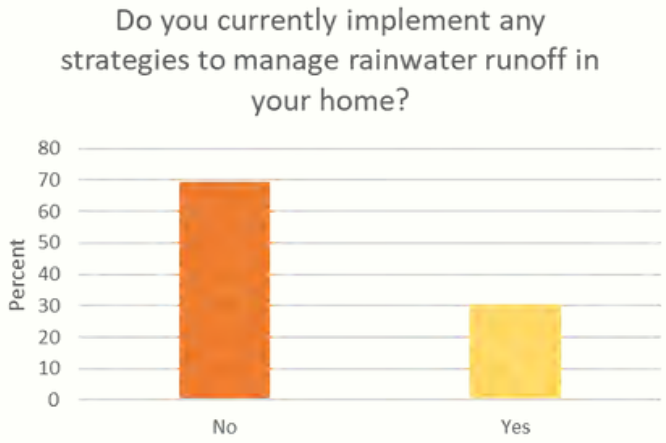
- ## IMPACT ON SECURITY AND SAFETY



•The impact on security and safety, including risks of violence and theft, is also significant, with many ratings at levels 3 to 5 in both areas, indicating heightened security concerns during floods.

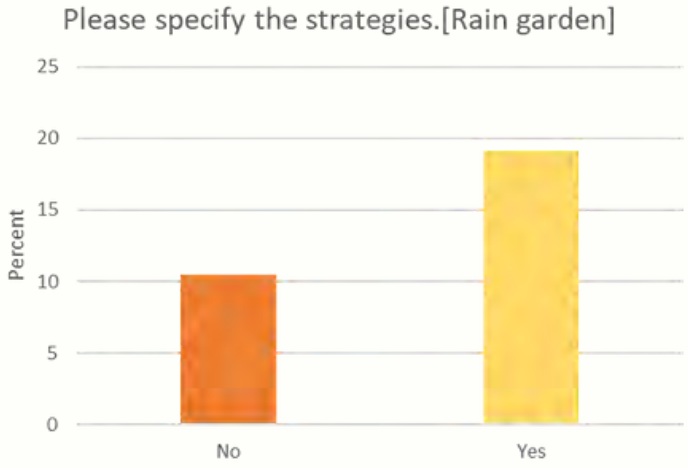
RAINWATER MANAGEMENT

- ## STORMWATER RUNOFF IMPLEMENTATION



Approximately 70% of respondents do not implement strategies to manage rainwater runoff at their homes, while around 30% do

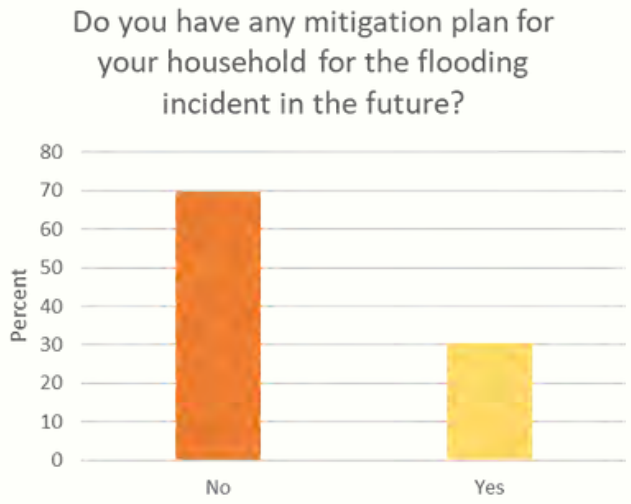
- ## STORMWATER RUNOFF STRATEGIES



•Among those who manage rainwater runoff, about 18% use rain gardens, compared to 12% who do not.

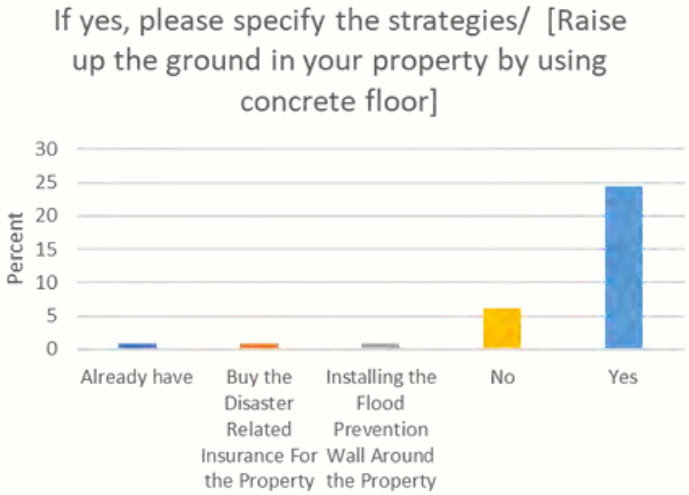
FLOOD MITIGATION PLAN

- ## MITIGATION PLAN FOR HOUSEHOLD



•Lack of Household Flood Mitigation Plans: Most respondents (around 70%) do not have any mitigation plan for future flooding incidents in their household.

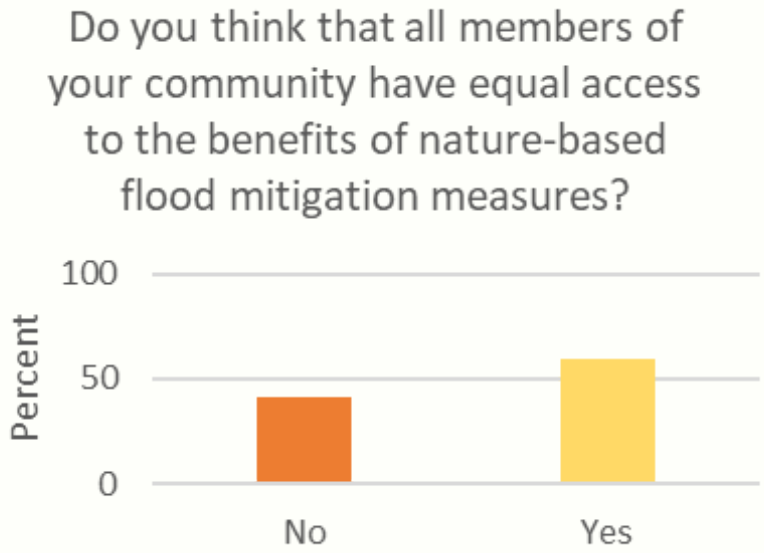
- ## STRATEGIES FOR MITIGATION PLAN



•Preferred Mitigation Strategy: Among those with a mitigation plan, the most common strategy (over 25%) is raising the ground level in their property using a concrete floor.

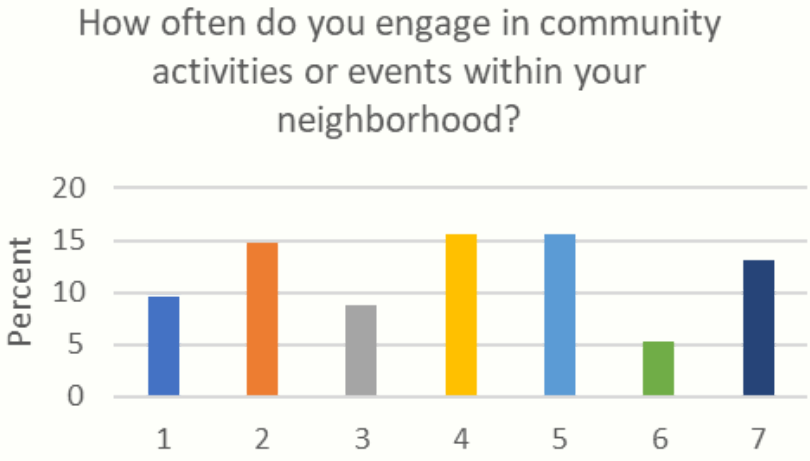
EQUITY AND SOCIAL COHESION

- **EQUALITY OF MITIGATION's BENEFITS**



•Around 55% of respondents believe all community members have equal access to nature-based flood mitigation benefits, while 45% do not.

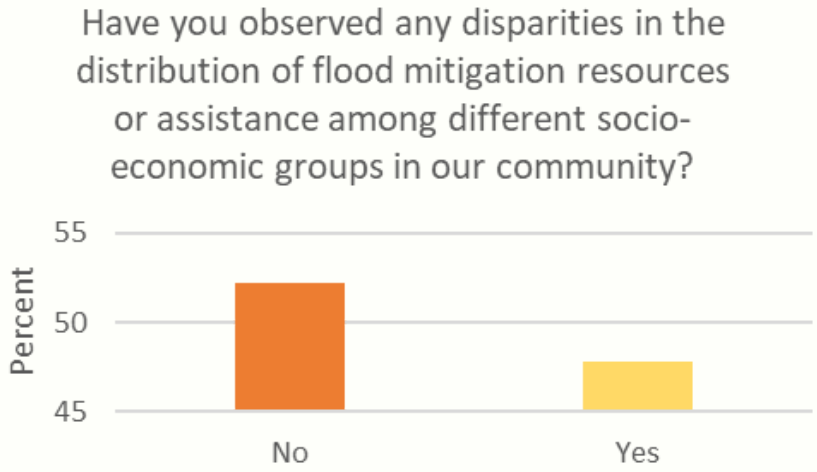
- **COMMMUNITY ENGAGEMENT'S PERCEPTION**



•The highest engagement in community activities is at level 4, with about 15% participation and notable involvement at other levels.

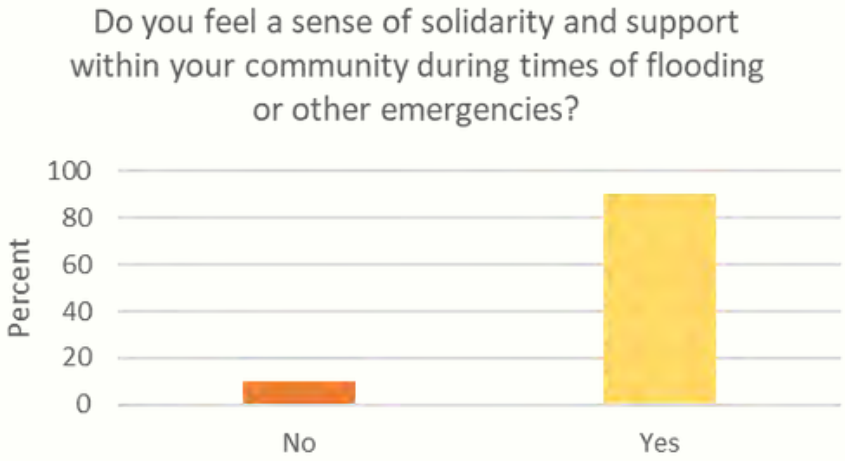
EQUITY AND SOCIAL COHESION

• DISTRIBUTION'S DISPARITIES



•Approximately 52% of respondents have not observed disparities in flood mitigation resource distribution among socio-economic groups, while 48% have.

• SENSE OF SOLIDARITY



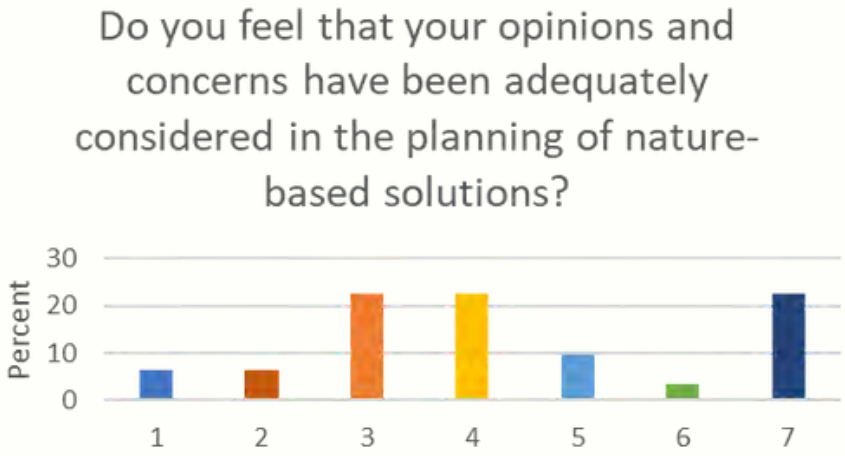
•Nearly 90% of respondents feel a strong sense of solidarity and support within the community during flooding or emergencies.

EXPECTATIONS FOR NBS PROJECT

- **INFORMATION AVAILIBILITY ON NBS PROJECT**

A significant portion of respondents (around 35%) rated the availability of information about the project and its benefits to the community at a medium level (rating 3 out of 7).

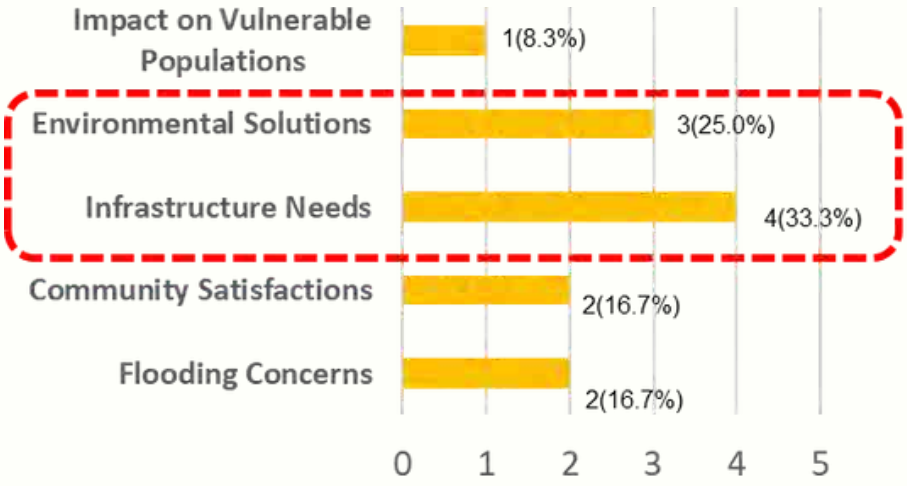
- **CONSIDERATION OF COMMUNITY OPINIONS**



Opinions on whether respondents feel their concerns have been considered in the planning of nature-based solutions are varied, with notable responses at both ends of the scale (ratings 3 and 7 out of 7), indicating mixed satisfaction levels.

THEMATIC ANALYSIS

FIVE (5) KEY THEMES



Summary:

-There are a balanced representation of male (57.1%) and female (42.9%), ensuring the voices and concerns of different genders are considered in the project's development.
-The feedback suggests a need for **immediate infrastructure improvements, sustainable environmental practices, and attention to the needs of vulnerable groups.**

CONCLUSION

The descriptive and thematic analysis of the survey responses provides valuable insights into the community's perspectives on the Penang Nature-Based Climate Adaptation Program. The diverse demographic composition of respondents, including a balanced representation of male (57.1%) and female (42.9%) participants, reflects the wide-ranging impact of flooding across various genders, races, ages, and socioeconomic backgrounds. This balance ensures that the voices and concerns of different genders are well-represented in the project's development.

The thematic analysis reveals five key themes: Infrastructure Needs, Environmental Solutions, Flooding Concerns, Community Satisfaction, and Impact on Vulnerable Populations. The emphasis on Infrastructure Needs and Environmental Solutions highlights the community's demand for practical, actionable measures to enhance flood management and environmental stewardship. Additionally, the themes of Community Satisfaction and Impact on Vulnerable Populations underscore the importance of equitable benefits and addressing specific vulnerabilities within the community.

By incorporating these insights, the Penang Nature-Based Climate Adaptation Program can be tailored to effectively reduce flood risk, promote environmental sustainability, and enhance the well-being of the entire community. This approach aligns with Penang Island's commitment to achieving the Sustainable Development Goals (SDGs), particularly in fostering sustainable cities and communities (SDG 11) and combating climate change (SDG 13). The integration of social, environmental, and gender-sensitive policies ensures the program not only addresses immediate challenges but also contributes to a more resilient, inclusive, and sustainable future for all.

REFERENCES

1. Lim, S. B., Malek, J. A., Hussain, M. Y., Tahir, Z. U. R. I. N. A. H., & Saman, N. H. M. (2021). SDGs, smart urbanisation, and politics: Stakeholder partnerships and environmental cases in Malaysia. J. Sustain. Sci. Manag, 16, 190-219.

APPENDIX A-

Survey Form (Environmental and Social Impact Assessment)

Section 1 of 12

Survey on Penang Nature Based Climate Adaptation Programme (PNBCAP)

Penang faces increasing challenges from floods due to climate change. To address this, a project is being developed that utilizes Nature-Based Solutions (NBS) to reduce flood risk in our community. These NBS solutions can include things like blue-green corridor, rain gardens, green roofs, and restored waterways.

This survey is being conducted to understand your experiences with flooding and your thoughts on the proposed NBS project. The Penang Nature-Based Climate Adaptation Programme (PNBCAP) is committed to promoting gender equality and ensuring that our projects address the needs and concerns of all community members. Your honest feedback is vital to the development of this project, aimed at mitigating flood risks and serving the community equitably across genders. Please be assured that your responses will remain confidential and are solely for research utilization. Should you have any further questions, please reach out to:

Gs. Dr. Nur Suhaili Mansor
+013-3582903
nursuhaili@uum.edu.my

Section 2 of 12

Respondent's Information

This section aims to gather your demographic information.

Gender/ *Jantina* *

- Male/ Lelaki
- Female/ Perempuan

Total number of people residing in your household, including relatives, siblings, parents, grandparents, children, etc. /
Jumlah keseluruhan orang yang tinggal di rumah anda, termasuk saudara-mara, adik-beradik, ibu bapa, datuk nenek, anak-anak, dan sebagainya.

Short answer text

Ethnicity/ *Kaum* *

- Malay/ Melayu
- Chinese/ Cina
- Indian/ India
- Orang Asal (Indigenous ethnic groups)
- Sabah and Sarawak bumiputera
- Others/ Lain-lain

Age / *Umur* *

- 20 years old or less / 20 tahun dan kebawah
- 21 to 30 years old/ 21-30 tahun
- 31 to 40 years old/ 31-40 tahun
- 41 to 50 years old/ 41-50 tahun
- 51 to 60 years old/ 51-60 tahun
- More than 60 years old/ 60 tahun keatas

Marital Status / *Status* *

- Single/ Bujang
- Married/ Sudah Berkahwin

Academic Qualification / *Tahap atau kelayakan akademik* *

- No formal education/ Tiada pendidikan formal
- UPSR or equivalent (Primary school level)/ Sekolah Rendah
- PMR/ SPM/ STPM or equivalent (Secondary school level)/ Sekolah Menengah
- Certificate or Diploma or equivalent/ Sijil atau Diploma
- Bachelor's degree/ Ijazah Sarjana Muda
- Master's degree/ Ijazah Sarjana
- Doctoral degree/ PHD
- Others/ Lain-lain

Employment Sector/ *Sektor Pekerjaan* *

- Government/ Kakitangan Kerajaan
- Private/ Swasta
- Unemployed/ Tidak bekerja

Work Sector/ *Sektor Pekerjaan* *

- Business/ Perniagaan
- Agriculture/ Pertanian
- Manufacturing/ Pembuatan
- Education/ Pendidikan
- Others/ Lain-lain

Average Monthly Income/ *Purata Pendapatan Bulanan* *

- Less than RM1,500
- RM1,501 to RM2,500
- RM2,501 to RM5,000
- More than RM5,000

Residential Area/ *Kawasan Kediaman* *

Short answer text

Section 3 of 12

Perceptions toward Climate Change and Flooding Issues

Description (optional)

Are you aware of climate change?/ *

Adakah anda sedar tentang perubahan iklim?

- Yes/ Ya
- No/ Tidak

How concerned are you about climate change?/ *

Sejauh mana kebimbangan anda terhadap perubahan iklim?

	1	2	3	4	5	6	7	
Not concerned at all/ Sangat tidak risau	○	○	○	○	○	○	○	Extremely concerned/ Sangat merisaukan

How do you perceive the impact of climate change on your local environment? *

Bagaimana anda melihat kesan perubahan iklim terhadap persekitaran tempatan anda?

	1	2	3	4	5	6	7	
Not concerned at all/ Sangat tidak risau	○	○	○	○	○	○	○	Extremely concerned/ Sangat merisaukan

Do you believe climate change has contributed to increased flooding in your area? *

Adakah anda percaya perubahan iklim telah menyumbang kepada peningkatan banjir di kawasan anda?

	1	2	3	4	5	6	7	
Not agree at all/ Sangat tidak setuju	○	○	○	○	○	○	○	Extremely agree/ Sangat setuju

In the past five (5) years, how frequently has your neighborhood experienced flooding?/ *

Dalam tempoh (5) tahun yang lepas, berapakah kekerapan kawasan kejiranan anda mengalami banjir?

- About once every 2 or 3 years/ Kira-kira sekali setiap 2 atau 3 tahun
- About once a year/ Sekali dalam setahun
- About twice a year/ 2 kali dalam setahun
- Approximately 3 times a year or more/ 3 kali setahun atau lebih

What is the estimated average flood depth that has ever been faced?/ *

Berapakah anggaran purata kedalaman banjir yang pernah dihadapi?

- Less than 1 feet/ Kurang 1 kaki
- Between 1 to 2 feet/ 1-2 kaki
- Between 3 to 4 feet/ 3-4 kaki
- More than 4 feet/ lebih 4 kaki

How has flooding affected your daily life and livelihood? *

Bagaimana banjir telah mempengaruhi kehidupan harian dan mata pencarian anda?

	1	2	3	4	5	6	7	
Not significant at all/ Sangat tidak ketara	○	○	○	○	○	○	○	Very Significant/ Sangat ketara

Section 4 of 12

Perception towards Preparedness for Flooding

Description (optional)

How prepared do you feel for potential flooding events? *

Sejauh mana anda merasa bersedia untuk kejadian banjir yang mungkin berlaku?

	1	2	3	4	5	6	7	
Very well prepared/ Sangat bersedia	○	○	○	○	○	○	○	Not prepared at all/ Langsung tidak bersedia

Rate the importance of the following measures to prepare for a flood:/ *

Nilaikan kepentingan langkah-langkah berikut untuk bersiap sedia menghadapi banjir:

	Not Important/ Tid...	Moderately Import...	Important/ Penting	Highly Important/ ...
Store important do...	○	○	○	○
Store clean water./...	○	○	○	○
Identify the locatio...	○	○	○	○
Prepare sufficient ...	○	○	○	○
Prepare power ban...	○	○	○	○
Always be prepare...	○	○	○	○

Do you have any mitigation plan for your household for the flooding incident in the future?/ *

Adakah anda mempunyai sebarang pelan mitigasi untuk isi rumah anda bagi kejadian banjir pada masa hadapan?

- ○ Yes/ Ya
- ○ No/ Tidak

If yes, please specify the strategies/

Jika ya, sila nyatakan strategi-strategi tersebut.

	Tick the box if related/ Tandakan bahagian yang te...
Raise up the ground in your property by using concr...	☐
Install the flood prevention wall around the property...	☐
Keep the sandbags in the storage./ Simpan beg pa...	☐
Keep the food and drinking supplies in the storage....	☐
Participate in the community group for flooding mit...	☐

What is the community's perception towards flood preparedness? *

Apakah persepsi komuniti terhadap kesiapsiagaan menghadapi banjir?

	1	2	3	4	5	6	7	
Not prepared at all/ Langsung tidak bersedia	○	○	○	○	○	○	○	Very well prepared/ Sangat bersedia

What resources or support do you need to improve your flood preparedness? *

Apakah sumber atau sokongan yang anda perlukan untuk meningkatkan persediaan menghadapi banjir?

- [ ] More information on flood risks./ Maklumat lanjut mengenai risiko banjir
- [ ] Financial assistance for flood-proofing./ Bantuan kewangan untuk menghalang banjir
- [ ] Community training programs./ Program latihan komuniti
- [ ] Improved early warning systems./ Sistem amaran awal yang lebih baik
- [ ] Other...

How does the community perceive flood awareness programs and their effectiveness in flood management? *

Bagaimana komuniti melihat program kesedaran banjir dan keberkesanannya dalam pengurusan banjir?

	1	2	3	4	5	6	7	
Very ineffective/ Sangat tidak berkesan	○	○	○	○	○	○	○	Very effective/ Sangat berkesan

Section 5 of 12

Authority, Management and Flood Assistance

Description (optional)

Based on your perception, which Department/ Agency is responsible in managing floods? *

Pada pendapat anda, Jabatan/ Agensi manakah yang bertanggungjawab dalam pengurusan banjir?

- ○ Jabatan Kerja Raya (JKR)
- ○ Jabatan Pengairan dan Saliran (JPS)
- ○ Jabatan Meteorologi Malaysia (METMalaysia)
- ○ Agenci Pengurusan Bencana Negara (NADMA)
- ○ Jabatan Kebajikan Masyarakat (JKM)
- ○ Other...

Do you aware of Department of Irrigation and Drainage (JPS) in managing floods?/ *

Adakah anda sedar tentang Jabatan Pengairan dan Saliran (JPS) dalam pengurusan banjir?

- ○ Yes./ Ya
- ○ No./ Tidak

How do you perceive government actions towards managing floods? *

Bagaimana anda melihat tindakan kerajaan dalam menguruskan banjir?

	1	2	3	4	5	6	7	
Very Ineffective./ Sangat Tidak Berkesan	○	○	○	○	○	○	○	Very Effective / Sangat Berkesan

How satisfied are you with the government actions in managing floods? *

Sejauh mana anda berpuas hati dengan tindakan kerajaan dalam menangani banjir?

	1	2	3	4	5	6	7	
Very Dissatisfied./ Sangat tidak berpuas hati	○	○	○	○	○	○	○	Very Satisfied./ Sangat berpuas hati

What is the amount of flood assistance have you received? / *

Berapakah bantuan banjir yang anda telah terima?

- ○ Less than RM100
- ○ RM100 - RM500
- ○ RM500 - RM1000
- ○ More than RM1000

Please indicate the sources of aid or support./

Sila nyatakan sumber bantuan atau sokongan.

	Tick if related/ Tandakan sekiranya berkaitan
Private Companies/ Syarikat Swasta	☐
Local Authorities/ Pihak Berkuasa Tempatan	☐
State Government/ Kerajaan Negeri	☐
Federal Government/ Kerajaan Persekutuan	☐
NGOs	☐
Individuals/ Individu Persendirian	☐

Please indicate the received forms of aid or support./

Sila nyatakan bentuk bantuan atau sokongan yang diterima.

	Tick if related/ Tandakan sekiranya berkaitan
Financial aid on housing recovery/renovation./ Ban...	☐
Financial aid on commercial fund to recover your b...	☐
Daily food and water support during flood./ Sokong...	☐
Medicine and first aid kit support / healthcare supp...	☐
Labor assistance for housing cleaning/recovery/re...	☐
Clothing./ Pakaian	☐

Have you observed any disparities in the distribution of flood mitigation resources or assistance among different socio-economic groups in your community?/

Adakah anda pernah melihat sebarang ketidakadilan dalam pengagihan sumber atau bantuan mitigasi banjir di kalangan kumpulan sosio-ekonomi yang berbeza dalam komuniti anda?

- ○ Yes/ Ya
- ○ No/ Tidak

If yes, which socio-economic groups do you believe are most affected by these disparities ?/

Jika ya, kumpulan sosio-ekonomi manakah yang anda percaya paling terkesan oleh ketidakadilan ini?

- ○ Low-income households./ Isi rumah berpendapatan rendah
- ○ Middle-income households./ Isi rumah berpendapatan sederhana
- ○ High-income households./ Isi rumah berpendapatan tinggi
- ○ Minority ethnic groups./ Kumpulan etnik minoriti
- ○ Other...

In what ways have these disparities manifested in the distribution of flood mitigation resources or assistance?/

Dalam apakah cara ketidakadilan ini ditunjukkan dalam pengagihan sumber atau bantuan mitigasi banjir?

- ○ Quantity of assistance received./ Kuantiti bantuan yang diterima
- ○ Quality of assistance provided./ Kualiti bantuan yang diberikan
- ○ Timeliness of assistance./ Ketepatan masa bantuan
- ○ Accessibility of resources or information./ Kebolehcapaian sumber atau maklumat
- ○ Other...

What types of flood mitigation assistance have you observed as being unequally distributed among different socio-economic groups?/

Apakah jenis bantuan mitigasi banjir yang anda lihat diagihkan secara tidak sama rata di kalangan kumpulan sosio-ekonomi yang berbeza?

- Financial aid./ Bantuan kewangan
- Emergency supplies (food, water, medicine)./ Bekalan kecemasan (makanan, air, ubat)
- Temporary housing or shelter./ Perumahan atau tempat perlindungan sementara
- Infrastructure repairs (roads, homes, utilities)./ Pembaikan infrastruktur (jalan raya, rumah, utiliti)
- Other...

Section 6 of 12

Flood Information and Awareness, & Early Warning System

Description (optional)

What is your perception of the causes of flooding in your area?/ *

Apakah persepsi anda terhadap punca banjir di kawasan anda?

- Natural causes./ Punca semula jadi
- Human activities./ Aktiviti manusia
- Combination of both./ Gabungan kedua-duanya
- Other..

Are you aware of the early warning systems for flooding in your area? *

Adakah anda sedar akan sistem amaran awal untuk banjir di kawasan anda?

- Yes./ Ya
- No./ Tidak

How effective do you find these early warning systems? *

Sejauh mana berkesannya sistem amaran awal ini menurut anda?

	1	2	3	4	5	6	7	
Very Ineffective./ Sangat Tidak Berkesan	○	○	○	○	○	○	○	Very Effective./ Sangat Berkesan

What is your perception of the most effective early warning system platform *

Apakah persepsi anda terhadap platform sistem amaran awal yang paling berkesan?

- [ ] Siren
- [ ] SMS
- [ ] Whatsapp
- [ ] Radio
- [ ] Television
- [ ] Other...

Section 7 of 12

Flood Impact

Description (optional)

What are the main things you would save during a flood?/ *

Apakah benda utama yang akan anda selamatkan ketika banjir?

- [ ] Important documents./ Dokumen penting
- [ ] Valuables (e.g., jewelry)./ Barang berharga (contohnya, barang kemas)
- [ ] Electronic devices./ Peranti elektronik
- [ ] Household items./ Barangan rumah
- [ ] Pets./ Haiwan peliharaan
- [ ] Other...

What is the estimated loss impact of floods on your property damage?/ *

Berapakah anggaran kerugian impak banjir terhadap harta benda?

- ( ) Less than RM1000
- ( ) RM1001 to RM5000
- ( ) RM5001 to RM10000
- ( ) More than RM10000

What is the estimated loss impact of floods on your business?/

Berapakah anggaran kerugian impak banjir terhadap perniagaan anda?

- Less than 1000 RM
- 1000 - 5000 RM
- 5000 - 10000 RM
- More than 10000 RM

How has flooding affected your health impact (illnesses, injuries, access to healthcare, etc.)?/ *

Bagaimanakah banjir telah menjejaskan kesihatan anda (penyakit, kecederaan, akses kepada penjagaan kesihatan, dan sebagainya)?

