PERAK

COMMUNITY BASED KINTA RIVER BASIN IRBM (CbKRB-IRBM) PLAN









SEPTEMBER 2024

Jabatan Pengairan dan Saliran Perak

YAYASAN HASANAH
A foundation of Khazanah Nasional

Global Environment Centre

COMMUNITY BASED KINTA RIVER BASIN IRBM (CbKRB-IRBM) PLAN

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The CbKRB-IRBM

The Community based Kinta River Basin Integrated River Basin Management (CbKRB_IRBM) Plan is a reference document to assist river basin practitioners, professionals and those interested in river management through local communities participation. Covers a broad spectrum of activities on river basin management through a smart partnership approach with all stakeholder: government agencies (at federal, state and local level), private sector, NGOs and local communities. CbKRB-IRBM differs with conventional IRBM mainly with the latter uses top down approach while this guide is to support related/relevant agencies to initiative river care initiative via bottom up and heart approach too. At the moment, Kinta River Basin don't have IRBM but it is covered as part of Perak IRBM. Hence, this CbKRB-IRBM can fill the gap of not having IRBM for Kinta River Basin and sametime can be a pilot initiative for Perak state itself.

The CbKRB_IRBM were developed to provide a step by step guide to encourage and promote community based integrated river basin management in a collaborative manner that involves working together with government agencies, corporations, NGOs and communities. This document can be used