	1	2	3	4	5	6	7	
Not Affected at All/ Langsung Tidak Terjejas	○	○	○	○	○	○	○	Extremely Affected/ Sangat Terjejas

What diseases have you or your community faced as a result of flooding?/

Apakah penyakit yang anda atau komuniti anda hadapi akibat banjir?

- [ ] Diarrhea./ Cirit-Birit
- [ ] Skin infections./ Jangkitan Kulit
- [ ] Respiratory infections./ Jangkitan pernafasan
- [ ] Malaria
- [ ] Other...

How has flooding affected your access to essential services such as water supply, electricity, and transportation?/ *

Bagaimanakah banjir telah menjejaskan akses anda kepada perkhidmatan penting seperti bekalan air, elektrik, dan pengangkutan?

	0	1	2	3	4	5	6	7	
Not Affected at All/ Langsung Tidak Terjejas	○	○	○	○	○	○	○	○	Extremely Affected/ Sangat Terjejas

How has flooding affected your security and safety (risk of violence, theft, etc.)?/ *

Bagaimanakah banjir telah menjejaskan keselamatan dan perlindungan anda (risiko keganasan, kecurian, dan sebagainya)?

	0	1	2	3	4	5	6	7	
Not Affected at All/ Langsung Tidak Terjejas	○	○	○	○	○	○	○	○	Extremely Affected/ Sangat Terjejas

Section 8 of 12

Perception towards Climate Change and Expectation towards Nature-Based Solutions (NBS) Programme

Description (optional)

How familiar are you with Nature-Based Solutions for climate adaptation? /

Sejauh mana anda mengenali Penyelesaian Berasaskan Alam Semula Jadi untuk adaptasi iklim?

	1	2	3	4	5	6	7	
Very unfamiliar./ Sangat tidak mengenali	○	○	○	○	○	○	○	Very familiar./ Sangat mengenali

How informed do you feel about the different types of Nature-Based Solutions available?

Sejauh mana anda merasa maklum tentang pelbagai jenis Penyelesaian Berasaskan Alam Semula Jadi yang ada?

	1	2	3	4	5	6	7	
Very uninformed./ Sangat Tidak Maklum	○	○	○	○	○	○	○	Very informed./ Sangat Maklum

Do you believe Nature-Based Solutions can effectively mitigate the impacts of climate change?/

Adakah anda percaya Penyelesaian Berasaskan Alam Semula Jadi boleh mengurangkan kesan perubahan iklim dengan berkesan?

	1	2	3	4	5	6	7	
Strongly Disagree./ Sangat tidak bersetuju	○	○	○	○	○	○	○	Strongly Agree./ Sangat bersetuju

What types of Nature-Based Solutions have you observed or participated in?

Apakah jenis Penyelesaian Berasaskan Alam Semula Jadi yang anda telah perhatikan atau sertai?

- [ ] Green roofs./ Bumbung Hijau
- [ ] Wetland restoration./ Pemulihan tanah bencah
- [ ] Permeable pavements./ Turapan boleh telap
- [ ] Blue-green corridor./ Koridor hijau dan biru

Have you heard about the proposed Nature-Based Solutions project through Penang Nature-Based Climate Adaptation Programme (PNBCAP) to reduce flood risk in Penang?/ *

Adakah anda pernah mendengar tentang projek Penyelesaian Berasaskan Alam (NBS) yang dicadangkan melalui projek Program Adaptasi Iklim Berasaskan Alam Semula Jadi Pulau Pinang (PNBCAP) untuk mengurangkan risiko banjir di Pulau Pinang?

- Yes/ Ya
- No/ Tidak

Do you expect the following benefits of this project?/ *

Adakah anda mengharapkan manfaat-manfaat berikut daripada projek ini?

	Expected/ Dijangkakan	Not Expected/ Tidak Dijangkakan
Reduced risk of flooding in my ne...		
Improved drainage./ Peningkatan...		
Increased green space and recre...		
Educational opportunities about ...		

Do you concern about the following issue related to the proposed NBS project?/ *

Adakah anda bimbang tentang isu berikut yang berkaitan dengan projek NBS yang dicadangkan?

	Concerned/ Bimbang	Not Concerned/ Tidak Bimbang
Disruptions during construction./...		
Maintenance of the NBS infrastru...		
Effectiveness of the NBS solution...		
Potential negative impact on wild...		

How would you rate the availability of information about the project and its benefits to the community?/ *

Bagaimanakah anda menilai ketersediaan maklumat tentang projek dan manfaatnya kepada komuniti?

	0	1	2	3	4	5	6	7	
No Information at All/ Tiada Maklumat Sama Sekali									Many Information Available/ Banyak Maklumat Tersedia

What type of information or resources would help you understand Nature-Based Solutions better?

Apakah jenis maklumat atau sumber yang akan membantu anda memahami Penyelesaian Berasaskan Alam Semula Jadi dengan lebih baik?

- [ ] Detailed guides./ Panduan Terperinci
- [ ] Workshops and training sessions./ Bengkel dan sesi latihan
- [ ] Community demonstrations./ Demonstrasi komuniti
- [ ] Online resources./ Sumber dalam talian
- [ ] Other...

Section 9 of 12

Expectation towards River Quality & Open Space Utilization

Description (optional)

How do you perceive the quality of rivers in your area? *

Apakah persepsi anda terhadap kualiti sungai di kawasan anda?

	1	2	3	4	5	6	7	
Very low quality./ Kualiti yang sangat rendah	○	○	○	○	○	○	○	Very high quality./ Kualiti yang sangat tinggi

How do you think rivers should be used (e.g., for stormwater management only, for community use, for recreation)? *

Bagaimana anda fikir sungai harus digunakan (contohnya, hanya untuk pengurusan air ribut, untuk kegunaan komuniti, untuk rekreasi)?

- [ ] For stormwater management only./ Hanya untuk pengurusan air ribut
- [ ] For community use./ Untuk kegunaan komuniti
- [ ] For recreation./ Untuk rekreasi
- [ ] Other...

How do you currently use open spaces in your community?/ *

Bagaimana anda menggunakan ruang terbuka di komuniti anda sekarang?

- [ ] Recreational activities./ Aktiviti rekreasi
- [ ] Community gatherings./ Perhimpunan komuniti
- [ ] Gardening./ Aktviti berkebun
- [ ] Left unused./ Tidak digunakan

What is your preference for the utilization of open spaces?/ *

Apakah pilihan anda untuk penggunaan ruang terbuka?

- [ ] Maintain green spaces./ Mengekalkan ruang hijau
- [ ] Recreational areas./ Kawasan rekreasi
- [ ] Pocket parks./ Taman poket
- [ ] Community gardens./ Kebun komuniti
- [ ] All mentioned above./ Semua di atas
- [ ] Other...

Do you prefer grey infrastructure (concrete, engineered solutions) or green infrastructure (Nature-Based Solutions)?/ *

Adakah anda lebih memilih infrastruktur kelabu (penyelesaian kejuruteraan konkrit) atau infrastruktur hijau (Penyelesaian Berasaskan Alam Semula Jadi)?

	1	2	3	4	5	6	7	
Strongly prefer grey infrastructure / Sangat memilih infrastruktur kelabu	○	○	○	○	○	○	○	Strongly prefer green infrastructure./ Sangat memilih infrastruktur hijau

How effective do you think Nature-Based Solutions are in reducing flood risks?/ *

Sejauh mana berkesannya Penyelesaian Berasaskan Alam Semula Jadi dalam mengurangkan risiko banjir menurut anda?

	1	2	3	4	5	6	7	
Very ineffective. / Sangat Tidak Berkesan	○	○	○	○	○	○	○	Very effective. / Sangat Berkesan

What additional benefits do you believe Nature-Based Solutions provide (e.g., biodiversity, recreational spaces)? *

Apakah manfaat tambahan yang anda percaya Penyelesaian Berasaskan Alam Semula Jadi dapat berikan (contohnya, biodiversiti, ruang rekreasi)?

- [ ] Increased biodiversity. / Meningkatkan biodiversiti
- [ ] Improved recreational spaces. / Memperbaiki ruang rekreasi
- [ ] Better air quality./ Kualiti udara yang lebih baik
- [ ] Enhanced community well-being./ Kesejahteraan komuniti yang lebih baik
- [ ] Other...

Have you noticed any changes in your community since the implementation of Nature-Based Solutions? *

Adakah anda melihat sebarang perubahan dalam komuniti anda sejak pelaksanaan Penyelesaian Berasaskan Alam Semula Jadi?

	1	2	3	4	5	6	7	
Yes, negative changes / Ya, perubahan positif yang ketara	○	○	○	○	○	○	○	Yes, significant positive changes/ Ya, perubahan negatif

Section 10 of 12

Community Engagement and Participation

Description (optional)

How involved are you in community initiatives related to Nature-Based Solutions? *

Sejauh mana anda terlibat dalam inisiatif komuniti yang berkaitan dengan Penyelesaian Berasaskan Alam Semula Jadi?

	1	2	3	4	5	6	7	
Very uninvolved./ Sangat tidak terlibat	○	○	○	○	○	○	○	Very involved./ Sangat terlibat

Do you think that all members of your community have equal access to the benefits of nature-based flood mitigation measures?/ *

Adakah anda berpendapat bahawa semua anggota komuniti anda mempunyai akses yang sama kepada manfaat langkah-langkah mitigasi banjir berasaskan alam semulajadi?

- ○ Yes/ Ya
- ○ No/ Tidak

What barriers do you face in participating in these initiatives? *

Apakah halangan yang anda hadapi dalam menyertai inisiatif ini?

- ☐ Lack of information./ Kekurangan maklumat
- ☐ Time constraints./ Kekangan waktu
- ☐ Lack of interest./ Kurang minat
- ☐ Other...

What can be done to improve community engagement and participation in Nature-Based Solutions?

Apakah yang boleh dilakukan untuk meningkatkan penglibatan dan penyertaan komuniti dalam Penyelesaian Berasaskan Alam Semula Jadi?

- [ ] Better information dissemination./ Penyebaran maklumat yang lebih baik
- [ ] Community training programs./ Program latihan komuniti
- [ ] Increased awareness campaigns./ Memperbanyakkan kempen kesedaran
- [ ] Other...

Section 11 of 12

Challenges, Improvements, Feedback and Suggestions

Description (optional)

What challenges do you think Nature-Based Solutions face in your area?

Apakah cabaran yang anda fikir Penyelesaian Berasaskan Alam Semula Jadi hadapi di kawasan anda?

- [ ] Lack of funding./ Kekurangan dana
- [ ] Lack of awareness./ Kekurangan kesedaran
- [ ] Technical difficulties./ Kesukaran teknikal
- [ ] Community resistance./ Penentangan komuniti
- [ ] Other...

How can the implementation of Nature-Based Solutions be improved in your community?

Bagaimana pelaksanaan Penyelesaian Berasaskan Alam Semula Jadi boleh diperbaiki dalam komuniti anda?

- [ ] Increased funding./ Peningkatan dana
- [ ] Better education and awareness campaigns./ Kempen pendidikan dan kesedaran yang lebih baik
- [ ] Technical support./ Sokongan teknikal
- [ ] Enhanced community engagement./ Peningkatan penglibatan komuniti
- [ ] Other...

Do you have any other comments or suggestions on how the Penang Nature-Based Climate Adaptation Programme can improve its effectiveness in flood reduction?/

Adakah anda mempunyai sebarang komen atau cadangan lain mengenai bagaimana Program Adaptasi Iklim Berasaskan Alam Pulau Pinang boleh meningkatkan keberkesanannya dalam mengurangkan banjir?

Long answer text

Would you be willing to participate in further consultations or focus groups to discuss strategies for flood management and climate adaptation?/ *

Adakah anda bersedia untuk mengambil bahagian dalam perundingan atau kumpulan fokus untuk membincangkan strategi pengurusan banjir dan penyesuaian iklim?

- Yes (You are required to provide contact information, email or phone number)/ Ya (Anda perlu menyedia...
- No/ Tidak

Section 12 of 12

Contact Information

Please provide us with your contact information, so that we can further collaborate with you. / Sila berikan maklumat hubungan anda untuk dihubungi supaya kami boleh bekerjasama dengan lebih lanjut.

Name/ Nama *

Short answer text

Phone number (e.g., 012345678)/ Nombor telefon *

Short answer text

Email address/ E-mail *

Short answer text

APPENDIX B-

Survey Form (Gender Impact Assessment)

Section 1 of 8

Survey on Penang Nature Based Climate Adaptation Programme (PNBCAP)

Penang faces increasing challenges from floods due to climate change. To address this, a project is being developed that utilizes Nature-Based Solutions (NBS) to reduce flood risk in our community. These NBS solutions can include things like blue-green corridor, rain gardens, green roofs, and restored waterways.

This survey is being conducted to understand your experiences with flooding and your thoughts on the proposed NBS project. The Penang Nature-Based Climate Adaptation Programme (PNBCAP) is committed to promoting gender equality and ensuring that our projects address the needs and concerns of all community members. Your honest feedback is vital to the development of this project, aimed at mitigating flood risks and serving the community equitably across genders. Please be assured that your responses will remain confidential and are solely for research utilization. Should you have any further questions, please reach out to:

Gs. Dr. Nur Suhaili Mansor
+013-3582903
nursuhaili@uum.edu.my

Gender/ *Jantina* *

- Male/ Lelaki
- Female/ Perempuan

Total number of people residing in your household, including relatives, siblings, parents, grandparents, children, etc. /
Jumlah keseluruhan orang yang tinggal di rumah anda, termasuk saudara-mara, adik-beradik, ibu bapa, datuk nenek, anak-anak, dan sebagainya. *

Short answer text

Ethnicity/ *Kaum* *

- Malay/ Melayu
- Chinese/ Cina
- Indian/ India
- Orang Asal (Indigenous ethnic groups)
- Sabah and Sarawak bumiputera
- Others/ Lain-lain

Age / *Umur* *

- 20 years old or less / 20 tahun dan kebawah
- 21 to 30 years old/ 21-30 tahun
- 31 to 40 years old/ 31-40 tahun
- 41 to 50 years old/ 41-50 tahun
- 51 to 60 years old/ 51-60 tahun
- More than 60 years old/ 60 tahun keatas

Marital Status / *Status* *

- Single/ Bujang
- Married/ Sudah Berkahwin

Academic Qualification / *Tahap atau kelayakan akademik* *

- No formal education/ Tiada pendidikan formal
- UPSR or equivalent (Primary school level)/ Sekolah Rendah
- PMR/ SPM/ STPM or equivalent (Secondary school level)/ Sekolah Menengah
- Certificate or Diploma or equivalent/ Sijil atau Diploma
- Bachelor's degree/ Ijazah Sarjana Muda
- Master's degree/ Ijazah Sarjana
- Doctoral degree/ PHD
- Others/ Lain-lain

Employment Sector/ *Sektor Pekerjaan* *

- Government/ Kakitangan Kerajaan
- Private/ Swasta
- Unemployed/ Tidak bekerja

Work Sector/ *Sektor Pekerjaan* *

- Business/ Perniagaan
- Agriculture/ Pertanian
- Manufacturing/ Pembuatan
- Education/ Pendidikan
- Others/ Lain-lain

Average Monthly Income/ *Purata Pendapatan Bulanan* *

- Less than RM1,500
- RM1,501 to RM2,500
- RM2,501 to RM5,000
- More than RM5,000

Residential Area/ *Kawasan Kediaman* *

Short answer text

Section 3 of 8

Gender-Specific Needs and Capacities & Gender-Responsive Project Implementation/ *Keperluan dan Keupayaan Berdasarkan Jantina & Pelaksanaan Projek Responsif Jantina*

This section focuses on the challenges faced by both gender during flooding and the measures needed to ensure the gender equality in this project./

Bahagian ini memberi tumpuan kepada cabaran yang dihadapi oleh kedua-dua jantina semasa banjir dan langkah-langkah yang diperlukan untuk memastikan kesamarataan gender dalam projek ini.

Do you believe that flooding affects men and women differently in your community?/ *

Adakah anda percaya bahawa banjir memberi kesan yang berbeza kepada lelaki dan perempuan dalam komuniti anda?

- Yes/ Ya
- No/ Tidak

Section 4 of 8

Gender Effect Explanation/ Penerangan Mengenai Kesan Gender

If your response to the previous question is 'YES'.

Explain why you believed that the flood impacts are different for men and women./ *

Terangkan mengapa anda percaya impak banjir berbeza untuk lelaki dan perempuan.

Long answer text

Section 5 of 8

Gender Effect Explanation/ *Penjelasan mengenai Kesan Gender*

If your response to the previous question is 'NO'.

Explain why you believe that there are no differences in the impact of floods on men and women./

Terangkan mengapa anda percaya bahawa tidak ada perbezaan dalam impak banjir terhadap lelaki dan perempuan.

Long answer text

Section 6 of 8

Gender Equality Challenges & Needs/ *Cabaran dan Keperluan Kesamarataan Gender*

Description (optional)

Which gender is more affected by the following challenges during flood incidents in your area: men, women, or both equally?/ *

Jantina yang lebih terjejas oleh cabaran-cabaran berikut semasa kejadian banjir di kawasan anda: lelaki, perempuan, atau kedua-duanya sama rata?

	Men	Women	Equally Affected
Lack of access to safe s...	○	○	○
Increased risk of gender...	○	○	○
Limited access to healt...	○	○	○
Loss of livelihood oppor...	○	○	○
Increased responsibilitie...	○	○	○
Physical health issues o...	○	○	○
Mental health issues./ ...	○	○	○
Limited privacy, e.g., sha...	○	○	○
Limited safety, e.g., dark...	○	○	○
Limited sanitary facilitie...	○	○	○
Limited access to mens...	○	○	○
High risk of mortality (d...	○	○	○

What measures do you think should be implemented to address these gender-specific challenges? (e.g., Safe shelter, healthcare access, livelihood support, economic diversification, inclusive decision-making, education & awareness, etc.)/

Apakah langkah-langkah yang sepatutnya dilaksanakan untuk menangani cabaran-cabaran yang khusus kepada gender ini? (contohnya, tempat perlindungan yang selamat, akses kepada penjagaan kesihatan, sokongan mata pencarian, diversifikasi ekonomi, penglibatan dalam membuat keputusan, pendidikan & kesedaran, dan lain-lain)

Long answer text

Do you think the current flood management and climate adaptation measures in your community adequately address the needs of both men and women?/

Adakah anda percaya langkah-langkah pengurusan banjir dan penyesuaian iklim semasa dalam komuniti anda mencukupi untuk menangani keperluan kedua-dua lelaki dan perempuan?

- ○ Yes/ Ya
- ○ No/ Tidak
- ○ Partially/ Secara Separa

What additional measures do you think should be taken to ensure gender equality in flood management and climate adaptation projects?/

Apakah langkah-langkah tambahan yang sepatutnya diambil untuk memastikan kesamarataan gender dalam projek pengurusan banjir dan penyesuaian iklim?

Short answer text

Would you be willing to participate in further consultations or focus groups to discuss gender-responsive strategies for flood management and climate adaptation?/ *

Adakah anda bersedia untuk mengambil bahagian dalam perundingan atau kumpulan fokus untuk membincangkan strategi responsif jantina untuk pengurusan banjir dan penyesuaian iklim?

- ○ Yes / Ya
- ○ No/ Tidak

Section 7 of 8

Contact Information

Please provide us with your contact information, so that we can further collaborate with you. / Sila berikan maklumat hubungan anda untuk dihubungi supaya kami boleh bekerjasama dengan lebih lanjut.

Name / Nama *

Short answer text

Phone number (e.g., 012345678)/ Nombor telefon *

Short answer text

Email address/ E-mail *

Short answer text

Section 8 of 8

Feedback and Suggestions/ Maklum balas dan Cadangan

This section emphasize on feedback and suggestions you may have for future improvement./

Bahagian ini memberi tumpuan kepada maklum balas dan cadangan yang anda ada untuk penambahbaikan pada masa akan datang.

Do you have any other comments or suggestions on how the Penang Nature-Based Climate Adaptation Programme can improve its gender responsiveness?/

Adakah anda mempunyai sebarang komen atau cadangan lain mengenai bagaimana Program Adaptasi Iklim Berasaskan Alam Pulau Pinang boleh meningkatkan responsiviti gender?

Long answer text

APPENDIX C-

Interviewee Details

Bil.	Nama	Jabatan / Agensi / Komuniti	E-Mail	No. Telefon
1	YB Zairil Khir Johari	EXCO Infrastruktur, Pengangkutan dan Digital	vijaychong@penang.gov.my	016 650 8018
2	YB Sim Tze Tzin	Ahli Parlimen Bayan Baru	-	-
3	YB Fahmi bin Zainol	ADUN Pantai Jerejak	helen_ng2004@yahoo.ie	012-595 3889
4	Duri Pantai Jerejak	ADUN	ilfiq@gmail.com	-
5	En. Chan Soon Aun	Ahli Majlis MBPP	-	-
6	En. Lee Seng Hwai	Ahli Majlis MBPP	-	-
7	En. Mohd Zaini bin Ahmad	MPKK Bayan Baru	-	-
8	Pn. Shahrum binti Khamis	MPKK Mayang Pasir	-	-
9	Ng. Soon Aun (Kelvin)	MPKK Jalan Tengah Selatan	kelvinscsan8@gmail.com	-
10	Siti Sahara Ibrahim	MPKK Bayan Baru	ctzainibg@smail.com	011-2136025
11	Ahmad bin Ali	T. Pengerusi Persatuan Penduduk Bayan Baru	ahmadadaptasi@gmail.com	012-4783400
12	Kwan Soo Chen	UN-Habitat	kwansoochien@un.org	017-6695508
13	Nicholas Chay	DUN Batu Maung	-	016-6114544
14	Syed Baharuddin	MPKK Mahsuri	syedbahar@gmail.com	011-23750449
15	Ooi Guat Ngoh	MPKK JTS	gn001777@gmail.com	012-4898472
16	Goh Heng Hooi (Bernard)	MPKK JTS	srithemart@gmail.com	016-4054278
17	Dr. Naganathan Arumugam	RABB	annaga9@gmail.com	017-4757227
18	Syarmimi binti Mohd Yusoff	MPKK BG	miniey1401@gmail.com	017-7777421
19	Shahrun binti Sulaiman	MPKK BG	-	017-8012965
20	Norhafizah bt Khalidi	MPKK BG	-	016-9795571
21	Nur Suhaili Mansor	UUM	nursha@uum.edu.my	013-3582903
22	Nurul Izzah	UUM	nisdah92@gmail.com	019-5024107
23	Idah Pindai Zengeni	UUM	idah798@gmail.com	014-7456204
24	Yong Cheng Keat	Penduduk	mikeckyong@yahoo.com	012-4217924
25	S. Sathu Raman	AJK PersatuanPenduduk	sathu2765@yahoo.com	012-4732256
26	Steven Asokan Pillai	Penduduk	stevenasokan@hotmail.my	019-4338114
27	Billy Khoo	Advisor Mahsuri	kmoobilly@gmail.com	012-6070668
28	Aku Landou	Penduduk	lara4567@gmail.com	019-4154677
29	Samantha	HEM Super Surprises	hemfinance@gmail.com	012-4038688
30	Yeap Chee Soon	CS Motion Art	cs_artwork@yahoo.com	019-4123103
31	Wong Goon Hem	HEM Super Surprise	hem.motor@gmail.com	017-4995089
32	Rasheedi	HEM	-	019-4441928
33	Ngow Siew Yee	Penduduk	-	019-8827218
34	Chong Ah Jeun	Tinted	-	016-4337328
35	Nor Amira Syazwani	Wani Cafe	noramira2688@gmail.com	011-6414961
36	Tan Say Tung	Penduduk	-	012-4686288
37	Lihuan Chee	Penduduk	cissxlihian@gmail.com	012-5567211
38	Tan Chun Liang	Taycan Motor	taycanbayanbaru@gmail.com	012-5564181
39	Roslan Johari	MPKK	-	018-4604692
40	Khoo Beng Kee	KRT Bayan Baru	-	012-4683585
41	Har Koo Fong	KRT Bayan Baru	-	019-5430543
42	Minanwar Basha Khan	RABB	-	019-4167441
43	Jaganathan	Penduduk	-	016-4155305
44	Susila Devi	Penduduk	-	-
45	Billy Per	Penduduk	-	012-5547707
46	Tan Ah	Penduduk	-	014-3387397
47	Ng Chong Weng	Penduduk	-	019-4123626

Annex 3: Letter from the Designated Authority endorsing the change in target sites

KEMENTERIAN SUMBER ASLI DAN KELESTARIAN ALAM
MINISTRY OF NATURAL RESOURCES AND ENVIRONMENTAL SUSTAINABILITY
Blok F11, Kompleks F
Lebuh Perdana Timur, Presint 1
Pusat Pentadbiran Kerajaan Persekutuan
62000 PUTRAJAYA
MALAYSIA

Tel: 603-8000 8000

NRES.700-7/1/7 (2) (S)
24 Februari 2025

The Adaptation Fund Board Secretariat
1818 H Street NW
MSN P4-400 Washington, D.C., 20433 U.S.A.
Fax: +1 (202) 522-3240/5
Email: afbsec@adaptation-fund.org

ENDORSEMENT FOR "NATURE-BASED CLIMATE ADAPTATION PROGRAMME FOR THE URBAN AREAS OF PENANG ISLAND"

With reference to the above matter,

2. In my capacity as Designated Authority (NDA) to the Adaptation Fund in Malaysia, I would like to re-confirm that the aforementioned project, with the proposed changes to the project sites as specified in the attached justification note, is in accordance with the Government of Malaysia's national priorities in implementing climate change adaptation actions to reduce the impacts caused by adverse effects of climate change in Malaysia in particular the island of Penang.

3. Accordingly, I am pleased to re-confirm the endorsement of the above project with support from the Adaptation Fund, implemented by the United Nations Human Settlement Programme (UN-Habitat) and executed by Malaysian entities, namely Penang Island City Council (MBPP), Penang State Department of Drainage and Irrigation (DID) and Think City Sdn. Bhd.

Sincerely,

(DATUK NOR YAHATI BINTI AWANG)
Designated Authority for Malaysia
Deputy Secretary General (Environmental Sustainability)
Ministry of Natural Resources and Environmental Sustainability

SULIT

Annex 4: Revised project document in track changes from UN-Habitat

REQUEST FOR PROJECT/PROGRAMME FUNDING FROM THE ADAPTATION FUND

The annexed form should be completed and transmitted to the Adaptation Fund Board Secretariat by email or fax.

Please type in the responses using the template provided. The instructions attached to the form provide guidance to filling out the template.

Please note that a project/programme must be fully prepared (i.e., fully appraised for feasibility) when the request is submitted. The final project/programme document resulting from the appraisal process should be attached to this request for funding.

Complete documentation should be sent to:

The Adaptation Fund Board Secretariat
1818 H Street NW
MSN P4-400
Washington, D.C., 20433
U.S.A
Fax: +1 (202) 522-3240/5
Email: afbsec@adaptation-fund.org

ADAPTATION FUND

PROJECT/PROGRAMME PROPOSAL TO THE ADAPTATION FUND

PART I: PROJECT/PROGRAMME INFORMATION

Project/Programme Category:	Regular
Country/ies:	Malaysia
Title of Project/Programme:	Nature-based climate adaptation programme for the urban areas of Penang island
Type of Implementing Entity:	Multi-lateral implementing entity
Implementing Entity:	United Nations Human Settlements Programme (UN-Habitat)
Executing Entities:	Ministry of Natural Resources and Environmental Sustainability (NRES)~~Ministry of Environment and Water (KASA)~~[1] Majlis Bandaraya Pulau Pinang (MBPP) Jabatan Pengairan Dan Saliran (JPS) Think City
Amount of Financing Requested:	$US 10,000,000

Project Summary

The main goal of the programme is to enhance urban resilience and reduce human and ecosystem health vulnerability to climate change impacts and extreme weather events by implementing nature-based solutions (NBS) to reduce surface temperatures and storm water runoff. The programme also seeks to increase social resilience and build institutional capacity.

Supported by an extended collaboration between stakeholders at local, regional and national levels (including government agencies, scientific support institutions and civil society), the programme has a strong community-focused approach, engaging with the most vulnerable groups of society in order to assess their main vulnerabilities in a collaborative effort.

The programme will pioneer the use of NBS solutions in Malaysia. It is designed to be demonstrative / proof of concept with a strong knowledge codification component so that it can be scaled in Malaysia and elsewhere in the region. It is structured around the following components:

Component 1: Adaptation to the urban heat island effect through urban greening (USD 3,175,000)

[1] ~~Renaming of **Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) to Ministry of Environment and Water (KASA)** as the National Designated Authority. (changed from Concept proposal)~~ Renaming of **Ministry of Environment and Water (KASA) to Ministry of Natural Resources and Environmental Sustainability (NRES)** as the National Designated Authority.

Component 2: Built projects for storm water and flood management (USD 2,725,000)
Component 3: Comprehensive vulnerability / baseline assessment and action plans in targeted communities (USD 160,000)
Component 4: Strengthening social resilience programme (USD 975,000)
Component 5: Institutional capacity and knowledge transfer platform (USD 1,381,977)

Project / Programme Background and Context Introduction

Penang is a state located in north-western Malaysia, five degrees north of the equator. It has an area of 1,049 km^2 and comprises two local authorities – one covering Penang Island (Majlis Bandaraya Pulau Pinang) and the other the mainland (Majlis Bandaraya Seberang Peral). The former is one of the two major project partners. The state is further divided into five administrative districts which are further divided into mukims (sub-districts). Two urban mukims located on the island – George Town and Bayan Lepas – are the focus of a proposed naturebased solutions (NBS) climate adaptation programme (see Figure 1).

Image 1. View over George Town mukim and the UNESCO World Heritage Site.

Source: Image taken by Think City 2018

The goal of the adaptation programme for the urban areas of Penang Island is to use NBS to 1) reduce climate change impacts (increased temperature and stormwater) including threats to human life, infrastructure and property associated with extreme weather events; and 2) strengthen social resilience and institutional capacity. The programme includes a community-focused approach as well as a strong knowledge transfer component to ensure the methodology can be scaled and adopted in the near future by other cities in Malaysia and the region.

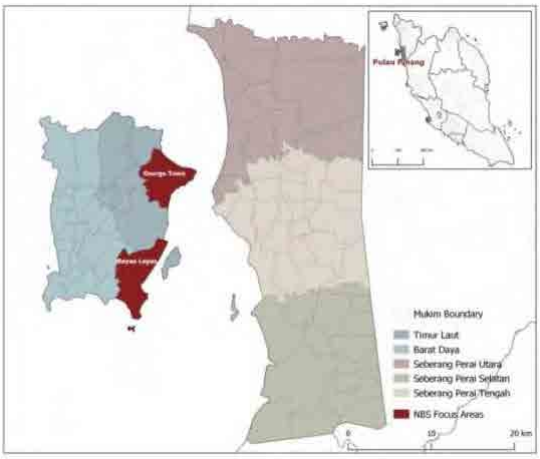


Figure 1: Penang State Administrative Regions and NBS Programme Focus Areas

Socio-economic context

Population

Penang state has an estimated population of 1,767,200, with 809,000 (46%) living on the island and 958,200 (54%) on the mainland, with densities of 26.9 people/ha and 12.8 people/ha respectively[2]. The Timur Laut district is the most densely populated with 45.9 people/ha.

Economy and labour force

Penang's gross domestic product (GDP) in 2018 was RM91.18 million (USD ~21.88 million), contributing 6.7% of national GDP[3]. Annual GDP growth of Penang was 5.1% while GDP per capita was RM52,937 (USD

[2] Department of Statistics Malaysia (2019) *My Local Stats Pulau Pinang*. Putrajaya.
[3] Department of Statistics Malaysia (2019) *My Local Stats Pulau Pinang*. Putrajaya.

~12,703). The economy (Table 1) is driven by an advanced manufacturing sector (including semiconductor, electrical & electronic and medical devices) and services (mainly cultural activities and tourism).

Table 1: Penang's GDP by type of economic activity at constant 2015 prices[4]

	RM million				% share to GDP			
Type of economic activity	**2015**	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**
Agriculture	2,084	1,988	2,032	1,968	2.7	2.4	2.3	2.2
Mining and quarrying	124	135	144	151	0.2	0.2	0.2	0.2
Manufacturing	33,597	35,411	37,426	39,460	43.0	42.9	43.1	43.3
Construction	2,712	2,984	2,689	2,586	3.5	3.6	3.1	2.8
Services	38,917	41,167	43,430	46,115	49.8	49.9	50.1	50.6
Utility, transport & storage and information & communication	8,617	9,468	10,168	10,967	11.0	11.5	11.7	12.0
Wholesale and retail trade, food & beverage and accommodation	12,356	13,061	13,906	14,976	15.8	15.8	16.0	16.4
Finance and insurance, real estate and business services	7,872	8,121	8,395	8,742	10.1	9.8	9.7	9.6
Other services	4,695	4,894	5,118	5,356	6.0	5.9	5.9	5.9
Government services	5,378	5,622	5,844	6,074	6.9	6.8	6.7	6.7
Import duties	712	808	1,017	894	0.9	1.0	1.2	1.0
GDP at purchasers' prices	78,146	82,493	86,738	91,175	100.0	100.0	100.0	100.0

Source: Department of Statistics Malaysia (2019) My Local Stats Pulau Pinang. Putrajaya

Penang's labour force is 849,400 people, with a participation rate of 67.7% (79.5% for men and 55.9% for women) and an unemployment rate of 2.2%[5]. The majority of jobs (95.7%) are located in urban areas. Reflecting GDP contributions, services accounts for 57.0% of jobs, followed by manufacturing 34.5%, construction 6.8%, agriculture, forestry and fishing 1.6%, and mining and quarrying 0.1%.

Income, poverty and vulnerability

The 2016 median monthly household income in Penang was RM5,409 (~USD1,296), 3.5% higher than the national median of RM5,228. There is an urban-rural divide with the median rural household income at 79.6% of urban households (i.e. RM4,365 versus RM5,477). Households on the island earn more than those in the mainland. Penang's Gini co-efficient was 0.356 versus 0.399 nationally.

Penang's households spent the largest proportion of total monthly expenditure on housing, water, electricity, gas and other fuels (RM1,232), amounting to nearly 30% of total expenses. This is followed by food and non-alcoholic beverages (15.9%; RM667.78).

Although Penang has nominal extreme poverty (0.1%), an estimated 10-20% of households are below the World Bank's upper middle-income International Poverty Line set at US$5.50 per day[6]. These households will bear the brunt of climate change impacts as they experience more severe exposure (e.g. working as labourers outdoors) and at the same time have the least capacity to protect themselves from overheating, food shortage and natural hazards such as flooding and drought.

There are several vulnerable communities in Penang island: a) communities living in areas that are flood

[4] Department of Statistics Malaysia (2019) *My Local Stats Pulau Pinang*. Putrajaya.
[5] Department of Statistics Malaysia (2019) *My Local Stats Pulau Pinang*. Putrajaya.
[6] Estimated from Department of Statistics Malaysia (2017) *Household Income and Basic Amenities Survey Report by State and Administrative District, Pulau Pinang 2016.* Putrajaya using the World Bank's upper middle-income International Poverty Line.

prone and coincide with the highest concentration of elderly in Penang; b) Low income groups with no access to air conditioning; c) Women and girls (women are the primary caregivers, which is demonstrated by their low labour force participation rate (59%).

Landuse and environment

Broadly, Penang island has an urban east coast, rural west coast and central green spine. Based on official data from the Department of Town and Country Planning, agriculture has the highest state landuse followed by forest and residential. There are marked differences between island and mainland, with the island being significantly more urbanised, but also having a higher proportion of forest (see Table 2).

Table 2: Penang's Landuse

	Island		Mainland		Total	
Land Use	Hectares	Percentage	Hectares	Percentage	Hectares	Percentage
Water Body	976.7	3.2	4,990.8	6.6	5,970.7	5.6
Forest	13,394.2	43.9	3,625.1	4.8	17,063.2	16.0
Industry	637.0	2.1	3,452.1	4.6	4,091.2	3.8
Infrastructure and Utility	130.0	0.4	771.6	1	902	0.8
Institution and Public Facilities	1,481.4	4.9	3,167.4	4.2	4,653.7	4.4
Commercial	585.1	1.9	1,323.5	1.7	1,910.5	1.8
Beach	18.0	0.1	-	0	18.0	<0.1
Mixed Development	1.7	<0.1	0.2	<0.1	1.9	<0.1
Transport	2,742.8	9.0	6,103.7	8.0	8,855.5	8.3
Agriculture	4,039.7	13.2	32,910.2	43.3	36,963.1	34.7
Residential	4,176.2	13.7	10,979.3	14.5	15,169.2	14.2
Vacant Lot	1,920.9	6.3	7,574.9	10	9,502.1	8.9
Open Space and Recreational Area	417.0	1.4	1,030.5	1.4	1,448.9	1.4
Total Area (Hectare)	3,0520.7	100	75,929.4	100	10,6550.1	100

Source: Department of Town and Country Planning

Images 2a and 2b. Remote sensing (Landsat 8) on land cover for Penang Island shows that in 2019 forest remains the highest (49.1%) though it has declined from 1988 (51.1%). Developed areas have increased from 15.9% in 1988 to 25.8% in 2019. The percentage of agriculture land remains steady at 14.5%, while shrubland and barren land have declined (11.5% to 8.7%; and 7.0% to 2.0% respectively). The significant increase of infrastructure development in Penang island since 1988 has substantially increased paved areas, reducing storm water natural onsite infiltration and contributing to runoff leading to flooding.

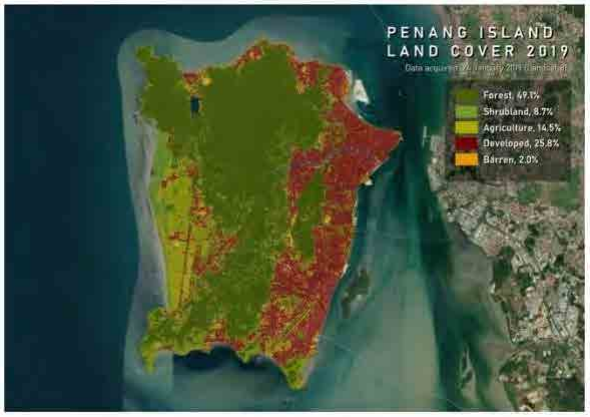
Source: Developed by Think City.

Penang state has 1,447 hectares of gazetted open spaces and recreational areas. Based on population figures for 2017, this equates to 8.3m^2 per capita, well short of the national standard 20m^2 per capita.[7] Based on this standard, the existing spaces are only enough for a population of 723,770 – less than half of Penang's current population. This is equivalent to a deficit of 1,204 ha of green and open space on the island, and 842 ha on the mainland.

Climate change impacts in Penang

Southeast Asia is one of the three regions in the world which will be hardest hit by climate change.[8] The main impacts in Malaysia will be increasing temperatures, increasingly frequent and severe extreme weather events as well as sea level rise.[9] Therefore, the project design and adaptation plans will take into consideration temperature changes and meanwhile the storm water management will consider the climate change and sea level rise in the implementation of the project.

Increasing temperatures will severely impact Malaysia, a country with a tropical rainforest climate and uniformly high temperatures and humidity throughout the year. According to the World Health Organisation, in 2050 the country will experience 200 days per year with heatwaves (in a scenario of a 3°C increase by 2100),[9] compared with 20 days in the 1980s.[10] The impact of temperature rise in Malaysia will be most felt in cities, due to the urban heat island (UHI) effect, which can increase urban temperatures up to 8°C compared to the surrounding natural or rural areas. While the impacts on public health will be high, hospitals in the country currently do not systematically identify (and code accordingly) heat stress or heat stroke, instead registering these health impacts as being of respiratory or cardiac natures.



Changes in weather patterns are already manifesting. The estimates for climate change impact on the Malaysian economy are a 12% reduction of GDP/year in the long term (in a scenario of a 3°C increase by

[7] Think City (2018) Pulau Pinang Green and Open Space Network Study

[8] IPCC (2018) 'Special Report on Global Warming of 1.5°C' [9] NAHRIM (2017) Impact of Climate Change: Sea Level Rise Projections For Malaysia.

[9] An approximate increase of 3°C by 2100 is the current estimation if all unconditional NDCs are implemented, according to the United in Science (2019) *High-level synthesis report of the latest climate science information convened by the Science Advisory Group of the UN Climate Action Summit 2019*.

[10] WHO (2015) 'Climate and Health Country profile for Malaysia'

2100).[11] The same study estimates for Australia a reduction of 1% GDP/year in the long term, 0.6% for the USA and 0.2% for Canada. Consequently, the divide between Malaysia and developed countries' economies will increase. Another study suggests that changes in temperature and rainfall patterns are estimated to lead to a crop yield reduction of between 10 and 15%.[12] This will likely lead to an increase in food costs, which tend to impact disproportionately more vulnerable communities. This programme introduces concrete adaptation strategies and projects in order to reduce these impacts, as well as to increase social resilience and build institutional capacity.

The programme will also set the foundation for future complementary climate adaptation strategies in a wider context. For example, to build upon the body of work of this proposal, an in-depth study of the impacts of sea-level rise in Penang state as well as the opportunities of ecosystem-based adaptation can be pursued to complement this programme. A parallel and/or subsequent funding application to the Global EbA Fund for impact assessments and vulnerability studies to guide appropriate adaptation measures is being developed.

Temperatures

Table 3 shows the magnitude of changes of annual and monthly mean temperatures at Bayan Lepas climate station during the 1951-2018 period. A significant increasing trend was found in both the annual and monthly mean temperatures from 1951 to 2018 at 95% confidence level, with magnitudes ranging from 0.18 to 0.27 °C/decade. The mean temperature (°C) increase from 1951 to 2018 is 1.50°C.

Table 3: Changes in mean temperature from 1951 to 2018 at Bayan Lepas station (trend at a 95% significance level)

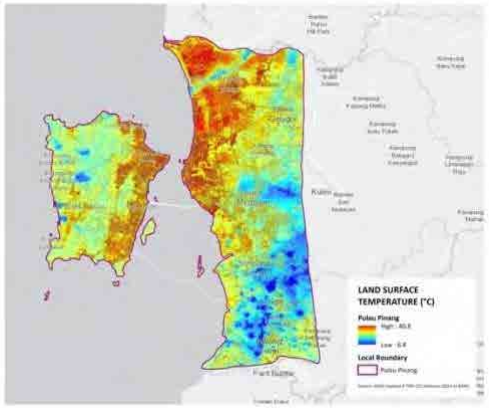
	Mean Temp Change (°C)
Jan	**1.53**
Feb	**1.50**
Mar	**1.66**
Apr	**1.24**
May	**1.45**
Jun	**1.71**
Jul	**1.86**
Aug	**1.52**
Sep	**1.38**
Oct	**1.34**
Nov	**1.50**
Dec	**1.34**
Annual	**1.50**

Source: Produced by the USM's Climatology department, 2019

Image 3. Remote sensing (Landsat 8) for surface temperatures in Penang island. Urban areas are significantly higher than neighbouring natural or rural areas by approximately 8°C due to the urban heat island effect.

[11] Kompas, T., Pham, V. H., & Che, T. N.(2018). The effects of climate change on GDP by country and the global economic gains from complying with the Paris Climate Accord. Earth's Future,6, 1153–1173. https://doi.org/10.1029/2018EF000922

[12] Firdaus, R.B., Latiff, I.A., Borkotoky, P. (2012) 'The impact of climate change towards Malaysian paddy farmers', *Journal of Development and Agricultural Economics,* 5(2), pp. 57-66 doi: 10.5897/JDAE12.105



Source: Image retrieved by Think City, 2019

Rainfall and flooding

Rainfall has been increasing and is predicted to increase further for all peninsular Malaysia. [13]

Table 4. Observed and projected rainfall in Malaysia

Parameter	Observed (1970 - 2000)	Projected for 2030	Projected for 2050
Average Annual Rainfall			
Peninsular Malaysia	1891 – 2619 mm	1998 – 2663 mm (1 to 6 % increase)	2068 – 2805 mm (7 to 11 % increase)

Source: Malaysia Third National Communication and Second Biennial Update Report to the UNFCCC (2018)

With an average annual rainfall for the past decade of 2,434mm, flooding is a major issue in Penang. In the past decade the average annual rainfall from 2010 to 2018 has seen an unusual high increase of 29.6% (Table 5) above NAHRIM's projections.

A combination of increased urbanisation, heavy rain and high tide inevitably results in floods as storm waters are unable to discharge into the sea or infiltrate into the ground table. These two factors, expanding built areas resulting in reduced stormwater absorption capacity and increased volume of rain combined with yet a third factor, decaying infrastructure, inevitably lead Penang island to become increasingly exposed and sensitive to flooding.

Table 5. Average annual rainfall for Penang island (2010-2018) showing an increasing trend.

[13] Ministry of Energy, Environment, Science, Technology and Climate Change (2018) *Malaysia Third National Communication and Second Biennial Update Report to the UNFCCCs*

Year	Average Annual Rainfall (mm)
2010	2088.65
2011	2260.38
2012	2359.86
2013	2519.10
2014	2389.98
2015	2453.13
2016	2493.41
2017	2642.25
2018	2706.76

Source: Data provided by JPS.

Increased rainfall and changes in patterns are already causing significant damage in Penang. In 2016, 47 cases of floods, many of them flash floods, were reported, with the most urbanised districts - Seberang Perai Tengah (mainland) and Timur Laut (island) - reporting the highest occurrence (19 and 12 cases respectively).[14] This is evidence that the capacity of drainage infrastructure in urban areas is unable to cope with increasing rain intensity and putting human life, property and the economy at risk.

In November 2017 Penang was hit by its worst recorded floods, with 7 lives lost and half of urban areas submerged. A total of 159 areas reported being affected by floods, 68 of had never previously flooded.[16] Losses to manufacturing were estimated at RM200 million and RM300 million (~USD 48 to 72 million).[17] It also impacted 2,626 farmers and 3,464 hectares of agricultural land, with a total economic loss estimated of approximately RM5.7 million (~USD 1.37 million) . In the fisheries sector, the estimated losses were of approximately RM57.5 million (~USD 13.8 million).[15]

Public health

The consequences of rising temperatures and more extreme weather associated with climate change now have immediate health consequences.[19] [16] [17] In Malaysia, this includes heat-stress related illness, injury from floods and storms, impacts on mental health due to loss of property and life, increased allergies due to weather changes, increased vector and water-borne diseases and potential malnutrition due to related to food insecurity.

There is research in Malaysia showing the impact of climate change on heat-related illnesses[18] and the growing threat of vector or water-borne diseases such as dengue, leptospirosis,[19] chikungunya and others.[20] A 2016 study revealed a potential increase of malarial cases by 15% with the rise in ambient temperature by 1.5°C in 2050 and positive correlation between rainfall and dengue and postulated that increased rainfall and surface temperature favoured the propagation and spread of dengue[21]. In Penang there has been a notable increase in dengue cases in recent years (Table 6) which supports that under current climate predictions the incidence of dengue and other vector or water-borne diseases is extremely likely to increase.

Table 6: Number of cases for major communicable diseases reported in Penang, 2012-2016.

[14] Jabatan Pengairan dan Saliran Malaysia (2018) *Laporan Banjir Tahunan Bagi Tahun 2016/2017* [online]. Available at: http://h2o.water.gov.my/man_hp1/Banjir_Tahun1617.pdf (Accessed: 7 November 2019)

[15] Penang Institute & Economic Planning Division, Penang (2019) *Penang Economic and Development Report 2017/2018.* George Town, Penang: Penang Institute. [19] Watts, N., Adger, W.N., Agnolucci, P., et al. (2015) "Health and climate change: policy responses to protect public health", The Lancet, Vol. 386 pp.1861-914 accessed on https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(15)60854-6.pdf

[16] Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Belesova, K., Boykoff, M., Byass, P., et al. (2019), "The 2019 report of The Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate", *The Lancet*, Vol. 394 No. 10211, pp. 1836–1878.

[17] Beggs, P.J., Zhang, Y., Bambrick, H., Berry, H.L., Linnenluecke, M.K., Trueck, S., Bi, P., et al. (2019), "The 2019 report of the MJA Lancet Countdown on health and climate change: a turbulent year with mixed progress", *Medical Journal of Australia*, p. mja2.50405.

[18] Mansor, Z. Ismail, N.H., Ismail, R., Hashim, J.H. (2019), "Thirst as the threshold symptom to prevent worsening heat-related illness", *Medical Journal of Malaysia*, Vol. 74 No. 1, accessed online http://www.e-mjm.org/2019/v74n1/heat-related-illness.pdf

[19] Garba, B., Bahaman, A.R., Bejo, S.K., Zakaria, Z., Mutalib, A.R. and Bande, F. (2018), "Major epidemiological factors associated with leptospirosis in Malaysia", *Acta Tropica*, Elsevier, Vol. 178 No. September 2017, pp. 242–247.

[20] Servadio, J.L., Rosenthal, S.R., Carlson, L. and Bauer, C. (2018), "Climate patterns and mosquito-borne disease outbreaks in South and Southeast Asia", *Journal of Infection and Public Health*, King Saud Bin Abdulaziz University for Health Sciences, Vol. 11 No. 4, pp. 566–571.

[21] Tang, K.H.D. (2019), "Climate change in Malaysia: Trends, contributors, impacts, mitigation and adaptations", *Science of the Total Environment*, Elsevier B.V., Vol. 650 No. September, pp. 1858–1871.

Disease	2012	2013	2014	2015	2016
Dengue fever/Dengue hemorrhagic fever	791	1,053	3,141	5,830	2,756
Tuberculosis (all forms)	1,245	1,230	1,252	1,283	1,385
Measles	245	153	53	11	7
HIV infections (all forms)	137	111	110	103	105
Food poisoning	360	556	2,227	497	609
Hepatitis B	40	21	13	33	20
Syphilis (all forms)	87	95	57	63	57
Malaria	37	39	37	17	3
Hand, foot and mouth disease	1,579	1,205	1,449	758	3,019
Typhoid and paratyphoid fever	2	6	6	8	4
Leptospirosis	128	98	192	140	43
Influenza	216	785	380	642	-

Source: 2016 Annual Report, Penang State Health Department, Malaysia

[16] Penang Institute & Economic Planning Division, Penang (2019) *Penang Economic and Development Report 2017/2018.* George Town, Penang: Penang Institute. [17] Federation of Malaysian Manufacturers Penang, cited in The Star (2019) '1,000 companies lose RM300mil to Penang floods', *The Star*, 10 November 2017 [online]. Available at: https://www.thestar.com.my/business/business-news/2017/11/10/1000-companies-lose-rm300mil-to-penang-floods (Accessed: 7 November 2019)

The severity of the health impact is not just determined by the level of exposure (e.g. larger mosquito population) but also the sensitivity and adaptive capacity of the individuals or the community.[22] An outdoor worker (high exposure) with diabetes (higher sensitivity) who does not have the financial resources for air conditioning at her home or pay for higher medical bills (low adaptive capacity) would experience a very high vulnerability of her health due to climate change.

Despite the evidence, there is very limited awareness among the community and health practitioners.[23] As a result, climate related illnesses are not systematically diagnosed as such or wrongly coded. As a result, less accurate statistics severely limits the preparedness of the health system. Additional research and capacity building is therefore required to fill the large knowledge gaps in the Malaysian public health system.

Rationale for the selection of focus areas

Two sub-districts or mukims have been selected as focus for the first phase of the nature-based climate adaptation programme for the urban areas of Penang island. They have been selected based on a combination of their likely climate change impacts, land use and community vulnerabilities.

- **George Town** is the state's capital. The total area is 2,501 ha. As of the last census (2010) it had a population of 198,298, the equivalent of 79 people / ha. Land uses comprise a combination of residential, commercial and mixed-use shop lots. UNESCO listed the historical centre of George Town as a World Heritage Site in 2008. It is highly vulnerable to both increasing heat and flooding. George Town mukim is particular vulnerable due to having a significant floodprone area coinciding with a high concentration of population of elderly people of 21% (41,000), which is above national average (14%) .
- **Bayan Lepas** is a larger area (2,898 ha) comprising Penang's airport and a large manufacturing zone. As of the last census it had a population of 122,654, the equivalent of 42 people / ha. As evident in Images 2a and 2b (page 7), the mukim has significantly urbanized in the last decade. While not as prone to severe flooding, it suffers from increased urban heat island effect, as verified

[22] Turner, B.L., Kasperson, R.E., Matson, P.A., McCarthy, J.J., Corell, R.W., Christensen, L., Eckley, N., et al. (2003), "A framework for vulnerability analysis in sustainability science", *Proceedings of the National Academy of Sciences*, Vol. 100 No. 14, pp. 8074– 8079.
[23] See footnote no 18 (Watts, 2019)

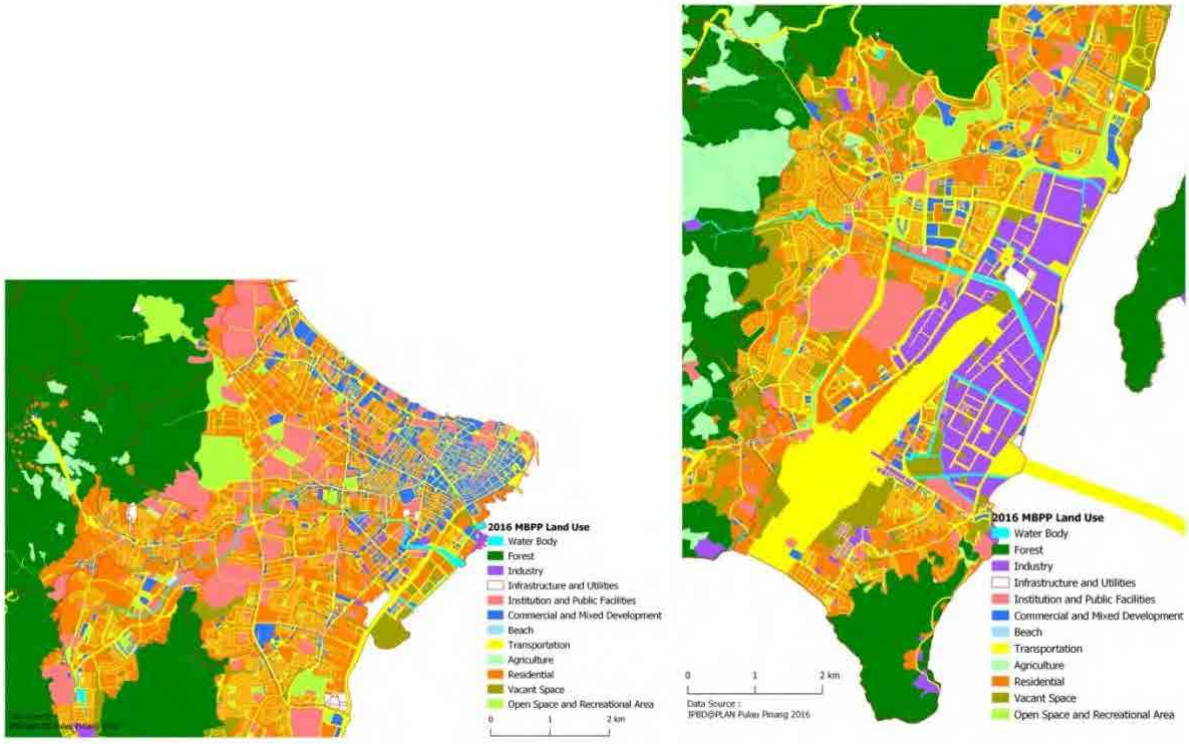
by remote sensing surface temperatures. The presence of global electronic firms offers an opportunity for co-investment in greening the industrial estate.

Table 7: George Town and Bayan Lepas Mukim Population Data (2010)

2010 population	0-14 years		15-64 years		65 years plus		Total
Penang State	352,975	23%	1,074,902	70%	98,447	6%	1,526,324
George Town Mukim	35,515	18%	143,700	72%	19,083	10%	198,298
Bayan Lepas Mukim	28,801	23%	88,020	72%	5,833	5%	122,654

Source: JPBD, 2010

Images 4a and 4b. Landuse of the George Town and Bayan Lepas mukims. George Town (left) has a significant residential land use on the outskirts and a commercial and mixed-use city core, which is now listed as a UNESCO World Heritage Site. Bayan Lepas (right) is a newer area comprising an industrial manufacturing zone, airport and residential areas.



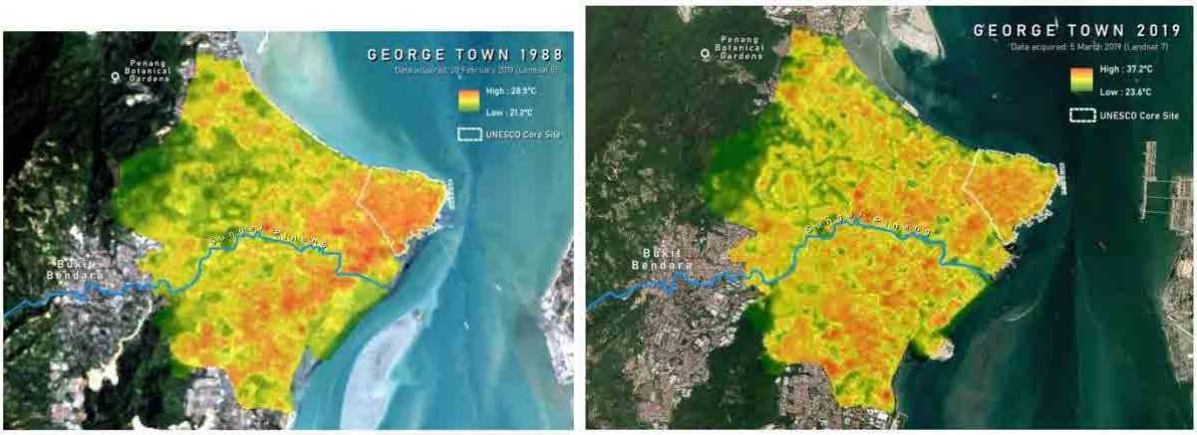
Source: JPBD, 2016. Land use for Georgetown (4a, left) and for Bayan Lepas (4b, right).

Urban Health Island Effect

Both the George Town and Bayan Lepas mukims have significant and increasing heat island effects (Images 5a, 5b, 6a & 6b).

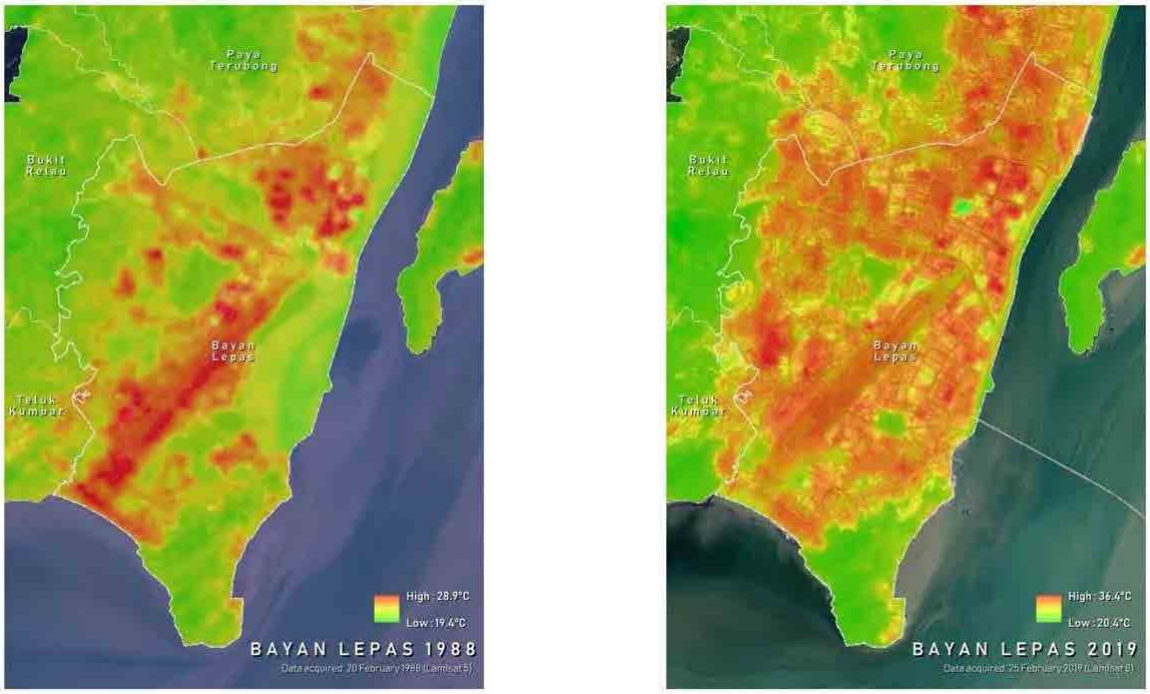
Images 5a and 5b. Remote sensing (Landsat 8) data on surface temperatures in 1988 and 2019 shows a stark increase for George Town Mukim: the temperature range in 1988 has a

minimum of 21.2°C and a maximum of 28.5 °C but in 2019, the minimum is of 23.6°C and the maximum of 37.2°C. The increase in surface temperature in 31 years is of 8.7°C and 2.4°C maximum and minimum temperatures respectively.



Source: Images retrieved by Think City.

Images 6a and 6b. Remote sensing (Landsat 8) data on surface temperatures in 1988 and 2019 shows a stark increase for the Bayan Lepas Mukim: the temperature range in 1988 has a minimum of 19.4°C with a maximum of 28.9°C but in 2019, the minimum is of 20.4°C and the maximum of 36.4°C. The increase in surface temperature in 31 years is of 7.5°C and 1°C maximum and minimum temperatures respectively. The impact of recent urbanisation is very visible by the expanding warming areas which coincide with built up areas.



Images 7a, 7b, 7c, 7d. Thermal imagery of George Town streets highlights the impact of materials and shading on surface temperatures. Images 7a and 7c (taken at similar times) show a marked difference in temperatures in shaded areas and bitumen road surfaces. Image 8c is taken in the George Town World Heritage Site, which is significantly hotter than other urban areas.

Source: Images taken by Think City.

Flooding

The George Town Mukim in one of the island's main flood prone areas, mostly concentrated upstream from the Penang River.

Image 8. Flood risk for George Town mukim.

Source: RBM (2018) Flood mitigation report for Penang island.

Focus of the proposal

The focus of the programme is to enhance urban resilience and reduce human and ecosystem health vulnerability to climate change impacts and extreme weather events by implementing nature-based solutions to reduce surface temperatures and storm water runoff, as well as to increase social resilience and build institutional capacity. It is a result of the identification of the most significant climate impacts to the urban areas of Penang island: increased rainfall leading to flooding and increased temperatures leading to public health impacts.

Supported by an unprecedented collaboration between stakeholders at local, regional and national levels (including government agencies, scientific support institutions and civil society), the programme has a strong community-focused approach, engaging with the most vulnerable groups of society in order to assess their main vulnerabilities in a collaborative effort (including vulnerable groups, women, disabled, and low income people - designated as B40 in Malaysia,

i.e. the bottom 40% of Malaysian households by income).

Table 8. Summary of target locations and vulnerabilities

Location	Critical infrastructures	Community	Climate hazards	Underlying vulnerability
George Town mukim (sub-district)	George Town World Heritage Site Cruise and ferry terminal Roads	Ethnically diverse Culturally rich Mixed income	Flooding Storm surge High urban heat island effect/ extreme heat	Traditional communities High proportion of poor housing conditions presence of low income families living in heritage areas Above average concentration of elderly population of 21% (41,000) on flood-prone area
Bayan - Lepas mukim (sub district)	High-tech manufacturing zone International Airport Roads Bridges	Middle income families High proportion of migrant workers High tech manufacturing cluster of industries Supporting SMEs	High urban heat island effect	Manufacturing workers (migrant) school High concentration of c children (percentage of 15%)

Project / Programme Objectives:
Goals

The main goal of the programme is to enhance urban resilience and reduce human and ecosystem health vulnerability to climate change impacts and extreme weather events by implementing nature-based solutions in order to improve stormwater management to reduce flooding, as well as improving microclimatic regulation, reducing the urban heat island effect and overall temperatures.

The programme seeks also to improve social resilience (with a particular focus on the most vulnerable communities) and to build institutional capacity.

Adopting a comprehensive approach in which a diversified set of components (i.e. urban greening, urban agriculture, public health) is implemented in one specific location reflects the acknowledgement of the complexity and interrelation of the multiple coexisting environmental and social dimensions. It will also allow to develop the programme as a pilot project which can

be scaled in other cities in Malaysia and Southeast Asia.

Objectives

Community-level

1) To support the implementation of nature-based solutions to reduce flooding and the urban heat island effect (UHI) and overall temperatures.
2) To strengthen the capacity of local Social Risk Screening communities to respond to extreme weather events by raising awareness and capacity development training.

Ward-level

3) To support the implementation of resilience concrete actions that target women, youth and other vulnerable communities. 4) To promote urban agriculture and food security at different levels, including training.

City-level

5) To reduce overall temperatures (due to reducing the UHI effect).
6) To reduce incidence and severity of flooding and damage to infrastructure and private property.
7) To strengthen institutional capacity and coordination between different stakeholders in climate-related issues, improving response to extreme weather events.

National level

8) Development of the first municipal climate change adaptation programme, providing reference and methodology (as well as specific tools), for other cities in Malaysia to adopt, via the knowledge transfer platform.
9) Development of the list of climate-resilient street trees for Malaysia (developed together with Jabatan Landskap Negara, the National Institute of Landscape Architecture and Botanical Experts).
10) Development of a public health programme which will include a pilot project to monitor heat related illness in selected hospitals in Penang (as there is no systematic identification of heat related illness in hospitals in Malaysia) providing reference and methodology (as well as specific tools), for other cities in Malaysia to adopt.

Project / Programme Components and Financing

Table 9. Programme components and financing

Project/Programme Components	Expected Concrete Outputs	Expected Outcomes	Amount (US$)
Component 1. Adaptation to the urban heat island effect through urban greening (*Adaptation Fund Outcome 5: Increased ecosystem resilience in response to*	Output 1.1. New tree-line streets / Connected canopies constructed	Outcome 1.1. Reduction of overall urban atmosphere temperatures by 1°C 5-7 years after project completion	775,000
	Output 1.2. Pocket parks / vacant	Outcome 1.2. Reduction of hard surfaces, resulting in the	950,000

climate change and variability induced stress and also addresses Outcome 4 Increased adaptive capacity within relevant development sector services and infrastructure assets)	spaces constructed	reduction of the urban heat island effect in the city	
	Output 1.3. Green parking spaces constructed	Outcome 1.3. Reduction of hard surfaces and increased shading, hence reducing the urban heat island effect in the city	625,000
	Output 1.4. Green facades constructed (Built structures greening)	Outcome 1.4. Reduction of temperatures in the streets and inside buildings Storm water retention on rooftops reducing flooding	200,000
	Output 1.5. Green rooftops constructed (Built structures greening)	Outcome 1.5. Reduction of temperatures in the streets and inside the buildings	225,000
	Output 1.6. Urban agriculture programme initiated	Outcome 1.6. New urban agriculture gardens are incorporated in the city Training sessions will take place in a total number of (4/month) 240 sessions in total	400,000
Component 2 . Built projects for storm water and flood management (*Adaptation*	Output 2.1 Blue-green corridors developed	Outcome 2.1. Reduced exposure of Penang state to storm water and flooding	1,385,0001~~,550,000~~

Fund Outcome 5: Increased ecosystem resilience in response to climate change and variability induced stress	Output 2.2. New ~~upstream~~ retention ponds constructed	Outcome 2.2. Reduced exposure of Penang state to storm water and flooding	1,195,000~~725,000~~
	Output 2.3. Swales and infiltration wells restored and constructed	Outcome 2.3. Reduced exposure of Penang state to storm water and flooding	145,000~~450,000~~
Component 3. Comprehensive vulnerability / baseline assessment and action plans in targeted communities *Adaptation Fund Outcome 1: Reduced exposure to climate-related hazards and threats*	Output 3.1. Capacity development support for vulnerability assessment and climate change related planning provided to the two mukims.	Outcome 3.1. Increased capacity of participatory and inclusive assessments focusing on vulnerable and disadvantaged communities to improve social resilience through inclusive environment.	160,000

Component 4. Strengthening social resilience *Adaptation Fund Outcome 3: Strengthened awareness and ownership of adaptation and climate risk reduction processes at local leve*	Output 4.1. School-level awareness programme developed and implemented	Outcome 4.1. Increased school building resilience, greater levels of knowledge and awareness among students, teachers and educational authorities.	575,000
	Output 4.2. Women and girls programme developed and implemented	Outcome 4.2. Reduced gender vulnerability asymmetries	400,000
Component 5. Institutional capacity and knowledge transfer platform *Adaptation Fund Outcome 2: Strengthened institutional capacity to reduce risks associated with climate-induced socioeconomic and environmental losses*	Output 5.1. Communications and knowledge platform developed and implemented	Outcome 5.1. Project implementation to be fully transparent. Information of strategies and projects to be made available to other municipalities in Malaysia and in the Southeast Asia region for replication.	550,000
	Output 5.2. Penang Climate Board created	Outcome 5.2. A unit created in connection to the municipality will monitor and evaluate all climaterelated risks, addressing the problem from with a fully comprehensive perspective	285,000
	Output 5.3. Climate relatedpublic health programme developed and initiated	Outcome 5.3. Comprehensive public health programme, including pilot project monitoring heat related illness in selected hospitals in Penang	546,977
6. Project/Programme Execution cost			799,613
7. Total Project/Programme Cost			9,216,590
8. Project/Programme Cycle Management Fee charged by the Implementing Entity (if applicable)			783,410
Amount of Financing Requested			10,000,000

Projected Calendar: Table
10. Programme calendar

Milestones	Expected Dates
Start of Project/Programme Implementation	November 2021
Mid-term Review (if planned)	December 2023
Project/Programme Closing	December 2025
Terminal Evaluation	September 2026

PART II: PROJECT / PROGRAMME JUSTIFICATION

A. Programme components

Climate change impacts in the urban areas of Penang island have been accelerating in the past decades. Even though sea level rise is not at threatening levels, increasing temperatures, rainfall and number of extreme weather events leading to flooding are threatening the island and its inhabitants' safety, future development and prosperity. It is necessary to implement adaptation measures and projects which can help overcome these challenges.

Nature-based solutions (NBS) have recently highlighted as a key concept in policy and management for achieving alignment of environmental and societal goals.[28] Having been found to be a possible major solution for climate change, they are now recommended for implementation at a global scale,[24] being supported by multiple international organisations, as is the case with the UN. The benefits extend beyond climate change, as nature-based solutions' impact is multifunctional, being advantageous at many different levels, such as social, public health, biodiversity and financial, having been proven to be highly beneficial in terms of costbenefit ratios.

In cities, NBS have an instrumental role to play in transitioning to a more liveable and sustainable future high-density model.[25] The introduction of green spaces (particularly strategically placed street trees) have been proven to be the most effective strategy to control rising temperatures[26]. In fact, the introduction of vegetation can play an important role in changing the urban climate closer to a state prior to climate change impacts.[27]

Analysis and planning play an important role, as green spaces must be introduced in strategic locations to achieve optimised results, taking advantage of parameters such as solar orientation, air circulation and others. Strategic planning includes choosing the most beneficial typology of space, planting and species, in general as well as for each specific location; for street trees, leaf organisation and canopy shape have in general the biggest impact (sparse crowns with large leaves have a higher cooling capacity)[28]. Tropical Southeast Asia has some particular advantages in terms of NBS implementation due to its climate, as vegetation growing ratios are significantly higher than for other climates.

Street trees' impact is particularly relevant in the urban context, as they require limited area at ground level and provide the broadest protection from radiation exposure to people, animals, structures and its materials, hence reducing the UHI effect.[29] Even just a few trees have been proven to significantly reduce excessive heat.[35] The positive impact of green spaces in urban contexts is well documented also in terms of public health. They provide cooling effects that can contribute to reduce stress factors that stem from overheating, leading to health-related impairments that may result in increased mortality rates.[36] They have also been proven to

[28] Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). *Nature-based Solutions to address global societal challenges*. Gland, Switzerland: IUCN. xiii + 97pp

[24] Griscom, B., Adams, J., Ellis, P., Houghton, R., Lomax, G., Miteva, D., Schlesinger, W., Shoch, D., Siikamäki, J., Smith, P., Woodbury, P., Zganjar, C., Blackman, A., Campari, J., T Conant, R., Delgado, C., Elias, P., Gopalakrishna, T., R Hamsik, M., Fargione, J. (2017). 'Natural climate solutions'. *Proceedings of the National Academy of Sciences*. 114 (44) 11645-116

[25] Emilsson, T. and Sang, A.O. (2017) 'Impacts of Climate Change on Urban Areas and Nature-Based Solutions for Adaptation' in Kabisch, N., Korn, H. Stadler, J. & Bonn, A. (eds) *Nature-based Solutions for Climate Adaptation in Urban Areas. Linkages between Science, Policy and Practice*. Springer Open, pp. 15-27

[26] Kardan, O., Gozdyra, P., Misic, B., Moola, F., Palmer, L.J., Paus, T., Berman, M.G. (2015) 'Neighborhood greenspace and health in a large urban center'. *Nature – Scientific Reports*. 5, 11610–11610.

[27] Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). *Nature-based Solutions to address global societal challenges*. Gland, Switzerland: IUCN. xiii + 97pp

[28] Leuzinger S, Vogt R, Körner C (2010) 'Tree surface temperature in an urban environment'. *Agric For Meteorol* 150(1). pp. 56–62.

[29] Lenzholzer, S. (2012) 'Research and design for thermal comfort in Dutch urban squares'. *Resources, Conservation and Recycling*, 64, pp.39-48. [35] Lindén, J., Fonti, P., Esper, J. (2016) 'Temporal variations in microclimate cooling induced by urban trees in Mainz, Germany'. *Urban Forestry & Urban Greening*, 20, pp.198209

reduce obesity, cardiovascular diseases, blood pressure, respiratory diseases and diabetes.[30] Additional benefits include the improvement of social cohesion, economic and aesthetic added values. [31]

Microclimate regulation achieved by planting green spaces will furthermore reduce the impact of heat waves[32], which will significantly increase in Malaysia. The UHI effect in Penang can be observed in Image 3, p.9 clearly showing the correspondence of higher temperatures with more densely built areas.

The UHI effect and overall temperatures' reduction achieved by the introduction of green spaces, in particular street trees, is supported not only by the extensive research mentioned above but by several projects. Such is the case with the Medellin NBS project, where local authorities have planted green corridors along 18 roads and 12 waterways and reduced temperatures in more than 2°C, in some cases reaching 3°C[33], winning the Ashden award, *Cooling by Nature*.

Adaptation strategies addressing flooding are urgent for Penang. Studies[34] have recommended the increase of green spaces for stormwater retention, as well as the creation of a linear park with retention areas in the Pinang River. However, a more flexible approach to stormwater management is needed to address the challenges associated with changes in rainfall patterns. City managers need to introduce a more resilient approach combining soft and hard infrastructures. A sustainable drainage systems' approach is behind the concept of the spongecity, which has achieved remarkable results in reducing floods.[35]

For this to be achieved, research has shown the need to address biophysical uncertainties (e.g. soil absorption, groundwater table level fluctuation). The way to address these uncertainties is to develop research and implement seasonal stormwater retention upstream areas, as well as swales and infiltration wells downstream and monitoring their impact in flood mitigation.

This programme aims to introduce a climate-conscious approach in the design of green spaces in the urban areas of Penang (either public or private), in which concerns regarding reducing temperatures and seasonally storing storm water will be an integral part of the process.

All of the project's proposed outcomes take into account sustainability; in terms of nature-based solutions, both financial and environmental sustainability, as these are far more cost-effective than existing alternatives, and mitigate climate change by sequestering carbon and ensure community/city ownership. The knowledge management component also promotes both financial and environmental sustainability at a national level. In terms of sustainable investments, demonstrating to the government its cost-effectiveness in Penang and other cities while likely promote their implementation by these entities from existing budgets.

[30] Ulmer, J.M., Wolf, K.L., Backman, D.R., Tretheway, R.L., Blain, C.J.A., O'Neil-Dunne, J.P.M., Frank, L.D. (2016), 'Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription'. *Health & Place*, 42, pp.54-62.

[31] Soares, A.L., Rego, F.C., McPherson, E.G., Simpson, J.R., Peper, P.J., Xiao, Q. (2011) 'Benefits and costs of street trees in Lisbon, Portugal'. *Urban Forestry & Urban Greening*, 10, pp.69-78.

[32] Lindén, J., Fonti, P., Esper, J. (2016) 'Temporal variations in microclimate cooling induced by urban trees in Mainz, Germany'. *Urban Forestry & Urban Greening*, 20, pp.198-209

[33] https://www.ashden.org/winners/alcald%C3%ADa-de-medell%C3%ADn

[34] DRR – Team Mission Report Malaysia (2018), Kingdom of the Netherlands.

[35] Chan F.K.S., Griffiths, J.A., Higgitt, D., Xu, S., Zhu, F., Tang, Y., Xu, Y., Thorne, C.R., (2018) '"Sponge City" in China—A breakthrough of planning and flood risk management in the urban context', Land Use Policy, 76, pp. 772-778 https://doi.org/10.1016/j.landusepol.2018.03.005

Remote sensing

To develop the plans, it is necessary to identify the most heat stressed areas, which can be achieved using remote sensing. As the main cause of UHI is the composition of land surfaces, linking Land Surface Temperatures (LST) and land cover data can substantially assist naturebased cooling strategies as they can quantify and predict direct and indirect cooling benefits of green spaces[36]. Climatic fluctuations and anomalies will be observed and analysed using chronological remote sensing as well as observing recorded anthropogenic impacts, which play significant roles in regional, national and global climate adaptation, planning, mitigation and projection. Attaining high-resolution remote sensing data will enable the identification of buildings and neighbourhoods which exacerbate the UHI effect. This will allow for targeted intervention, introducing green spaces and promoting air flow in the most heat stressed areas.

Scenario and impact modelling (to be developed by the National Hydrological Institute Malaysia (NAHRIM) and local university Universiti Sains Malaysia (USM) experts will also assist in developing the detailed plans.

Remote sensing will, therefore, be used in this programme at three different levels: 1) identifying the most heat stressed urban areas as priorities for intervention; 2) monitoring the development of the pilot projects in order to identify the most effective strategies for replication - research through design (RTD); 3) monitoring and evaluation of the programme's impacts.

The programme's components are as follows

Component 1: Adaptation to the urban heat island effect through urban greening

This component focuses on reducing the impact of increasing temperatures by introducing different green elements, such as street trees, rooftop gardens, pocket parks and blue-green corridors. The introduction of these green elements will contribute to reduce the UHI and, therefore, overall urban temperatures.

This component comprises six different groups of activities:

1.1 New tree-lined streets / Connected canopies constructed. Introducing new tree-lined streets in both George Town and Bayan Lepas mukims and completing the alignments in streets that are already partially shaded by street trees. The most heat stressed areas were mapped in order to identify the areas in which strategically introduced street trees will be planted in order to reduce the temperatures. The budget was calculated based on the number of trees to be planted. This activity was costed based on the assumption that 3,690 trees would be planted at a cost of USD210 per tree.

1.2 Pocket parks / vacant spaces constructed. Vacant spaces are converted into pocket parks or urban gardens, with a microclimate-oriented design, in order to reduce hard surfaces and add shade (both aiming to reduce the urban heat island effect). Vacant spaces which can become small green urban spaces were mapped and the areas calculated in order to develop a budget with reference costs provided by contractors. This activity was costed based on the assumption that an area of 10,555 m2 would be planted at a cost of USD90 per square meter.

[36] Zhang, Y., Murray, A. and Turner, B. (2017). 'Optimizing green space locations to reduce daytime and night-time urban heat island effects in Phoenix, Arizona'. *Landscape and Urban Planning*, 165, pp.162-171.

1.3 Green parking spaces constructed. Introducing trees in car parks, for shading and UHI reduction. This will be done in both George Town and Bayan Lepas mukims, but more in the latter, due to the greater number and size of car parks in the Bayan Lepas manufacturing zone. Due to the small space occupied by tree pits, the number of car park spaces will be reduced by no more than 10%. To determine the cost of this activity, the existing car parks were mapped, and preliminary tree planting activities developed in order to determine the number of trees necessary and the budget calculated with reference costs provided by contractors and suppliers. Based on this the budget assumes 2,975 trees would be planted at a cost of USD210 per tree. Following the project planning workshops held with the local city council, it was decided that this activity would be best carried out through grants as a vast area of parking spaces are within private lands.

1.4 Green facades constructed (Built structures greening). It will be developed as a grants programme. The existing buildings in which green facades can be installed were identified and a preliminary budget calculated with reference costs provided by contractors and suppliers. Based on this the budget assumes a vertical area of 1,110 m2 would be planted at a cost of USD180 per square meter.

1.5 Green rooftops constructed (Built structures greening). It will be developed as a grants programme. The existing buildings in which rooftop gardens can be installed were identified and a preliminary budget calculated with reference costs provided by contractors and suppliers. Based on this, the budget assumes an area of 3,750 m2 would be planted at a cost of USD60 per square meter (no trees introduced).

1.6 Urban agriculture programme initiated. Identification of vacant spaces in order to add urban agriculture as well as training sessions. It will be developed as a grants programme. Vacant spaces with potential for urban agriculture were identified and areas calculated in order to budget this sub-component with reference costs for construction and training provided by contractors and NGOs working in this field.

The nature-based climate adaptation programme for the urban areas of Penang island includes the greening of four waterways (in total approximately 14 km) and 32 streets and roads corridors (in total approximately 42 km). Using as reference green spaces impact in UHI reduction and case studies such as the Medellin project, it is reasonable to expect temperatures to decrease approximately 1-1.5 °C five to seven years in surrounding areas after project implementation. Evaluation and monitoring of temperatures will provide assessment regarding the effectiveness of the proposal.

One important study resulting of this programme is the identification of climate-resilient urban trees species for Malaysia (which has not been developed yet). This study is important because, as climate changes in the future, certain tree species will not be able to cope; it is essential to plant trees in the present that will be able to survive (and, hopefully, thrive) in the climate that Penang will have in 2050. This study will be developed during the programme in collaboration with the National Institute of Landscape Architecture (Jabatan Landskap Negara) and local botanic experts.

The budget allocated to component 1, Adaptation to the urban heat island effect through urban

greening is of USD 3,175,000. The budget was calculated by mapping and calculating all areas and then consulting with contractors and suppliers to establish reference costs. Similar existing projects in Malaysia were also identified and their budget used as reference. The outputs with the highest budgets, 1.2 pocket parks/vacant spaces (USD 900,000) and 1.1 new tree-lined streets/connected canopies, (USD 750,000) are the ones which will be implemented more extensively and are estimated to have the biggest impact in terms of heat stress reduction. In the case of output 1.6, urban agriculture, (USD 400,000), There will be additional external funding as several sponsors have committed to support this initiative. it;

Component 2: Improved Storm Water Management

Flooding in Penang has increased due mainly to the increase of annual rainfall and rainfall patterns and impervious surfaces due to urbanisation.

The programme includes a comprehensive nature-based approach to flood management including ~~upstream~~ retention, expanding blue-green corridors, and restoring and adding swales and infiltration wells where possible.

This component comprises three different outputs:*2.1. Blue-green corridors developed*

Rivers are natural topography corridors for stormwater circulation, so every time there's increased rainfall, their levels rise, which often leads to flooding of neighbouring areas. Keeping the rivers free of hard materials and modelling the river margins in different levels / platforms may constrain the path of water and protect neighbouring urbanised areas. The association of green spaces with the blue corridors is essential, as it allows for the infiltration of stormwater to the groundwater table. Water retention capacity will be increased associated with the rivers in the urban areas of Penang island even though their margins have limited space. This will be made with temporarily flooded areas – mangroves around river mouths areas which may have been removed their reinstatement will be considered as a priority. Blue-green corridors will also have additional benefits in reducing heat beyond storm water management.

Following in-depth discussions with the project team, including the Department of Irrigation and Drainage (JPS Pulau Pinang) as well as experts from the River Engineering & Urban Drainage Research Centre (REDAC, USM), it was agreed that flood mitigation projects in the pipeline for Sungai Pinang and its tributaries will be further assessed and studied under the 12th Malaysia Plan to incorporate Nature-based Solutions. A team of consultants will be appointed by JPS Pulau Pinang to look into land status matters, suitability of specific sites, existing utilities as well as detailed design for its implementation. This will include operational costs and future maintenance.

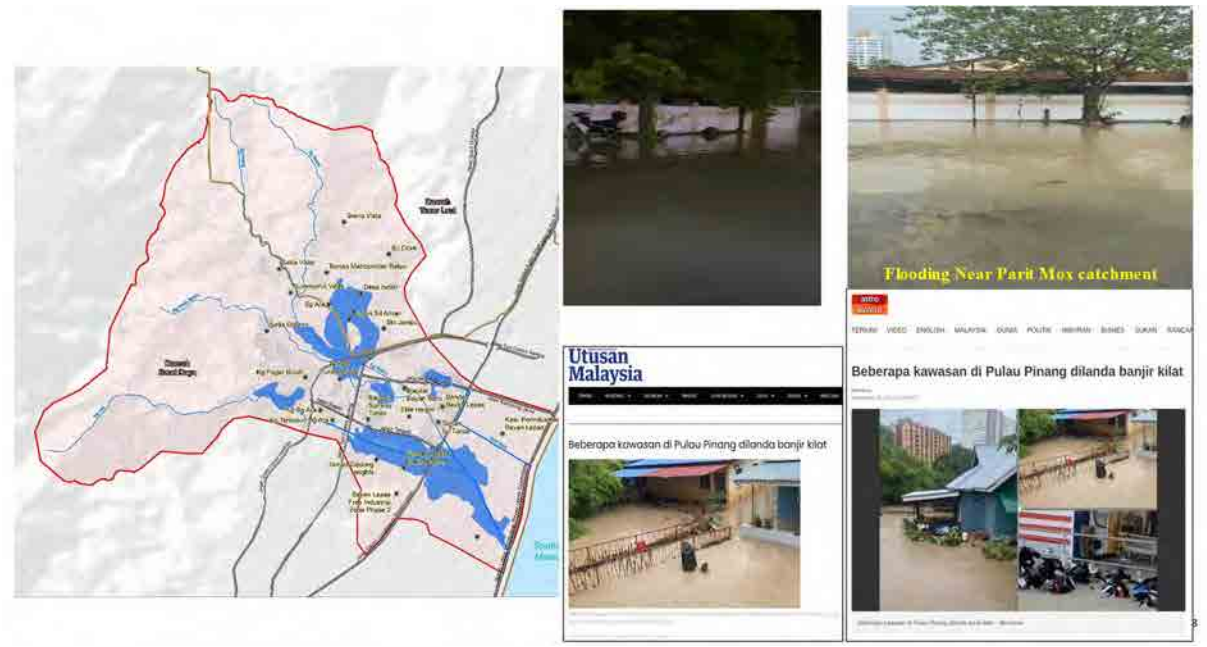
While the initial budget allocation for the development of blue-green corridors assumes an area of 17,220 m2 at a cost of USD 90 per square metre, further consultations with JPS Pulau Pinang refined the area to 1,826 m2 at a cost of USD 115 per square metre to reflect the requirements and status of pipeline projects in the state

Following in-depth discussions with the project team, including the Department of Irrigation and Drainage (JPS Pulau Pinang) as well as experts from the River Engineering & Urban Drainage Research Centre (REDAC, USM), it was agreed that flood mitigation projects in the pipeline for Sungai Pinang and its tributaries will be further assessed and studied under the 12th Malaysia Plan to incorporate Nature-based Solutions. A team of consultants will be appointed by JPS Pulau Pinang to look into land status matters, suitability of specific sites,

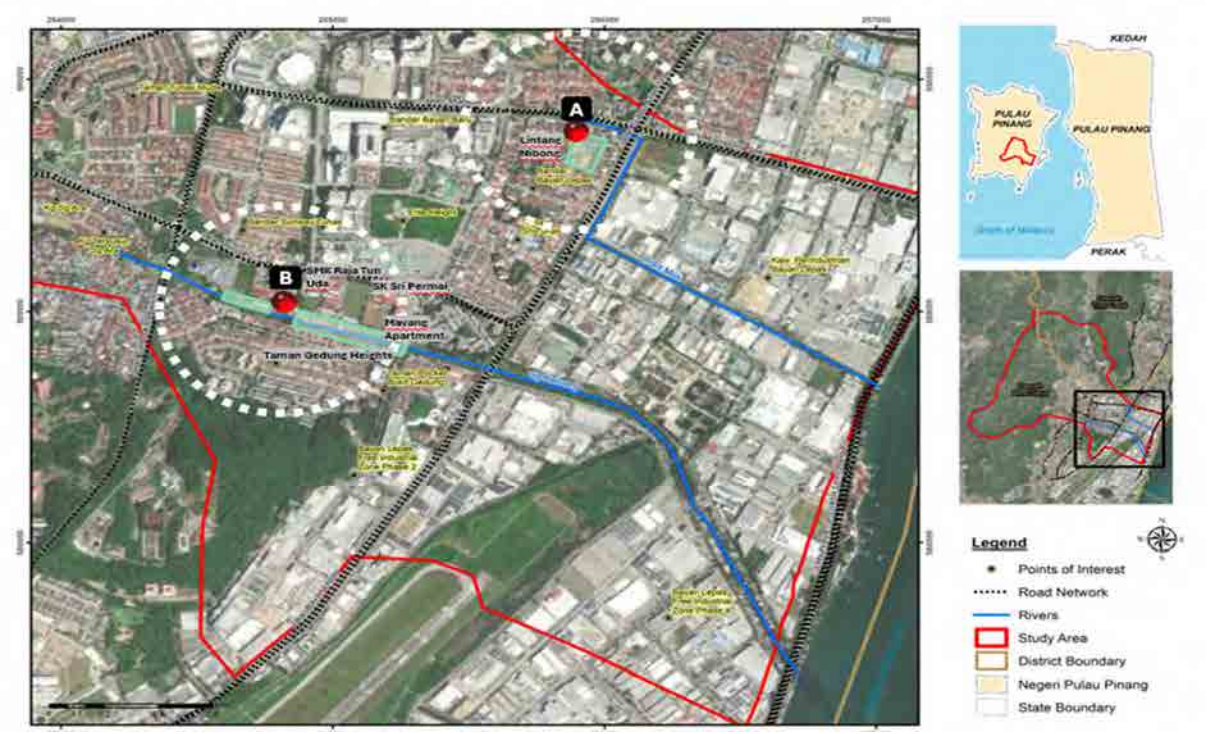
existing utilities as well as detailed design for its implementation. This will include operational costs and future maintenance.

However, as the Federal Government initiated the Sungai Pinang Flood Mitigation Project in 2020, Sungai Pinang was no longer available for the project implementation. Thereafter, JPS Pulau Pinang has assessed several potential sites for the project implementation. The final assessment by the Penang State Department of Irrigation and Drainage (JPS Pulau Pinang) determined that Sungai Keluang in Bayan Baru, Bayan Lepas is the most suitable site for implementing the blue green corridor. The communities in Bayan Baru have been experiencing frequent floods since 2017. The figure below presents the map of the flood area.

The project area is determined to be 8,800 m^2. The second figure below shows the project site (B) for the blue green corridor within the frequently flooded area.



Map of frequently flooded area (in blue) in Bayan Baru.



Project sites within the frequently flooded area: (A) Lintang Nibong for the retention pond, swale and infiltration well; (B) Sungai Keluang for blue green corridor.

Following further discussions, the Executing Entities reached an agreement that both JPS Penang and the Local Council of Penang Island (MBPP) will work together to implement this initiative. The purpose of this programmatic arrangement is to integrate the blue-green corridor feature into Project *Component 1: Adaptation to the urban heat island effect through urban greening*, primarily implemented by MBPP. This integration aims to enhance the effectiveness of reducing temperatures and minimizing flood risks simultaneously. The blue-green corridor with MBPP will be implemented in the same area of Component 1.

2.2. New ~~upstream~~ retention pond~~s~~ constructed

Due to a combination of increased built up areas and increased rainfall, stormwater runoff leads to flooding in lower lying areas, which both in George Town and Bayan Lepas mukims are located in the heavily urbanised areas. In order to avoid this, it is essential to retain stormwater in ponds upstream so they won't runoff to downstream areas. Retention ponds also allow for slow infiltration of stormwater to the groundwater table. The most crucial areas in which to introduce retention ponds are currently being identified by experts associated to the programme - a dedicated task force was established in 2019 with different experts in stormwater management to map the most important areas in which to retain the water, and the full study is expected to be completed in August 2020.

Upstream retention areas are locations that store water in periods of heavier rainfall. In Penang, the existing drainage system is threatened by high tides and storm surges combined with a relatively small impact of sea level rise in island. Therefore, when heavy rainfall occurs simultaneously with high tides and storm surges, the drained water is pushed back inland by the tide, causing a backflow in the drainage system, which the system can't cope with, leading to

severe flooding.[37] It is essential, because of this, to retain the water upstream, not allowing it to reach either rivers or the drainage system. It has been proved that, using a combination of nature-based solutions for stormwater management, peak discharge of a catchment can be reduced by more than 50%.[45] Because of this adaptation effectiveness, the project design team and all stakeholders agree that upstream retention is a critical intervention to prevent flooding in the highly urbanized area of Penang.

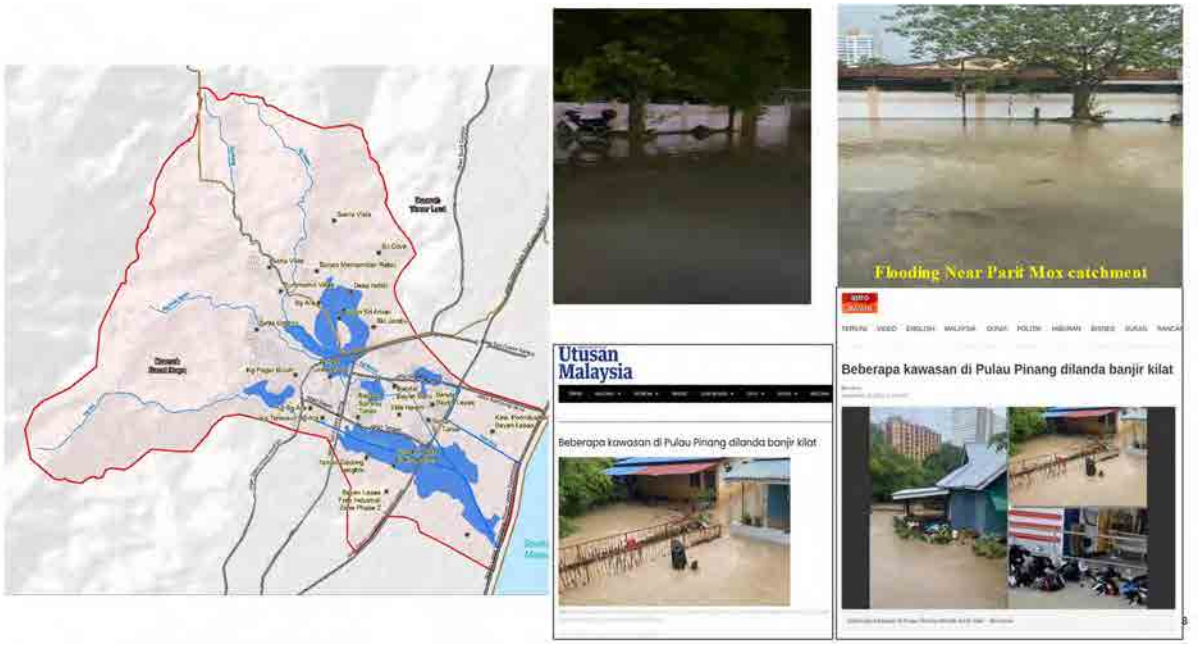
The areas identified for upstream retention are mostly green spaces associated with rivers but also to some isolated crucial green spaces, such as sports grounds and vacant land, which are heavily pressured hydrologically due to morphology reasons. Green buffers and vegetation will be added to all alternatives.

While the initial budget allocation for the construction of new retention ponds assumes an area of 12,080 m2 at a cost of USD 60 per square metre, further consultations with JPS Pulau Pinang refined the area to 2,200 m2 at a cost of USD 818 per square metre to reflect the requirements and status of pipeline projects in the state.

However, as the Federal Government initiated the Sungai Pinang Flood Mitigation Project in 2020, Sungai Pinang was no longer available for the project implementation. Thereafter, JPS Pulau Pinang has assessed several potential sites for the project implementation. The final assessment by JPS Pulau Pinang determined that a recreational field at Lintang Nibong within the catchment area of Parit MOX in Bayan Baru, Bayan Lepas is the most suitable site for implementing the new retention pond. The communities in Bayan Baru have been experiencing frequent floods since 2017. The figure below presents the map of the flood area.

The project area is determined to be 8,800 m^2 for a retention pond at Lintang Nibong. While the project site selected for the retention pond is situated midstream, the implementation at the selected project site is expected to reduce flooding in the area. The second figure below shows the project site (A) for the retention pond within the frequently flooded area.

[37] Understanding stormwater inundation. www.coast.noaa.gov. Retrieved on April 17th 2020 from https://coast.noaa.gov/stormwater-floods/understand/ [45] Qiu, Y., Ichiba, A., Scherzer, D., Tchiguirinskaya, I. (2018) 'Evaluation of nature-based solutions for stormwater management with a fully distributed model in semi-urban catchment'. UrbanRain18, 11 th International Workshop on Precipitation in Urban Areas.



Map of frequently flooded area (in blue) in Bayan Baru.

Project sites within the frequently flooded area: (A) Lintang Nibong for the retention pond, swale and infiltration well; (B) Sungai Keluang for blue green corridor.

2.3. Swales and infiltration wells restored and constructed

Swales are vegetalised open drains which, unlike typical drains, not only collect stormwater but also allow for its infiltration to the groundwater table along its full extension. This approach seeks to reduce the accumulation of stormwater downstream, which in case of heavy rainfall often

leads to flooding and possible damages of drainage infrastructure.

Infiltration wells are solutions used for heavily urbanised areas, as they provide stormwater retention and fast infiltration to the ground water table using several deep layers of aggregates of different dimension, with the function of accelerating and retaining stormwater.

While the initial budget allocation for the construction and restoration of swales and infiltration wells assumes an area of 1,880 m2 at a cost of USD 90 per square metre, further consultations with JPS Pulau Pinang refined the area to 3,000 m2 at a cost of USD 238 per square metre to reflect the requirements and status of pipeline projects in the state..

Adaptation strategies addressing flooding are crucial and urgent for Penang, considering the increase in rainfall and the damages caused by the latest floods. Flood mitigation studies specific for Penang island have previous identified the need for an increase of green spaces for water retention, along the Pinang River as well as in upstream retention.[38]

To face the challenges, a sponge-city approach should be adopted, identifying upstream areas that are more heavily pressured hydrologically to be converted (partially or seasonally), into retaining/storing water functional spaces. Introducing swales and infiltration wells downstream will also reduce impacts. With this goal in mind, the programme includes as co-implementing partners NAHRIM (Institut Penyelidikan Hydraulic Kebangsaan Malaysia, the National Hydraulic Research Institute of Malaysia) and USM (Universiti Sains Malaysia, the local university). A partnership for knowledge sharing is being established with the Sponge Cities Research Institute of Tsinghua University Innovation Center in Zhuhai, China.

JPS Pulau Pinang will be looking to incorporate and fulfil requirements of Nature-based Solutions in the flood mitigation projects under the 12th Malaysia Plan, particularly along Lembangan Sungai Pinang and its tributaries. Design and specifications for the development of infiltration wells and bioretention swales will be in accordance to the national blueprint - Urban Stormwater Management Manual for Malaysia (MSMA 2nd Edition).

However, as the Federal Government initiated the Sungai Pinang Flood Mitigation Project in 2020, Sungai Pinang was no longer available for the project implementation. Thereafter, JPS Pulau Pinang has assessed several potential sites for the project implementation. The final assessment by JPS Pulau Pinang determined that a recreational field at Lintang Nibong within the catchment area of Parit MOX in Bayan Baru is the most suitable site for implementing the swales and infiltration wells. The communities in Bayan Baru have been experiencing frequent floods since 2017. The figure below presents the map of the flood area.

The project area is determined to be 2,600m^2 for the swales and infiltration wells at Lintang Nibong. The second figure below shows the project site (A) for the retention pond within the frequently flooded area.

The total budget for the physical activities for Component 2 on stormwater and flood management is USD 2,725,000. The three sub-components were mapped, the areas calculated and estimate costs obtained by initially consulting suppliers and contractors, and later refined by JPS Pulau Pinang.

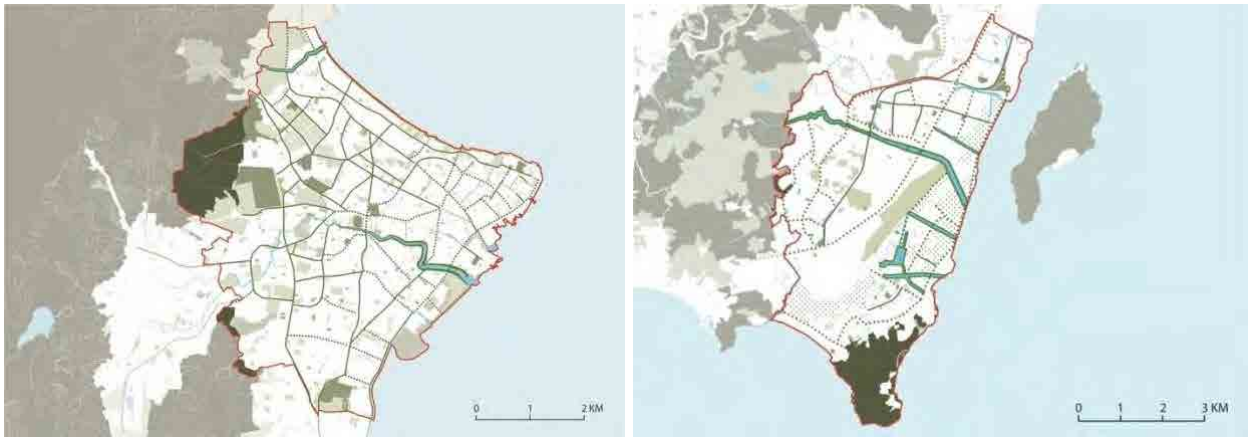
[38] DRR – Team Mission Report Malaysia (2018), Kingdom of the Netherlands.

The allocated budget per sub-component is as follows:

Stormwater Management Components	Quantities	Total USD
Blue green corridors	8,800 m2~~1826m2~~	1,385,000 ~~210000~~
~~Upstream~~ R~~r~~etention pond	8,800 m2~~2200m2~~	1,195,000 ~~1800000~~
Infiltration /retention underground storage	2,600 m2~~3200m2~~	145,000 ~~715000~~
Total		2725,000

The plans below show the areas for green infrastructure extension in both George Town and Bayan Lepas mukims. The final assessment by JPS Pulau Pinang determined that the most suitable sites for the three sub-components are at Sungai Keluang and Lintang Nibong in Bayan Baru, Bayan Lepas.

Images 9a and 9b. Green infrastructure plans for George Town and Bayan Lepas mukims, including blue and green corridors and upstream retention, developed for the nature-based programme.



Source: Plans developed by Think City 2019.

Component 3: Comprehensive vulnerability / baseline assessment and action plans for social resilience strengthening developed for George Town and Bayan Lepas mukims.

Output:

3.1. Capacity development support for vulnerability assessment and climate-change related

planning provided for the two mukims.

Having the Adaptation Fund Outcome 1 in mind, as well as regional priorities, this component focuses on laying the groundwork for reducing vulnerability to climate change impacts and hazards. Community-level resilience is the focus in the two targeted mukims, George Town and Bayan Lepas. It will include:

1) Conducting climate change vulnerability assessment.
2) Producing action plans that identify resilience investment and priorities.
3) Conducting a survey on the willingness to pay / green infrastructure revenue to ensure that infrastructure generates revenue that can be re-invested in operations, maintenance and upgrading. A special survey targeted at the private sector in the industrial area of Bayan Lepas will be conducted in order to assess willingness to pay in the near future.

The goal of this in-depth vulnerability assessment and resulting action plans is to gain as much insight and understanding of all issues and needs as possible, as well as to increase ownership and institutionalise and support priority interventions.

The vulnerability assessment and adaptation action planning will be guided by the Planning for Climate Change framework (P4CC). These principles are strategic, as implementation should be value-based and should make the best use of resources available. The programme should engage as many stakeholders as possible throughout the project life cycle and integrated them in a unified approach to climate change adaptation: the development of the programme has already achieved a significant engagement so far (see the organisational structure description in component 5, Building Institutional Capacity).

Gender assessment will be a strong component of the vulnerability baseline assessment. Women in Penang are identified as vulnerable in particular low-income groups as they are primary caregivers which is indicated by a low labour force participation rate (59%).
The budget for the comprehensive vulnerability baseline assessment and actions plans was calculated by comparing with similar studies' budgets for reference and by consulting with the city council and consultants working in this field,

Component 4: Strengthening social resilience

The social resilience programme has two main outputs:

4.1. School-level awareness programme developed and implemented

The schools programme is focused on educating young people. Creating game and technology based learning with input from youth will be appealing and can reach major proportions of students (over 10,000 secondary school students). This knowledge component is supplemented with training in urban agriculture in the school grounds. It will also include training in climate change specific issues, particularly in extreme weather events and disaster situations, but also in the science behind climate change and in mitigation strategies.

4.2. Women and girls programme developed and implemented

The women and girls programme's aim is to reduce gender vulnerability asymmetry and strengthen agency within the overall programmes geographic focus areas. Partnering with the Women's Centre for Change, Penang's most widely recognised Women's organisation, will provide wide access to women and girls. A series of engagements will bring together women

NGOs, climate experts and women and girls to co-produce adaptation resources on various topics from extreme heat to urban agriculture and establish a network of peer educators for distribution and building a social support network.[39] The programme will also include a component to promote women's participation in decision-making processes related to climate change adaptation and mitigation strategies and plans. The programme will reach 25% of B40 women and girls of George Town and Bayan Lepas mukims, which corresponds to an approximate number of 16,000 women and girls.

Activities under this component will target different types of vulnerable communities: a) areas that are periodically flooded and coincide with the highest concentration rate of elderly population in Penang; b) Low income groups (known locally as B40 communities) c) women and girls. Community engagements have shown that the B40 population in George Town Mukim describes the impacts of heatwaves to be initially in the health of children (more specifically babies) and elderly people. As such, this impacts also the caregivers, which are predominantly women. The main benefits will be to reduce exposure to flooding and heat and to empower and reduce pressure on women.

The budget for the social resilience component was estimated by consulting with the city council and different NGOs with experience in this area.

Component 5: Institutional capacity and knowledge transfer platform Iinstitutional capacity will be reinforced via three outputs:

5.1 Communications and knowledge platform developed and implemented

The knowledge management platform will allow the capturing and dissemination of results from the programme not only to other mukims and districts in Penang state but also to other cities in Malaysia, with enhanced replication potential. It will also ensure full transparency in the implementation process, with all stakeholders being informed of strategies, monitoring and evaluation tools and results. A dedicated website will be created and monthly reports will be sent to all stakeholders.
The project development team views the knowledge management component as a central part of the programme, with the strong belief that it will have national impact. The online platform will be designed to capture the methods and impacts of the programme in a format that can be readily transferred to other Malaysian municipalities with the support from MESTECC and NAHRIM). The Penang Climate Board will act as the main repository of the knowhow within the Penang state government and be used to drive the programme beyond the Bayan Lepas and George Town mukims. However the board's primary purpose is to become a dedicated unit to address climate change specific issues holistically.

The organizational structure proposed for the programme is composed by multiple entities at local, municipal, regional and national levels, also including civil society and academic institutions. Ministry of Environment and Water (KASA)be an executing entity (as the National Designated Authority), as well as MBPP (city council), JPS (the Department of irrigation and drainage) and Think City (as the local project manager), together with Penang Green Council. Supporting executing entities include the Penang state government (with an important role in terms of coordinating and integrating areas in between MBPP and JPS jurisdictions), Jabatan Landskap Negara (the National Institute of Landscape Architecture) with whom the list of

[39] Hashagen, S., Kennedy, J., Paterson, A. and Sharp, C. 2011. Doing with, not to: Community resilience and Co-production The Implications for NHS Education for Scotland. Scottish Community Development Centre. Accessed at https://www.nes.scot.nhs.uk/media/555269/doing_with__not_to_final_version.pdf

climate-resilience street trees for Malaysia will be developed and mainstreamed into national

policy; Plan Malaysia; Perhilitan (National Institute of Wildlife); and Perhutanan (National Forestry Institute). As supporting scientific entities, USM (Universities Sains Malaysia, the local university, which has allocated a multidisciplinary team to support the programme); NHARIM, the National Hydrology Research Institute; MRSA (Malaysian Remote Sensing Agency). As supporting NGOs and CSOs, MERCY Malaysia, WCC (Women's Centre for Change, a Penang organisation focused on women's rights) and WWF Malaysia (other organisations are expected to join in the future).

Specific benefits of intra-municipal cooperation for the implementation of NBS strategies have been identified in research. Besides enhancing the overall performance and speed of implementation of the programme, capacity building and knowledge transfer will be additional benefits for the institutions and departments involved. Beyond Penang, inter-municipal exchange platforms can serve as a multiplying factor in mainstreaming NBS into urban planning. The benefits of implementing the first NBS climate adaptation programme in Malaysia can therefore extend to the regional and national levels.

Streamlining information regarding municipal adaptation will help other cities in Malaysia and in the Southeast Asia region to develop their own climate adaptation programmes with a focus not only on resiliency but also on sustainability.

The city of Langkawi has been identified by government agencies at national level as a potential site for enhanced replication of a climate adaptation programme, particularly in the areas of stormwater and coastal management. In addition to the online knowledge-sharing platform, capacity building workshops and stakeholder engagements with the Langkawi Municipal Council will be prioritised to facilitate inter-municipal exchange of knowledge on NBS strategies for coastal cities.

The creation of a knowledge transfer platform will allow for the mainstreaming of the programme's methodology as well as the assessment of the different strategies and of projects' effectiveness. This will include (but will not be limited to): the monitoring of the flood impacts and temperatures reduction, the assessment of impact of the pilot projects, as well as the list of climate-resilient street trees species specific for Malaysia. The communications plan activities will be managed and mainstreamed via this platform. The platform will have an advocacy role at local as well as at national level.

5.2 Penang Climate Board created

The creation of the Penang Climate Board aims to create the conditions for an integrative and all-encompassing approach to all issues related to climate change, as a multi-layered comprehensive coordinated response to climate related risks should be prioritised. The climate board will manage different projects, as will be the case with the public health programme. The goal is to create a dedicated unit to centralize all issues related to climate change - the Penang Climate Board, and it will be under the supervision of the local city council.

5.3 Climate-related public health programme developed and initiated.

Public health issues should be addressed in adaptation projects, as climate change will be significantly impact physical, mental and community health. In the recent *Lancet Countdown on*

Health and Climate Change[48] it is stated that climate change affects people across the life span and children will be affected the worst. The Penang public health programme focusses on the same geographic area as the other strategies. Its purpose is to measure for the first time current public health impact and set up a system for monitoring change that can also measure health improvements resulting from the environmental strategies.

The strategy of using NBS for the climate adaptation of urban areas in Penang will also result in several co-benefits in terms of public health and wellbeing. Research over the past years has significantly developed and demonstrated the following effects: reduced anxiety and depression, decreased stress, increased immunity, better control of non-communicable diseases (NCDs)[49] [50], increased vitamin D production (sun exposure), denser social connections[51], reduced aggression[40] and improved learning and intellectual development in children[41]. The pathways to these benefits are interrelated and mediated for example, green and thermo-comfortable spaces encourage outdoor physical activity which in turn is linked to reduction in depression[42], reduction in weight, prevention and better management of NCDs.

Three action areas make up the public health programme:

1. Measure the extreme heat impact on hospital admissions and mortality rates for better surveillance and feeding into future preparedness and community prevention strategies.

The research evidence highlights that there are certain temperature points when hospital admissions soar and death rates sharply rise[43]. The conditions are not limited to heat stress and stroke but many other conditions from kidney related diseases[44] to injuries (increased violence) and suicides.[45] [46] The study would select a number of hospitals to correlate access hospital admissions (those higher than usual) with heat wave events. As there is no lag time between symptoms and heat wave event, same days can be compared. The second part of this study would analyse death records[47] to assess increase death with heat waves.

2. Correlate climate sensitive communicable diseases with climate data and assess trends that can be used for public health interventions and assess the impact of adaptation initiatives.

Dengue, Leptospirosis, Chikungunya and other communicable diseases are on the rise due to climate change.[48] As a tropical city, most of these diseases are already endemic but the

[48] Watts N., Amann M., Arnell N. et al. (2019) The 2019 report of The Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate. Lancet. 394:1836-78.

[49] Kardan, O., Gozdyra, P., Misic, B., Moola, F., Palmer, L.J., Paus, T., Berman, M.G. (2015) 'Neighborhood greenspace and health in a large urban center'. *Nature – Scientific Reports*. 5, 11610–11610. DOI: 10.1038/srep11610

[40] Kuo, F.E., Sullivan, W.C. (2001) 'Agression and violence in the inner city: effects of environment via mental fatigue'. *Environmental Behavior*, 33, pp.543-571.

[41] Haaland, C. van den Bosch, C.K. (2015) 'Challenges and strategies for urban green-space planning in cities undergoing densification: A review'. *Urban Forest & Urban Greening*, 14, pp.760-771.

[42] Ulmer, J.M., Wolf, K.L., Backman, D.R., Tretheway, R.L., Blain, C.J.A., O'Neil-Dunne, J.P.M., Frank, L.D. (2016), 'Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription'. *Health & Place*, 42, pp.54-62.

[43] Beggs PJ., Zhang Y., Bambrick H. et al. (2019) The 2019 report of the MJA-Lancet Countdown on health and climate change: a turbulent year with mixed progress. Medical Journal of Australia. Published online 14. November 2019. doi: 10.5694/mja2.50405

[44] Hanson AL, Bi P, Ryan P, Nitschke M, Pisaniello D, Tucker G (2008). The effect of heat waves on hospital admissions for renal disease in a temperate city of Australia. International Journal of Epidemiology. 37:1359-65.

[45] Beggs PJ., Zhang Y., Bambrick H. et al. (2019) The 2019 report of the MJA-Lancet Countdown on health and climate change: a turbulent year with mixed progress. Medical Journal of Australia. Published online 14. November 2019. doi: 10.5694/mja2.50405

[46] Davis RE, Novicoff WM (2018). The impact of Heat Waves on Emergency department Admissions in Charlottesville, Virginia, U.S.A. International Journal of Environmental Research and Public Health. 15 (7):1436 doi: 10.3390/ijerph15071436

[47] Linares C, Diaz J (2007). Impact of high temperatures on hospital admissions: comparative analysis with previous studies about mortality (Madrid). European Journal of Public Health. 18 (3): 317-322.

[48] Garba B., Bahaman AR, Bejo SK et al. (2018) Major epidemiological factors associated with leptospirosis in Malaysia. Acta Tropica. 178: 242-247.

[50] Ulmer, J.M., Wolf, K.L., Backman, D.R., Tretheway, R.L., Blain, C.J.A., O'Neil-Dunne, J.P.M., Frank, L.D. (2016), 'Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription'. *Health & Place*, 42, pp.54-62.

[51] Ulmer, J.M., Wolf, K.L., Backman, D.R., Tretheway, R.L., Blain, C.J.A., O'Neil-Dunne, J.P.M., Frank, L.D. (2016), 'Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription'. *Health & Place*, 42, pp.54-62.

conditions for breeding and transmission are become even more favourable. This study will explore increases in specific communicable disease with certain weather conditions. Here lag times have to be considered, e.g. the lag between breeding cycles of mosquitoes or rats and increase in disease outbreaks.

3. Workforce Development: Raise awareness and upskill health professionals and administrators to improve recognition of relevant symptoms, understanding of correct coding and shape their community outreach and education programmes.

When doctors, hospital administrators and public health officials are more aware of the links between climate change and health, particularly when local data is available, medical conditions are more likely to be linked to specific climate change events such as a heat wave. This in turn can lead to more accurate coding which results in more accurate data feeding into the other proposed action areas and community outreach/education programmes. Strategies could include PhD scholarships for climate and health research and supporting the Medical Association of Malaysia, Penang Chapter to facilitate upskilling, awareness raising and building a community of practice that is interested in more closely linking with the adaptation fund.

Under Component 5, Building Institutional Capacity, is particularly relevant for this programme. It was designed to impact as much as possible other cities in Malaysia, in accordance with the intentions of the National Designated Authority, and it has a total budget of USD 1,306,014 for three outputs. The budget was allocated based on a combination of discussions with the senior leadership of the main project partners, the community consultation process and technical advice. The output 5.1 is the most relevant in terms of actively transmitting methodology and data to other cities in the country and, the budget of USD 550,000 was estimated by consulting with firms providing services in this field and by comparing reference costs of similar existing platforms in the region. The budget for output 5.2. was provided by the city council, as they had been planning for the creation of a similar unit (although exclusively dedicated to Disaster Risk Reduction). The budget for output 5.3., was estimated by consulting with different public health experts.

Components 1 and 2 constitute the built components of the programme to which 70,7% of all components' funding will be allocated. The high budget results from the type and specific nature of these activities and their intended outcomes: substantial results in terms of temperatures reduction and stormwater management improvement. Component 5, institutional capacity has the third highest budget, as it is the intention of all stakeholders to extend the benefits of the programme to other cities in Malaysia, and is in-line with the policy of the national government. The social vulnerability component (4) has a lower but still substantial budget, capable of leading to transformative change. The component with the lowest budget is Component 3, the vulnerability baseline assessment and action plans. 6

B. Economic, social and environmental benefits

Table 11. Economic, social and environmental benefit

Type of benefit	Baseline	With/after the project

Economic	• Increase of extreme weather events resulting in floods, impact on private property and public infrastructure, economic losses and worsen livelihood conditions. • Increased impact to human health due to heat stress. • Decreased productivity for outdoor workers. • Increased negative impact in agriculture and overall ecosystem health due to weather irregularity and extreme events.	• Reduced losses on private property due to flooding. • Reduced losses on public infrastructure due to flooding. • Reduced impact to human health due to flooding. • Reduced impact to human health due to heat stress. • Reduced impact on crop yields and ecosystem health via biodiversity supporting measures. • Reduced disruption to business due to flooding
Social	• Extreme weather events such as floods and heatwaves are considered co-drivers of poverty and result in social problems such as sanitation, food security and so on. • Damage to infrastructure and property resulting of flooding have a disproportional impact on the most vulnerable communities (the poorest, the elderly, the young and the disabled people). • Heat stress has a severe impact in public physical and mental health.	• Reduced social impacts in communities under poverty. • Reduced damage to infrastructure. • More resilient vulnerable communities. • Reduced public health impacts. • Reduced mental health problems due to extreme weather events', flooding, displacement and heat stress impact on the population.
Environmental	• Extreme weather events such as floods and heatwaves have a severe impact on ecosystems and biodiversity. • Long term stress such as heat stress can have a severe impact on ecosystems and biodiversity.	• Reduced human impact in environmental degradation. • More balanced ecosystem health. • Reduced loss of urban biodiversity. • Sustained and enhanced capacity of ecosystems to provide life-supporting services

The programme will also result in an accessory benefit, although it is not the focus of this proposal: mitigating climate change, as overall temperatures being reduced will lead to reduced use of air conditioning and of energetic costs.

C. Cost effectiveness

NBS are well known for being considerably cost-effective in terms of climate change adaptation.[49]

The programme aims to be cost-effective also by:

a) Reducing impacts to public health.
b) Reducing impacts to infrastructure and private property due to flooding.
c) Reducing damage to ecosystem health and loss of biodiversity.

Other positive aspects are effectiveness of operations, community engagement and adequate selection of technical options.

Approximately 70% of the investments will be directed to built interventions, maximizing the direct beneficiaries of the project. The investments in strategies and actions will be directed to:

a) greatly benefit the implementation of the built projects;
b) strengthen the community's awareness and resilience;
c) strengthen local, regional and national levels' institutional capacity and planning policy.

Table 12. Brief cost effectiveness analysis of proposed adaptation options

Proposed action	Cost effectiveness criteria		Alternative action	Cost effectiveness criteria	
Greening urban Penang / heat reduction	Future cost of climate change	✓	Built structures for shading and introducing pedestrian air conditioned streets	Future cost of climate change	X
	Project efficiency	✓		Project efficiency	X
	Community involvement	✓		Community involvement	-
	Cost/feasibility	✓		Cost/feasibility	X
	Environmental and safeguarding risks	✓		Environmental and safeguarding risks	X
Stormwater management	Future cost of climate change	✓	Significantly extend hard drainage infrastructure	Future cost of climate change	-
	Project efficiency	✓		Project efficiency	X
	Community involvement	✓		Community involvement	-
	Cost/feasibility	✓		Cost/feasibility	X
	Environmental and safeguarding risks			Environmental and safeguarding risks	X

[49] Doswald, N. et al. (2014) 'Effectiveness of ecosystem-based approaches for adaptation: review of the evidencebase'. *Climate and Development,* 6, pp.185–201.

		✓			
Comprehensive vulnerability / baseline assessment and action plans for	Future cost of climate change	✓	Programmes for vulnerability self-assessment and	Future cost of climate change	✓
	Project efficiency	✓		Project efficiency	X
	Community involvement	✓		Community involvement	✓
social resilience strengthening in mukims George Town and Bayan Lepas	Cost/feasibility	✓	awareness, post disaster assistance and relocation	Cost/feasibility	X
	Environmental and safeguarding risks	✓		Environmental and safeguarding risks	✓
Strengthening social resilience	Future cost of climate change	✓	Women and youth posttraumatic support centre; Temporary shelters; School temporary relocation..	Future cost of climate change	X
	Project efficiency	✓		Project efficiency	X
	Community involvement	✓		Community involvement	X
	Cost/feasibility	✓		Cost/feasibility	X
	Environmental and safeguarding risks	✓		Environmental and safeguarding risks	X
Building institutional capacity	Future cost of climate change	✓	Developing new climate adaptation studies for each municipal programme; Climate-related programmes to be developed for all organizations and city council departments. New national level policy from the Malaysian Ministry of Health.	Future cost of climate change	✓
	Project efficiency	✓		Project efficiency	X
	Community involvement	✓		Community involvement	✓
	Cost/feasibility	✓		Cost/feasibility	X
	Environmental and safeguarding risks	✓		Environmental and safeguarding risks	✓

D. Consistency with national or sub-national strategies

The 11th Malaysia Plan 2016-2020 is Malaysia's five-year development plan towards realising its Vision 2020 and has been mapped against the UN's Agenda 2030 and its direction filters down in sub-national plans. The Nature-Based Climate Adaptation Programme for the Urban Areas of Penang Island is consistent with the 11th Malaysia Plan, notably Focus Area D Strengthening Resilience Against Climate Change and Natural Disasters – and is aligned with programme

strategies as follows:

Programme area: Stormwater management

The Department of Irrigation and Drainage Malaysia (JPS) will use alternative and new technologies, including multifunctional mechanisms, to mitigate floods and encourage investment. For example, retention ponds, besides mitigating floods, will also be used as artificial wetlands for water quality improvement, habitat grounds for wildlife and recreational parks. Retention ponds with aesthetic improvements will increase the commercial value of land surrounding the area.
In addition, the JPS and relevant agencies will strengthen long-term flood mitigation solutions through implementation of Integrated Water Resource Management, Integrated River Basin Management and Integrated Flood Management. This includes the implementation of integrated solutions using a combination of structural components (e.g. retention ponds, diversion and river improvement works) and non-structural components (e.g. flood maps, flood warning system and flood proofing).

Programme area: Vulnerability assessments

The Government will implement strategies to raise the income and wealth ownership of the B40 (Bottom 40%) households, address the increasing cost of living and strengthen delivery mechanisms for supporting B40 households. The Government is also committed to introduce the Multidimensional Poverty Index (MPI) to ensure that vulnerability and quality of life is measured in addition to income. The use of the MPI will ensure that policy deliberations will shift beyond poverty, to include vulnerability as well and complement the Poverty Line Income.

Programme area: Institutional capacity: Knowledge transfer, climate board, public health programme

Communication, education and public awareness (CEPA) programmes engaging all levels of society will be enhanced to increase awareness about the environment, climate change adaptation and mitigation, conserving natural resources, and the role of green growth in raising productivity. This will instil a sense of shared responsibility among all stakeholders including federal and state governments, the private sector, academia, NGOs and the community towards comprehensive and coordinated efforts for better quality of life.

In addition to the 11th Malaysia Plan, the National Environmental Health Action Plan[50] was recently launched. It is a national level method of planning and implementing comprehensive and holistic actions with regard to the health of the environment and how to address climate change and health issues.

Social resilience building: Women and schools

The Government will improve the effectiveness of CEPA programmes by coordinating and integrating public awareness messages communicated by different public sector agencies and on different themes, including demand side management, transport, energy consumption, recycling, biodiversity conservation, climate change, disaster risk management and

[50] http://nehapmalaysia.moh.gov.my/
63 Eleventh Malaysia Plan 2016-2020: https://www.talentcorp.com.my/clients/TalentCorp_2016_7A6571AE-D9D0-4175-B35D99EC514F2D24/contentms/img/publication/RMKe-11%20Book.pdf

environmental pollution. Better coordination will increase understanding, visibility and retention of such messages, ensuring the right messages are communicated to the correct target audiences, such as women and school children.[63]

Several related policies have been developed by the government to ensure that climate resilient development is able to fulfill the national sustainability agenda.

Ministry of Environment and Water (KASA) .[64]

KASA's vision is to ensure energy sustainability and wealth creation through science and technology, and environmental sustainability. The federal agency has four key missions: 1) managing energy resources, 2) creating growth opportunities through investment in science and technology, 3) preserving the environment through education, awareness and enforcement, and 4) leading climate change adaptation and mitigation measures to ensure the country's resilience. Most, if not all, of these are in development: establishing a National Climate Change Centre (NCCC); developing climate change mitigation and adaptation plans; and drafting a Climate Change Act 2021 bill. Recently, a draft final report on a National Low Carbon Cities Masterplan has been developed which draws out a guide for the implementation of low carbon cities at the state and local level.

The programme is fully aligned with the *Malaysia Third National Communication and Second Biennial Update Report to the UNFCCC*, developed by the Ministry of Energy, Environment, Science, Technology and Climate Change and finalised in 2018 in terms of the development of relevant adaptation strategies.

With regards to the state of Penang, both the Penang State Government and the Penang Island City Council have a general greening policy which tackles waste management and greening schemes. They are currently developing policies to address climate change.

Penang State Government

Prior to the State's Penang 2030 vision, a Cleaner Greener Penang policy was formed to beautify Penang's image as a green and clean state and to improve the liveability of its built environment with a focus on waste management. Under Penang 2030 one of its four primary thrusts is to invest in the built environment to improve the state's resilience through the development and implementation of a climate change adaptation plan. The State is concurrently developing the Penang Green Agenda which aims to identify and prioritise environmental targets including strategies to mitigate and adapt to climate change.

Penang Island City Council

The City Council adopted the State's Cleaner Greener Penang initiative as a general road map to deliver a cleaner and greener city and improve the quality of life in Penang. Some of these initiatives include a bike sharing system, energy efficient lighting, plogging and tree-planting programmes. The city council is currently developing a low carbon cities framework to guide future urban development in the state.

E. Compliance with relevant national technical standards and the Environmental

and Social Policy of the Adaptation Fund.

The Nature-Based Climate Adaptation Programme for the Urban Areas of Penang Island is cognizant of complying with relevant technical standards and will take due care to do so.

64 http://inisiatif.mestecc.gov.my/core/3rd_sector/3.4.2_ms.html & http://inisiatif.mestecc.gov.my/core/3rd_sector/3.4.3_ms.html

Compliance will be ensured with all national technical standards as well as UN-Habitat and Adaptation Fund Environmental and Social, and Gender Policy requirements.

The programme is in accordance with two national regulation plans, the National Landscape Master Plan and the National Urbanisation regulations, which provide mostly guidelines but also a few technical standards. The National Landscape Master Plan regulations provides guidelines on green urban spaces, softscape and hardscape and on the protection of Malaysian landscape. The National Urbanisation Plan regulations provides guidelines on urban open spaces, recreational and sports areas.

PlanMalaysia's planning guidelines include a few standards related to green neighbourhoods[51], rooftop gardens[52] and back lanes.[53]

The organisations in charge of executing the programme will also comply with the Malaysian technical standard MS ISO 14001:2015, which is identical to ISO 14001:2015, *Environmental management systems - Requirements with guidance for use, published by the International Organization for Standardization (ISO).*'

Table 13. Compliance with relevant national technical standards and tools

Expected Output or Intervention	Relevant rules, regulations, standards and procedures	Compliance, procedure and authorities involved	Screening against AF ESP Principles

51 https://www.townplan.gov.my/index.php/en/agensi/penerbitan-planmalaysia/garis-panduan-perancangan/2083-5-gp024gpp-kejiranan-hijau/file

52 https://www.townplan.gov.my/index.php/en/agensi/penerbitan-planmalaysia/garis-panduan-perancangan/2082-4-gp014-agpp-taman-atas-bumbung/file

53 https://www.townplan.gov.my/index.php/en/agensi/penerbitan-planmalaysia/garis-panduan-perancangan/2090-12-gp025gpp-lorong-belakang/file

Output 1.1. New treeline streets / Connected canopies constructed **Output 1.2.** Pocket parks / vacant spaces constructed **Output 1.3.** Green parking spaces constructed **Output 1.4.** Green facades constructed (Built structures greening) **Output 1.5.** Green rooftops constructed	11th Malaysia Plan 20162020: Anchoring Growth on People; dated 2015 12th Malaysia Plan 2021-2025; pending parliamentary approval National Policy on Climate Change; dated 2019 National Policy on Biological Diversity 2016-2025; dated 2016 National Landscape Master Plan; dated 2011 National Environmental	Collaboration with the national government will be part of the process of promoting the social programmes output, raising public awareness, and using their multidimensional poverty index to conduct the vulnerability assessments. Outputs 1.1 to 2.3, focused on implementing nature-based solutions, will require coimplementing partners such as The Penang State Government, The Department of Irrigation	All principles will be considered when producing the outputs. No environmental and social principles are expected to be triggered as a result of this action When carrying out outputs 1.1 to 1.6 and outputs 2.1 to 2.3, particular importance will be placed maintaining AF ESP Principles 1 2, 3, 8, 9, and 10,

(Built structures greening) **Output 1.6.** Urban agriculture programme initiated **Output 2.1.** Bluegreen corridors developed **Output 2.2.** ~~Upstream~~ Rretention pond constructed **Output 2.3.** Swales and infiltration wells constructed **Output 3.1.** Capacity development support for vulnerability assessment and climate change-related planning provided to the two mukims. **Output 4.1.** Schoollevel awareness programme developed and implemented **Output 4.2.** Women and girls programme developed and implemented **Output 5.1.** Communications and knowledge platform developed and implemented **Output 5.2.** Penang Climate Board created **Output 5.3.** Climaterelated public health	Health Action Plan, dated 2007 Cleaner, Greener Penang state initiative; launched 2010 Penang 2030: A Familyfocused green and smart state that inspires the nation; dated 2018 Penang Green Agenda; expected 2020 publication date Low Carbon City Framework (LCCF); Performance Criteria 2,3 and 10; dated 2011 Urban Stormwater Management Manuel for Malaysia 2011; dated 2011 National Urbanisation Plan, dated 2006 Malaysia Standard ISO14001:2015: Environmental management systems, dated 2015 Kejiranan Hijau guidelines (Green Neighbourhood); dated 2012 Lorong Belakang (Lorong Belakang); dated 2014 Taman Atas Bumbumg guidelines (Rooftop Gardens); dated 2012	and Drainage (JPS), NAHRIM (National Hydrology Research Institute), National Institute of Landscape Architecture, the National Forestry Institute, and so on, to ensure the appropriate procedures are followed. Several knowledgeexchange partnerships will be established, most notably with the Smart Utilities Research Institute of Tsinghua University Innovation Center in Zhuhai, China, to discuss the design of sponge cities. The project aims to partner with the Women's Centre for Change, Penang's most widely recognised women's organisation, to ensure gender inclusive outputs. To deliver Penang 2030, the Cleaner Greener initiative, and meet the necessary compliance procedures for each output, the project will work closely with Penang State Government and the Penang Island City Council. The Mistry of Energy, Science, Technology, and Climate Change (KASA) will be the executive entity for the Penang Climate Board output.	due to their relevance to the delivery process. When carrying out output 3.1, AF ESP Principles 3, 4, 5, 6, 7, and 8 will be observed to ensure all vulnerabilities are accounted for. When carrying out outputs 4.1 to 4.2, special focus will be placed aligning with AF ESP Principles 2, 3, 4 and 5 so as to achieve equitable and inclusive outputs. When carrying out outputs 5.1 to 5.3, observing AF ESP Principles 2, 3, and 4 will be especially important for the delivery of equitable and inclusive outputs.

programme developed and initiated			

The programme may result in adjustments to national technical standards. Some outputs, such as the selection of climate-resilient street trees for Malaysia, to be developed together with Jabatan Landskap Negara (National Institute of Landscape Architects), will have an impact on policy and urban design guidelines and, possibly, on technical standards as well, in what relates to specific construction details for tree pits.

F. Duplication with other funding sources

The Penang state government has allocated for the year RM150 million in funds to implement 8 flood mitigation projects to reduce flood occurrence risk in hotspots area funds for flood mitigation projects, which will include mostly drainage infrastructure and approximately 15% of nature-based solutions.

No other relevant nature-based climate adaptation projects are being proposed for Penang island external to the programme and the projects listed below and. It is, however, possible that there will be social vulnerability reduction initiatives being developed parallel to the programme by NGOs without the team's knowledge. Most investments from Penang government are mitigation-focused (solar panels and so on). These are complementary and not overlapping measures.

The significant projects from the city council (MBPP) are:

a) Tree planting in George Town and Bayan Lepas for 2020/2021 – budget of RM 250,000.
b) Backlanes greening in Kampung Malabar, Lebuh Cintra and Lebuh Chulia for 2020/2021 - budget of RM 800,000.
c) Backlanes greening in People's court area for 2020/2021 – budget of RM 1,000,000.
d) Grant offer for application by public and organizations to encourage Green Initiatives / Green Building Institute (GBI) certifications - budget of RM 1,000,000.
e) There will be additional co funding to some components of the programme. Since the concept note was submitted to the Adaptation Fund, the programme has received the Climathon Global Cities Award from EIT Climate-KIC, in the amount of Euros 60,000. This amount will be allocated mostly to the study of climate-resilient street trees for Malaysia. Naturally adjustments will be made to the budget before the final proposal is submitted and during the development of the programme.

The additional co funding for urban agriculture is as follows:
RM 200,000 (Habitat Foundation – RM 35,000; Sultan Idris University – RM 10,000; US State department/US embassy – RM 25,000; Penang state government – RM 40,000; Homegrown farms – RM 30,000; Chief Minister Incorporated – RM 60,000).

G. Learning and knowledge management

At a local level, a participatory approach involving communities and local authorities in planning and implementation will lead to increased local awareness and knowledge on climate change risks and adaptation. Pilot projects will contribute to sharing lessons and evaluate the best strategies.

At city level, transfer of results and lessons learnt to other communities across Penang state will be promoted. All information will be consolidated in reports and fully accessible online via the knowledge management platform, which will, naturally, also be available nationally and internationally. Beyond reports, specific tools and guidelines will also be available to all levels.

As the programme is designed to be demonstrative / proof of concept with a strong knowledge codification component, to be scaled in Malaysia and elsewhere in the region, both national and international levels are particularly important. To that end, the full proposal will seek to track and measure all the project's adaptation benefits, and use its knowledge management-related

activities to promote and replicate both the benefits and the MRV system that tracks them.

At national level, knowledge transfer will benefit other vulnerable municipalities by mainstreaming municipality adaptation methodology and assessment of effectiveness of the different strategies. Partnering ministries, government agencies, CSOs and scientific support institutions (as NAHRIM) in the programme will facilitate countrywide dissemination of strategies and methodology, including in terms of policy. By partnering with NAHRIM for monitoring and modelling purposes, effective knowledge consolidation will trigger institutional learning processes, allowing for replication and scaling of strategies nation-wide.

Beyond the knowledge transfer online platform, KASAand NAHRIM will help to mainstream municipal climate adaptation framework and methodology to all cities in Malaysia in multiple formats.

At international level there are several knowledge-exchange partnerships being discussed, most notably with the Smart Utilities Research Institute of Tsinghua University Innovation Center in Zhuhai, China, focused on sponge cities design.Since the concept note was submitted to the Adaptation Fund, the programme has received the Climathon Global Cities Award from EIT Climate-KIC. This already allowed for international exposure, and the award is comprised of scientific support from the Crowther Lab and ETH Zurich university, beyond the monetary reward.

UN-Habitat will also provide a knowledge platform for the programme via a number of international dissemination mechanisms.

A communications plan established in the inception phase of the project and managed in association with the knowledge management plan, will contribute to ensure active knowledge dissemination at all levels.

Table 14. Learning and Knowledge Programme Components

Expected concrete outputs	Learning objectives & indicators	Knowledge products
1.1 In-depth comprehensive vulnerability / baseline assessment and action plans for social resilience strengthening in mukims George Town and Bayan Lepas	a) Improved climate change -sensitive planning at community and city level	Mukims climate action plans
1.2. Extensive tree alignments will be introduced in existing streets	b) Impact of street trees on temperature reduction	List of climate-resilient street trees' species for Malaysia (developed together with Jabatan Landskap Negara and botanic experts, to be incorporated in policy) Scientific reports and articles
1.3. New climate-conscious green	c) Impact of small green	Scientific reports and articles
areas will be built in vacant spaces in urban areas	urban spaces on temperature reduction	

1.4. Existing car parks will be shaded by trees	d) Impact of tree-shading in car parks and asphalt	Scientific reports, toolkits and articles
1.5. Green will be introduced to facades	e) Impact of green facades in street temperature	Scientific reports, toolkits and articles
1.6. New green roofs	f) Impact of green roofs in reducing the UHI effect	Scientific reports, toolkits and articles
1.7. New urban agriculture plots will be introduced, and training provided	g) Improving resilience and diet of communities	List of species for urban agriculture in Penang and how different species can contribute to reduce nutrient-deficiency Toolkits
1.8. Climate-conscious green elements will be added to existing river corridors to promote temperature reduction, air circulation and stormwater storage and retention	h) Impact of river corridors in temperature reduction and stormwater retention capacity	Scientific reports and articles
1.9. Storage and retention areas will be introduced in strategic areas ~~upstream~~ in order to reduce flooding	i) Impact of ~~upstream~~ retention areas in reducing flooding downstream	Scientific reports and articles
1.10. Swales and infiltration wells will be introduced in urban areas	j) Impact of swales and infiltration wells in reducing flooding	Scientific reports and articles
1.11 Schools programme	k) Increased awareness of main challenges youth faces	Reports
1.12 Women and girls programme	l) Improved understanding of gender-biased climate vulnerability m) Equal gender representation in climaterelated decision making processes	Reports Standards for gender representation in climate-related decision making
1.13. Creation of a knowledge transfer platform and a communications plan	n) understanding how knowledge dissemination will be extended to other vulnerable communities	Online knowledge transfer platform Monthly reports sent to all stakeholders
1.14. Creation of the Penang climate board, a unit in the municipality to address climate-related issues	o) improve understanding of how effective a climate dedicated unit in the city council will be and its impact in different municipality departments' decisions	Scientific reports and articles
1.15. Development of a climate-related public health programme	p) contribute to the understanding of the impact of climate change in public health in Malaysia	Scientific reports and articles

H. Consultative process

During the development of the programme a multipronged community and stakeholder consultation methodology was undertaken that included a series of one-on-one meetings, two workshops, six focus group discussions (FGD) and a survey. The workshops were attended by 77 local people, the focus groups by 53 and the survey was answered by 324 people.

A display outlining the programme was installed as part of the Penang Climate Action Week (the first of its kind to take place in Malaysia). An additional workshop on climate adaptation was held by the Penang State Government in November 2019 as part of its Penang2030 initiative and was attended by 35 participants from multiple organisations.

The goal of the engagement was to gain insights on the impacts of climate change, selfidentified vulnerabilities, as well as to identify the main concerns and possible strategies for adaptation. Nature-based solutions were presented and advantages and challenges of implementation discussed with the community and key stakeholders. Most consultation activities took place in October and November 2019.

FGDs were held in communities vulnerable to climate change impacts: a) UNESCO World Heritage Site (vulnerable to floods, heat stress and extreme weather events), b) Sungai Pinang community (the most flood-prone area of the city), c) Air Itam (low income communities). Other relevant stakeholders engaged were significant industry players, different CSOs, some of them representative of vulnerable groups (women and youth) and various government and nongovernment agencies.

Table 15. Stakeholders and communities engaged

Communities	World Heritage Site	Communities	Lim Jetty
			Acheh Mosque
			People's court
	Sungai Pinang		Hasnim Yahya Mosque
			Taman Free School
			Jalan Perak
	Air Itam		Kampung Melayu
			Kampung Pisang
			Taman Lumba Kuda
			Masjid Negeri
CSOs	Penang Youth Development Centre		
	Youth Parliament of Malaysia		
	Penang Women Development Corporation		
	Women and Family Development committee		
	Penang Deaf Association		
	Penang Forum		
	Water Watch Penang		
	Persatuan Ilmu Murni Pulau Pinang		
	Malaysia Nature Society		
Industry	Penang Skills Development Corporation		
	Penang Development Corporation		
	LLA Arkitet		
	Perunding YAA		
	PAM (Malaysian Architects Association)		
	CREST		

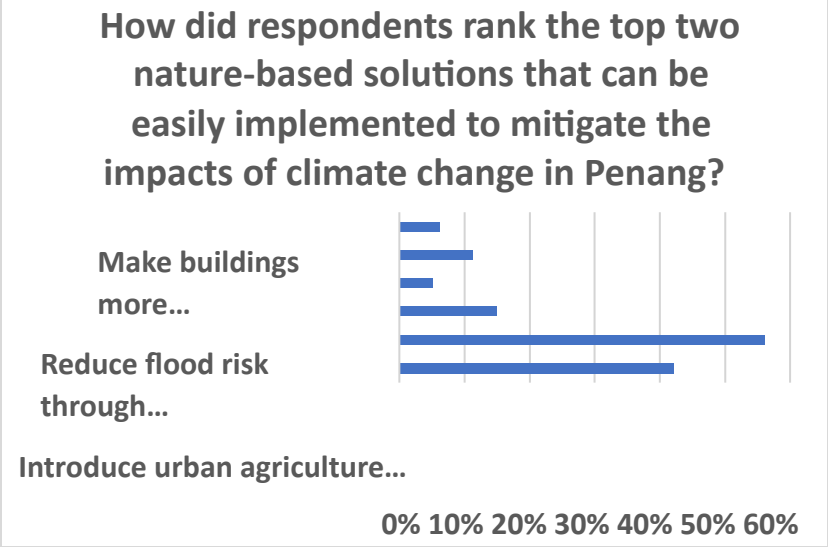
	ILAM (Malaysian Landscape Architects Association)
	Real Estate & Housing Developers' Association
	Construction Industry Development Board
	Perbadanan Bekalan Air Pulau Pinang
	Penang Hill Corporation
	Master Builders Association Malaysia
Government	Majilis Bandaraya Pulau Pinang urban services
	Jabatan Kerja Raya (Public Works Department)
	EXCO YB Phee Boon Poh (State minister for Social Harmony and Environment)
	EXCO YB Zairil KHir Johari (State minister for Public Works and Flood Mitigation)
	Penang Green Council
	Jabatan Pengairan Dan Saliran (Drainage and Irrigation Department)
	Chief Minister Incorporated
	BPEN (State Economic Planning Unit)
	Plan Malaysia
	Jabatan Kerja Raya (Public Works Department)
	Pegis Penang
	Majlis Bandaraya Seberang Perai
	Bahagian Kerajaan Tempatan
	Malaysia Green Building Council
	Implementation Coordination Unit
	Jabatan Alam Sekitar
	Penang 2030
Institutions	Penang Institute
	Habitat Foundation
	Penang Botanical Garden
	Universiti Sains Malaysia

Findings

- All stakeholders agreed that Penang is vulnerable to climate change impacts due to its geographic location, however, awareness varies between groups.
- All stakeholders mention increased temperatures and flooding as the main impacts' changes in terms of climate in Penang island.
- Flooding was the impact highlighted for George Town mukim and temperature rise for the Bayan Lepas mukim.
- Vulnerable communities identified an increase of heat-related diseases (flu, fever and so on), mainly linked to the elderly and children.
- Vulnerable communities identified mental health impacts of heat, such as increased irritability, and emotional stress related to storms.
- Some stakeholders – not all – were able to link their socio-economic wellbeing to climate change impacts.

- The use of NBS for the urban areas of Penang island was overwhelmingly supported but some obstacles were highlighted, such as operational challenges and contestation over responsibility.
- Residential as well as commercial areas have reported losses due to flooding (in a range of RM10,000 to 50,000) and associated limited mobility.
- Lack of community organisation identified in non-commercial areas, making it difficult to organise a response in times of crisis.
- In the George Town mukim consultation, new tree lined streets were consistently rated has having a high impact but challenging to implement due to impact of the root system in the pavement and maintenance costs.
- In the Bayan Lepas mukim consultation, the NBS prioritised was new tree lined streets as well as greening car parks. Green roofs were considered to be of low to medium impact but of easy implementation.

Figure 2. Results of the Penang Climate Adaptation Survey



Conclusions

- Climate change awareness is needed for the entire population but youth groups were identified as being particularly unaware of climate change risks. This may signal the need to develop specific awareness programmes dedicated to this age group.
- Challenges identified in relation to the implementation of NBS are often a result of technical implementation errors, as is the case with trees falling during storms. The reason for this to happen in Penang is more often due to the lack of proper development of the root system, which curtails its structural function (due to lack of adequate sizing of the tree pit and the wrong choice of tree species) than to the intensity of winds.
- Increase of heat-related diseases in the elderly and children may pose a risk of overburdening women, due to their role as main caregivers.
- Despite the seven casualties in the floods of 2017, health is mentioned more in association to heat stress than to flooding.
- Even though NBS implementation in Penang was supported, some mentioned construction as being a disruptive.
- Upstream retention is not prioritised possibly because it is a technical, unfamiliar term and concept and its potential for reducing flooding is not fully understood.

The multipronged community consultation adopted used different techniques to solicit community and stakeholders' views. The survey results legitimise the inclusion of an urban agriculture component, but other forums suggested that vulnerable groups were more concerned about heat stress and the risk of flooding. The consultation also helped shape the project components, for example extra support for caregivers (mostly women) as heat stress has demonstrated to have a major impact on children and elderly's health. The full consultation document is available upon request.

I. Justification

Table 16. Project justification

Outcomes / planned activities	Baseline (without AF)	Additional (with AF)	Comment and alternative adaptation scenarios
Outcome 1.1. Reduction of overall urban atmosphere temperatures by 1°C 5-7 years after project completion.	Increased heat stress. Specific vulnerable groups, as outdoor workers, children and the elderly becoming more exposed.	Reduced temperatures and heat stress.	Introduction of artificial shading in the streets (research shows its impact will be significantly lower than that of street trees). Introduction of air conditioning in the streets, furthering climate change problems (production of carbon dioxide) and vulnerabilities (by increasing reliance and pressure on the power grid, exposing the population to power outages).
Outcome 1.2. Reduction of hard surfaces, resulting in the reduction of the urban heat island effect in the city.	Cumulative impact of urban heal island effect and climate warming increasing the temperature above the mean atmosphere temperature.	No additional temperature increase due to the urban heat island effect.	Adding a coating that reduces heat absorption to pavement. Tests developed in Penang by Think City demonstrate that this type of coating may reduce the temperature of temperature up to 8C degrees, while hard/surfaces/soft surfaces can differ in up to 30C degrees.
Outcome 1.3. Reduction of temperatures in the streets and inside buildings.	Increased temperatures and dependency on air conditioning. Increased energy costs, disproportionally impacting vulnerable communities.	Reduced temperatures in urban areas and therefore, in households. Reduced reliance on air conditioning and costs with energy costs.	To reduce disproportional impact to vulnerable communities, possibly creating a support programme to finance low income households' energy costs.
Outcome 1.4. New urban agriculture gardens are incorporated in the city. Training sessions will take place in a number of (4/month) 240 sessions in total.	Increased costs of food disproportionally impacting the most vulnerable communities.	Community gains knowledge on urban agriculture and nutrition, Community grows their own produce. Reduced nutrient deficiency. Reduced food miles	Policies and initiatives supporting low income communities' access to produce and nutrition.

Temporary storage of stormwater, reducing flooding	Increased flooding.	Reduction in economic losses (private property and infrastructure) and negative impacts to public health, natural assets and ecosystems.	Significant extension of the drainage hard infrastructure. Although Penang urban areas are not very vulnerable to sea level rise, drainage infrastructure could be impacted, as there's a risk that stormwater could not be drained in a situation of combined high tide and heavy rainfall

Outcome 1.5. Increased awareness on systems assessment, including private property, infrastructure and natural assets; improved planning for adaptation.	Vulnerable community with little awareness regarding climate risks in general and on critical infrastructure and private property.	Community is aware, critical infrastructure and property become more resilient. New projects developed include climate adaptation measures.	No alternatives to awareness on climate change and improved planning for adaptation were identified.
Outcome 1.6. Increased school building resilience, greater levels of knowledge and awareness among students, teachers and educational authorities.	Youth is unaware of climate risks (as verified in community consultation). Schools are vulnerable to disruptions resulting of extreme weather events. Youth is uninformed and untrained on urban agriculture. School grounds do not fulfil their potential in temporary stormwater retention.	Youth becomes aware of climate risks and trained in urban agriculture. Schools are prepared to deal with extreme weather events.	Other programmes directed at youth on climate change awareness may be developed at national level.

Outcome 1.7. Reduced gender vulnerability asymmetries.	Women are disproportionally impacted by climate change. Women are not represented equally in climate-related decisionmaking processes. Increase of heat-related diseases in children and elderly people place an additional burden on women as the main caregivers.	Women are aware of climaterelated risks and given tools to deal with specific challenges, such as children and elderly heat-related diseases. Quotas for women representation in Penang climate-related decision-making processes.	Other programmes directed at youth on climate change awareness may be developed at national level.

Outcome 1.8. Project implementation to be fully transparent. Information of strategies and projects to be made available to other municipalities in Malaysia and in the Southeast Asia region for replication.	Knowledge transfer and dissemination is not developed in terms of municipal climate adaptation.	Knowledge transfer will increase and the likelihood of follow up finance for additional investment will be increased. Other vulnerable communities in Malaysia and in the Southeast Asia region can access knowledge developed in the programme, which may assist with the development of their own climate adaptation projects and plans.	Without the knowledge transfer platform the chances of wider knowledge generation resulting of the programme and follow-up financing would be limited.
Outcome 1.9. Penang climate board: a unit created in connection with the municipality will monitor and evaluate all climate-related risks, addressing the problem with a comprehensive perspective.	There is no city council department addressing climate change in a holistic, integrated way.	The creation of a dedicated and centralised unit addressing climate related risks and challenges will be of great significance in increasing resilience in Penang island.	National and regional level dedicated units for climate related risks and challenges.

Outcome 1.10. Comprehensive public health programme, including pilot project monitoring heat related illness in selected hospitals in Penang.	Heat-related diseases such as heat stress and heat stroke are not identified and coded accordingly in hospitals, therefore there is no data related to public health impact of heat waves and temperature rise.	Heat-related and other climaterelated diseases are identified by hospitals and research can be developed in order to identify measures which can be put in place to reduce the risks.	A programme addressing specific climate-related public health risks developed at national level.

J. Sustainability

Institutional

The programme is aligned with Malaysian national goals in terms of adaptation initiatives. It is expected that the programme will contribute to the adaptation of other municipalities in Malaysia via knowledge transfer platform and replication of strategies.

Penang2030 was launched in 2018 by the Penang State Government with the headline to be a “family focused, green and smart state that inspires the nation’. One its four overarching themes is to invest in the built environment to improve resilience. There is an explicit initiative to implement a climate adaption programme underpinned by nature based solutions, sponge city principles and partnerships with international agencies (www.penang2030.com).

Social

Community consultation had a significant impact in designing the programme. When the projects are implemented, communities will gain greater awareness of climate change impacts and the need for adaptation. Additional benefits are added training and skills in urban agriculture and building and maintaining green infrastructure.

By directly addressing the needs and engaging with vulnerable communities (B40, women and girls and youth) the programme will also contribute to reduce unbalances in the social dynamics in what relates to vulnerability to climate impacts.

Economic

Adaptation measures are essential in order to reduce economic losses, mainly from flooding. As exemplified previously in the cost-benefit analysis, one flood in 2017 caused significant damages; avoiding floods would have a significant positive impact in limiting damages and economic losses.

Financial

When action plans are completed under component 3, a study will be conducted to identify national, regional and local financial sustainability models. Willingness to pay engagements and studies will be conducted, particularly directed to the private business community of Bayan Lepas mukim.

Environmental

It is of utmost importance that no component of the project (particularly built components 1 and 2) has any negative impacts in the ecosystem. Beyond the botanical experts consulting for the programme, both Perhilitan (National Institute of Wildlife) and Perhutanan (Forestry National Institute) were invited to participate as supporting executing entities, to which they have agreed. All elements (plant species and projects) will be reviewed by these two entities in order to confirm they have no negative impact in local ecosystems or wildlife.

K. Environmental and social impacts and risks

The proposed project seeks to fully align with the Adaptation Fund’s Environmental and Social Policy (ESP). As shown in Table 17 the project is in full alignment with Adaptation Fund’s Environmental and Social Policy (ESP) and screened according to UN-Habitat’s Environmental and Social Safeguards policy . This section briefly describes the initial analysis of environmental and social impacts of the project based on the ESP.

Risks associated with the creation of green spaces are mainly associated with possible negative ecosystem impacts of species introduced. By having Perhilitan (National Institute of Wildlife) and Perhutanan (Forestry National Institute) as supporting executing entities, analysing and validating the species proposed, this risk is greatly reduced.

In the community consultation stage two other risks were identified. The first risk was the possibility of trees falling during storms and damaging property or endangering lives. Trees falling during storms occasionally happens in Penang, not due to the intensity of winds, by as result of technical implementation errors resulting in the lack of proper development of the root system. Two main reasons for this were identified: small and inadequately designed tree pits and the wrong choice of tree species may lead to an abnormal development of trees, in which the canopy is not balanced in size by the root system, severely endangering its natural structure. This risk will be mitigated by the development of a list of climate-resilient street trees for Malaysia, in partnership with Jabatan Landskap Negara and local botanical experts as well as typical construction details for street trees' pits.

The second risk identified in community consultation was the disturbance of the normal life of citizens during construction. This risk will be mitigated by having a strong and detailed planning phase, which will allow to reduce the duration of the construction works to the minimum and, therefore, also reduce the disturbance of the citizens' routines.

The risk and solution for the mitigation were identified. Thus, activities under all components have been categorized as low risk (Category C). Despite this, steps will be taken to ensure that no environmental or social impacts can occur. This includes the use of quota systems that ensure active representation of women and marginalized and vulnerable groups in the planning processes and ensuring transparency of the execution of all activities, such as posting attendance lists and outcomes of meetings and trainings.

Table 17. Risk Mitigation Actions

Checklist of environmental and social principles	No further assessment anticipated required for compliance	Potential impacts and risks – further assessment and management required for compliance
Compliance with the Law	X	
Access and Equity		X
Marginalized and Vulnerable Groups		X
Human Rights	X	
Gender Equity and Women's Empowerment		X
Core Labour Rights		X
Indigenous Peoples	X	
Involuntary Resettlement		X
Protection of Natural Habitats		X
Conservation of Biological Diversity		X

Climate Change		X
Pollution Prevention and Resource Efficiency	X	
Public Health		X
Physical and Cultural Heritage		X
Lands and Soil Conservation	X	

Table 18. ESP risks and possible mitigation measures for further analysis

Adaptation Fund environmental and social principles	**Possible risks**	**Possible mitigation measures**
Compliance with the Law	None beyond the compliance issues identified in Part II Section E of this proposal document	No mitigation measures required
Access and Equity	Certain groups may have less access to training or to green infrastructure or urban agriculture or specific groups may have privileged access	Community management rules ensuring equal access is guaranteed, enforced through monitoring and legal agreements (where necessary)
Marginalised and Vulnerable Groups	There are some refugees in the Bayan Lepas area who are vulnerable to discrimination. Other forms of racial discrimination	Community management must ensure equal access extends to refugees and migrant population and equal treatment among

Human Rights	None, other than those issues in Marginalised and Vulnerable Groups, Gender Equality and Women's Empowerment, Core Labour Rights and Involuntary Resettlement	No mitigation measures required
Gender Equity and Women's Empowerment	Women not having equal representation in decision making processes, women are excluded from activities under the programme, such as training and urban agriculture	Quotas for female participation and inclusion in decision making at all levels
Core Labour Rights	People working on the project may have improper contracts, working conditions, unsatisfactory occupational health and safety or there could be discrimination against women at work.	Proper contracts, in compliance with ILO standards and occupational health and safety standards in line with international best practices.
Indigenous Peoples	There are no indigenous people in Penang island	No mitigation measures required -
Involuntary Resettlement	Involuntary resettlement or disruption of access arising from construction	Proposed interventions only on state land
Protection of Natural Habitats	Damage to local ecosystems due to introduction of dangerous species of flora	The Atlas of Climate Resilient Tree Species for Malaysia will be used for the project.~~Perhilitan and Perhutanan to review all projects to make sure no dangerous species is proposed~~
Conservation of Biological Diversity	Damage to local ecosystems due to introduction of dangerous species of flora	The Atlas of Climate Resilient Tree Species for Malaysia will be used for the project.~~Perhilitan and Perhutanan to review all projects to make sure no dangerous species is proposed~~
Climate Change	Inefficient sourcing of materials may generate emissions. Poor construction/planning may lead to "mal-adaptation"	Preferring local materials in the procurement process. Multi-stakeholder consultation and approval process for designs

Pollution Prevention and Resource Efficiency	Built projects will generate waste	Incorporate waste management and disposal into design
Public Health	Construction sites pose a risk to the public if not properly managed and demarcated. Water-related activities pose contamination risks	Zero-accident construction site management. Practices to ensure water sources are not contaminated
Physical and Cultural Heritage	Penang old town is a UNESCO World Heritage Site	Consultation with UNESCO, Department of Heritage Conservation (MBPP) and George Town World Heritage Incorporated about implementing the project in accordance with heritage preservation principles.
Lands and Soil Conservation	No risks identified beyond those highlighted in Protection of Natural Habitats	

PART III: IMPLEMENTATION ARRANGEMENTS

A. Arrangements for project management

The UN-Habitat will be the Multi-lateral Implementing Entity (MIE) for the nature-based climate adaptation programme for the urban areas of Penang island, as requested by the National Designated Authority (NDA), the Ministry of Environment and Water and by the city council of Penang island. The programme involves a broad range of stakeholders, local government, scientific institutions, and civil society in order to deliver a broad range of results, with impacts on the physical, technical, social, policy and institutional levels. The impacts of climate change are already being felt in Penang island, particularly in terms of temperature rise and in changes in rainfall patterns leading to flooding. The programme will deliver nature-based physical projects to address these issues and also programmes addressing social vulnerability and capacity building.

The Executing entities will be MBPP, JPS and Think City. They will be responsible jointly for the timely delivery of inputs and outputs and for coordination of all other responsible parties including other ministries, relevant agencies, and a broad range of institutes and local organisations. The Project Director will be appointed by the Steering Committee.

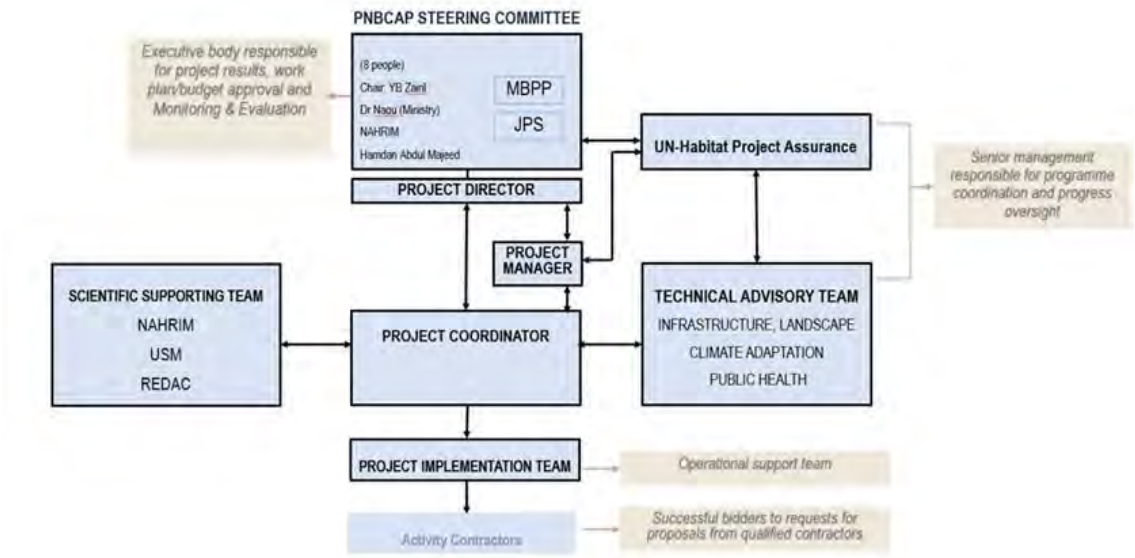


Image 10. Organigramme of the programme.

The programme organisation is presented in image 10. Project Execution Responsibilities are outlined below.

SC - Steering Committee – The Executive body, made up of eight members, will include key personnel from the executing entities, government, local council, scientific and research bodies, as well as civil society, representing interests from all levels of society. They will be responsible for policy guidance for management decisions for the programme, playing a critical role in programme monitoring and evaluation and quality of processes,. The SC will also be responsible for evaluations for performance improvement, accountability and learning.

PD - Project Director – The PD is to be appointed by the Steering Committee and will serve as the designated National Executing Entity lead officer and focal point for the project. The PD will report to UN-Habitat and provide liaison between the Steering Committee and the PC and the PM, supporting the coordination of the various project components.

PM - Project Manager – a Penang-based UN-Habitat liaison project manager for the duration of the project. The Project Manager's prime responsibility will be to ensure the programme is run in accordance to the AF and UN-Habitat's guidelines within specified time constraints and cost.

PC – Project Coordinator - the local project coordination unit will facilitate the drawing up of the scope and standards of the project's components and the production of the expected outputs as specified in the programme documentation. Responsible for stakeholder management and for providing guidance and supervision to the Project Implementation team.

PIT – Project Implementation Team - An operations task force consisting of key staff facilitated by technical and community consultants. The team will be responsible for the dayto-day management of project activities and the overseeing of the implementation of relevant project activities that will be largely delivered by Activity Contractors. They will also be responsible for developing the technical specifications for the project activities.

SST - Scientific Supporting Team - A multidisciplinary team comprising of representatives from several academic and scientific institutions, namely NAHRIM, USM, and REDAC, who will be co-implementing partners. The team will be responsible for providing a wide range of

scientific and research support, advisory, assurance and guidance with regards to water management, drainage, and climate-monitoring. They will also support capacity development and training as part of the knowledge management component of the programme.

TAT - Technical Advisory Team – The Technical Coordination Team will serve as the Advisory Group, assisting the PC on technical matters. They will provide guidance and advice on technical questions relating to climate change/resilience, water management, landscape and urban planning, health and hygiene, as well as vulnerable and marginalised communities. The main objective of the TAT is to identify technical strengths and weaknesses in the programme, propose solutions to pressing technical issues, and provide overall technical support to the programme. TAT also provides gender-responsive elements, and acts as a gender focal point.

Project Assurance - UN-Habitat as the Multilateral Implementing Entity, will support the project implementation through the monitoring of project budgets/expenditures and recruiting/contracting of project personnel and consultant services. They will also monitor the overall management of the programme, achievement of the project outcomes/outputs, and ensure the efficient use of funds through the assigned Steering Committee and Project Director. (overall PM). For gender-responsive elements, UN-Habitat will support gender related activities and provide guidance and monitoring framework based on UN-Habitat and AF gender policies.

EEIC – Executing entity in charge – MBPP, JPS and Think City.

Activity Contractors - Packages of work activities will be procured through competitive bidding processes managed by the **EEIC** and overseen by the PC, with specifications approved by the PIT.
PT - Project team, all of the above except for the activity contractors.

B. Measures for financial and programme risk management

The key risks which may threat the programme have been analysed during its formulation phase and included consideration of different types of threats, characteristics of local governance and specificity of target sites.

The status of financial and programme risks will be monitored and overviewed by UNHabitat throughout the programme, including the identification of measures required to avoid, minimise and mitigate them. A risk analysis and documentation meeting will be held every six months, scheduled by the PC.

The risks facing the project and mitigation strategies are listed below:

TABLE 19. Risks and risk management

No.	Type	Description	Management/mitigation strategies	Rating Impact/ Probability (1:Low-5:High)

1	Institutional	Complex programme structure and heavy bureaucracy impacting and delaying schedule	- Joint responsibility regarding programme schedules between the Implementing Entity, Executing Entities, and the Project Manager. - Establishment of an inclusive Steering Committee will ensure overall commitment, participation, and ownership towards the project's progress.	Impact: 3 Probability: 4
2	Institutional	Policy makers prioritise economic benefits over long-term benefits and sustainable activities	- The programme is deliberately designed to closely engage policy makers in knowledge and capacity building, promoting the complementary and multidimensional benefits of nature-based and resilient systems towards holistic development.	Impact: 2 Probability: 2
3	Institutional	Policy makers prioritise short term nonsustainable initiatives over medium-long term sustainable actions	- Justifications and knowledgesharing via a knowledge management platform will serve as demonstration/proof of effectiveness of the naturebased solutions whilst providing transparency on the implementation process.	Impact: 3 Probability: 2
4	Institutional	Failure in monitoring of activities due to conflict of interest among stakeholders	- Both the Steering Committee and UN-Habitat will be involved in the monitoring of the project activities with the scope and role of each stakeholders defined through a clear agreement to ensure accountability.	Impact: 4 Probability: 2

5	Institutional	Communities may not adopt/maintain activities/ infrastructure after the AF project	- The interventions will be institutionalised within the ministry/local council and formal agreements put in place to ensure sustainable delivery post project implementation. - Community engagement from the inception to promote community ownership	Impact: 3 Probability: 1
6	Institutional	Lack of monitoring and enforcement capability to follow through with interventions, (before and during the executing process)	- Project management measures put in place: risks identified by the Implementation team will be categorized in three levels (green, yellow and red. When a risk is identified with colour red, the PM will fast track it to the SC within a 10-day timeframe. - The establishment of the Penang Climate Board to coordinate effort/ response to breaches that pose climate related risks.	Impact: 3 Probability: 4
7	Environmental	Pandemic control measures/constraints that may delay project activities	- Implementing and Executing Entities to work closely in monitoring the current and possibly recurring pandemic and taking into consideration its impact on planning and execution of programme activities. Vulnerability/baseline assessments along with a climate-related public health programme will be initiated in the early stages of the project to better prepare and complement contingency plans in the event of a pandemic.	Impact: 3 Probability: 3

8	Social	Built interventions/maintenance work may become obstructive to daily routine of community during construction	- Extensive planning and regular consultations with community groups, MBPP and JPS will be carried out to ensure execution of works are carried out during 'offpeak' hours and kept to a minimum duration.	Impact: 1 Probability: 4
9	Social	Lack of commitment/buy-in from local communities may result in delay at intervention sites	- A multi-pronged community and stakeholder consultation held between October to November 2019, has contributed to the development of the vulnerability assessment outline, understanding the needs of the communities and further raising - awareness among all parties to ensure ownership and buy-in. A grievance mechanism will be established to allow any affected communities to raise concerns/suggestions to the Project Implementation team.	Impact: 2 Probability: 1
10	Social	Lack of community organisation/representation in noncommercial areas to organise response during crisis	- Community engagements will be facilitated periodically throughout the project life cycle through focus group discussions with all levels of the civil society to ensure unified action plans are established.	Impact: 2 Probability: 2

11	Financial	Costs of proposed activities may be higher than expected	- Programme activities have been costed as accurately as possible and referenced against similar existing projects during the development stage. - Monitoring mechanisms via the annual work plan and expenditure as well as periodic progress reports will assist in ensuring activities are executed within the budget.	Impact: 3 Probability: 2
12	Financial	Cost of remodelling/ reconfiguring/ restoring existing infrastructure may be higher than actual project activities	- The built projects under Components 1 and 2 will be meticulously planned in the early stages of the programme with due considerations given to existing infrastructure and systems and consultations with respective stakeholders including community. . Extensive consultations will also be undertaken with the Technical Coordination and Project Implementation team to ensure optimisation of resources.	Impact: 3 Probability: 4
13	Financial	Incompetent financial governance/management on a local level may impede project execution and lack integrity	- UN-Habitat in its capacity as Implementing Entity, will ensure adherence to AF's operating policies and guidelines in particular, the *Fiduciary Risk Management Standards*. - Transactions and disbursement of funds by the IPs are to be audited periodically by an independent organisation.	Impact: 4 Probability: 3

C. Measures for management of environmental and social risks

A broad range of local stakeholders, including government, civil society, NGOs and scientific institutions were engaged in different consultations held in multiple occasions spanning the 12 months prior to the submission of the full proposal (mentioned in chapter X and annexes Y and Z). These consultations included in depth discussions of the programme and of screening and assessing potential threats, including threats to its implementation. These inputs substantially contributed to the programme's proposed framework and to the component's activities.

An environmental and social risk management plan (ESMP) has been developed to ensure risks are identified and avoided; if it is not possible to avoid the risks, mitigation measures will be put in place in order to minimise their threat. The ESMP identifies roles and responsibilities for monitoring risks, as well as risk management arrangements, risk reduction and programme's grievance mechanism.

The ESMP identifies measures and actions that will reduce potentially adverse environmental and social impacts. The ESMP is focused on:

a) Identifying and summarizing adverse environmental and social impacts in accordance with the Adaptation Fund ESP principles.
b) Identifying and describing mitigation measures at two levels, the first in order to mitigate the risks in terms of the activity implementation/development and the second in order to uphold all ESP principles.

c) Describing a process for establishing screening procedures and assessment of programme activities and conditions under which screening and mitigation will be required.

d) Assigning roles and responsibilities for screening, assessment, mitigation, approvals and monitoring and reporting.

e) Fully integrates and complies with Malaysia's federal regulations and laws as well as Penang's states regulatory framework.

An assessment of gender issues was conducted in order to comply with the Adaptation Fund gender policy. Extensive data on gender issues was available in several Penang's NGOs and governmental and scientific institution's departments focused on addressing gender vulnerabilities; this assessment is included in annex 8. The data collected has informed the development of the components' activities. Gender-specific risks will be monitored by the M&E arrangement plan Monitoring strategy:

A monitoring plan will be developed during the inception phase of the programme, describing the types of Monitoring & Evaluation (M & E) activities, responsible parties, allocated budget, and frequency of reporting. The M & E of progress in achieving project results will be based on targets and indicators established in the Project Results Framework. Besides that, the status of identified environmental and social risks and its management plan (ESMP), financial, and project management risk, including the required mitigation measures, will be monitored throughout the project via annual project performance, mid-term, and final evaluations.

- A fully developed monitoring plan will be prepared during the inception stage of the project identifying roles and responsibilities regarding the monitoring of activities and results framework indicators. Reporting systems will be developed according to the

AF, UN-Habitat, federal government of Malaysia and the government of Penang state requirements, monthly, quarterly, and annually.

Due to the nature of the programme activities, the Project Implementation Team (PIT) will play a critical role in providing operational support and oversight. The PIT's purpose is to provide technical and field filed supervision on detailed specifications and implementation; its tasks include enhanced quality assurance, effective management M&E system. The PIT will focus on three outcomes:

a) Technical and environmental quality assurance in the implementation by activity contractors.

b) Effective communication with the PM and between the PM, EEIC and activity contractors, as well as with the local community.

c) Monitoring and reporting of risks, the effectiveness of management strategies and tracking the medium-term implementation plans.

The implementation team will be focused on overseeing implementation and field operations, as well as in identifying and flagging risks, communicating, supporting and being supported by the PM. The scope of the PIT includes also technical guidance, work implementation plans and quality monitoring and reporting. The PIT will complement the PM in terms of ensuring, on the ground, that the scope of activities is implemented effectively, aligned with the pre-defined quality standards, on schedule and within budget, managing adjustments as necessary. The PIT will also be in charge of flagging risks, colour-coding them (green- non-urgent risks; yellow- medium level of urgency; red – urgent threats) in order for the PM to proceed accordingly (risks colour-coded in red will be fast-tracked within a 10-day timeframe to the SC).

- Adaptive environmental management of strategic issues

The adaptive environment management approach is developed to ensure that certain risk management and knowledge development objectives are addressed and adequately dealt with. This approach is based on the use of scientific methods in a systematic manner to identify, test and refine environmental interventions and associated assumptions, adapting the interventions based on experience and on a rolling basis. It includes a 'research by design' perspective, as well as the fundamentals of a learning organization, in a process of continuous evolution and adjustment of processes. This is in order to learn from the ongoing activities by integrating this knowledge in the programme's framework for continuous improvement of processes and outcomes.

TABLE 20. Monitoring and evaluation plan of the proposed project

Type of M&E activity	Responsible Parties	Budget USD	Time frame
Inception workshop and Report	Project Manager (P) Steering Comitee (SC) UN-Habitat	3,000 USD	Within 3 months of programme's initiation
Measurement of means of verification for Project Progress on output and implementation	rsight by: PM Technical Coordination Team (TCT) SC	n/a	Annually prior to the PPR and to the definition/adjustment of the yearly work plans

PPR	PM TCT SC UN-Habitat	0	Yearly
Periodic status/ progress reports	PM Project Implementation Team (PIT)	0	Quarterly and annually
Community consultations	EEIC SC PM	0	Prior to implementation, during planning stage
Mid-term evaluation	PM TCT UN-Habitat	40,000	No later than six month after the mid-point of the programme
Final evaluation	PM UN-Habitat TCT External consultants	40,000	Nine month after programme closing
Audit	UN-Habitat PM	2,000	As per UN-Habitat regulations
Visits to field sites	MBPP, JPS and Penang Government representatives UN-Habitat	30,000	Yearly
TOTAL COST			115,000

Note: TCT is the Technical Coordination Team and it is constituted by experts in the relevant technical fields, mainly in urban greening (arborists and landscape architects) and drainage (drainage engineers). The TCT team is in charge of overviewing and approving technical decisions and documentation. Neither the Project Implementation Team (PIT) or the Project Coordinator (PC) are required to be technical experts in these fields and will rely on the expertise of the TCT for these purposes.

Table 21 . Project evaluation plan

Type of M&E Activities	Responsible Parties	Timeframe	Reporting
Inception Workshop and Report	National Project Manager Project Implementing Team UN-Habitat ROAP	Workshop: within first two months of start Report: within first quarter	Inception Report
Periodic status/ progress reports	National Project Manager	Quarterly	Quarterly Reports
Final Evaluation	National Project Manager UN-Habitat ROAP Project Implementing Team External Consultants	Final: At least three months before the end of project implementation	Final Evaluation Report

Project Terminal Report	National Project Manager UN-Habitat ROAP Local consultant	At least three months before the end of the project	Terminal Report
Audit	UN-Habitat ROAP National Project Manager	As per UN-Habitat regulation	Audit Reports

D. Arrangements for monitoring, reporting and evaluation

The programme will fully comply with formal guidelines, regulations, protocols and toolkits issued by the AF, UN-Habitat, the federal government of Malaysia and the government of Penang state.

The Monitoring and Evaluation (M&E) will be based on targets and indicators established in the programme results framework (E) and focused on achieving programme's expected results. The status of environmental and social risks and the ESMP will be monitored throughout the programme's life-cycle (quarterly, yearly, mid-term and terminal report). The same applies to financial and project management risks and mitigation measures.
The project team (PT) will develop an M&E plan during the programme's inception phase, which will be circulated among all participants in the inception workshop. The focus of the M&E plan will be on:

a) Participatory outcome and results' monitoring

b) Programme's risks (programme management & financial, environmental & social)

c) Programme learning and a 'adaptive environmental management' and 'research by design' approach

d) Programme's sustainability

UN-Habitat will ensure that the project team (PT) is fully briefed on requirements related to the M&E and will ensure baseline and progress data to be fully collected and for the codification of the M&E for programme's PPR and 'learning organisational' purposes and into the Knowledge transfer component.

The development and outcomes of the action plans and of the programme's components data will be collected also for the purpose of the knowledge transfer platform to be created, one of the programme's components. Household and sub-household level data focused on vulnerable communities will be collected, when possible disaggregated.

Participatory monitoring mechanisms will build upon the above-mentioned information and database; they will include different levels of government, institutions such as PAM and ILAM, and collected data via the app to be developed within the scope of the social vulnerability component. The systems put in place are focused on fully transparent decisionmaking and learning mechanisms for the updating of data to support M&E and reporting

The communities will be able to access all data and provide inputs to the M&E process and to highlight issues in programme delivery in order to strengthen adaptation benefits, including in the replication and sustaining of programme's gains. The data collected will include the most vulnerable communities of both George Town and Bayan Lepas mukims, disaggregated when possible.

The annual programme performance review will be prepared to monitor progress since programme initiation, particularly for the previous reporting period. The PPR includes, but it is not limited to:

a) Progress on the programme's objectives and outcomes (addressed via indicators, baseline data and targets)

b) Project and programme's annual outputs

c) Lessons learned/'research by design' approach.

d) Annual work plan and expenditure

e) Annual management

f) Environmental and social risks (status of implementation of the ESMP, including the measures required to minimize or mitigate risks. The report will also include corrective actions when deemed necessary.)

g) Project financial and management risks.

The independent Terminal Evaluation (TE) will take place as the last activity before programme closing, in accordance to the AF guidance and following UN-habitat's practices and standard framework. This evaluation will focus on delivery of the programme's results, as initially planned and reflected in the M&E framework, including implementation of environmental and social mitigation measures. The TE will assess the impact ans sustainability of results, including their contribution to capacity building and the achievement of the programme's gains and benefits.

The reports which will be prepared in the context of M&E are:

a) M&E plan

b) Programme inception report

c) Annual, mid-term and terminal programme performance reports

d) Technical reports associated to different programme's components.

For the M&E budget a breakdown of implementing entity's fees will be utilized in the supervision of the M&E function; for the related data, targets and indicators, see programme proposal results framework.

E. Project Proposal Results Framework

TABLE 22. Project results framework with indicators, their baselines, targets, risks & assumptions and verification means.

Objective & Components	Indicators	Baseline	Targets	Source of Verification	Risks & Assumptions
Programme Objective:	Enhance urban resilience and reduce human and ecosystem health vulnerability to climate change impacts and extreme weather events				
Component 1: Adaptation to the urban heat island effect through urban greening	Temperature reduction in the surrounding areas, 5 - 7 years after project implementation. Reduction of hard surfaces and increased shading.	Mean temperature increase in Bayan Lepas from 1951 to 2018 is 1.5 °C. Surface temperatures in urban areas of Penang Island are approximately 8°C higher than neighbouring natural/ rural areas.	Recorded temperature decrease between 1 - 1.5°C in the surrounding areas, 5 -7 years after project implementation. Indirect Beneficiaries 95667	Remote sensing of surface temperatures recorded annually	Implementation and maintenance on the urban greening interventions are followed through the duration of the programme and beyond with strong buy-in / commitment by local agencies and communities.
	Number of community groups with knowledge of urban agriculture and access to such sites.	Zero	At least 26 community groups are trained with 50% participation from women in urban agriculture and have access to farmed produces.	Training impact evaluations and field assessment surveys	
Outputs: 1.1 New tree-lined streets / Connected canopies constructed 1.2 Pocket parks/ vacant spaces constructed 1.3 Green parking spaces constructed 1.4 Green facades constructed 1.5 Green rooftops constructed 1.6 Urban agriculture programme initiated					

Component 2: Built projects for storm water and flood management	Increased water retention capacity of rivers in the urban areas of Penang Island. Reduction of peak discharge of catchment	Increased in impervious surface resulting in generation of high runoff volume and peak discharge during storm events due to development of major new residential and commercial areas in the suburban areas of George Town over the last decade. Total of 159 areas in Penang affected by floods in its worst recorded flooding in 2017. The communities in Bayan Baru have been experiencing frequent floods since 2017. ~~Areas along Sungai Pinang, including the historical core of George Town, up to Sungai Air Hitam are projected to experience Moderate to High Flood Hazard (>0.5m) under the 50 and 100 years ARI Design Flood.~~	By the end of the programme, all areas have 0% or reduced flood risks (low risk - flood depth below 0.5m). Reduction of peak discharge of catchment by 50% An indicative 248,072 indirect beneficiaries are expected	Annual flood reports by JPS / NAHRIM	Identification of key ~~upstream~~ areas and targeted interventions monitored periodically with the support and input of technical agencies/ institutions.
Outputs: 2.1 Blue-green corridors developed 2.2 New ~~upstream~~ retention ponds constructed 2.3 Swales and infiltration wells restored and constructed					

Component 3: Comprehensive vulnerability / baseline assessment	Percentage of targeted population with increased level of awareness on systems assessment, including private property, infrastructure	Estimated losses of RM200 - 300 million in the manufacturing sector during the 2017 flooding.	At least 50% of vulnerable community groups in the target locations of George Town and Bayan Lepas are aware and	Field assessment surveys by MERCY Malaysia	Vulnerable groups actively engaged and equipped in consultations, assessments and action plans alongside
and action plans in targeted communities	and natural assets, and improved planning for adaptation. Increased ownership with institutionalised priority interventions	2,626 farmers and 3,464 hectares of agricultural land impacted with an estimated economic loss of RM5.7 milliion during the 2017 flooding. Estimated losses of RM57.5 million in the fisheries sector during the 2017 flooding. Difficulty in organising strategic response to crisis and disasters due to lack of community organisation in noncommercial areas	prepared. Critical infrastructure and property become more resilient. All new projects developed include climate adaptation measures An estimated 12,988 indirect beneficiaries	Monitoring reports by Penang Climate Board	NGOs. CSOs, and government agencies. Strong commitment by local government and key industry players to incorporate climate adaptation measures in new developments.
Outputs: 3.1 Capacity development support for vulnerability assessment and climate change-related planning provided to the George Town and Bayan Lepas mukims.					

Component 4: Strengthening social resilience	Number of schools and youths equipped with awareness and knowledge of climate change and its mitigation/adaptation strategies. Reduced gender vulnerability asymmetries	Youth groups are particularly unaware of climate change risks. Youth is uninformed and untrained in urban agriculture. Schools are vulnerable to disruptions resulting from extreme weather events. Women are disproportionally impacted by climate change	At least 10,000 students (direct beneficiaries) from local schools are engaged and equipped with the knowledge and knowhows of urban farming and climate mitigation/adaptation strategies. At least 25% of B40 women and girls of George Town and Bayan Lepas, equivalent to approximately 16,000 women and girls (direct beneficiaries) ,	Annual assessments and project reports Field assessment surveys	Relevant and practical engagement tools are used. Strong participation in the programmes from its inception phase of building awareness. Targeted action plans guided by detailed vulnerability assessments.
		Increase of heat-related diseases in children and elderly people place an additional burden on women as the primary caregivers.	are aware of climaterelated risks and given tools to deal with gender-specific challenges. Approximately 6,479 single mothers (direct beneficiaries) benefit from the peer support network and disasterpreparedness programmes		Strong buy-in and participation by women's group at all levels.

		Women are not represented equally in climate-related decisionmaking processes.	Adoption of a 40:40:20 ratio, whereby a benchmark allocation of 40% women representation in the committee of the Penang Climate Board is implemented Indirect beneficiaries 12988	Annual review of Gender Inclusiveness Policy within the Penang Climate Board	Continuous capacity building efforts and leadership training among women's groups to ensure strong representation at decision-making level.
Outputs: 4.1 Youth and school awareness programme developed and implemented. 4.2 Women and girls programme developed and implemented.					
Component 5: Institutional capacity and knowledge transfer platform	Availability of information on strategies and projects to other municipalities in Malaysia and in the Southeast Asian region.	Limited knowledge and dissemination mechanisms in terms of municipal climate adaptation.	By the end of the programme, all municipalities in Malaysia will have full access to the methodologies and impacts of the programme that will assist the development of their own climate adaptation plans.	Development of database, manuals and user guide produced for practitioners	Well-developed methodologies and evaluation tools for establishment of the knowledge management platform.
	Comprehensive approach in monitoring, evaluating, and addressing all climaterelated risks at the municipal level.	There is no integrated department at municipal level addressing climate change issues in a holistic way.	A dedicated and centralised unit addressing climaterelated risks and challenges is established within the local council in Penang Island.	TORs and other official documents noting the establishment of the Penang Climate Board committee	An operational framework for the unit is set in place and implemented.

	Improved monitioring of heat-related illnesses in health institutions in Penang.	Lack of data related to public health impacts of heat waves and temperature rise.	A pilot comprehensive public health programme, including the monitoring and systematic coding of heat and climaterelated illnesses is established in 3 selected hospitals in Penang to develop measures for risks reduction. Indirect beneficiaries 343739	Development of database (including risks and measures to reduce health impacts of climate change)	Strong buy-in and collaboration among public and private health sectors.
Outputs: 5.1 Communications and knowledge platform developed and implemented 5.2 Penang Climate Board created 5.3 Climate-related public health programme initiated and developed					

F. Project Alignment with the Adaptation Fund Results Framework

TABLE 23. Project alignment with the Adaptation Fund results framework

Project Outcome	Project Outcome Indicator	Fund Outcome	Fund Outcome Indicator	Grant Amount (USD
Adaptation to the urban heat island effect through urban greening	Temperature reduction in the surrounding areas, 5 -7 years after project implementation.	Increased ecosystem resilience in response to climate change and variability induced stress	Ecosystem services and natural resource assets maintained or improved under climate change and variabilityinduced stress	3,175,000
Built projects for stormwater and flood management	Increased water retention capacity of rivers in the urban areas of Penang Island.	Increased ecosystem resilience in response to climate change and variability induced stress	Ecosystem services and natural resource assets maintained or improved under climate change and variabilityinduced stress	2,725,000
Comprehensive vulnerability / baseline assessment and action plans for social resilience strengthening developed for George Town and Bayan Lepas mukims	Percentage of targeted population with increased level of awareness on systems assessment, including private property, infrastructure and natural assets, and improved planning for adaptation.	Reduced exposure to climate-related hazards and threats	Relevant threat and hazard information generated and disseminated to stakeholders on a timely basis	160,000

Strengthening social resilience Programme	Number of schools and youths equipped with awareness and knowledge of climate change and its mitigation/adaptation strategies.	Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level	Percentage of targeted population aware of predicted adverse impacts of climate change, and of appropriate responses	975000
Institutional capacity and knowledge transfer platform	Availability of information on strategies and projects to other municipalities in Malaysia and in the Southeast Asian region.	Strengthened institutional capacity to reduce risks associated with climateinduced socioeconomic and environmental losses	No. of targeted institutions with increased capacity to minimize exposure to climate variability risks	1,381,977

TABLE 24. Indicative Core Indicator Targets

Adaptation Fund Core Indicators	Indicative Targets	Comments
1. Number of beneficiaries	343,739	The beneficiaries include both direct (32479) [54] and indirect (311257) [55]from the results of the project.
2. Early warning systems	1	The project will look into the development of a peer support network on mobile application for disaster-preparedness under the Women and Girls programme.
3. Assets produced, devel oped, improved or strengthened	3	At this stage, it is conservatively estimated that three infrastructure / infrastructure system will be improved and strengthened over the two mukims

[54] Details of the direct beneficiaries under each component are indicated in table 25
[55] Details of the indirect beneficiaries under each component are indicated in table 25

4. Increased income or avoided decrease in income	All beneficiaries	The project will reduce the impacts of the urban heat island effects and extreme weather events on economic activities.
5. Natural assets protected or rehabilitated	2	Two mukims will benefit from ecosystem improvements

Table 25
Details of the direct and indirect beneficiaries under each component

Component	Beneficiaries
	Direct Beneficiaries

Component 1: Urban Greening	Households on the immediate streets within the World Heritage Site in George Town mukim and in Bayan Lepas mukim. The elderly population (aged 65 and over) of Timur Laut district in 2019 is estimated to be 66,624 (11% of population) where George Town mukim is located. Meanwhile elderly population in Barat Daya district (Bayan Lepas mukim) is 16,028[56] (7% of population). These elderly persons are more vulnerable to increasing temperature. Within the George Town mukim, there are an estimated 1,240 households (2,916 people, 0.5% of the population) living in absolute poverty. In Bayan Lepas mukim, there are an estimated 956 households (2,341 people, 1.0% of the population) living in absolute poverty[71]. These households are living below the Malaysia Poverty Line Income of RM 2,208 (monthly gross household income which is equivalent to USD 530), making them particularly vulnerable to the impacts of increasing temperature due to a lack of access to resources and adaptive capacity.
	Business owners benefiting from energy bill savings due to lower temperatures and reduced need for airconditioning.
	Manufacturing and outdoor workers, specifically migrant workers and their families in Bayan Lepas industrial zone.
	Grantees of the Green Parking Spaces Programme
	Grantees of the Green Façade Programme
	Grantees of the Green Rooftop Programme
	Grantees of the Urban Agriculture Programme
	Indirect Beneficiaries
	Population of Penang state – 1,787,100[57]

[56] Department of Statistics Malaysia (DOSM) (2019). Current Population Estimates, Malaysia [71] DOSM (2019) Household Income and Basic Amenities Survey Report by State and Administrative District. Pulau Pinang, 2019.

[57] Department of Statistics Malaysia (2019) Household Income Survey Pulau Pinang. https://www.dosm.gov.my/v1/uploads/files/1_Articles_By_Themes/Prices/HIES/HISReport/HIS_Pulau_Pinang.pdf

	Tourist to the World Heritage Site, George Town. There are an estimated 6.66 million tourists per year visiting Penang. They comprise of 45% of domestic tourists and 55% of international tourists[58].
	Population visiting George Town for commercial, recreational and leisurely activities On any given day at peak-hour during the day, there are 20,820 visitors (2019) in George Town. In addition, there are 23,203 and 2,710 workers at peak-hour during the day and night respectively[59].
	Property owners due to increase in value associated with proximity to green infrastructure. There is an estimated number of 25,319 properties in George Town mukim. There is an estimated number of 18,856 properties in Bayan Lepas mukim.
	Manufacturing and construction firms due to reduced energy costs and fewer days of lost productivity due to heat stress among its workers.
Component 2: Stormwater Management	**Direct Beneficiaries**
	Households within proximity to ~~Sungai Pinang and Air Itam areas, George Town~~Sungai Keluang and Lintang Nibong, Bayan Baru, Bayan Lepas. Within the George Town mukim, there are an estimated 1,240 households (2,916 people, 0.5% of the population) living in absolute poverty. These households are living below the Malaysia Poverty Line Income, making them particularly vulnerable to the impacts of extreme weather due to a lack of access to resources and adaptive capacity. The elderly population (aged 65 and over) of Timur Laut district in 2019 is estimated to be 66,624 (11% of population) where George Town mukim is located.

[58] Tourism Malaysia (2019) Malaysian Tourism key performance indicators. http://mytourismdata.tourism.gov.my/wp-content/uploads/2019/10/key-performance-indicators-2018pdf.pdf

[59] Think City Sdn Bhd (2019) George Town World Heritage Site: Population and Land Use Census 2009 – 2019. A City in Transition. Pulau Pinang

	These elderly persons are more vulnerable to extreme weather.
	Households along the jetties in the World Heritage Site, George Town Within the George Town mukim, there are an estimated 1,240 (0.5% of the population) households living in absolute poverty. These households are living below the Malaysia Poverty Line Income, compounding their vulnerability to flooding due to a lack of access to resources and adaptive capacity. The elderly population (aged 65 and over) of Timur Laut district in 2019 is estimated to be 66,624 (11% of population) where George Town mukim is located. These elderly persons are more vulnerable to extreme weather.
	Business owners, particularly of small and traditional businesses due to negated disruptions caused by flooding. There is a total of 66,921 Small and Medium Enterprise (SME) establishments in Penang state[60]. Micro and smaller businesses tend to have less capital and this makes them more vulnerable to disruptions and flood hazard.
	Indirect Beneficiaries
	Tax payers due to reduced need for investments in hard infrastructure flood mitigation
Component 3: Comprehensive vulnerability/ baseline assessment & action plans	**Direct Beneficiaries**
	Local city council and policy makers with better identification of resilience investments as well support for priority interventions
	Indirect Beneficiaries
	Households on the immediate streets within the World Heritage Site, George Town. Within the George Town mukim, there are an estimated 1,240 households (0.5% of the population) living in absolute poverty. The elderly population (aged 65 and over) of Timur

[60] SME Corp Malaysia (2019/2020) Economic Performance and Outlook 2019-2020. SMEs in the New Normal: Rebuilding the Economy. https://www.smecorp.gov.my/images/pdf/2021/LTPKS/BI/Economic%20Report/5.%20Economic%20Performance%20&%20Outlook%202019_20%20-%20Appendices.pdf

	Laut district in 2019 is estimated to be 66,624 (11% of population) where George Town mukim is located.
	Households within proximity to Sungai Pinang and Air Itam areas, George Town. Within the George Town mukim, there are an estimated 1,240 households (0.5% of the population) living in absolute poverty. The elderly population (aged 65 and over) of Timur Laut district in 2019 is estimated to be 66,624 (11% of population) where George Town mukim is located.
	Households along the jetties in the World Heritage Site, George Town Within the George Town mukim, there are an estimated 1,240 (0.5% of the population) households living in absolute poverty. The elderly population (aged 65 and over) of Timur Laut district in 2019 is estimated to be 66,624 (11% of population) where George Town mukim is located.
Component 4: Strengthened Social Resilience	**Direct Beneficiaries**
	Students from local schools in George Town and Bayan Lepas • Targeted 10,000 students through the Youth and Schools Programme
	B40 (households with income below RM4,849) women and girls in George Town and Bayan Lepas • Targeted 25% of women and girls of low-income households through the Women and Girls Programme
	Approximately 6,479 single mothers benefitting from the peer support network and disaster-preparedness modules under the Women and Girls Programme.
	Indirect Beneficiaries
	Women and community leaders through the adoption of a benchmark allocation of 40% women representation in the committee of the Penang Climate Board and related public agencies.

Component 5: Institutional Capacity and Knowledge Transfer	**Direct Beneficiaries**
	Three selected hospitals with a systematic monitoring and coding of heat and climate-related illnesses
Platform	process in place through the Public Health Programme.
	Local city council due to better management of climaterelated risks and challenges through the establishment of the Penang Climate Board embedded within the council.
	Vulnerable communities in Penang Island including elderly and babies
	Indirect Beneficiaries
	The state health department through better diagnostics and allocation of resources
	Healthcare providers due to reduced heat stress cases and more efficient diagnostics
	Universities and researchers through access to the Knowledge Transfer Platform
	Other districts in Penang and cities across Malaysia through access to the methodologies and impacts of the programme that will assist the development of their own climate adaptation plans.

G. Detailed Budget

Programme Component	Output	Activity	Total Budget (USD)	2021 (Year 1)	2022 (Year 2)	2023 (Year 3)	2024 (Year 4)	2025 (Year 5)	2026 (Year 6)
Component 1. Adaptation to the urban heat island effect through urban greening	1.1 New tree-line streets / Connected canopies constructed	1.1.1 Carry out preliminary studies and draw scope of work 1.1.2 Conduct community engagement at project site 1.1.3 Launch of design tender bids 1.1.4 Development of design and specifications 1.1.5 Launch of construction tender bids 1.1.6 Construction / Project implementation 1.1.7 Maintenance / Surrender of project site	$ 775,000	$ 15,000	$ 25,000	$ 150,000	$ 225,000	$ 210,000	$ 150,000
		1.1.8. Monitor of project implementation							
		1.1.9.Gender-responsive implementation for all actions under Component 2 Output 1.1							
	Output total		$ 775,000	$ 15,000	$ 25,000	$ 150,000	$ 225,000	$ 210,000	$ 150,000
	1.2 Pocket parks / vacant spaces constructed	1.2.1 Carry out preliminary studies and draw scope of work 1.2.2 Conduct community engagement at project site 1.2.3 Launch of design tender bids 1.2.4 Development of design and specifications 1.2.5 Launch of construction tender bids 1.2.6 Construction / Project implementation 1.2.7 Maintenance / Surrender of project site	$ 950,000	$ 30,000	$ 50,000	$ 120,000	$ 250,000	$ 300,000	200000
		1.3.8.Gender-responsive implementation for all actions under Component 2 Output 1.2							
	Output total		$ 950,000	30,000	50,000	120,000	250,000	300,000	200,000
	1.3 Green parking spaces constructed	1.3.1 Launch and initiation of the grants programme 1.3.2 Review and processing of applications 1.3.3 Awarding of grants 1.3.4 Monitoring of project implementation	$ 625,000		$ 175,000	$ 200,000	$ 150,000	$ 100,000	
		1.3.5.Gender-responsive implementation for all actions under Component 2 Output 1.3	$ 625,000						
	Output total				175,000	200,000	150,000	100,000	
	1.4 Green facades constructed (Built structures greening)	1.4.1 Launch and initiation of the grants programme 1.4.2 Review and processing of applications 1.4.3 Awarding of grants 1.4.4 Monitoring of project implementation	$ 200,000		$ 10,000	$ 25,000	$ 60,000	$ 60,000	45000
		1.4.5.Gender-responsive implementation for all actions under Component 2 Output 1.4							
	Output total		$ 200,000	$ -	$ 10,000	$ 25,000	$ 60,000	$ 60,000	$ 45,000
	1.5 Green rooftops constructed (Built structures greening)	1.5.1 Launch and initiation of the grants programme 1.5.2 Review and processing of applications 1.5.3 Awarding of grants	$ 225,000		$ 10,000	$ 50,000	$ 60,000	$ 60,000	45000

		1.5.4 Monitoring of project implementation								
		1.5.5.Gender-responsive implementation for all actions under Component 2 Output 1.5								
	Output total		$ 225,000		10,000	50,000	60,000	60,000	45,000	
	1.6 Urban agriculture programme initiated	1.6.1 Launch and initiation of the grants programme 1.6.2 Review and processing of applications 1.6.3 Awarding of grants 1.6.4 Faciltate training and workshops 1.6.5 Monitoring of project implementation	$ 400,000	60000	$ 100,000	$ 150,000	$ 75,000	$ 15,000		
		1.6.6.Gender-responsive implementation for all actions under Component 2 Output 1.6								
	Output total		$ 400,000	$ 60,000	$ 100,000	$ 150,000	$ 75,000	$ 15,000	$ -	
	Component 1 Total		**$ 3,175,000**	**$ 105,000**	**$ 370,000**	**$ 695,000**	**$ 820,000**	**$ 745,000**	**$ 440,000**	
Component 2. Built projects for stormwater and flood management	2.1 Blue-green corridors developed	2.1.1 Carry out preliminary studies (utilities mapping and feasibility study) and draw scope of work	$ 1,385,000~~1,550,000~~	$ 40,000	$ 75,000	$ ~~100,000~~105,000	$ ~~600,000~~340,000	$ ~~400,000~~390,000	~~335000~~435,000	
		2.1.2 Conduct stakeholders engagement at project site								
		2.1.3 Launch of design tender bids								
		2.1.4 Development of design and specifications								
		2.1.5 Launch of contsruction tender bids								
		2.1.6 Constuction / Project implementation								
		2.1.7 Maintenance / Surrender								
		2.1.8. Monitor of Implementation								
		2.1.9.Gender-responsive implementation for all actions under Component 2 Output 2.1								
	Output total		$ ~~1,550,000~~1,385,000	$ 40,000	$ 75,000	$ ~~100,000~~105,000	$ ~~600,000~~340,000	$ ~~400,000~~390,000	$ ~~335,000~~435,000	
	2.2 New ~~upstream~~ retention ponds constructed	2.2.1 Carry out preliminary studies (utilities mapping, feasibility study, design development) and draw scope of work	$ ~~725,000~~ 1,195,000		$ 65,000	$ ~~80,000~~100,000	$ ~~300,000~~600,000	$ ~~250,000~~400,000	30000	
		2.2.2 Conduct stakeholders engagement at project site								

	2.2.3 Launch of construction tender bids 2.2.4 Construction / Project implementation 2.2.5 Maintenance / Surrender 2.2..6 Monitor of implementation 2.2..7 Gender-responsive implementation for all actions under Component 2 Output 2.2								
Output total		$ 1,195,000~~725,000~~		65,000	100,000~~80,000~~	600,000~~300,000~~	250,000~~400,000~~	30,000	
2.3 Swales and infiltration wells restored and constructed	2.3.1 Carry out preliminary studies (utilities mapping, feasibility study, design development) and draw scope of work 2.3.2 Conduct stakeholders engagement at project site 2.3.3 Launch of construction tender bids 2.3.4 Construction / Project implementation 2.3.5 Maintenance / Surrender 2.3.6. Monitor of implementation 2.3.7 Gender-responsive implementation for all actions under Component 2 Output 2.3	$ 145,000~~450,000~~			$ 45,000~~20,000~~	$ 60,000~~20,000~~	$ 180,000~~40,000~~	$ 165,000~~65,000~~	
Output total		$ 450,000~~145,000~~			20,000~~45,000~~	20,000~~60,000~~	40,000~~180,000~~	65,000~~165,000~~	
Component 2 Total		**$ 2,725,000**	**$ 40,000**	**$ 140,000**	**$ 225,000**	**$ 960,000**	**$ 830,000**	**$ 530,000**	

Component 3. Comprehensive vulnerability / baseline assessment and action plans in targeted communities	3.1 Capacity development support for vulnerability assessment and climate change-related planning provided to George Town and Bayan Lepas mukim	3.1.1 Plan, conduct, and provide reports for the comprehensive social/ community vulnerability assessment associated with climate change impacts in George Town and Bayan Lepas mukim 3.1.2 Plan and develop communications / social engagement strategy 3.1.3 Conduct 20 public engagements and 10 training workshops 3.1.4 Prepare final comprehensive report 3.1.5. Monitoring of implementation 3.1.6 Gender-responsive implementation for all actions under Component 3 Output 3.1	$ 160,000	64153	$ 20,430	$ 24,971	$ 24,971	$ 25,475	
	Component 3 Total		**$ 160,000**	**$ 64,153**	**$ 20,430**	**$ 24,971**	**$ 24,971**	**$ 25,475**	**$ -**

	4.1 School-level awareness programme developed and implemented	4.1.1 Create an awareness and communication campaign to promote the advocacy of women empowerment and awareness of genderspecific risks 4.1.2. Monitoring of Implementation 4.1.3 Gender-responsive implementation for all actions under Component 4 Output 4.1	$ 385,000	40,000	75,000	120,000	75,000	75,000	
Component 4. Strengthening social resilience Programme	**Output total**		$ 385,000	40,000	75,000	120,000	75,000	75,000	0
	4.2 Women and girls programme developed and implemented	4.2.1 Develop education programmes with women NGOs and local climate leaders at both institutional and community level, on the genderspecific climate threats and disaster preparedness 4.2.2 Promote co-production of training modules, tools, and adaptation resources on various topics from extreme heat to urban agriculture for community women NGOs, climate experts and women leaders 4.2.3. Create a Flexible Peer Support Network on mobile application which will have multiple modalities capable of responding to different environmental threats 4.2.4 Provide support, access to information, and training for women leadership in the skills that they need to influence climate discussions and activism, including training on how to train other women in the community 4.2.5Adopt the 40:40:20 ratio, whereby a benchmark allocation of 40% women representation in the committee of the Penang Climate Board is implemented 4.2.6 Create a climate and environmental women activitist forum to discuss gender-specific risks, policies, and actions, and to further raise awareness on the issue 4.2.7. Monitoring of Implementation 4.2.8 Gender-responsive implementation for all actions under Component 4 Output 4.2	$ 400,000	50000	$ 125,000	$ 125,000	$ 100,000		
	Output total		$ 400,000	50,000	125,000	125,000	100,000		
	Component 4 Total		$ 785,000	$ 90,000	$ 200,000	$ 245,000	$ 175,000	$ 75,000	$ -

	5.1. Communitions and knowledge platform developed and implemented	5.1.1 Conduct school visits to selected natural environments 5.1.2 Climate awareness exhibition 5.1.3 Facilitate lectures on climate change at seven participating schools, conducted by partner organisations once every four months 5.1.4 Conduct Nature through Art and story-telling competitions culminating in an exhibition at the Youth for Nature Forum for the winners 5.1.5 Conduct a Makers' Workshop once every four months for youths to address urban challenges and energy transitions	$ 550,000	50000	$ 100,000	$ 120,000	$ 140,000	$ 100,000	40000

		5.1.6 Conduct a Sustainable School Programme for five participating schools over a duration of 2 - 6 weeks							
		5.1.7 Initiate 6-month internships for young people aged between 18 - 22 in monitoring the rivers, sponsored by MBPP and JPS							
		5.1.8 Provide 2 one-day training sessions for 15 youths to monitor, sample, and test air, soil, and water for environmental pollution at two survey sites in Sungai Ara/ Sungai Keluang river basin							
		5.1.9 Initiate Youth for Nature Forum as a youth-oriented platform for nature advocacy building							
		5.1.10 Establish the Penang chapter of the Malaysian Youth Delegation							
		5.1.11 Create database of the programme's scientific and technical framework							
		5.1.12 Monitor and collate results in a database							
		5.1.13 Create a website for collecting all programme information and disseminate it upon registration to cities' authorities							
		5.1.14 Monitoring of Implementation							
		5.1.15 Gender-responsive implementation for all actions under Component 5 Output 5.1							
	Output total		$ 550,000	$ 50,000	$ 100,000	$ 120,000	$ 140,000	$ 100,000	$ 40,000
Component 5. Institutional capacity and knowledge transfer platform		5.2.1 Representative selection							
		5.2.2 Develop operational framework							
		5.1.3 Develop standard proceedings and policy integration							
	5.2 Penang Climate Board created	5.1.4 Establish Penang Climate Board							
		5.1.5. Monitoring of Implementation							
		5.1.6. Gender-responsive implementation for all actions under Component 5 Output 5.2	$ 285,000 $ 285,000	$ 15,000 $ 15,000	$ 60,000 $ 60,000	65000 $ 65,000	75000 $ 75,000	70000 $ 70,000	
	Output total								
		5.3.1 Undertake study of hospital admissions and deaths during heat waves over the past 5 years in at least 3 hospitals and continue an annual assessment							
		5.3.2 Raise community awareness campaigns and calls to action to support the public health interventions							
		5.3.3 Identify trends in climate-sensitive communicable diseases in partnership with Penang Health Department and map cases geospatially							
		5.3.4 Set up a set of workshops with health professionals and hospital administators on heat impact on hospital admissions							
	5.3 Climate-related public health programme developed and initiated.	5.3.5 Provide professional development for Penang-based medical doctors on climate and health, focussing on heat, flooding, and managing at-risk patients							
		5.3.6Set up a set of workshops with health professionals and hospital administators on heat impact on hospital admissions							
		5.3.7 Provide professional development for Penang-based medical doctors on climate and health, focussing on heat, flooding, and managing at-risk patients							
		5.3.8 Monitoring of Implementation							
		5.3.9. Gender-responsive implementation for all actions under Component 5 Output 5.3	$ 546,977	$ 46,977	$ 100,000	$ 100,000	$ 125,000	$ 100,000	$ 75,000
	Output total		546,977	$ 46,977	$ 100,000	$ 100,000	$ 125,000	$ 100,000	$ 75,000
	Component 5 Total		**$ 1,381,977**	**$ 111,977**	**$ 260,000**	**$ 285,000**	**$ 340,000**	**$ 270,000**	**$ 115,000**
ESMP Compliance	**ESMP complieance in all activites**		**$ 190,000**	**$ 15,000**	**$ 30,000**	**$ 35,000**	**$ 35,000**	**$ 40,000**	**$ 35,000**
	A. Project Activities Total		**$ 8,416,977**	**$ 426,130**	**$ 1,020,430**	**$ 1,509,971**	**$ 2,354,971**	**$ 1,985,475**	**$ 1,120,000**

Programme Execution Costs	**Project Manager (NOC level of United Nations)**		**$ 306,765**	**$ 15,085**	**$ 60,336**	**$ 60,336**	**$ 60,336**	**$ 80,122**	**$ 30,550**
	Project Coordinator		**$ 143,600**	**$ 13,600**	**$ 18,000**	**$ 18,000**	**$ 49,902**	**$ 36,098**	**$ 8,000**
	Office staff and technical support		**$ 246,048**	**$ 10,597**	**$ 14,205**	**$ 20,712**	**$ 109,084**	**$ 68,000**	**$ 23,450**
	Travel related to execution		**$ 23,200**	**$ 1,200**	**$ 4,400**	**$ 4,400**	**$ 4,400**	**$ 4,400**	**$ 4,400**
	Project Evaluation		**$ 80,000**			**$ 40,000**			**$ 40,000**
			$ 799,613	$ 40,482	$ 96,941	$ 143,448	$ 223,722	$ 188,620	$ 106,400
	B. Programme Execution Total	**9.5%**	**$ 799,613**	$ 40,482	$ 96,941	$ 143,448	$ 223,722	$ 188,620	$ 106,400
	Total Programme Cost		**$ 9,216,590**	**$ 466,612**	**$ 1,117,371**	**$ 1,653,419**	**$ 2,578,693**	**$ 2,174,095**	**$ 1,226,400**
C. Programme Cycle Management Fee for IE	PSC 7 Percent (on total operational budget including components below) approx. 7.1 percent		**$ 654,206**	**$ 33,121**	**$ 79,313**	**$ 117,362**	**$ 183,039**	**$ 154,320**	**$ 87,051**
	Evaluation support cost (HQ)		**$ 10,000**		**$ 1,500**	**$ 2,000**	**$ 1,500**	**$ 2,000**	**$ 3,000**
	Project Support Costs (ROAP)		$ 88,000	**$ 4,137**	**$ 8,464**	**$ 15,379**	**$ 28,850**	**$ 22,678**	**$ 8,492**
	- Project Steering Committee Meetings		**$ 16,304**	**$ 1,304**	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**	**$ 3,000**
	- IE staff salary / supervision of reports etc.		**$ 8,100**	**$ 700**	**$ 1,500**	**$ 1,500**	**$ 1,500**	**$ 1,500**	**$ 1,400**
	- Project supervision missions		**$ 6,800**	**$ 400**	**$ 1,200**	**$ 1,300**	**$ 1,300**	**$ 1,300**	**$ 1,300**
		8.5%	**$ 783,410**	**$ 39,662**	**$ 94,977**	**$ 140,541**	**$ 219,189**	**$ 184,798**	**$ 104,243**
	Amount of Financing Requested (A+B+C)		**$10,000,000**	**$ 506,274**	**$1,212,348**	**$ 1,793,960**	**$ 2,797,882**	**$2,358,893**	**$ 1,330,643**

G. Disbursement Schedule

Schedule Date	October 2021 or Upon Signing (USD)	October 2022 (USD)	October 2023 (USD)	October 2024 (USD)	October 2025 (USD)	October 2026 (USD)	Total
A. Project Funds	1,262,547	1,262,547	1,683,395	1,683,395	1,683,395	841,698	8,416,977
B. Programme Execution	119,941	119,942	159,923	159,923	159,923	79,961	799,613
C. Programme Cycle Management	117,512	117,511	156,682	156,682	156,682	78,341	783,410
Total	1,500,000	1,500,000	2,000,000	2,000,000	2,000,000	1,000,000	10,000,000

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. Record of endorsement on behalf of the government[761] *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

KEMENTERIAN ALAM SEKITAR & AIR
MINISTRY OF ENVIRONMENT & WATER
Level 1-10, Block F11, Complex F
Lebuh Perdana Timur, Precinct 1
Federal Government Administrative Centre
62000 PUTRAJAYA
MALAYSIA
www.kasa.gov.my

Our reference : KASA.BPI.S.800-2/9/2 Jld.3 (7)
Date : 09 Aug 2021

The Manager,
Adaptation Fund Board Secretariat
c/o Global Environment Facility
Mail stop: N 7-700
1818 H Street NW
Washington DC 20433, USA

Dear Sir,

ENDORSEMENT FOR THE FULL PROPOSAL OF THE "NATURE-BASED CLIMATE ADAPTATION PROGRAMME FOR THE URBAN AREAS OF PENANG ISLAND"

In my capacity as designated authority for the Adaptation Fund in Malaysia, I confirm that the aforementioned project proposal is in accordance with the Government of Malaysia's national priorities in implementing climate change adaptation actions to reduce the impacts, caused by adverse effects of climate change in Malaysia in particular the island of Penang.

2. Accordingly, I am pleased to endorse the aforementioned project to receive support from the Adaptation Fund. If approved, the project will be implemented by United Nations Human Settlement Programme (UN-Habitat) and executed by Malaysian agencies, namely Penang Island City Council, Department of Drainage and Irrigation (DID) and Think City Sdn. Bhd. Several other ministries, sub-national authorities, non-governmental organizations and scientific institutions will also be involved in the implementation of this project.

3. The proposed project builds on the state, district and municipal level planning process and goals, seeking to mainstream climate change adaptation. The project design is based on numerous in-depth engagements; in close consultation with scientific institutions and national governmental entities and sub-national authorities. The outcome of this project will support the implementation of the adaptation actions and experiences and knowledge will be shared with other urban areas in Malaysia.

Please accept, Sir, the assurance of our highest consideration.

(DR. K. NAGULENDRAN)
National Designated Authority to the Adaptation Fund
Ministry of Environment and Water
Malaysia

Implementing Entity Certification

[61] Each Party shall designate and communicate to the secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

I certify that this proposal has been prepared in accordance with the guidelines provided by the Adaptation Fund Board, and prevailing National Development Plans, including 11th Malaysia Plan, the National Environmental Health Action Plan, national sustainability agenda, Malaysia Third National Communication and Second Biennial Update Report to the UNFCCC. Subject to approval by the Adaptation Fund Board, I commit to implement the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund Board and on the understanding that the implementing entity will be fully (legally and financially) responsible for the implementation of the project/programme.	
Raf Tuts Director, Global Solution Division UN-Habitat	
Date: 04/08/2021	Tel: +254-20-762-3736 E-mail: raf.tuts@un.org
Project Contact Person: Laxman Perera, Human Settlements Officer, UN-Habitat Regional Office for Asia and the Pacific	
Tel: 81-97-724-7121	Email: laxman.perera@un.org

Disbursement schedule

The disbursement schedule to use for the AF funds is as follows: AF Trustee transfers the funds to UN-Habitat in 6 tranches based on the following time-bound milestones. All figures in US Dollars.

	Upon agreement signature	One year after project start	Year 2	Year 3	Year 4	Year 5	Total (USD)
Project funds (a)	1,262,547	1,262,547	1,683,395	1,683,395	1,683,395	841,698	8,416,977
Execution cost (b)	119,941	119,942	159,923	159,923	159,923	79,961	799,613
(a) + (b)	1,382,488	1,382,489	1,843,318	1,843,318	1,843,318	921,659	9,216,590
Implementing Entity Fee	117,512	117,511	156,682	156,682	156,682	78,341	783,410
Total	**1,500,000**	**1,500,000**	**2,000,000**	**2,000,000**	**2,000,000**	**1,000,000**	**10,000,000**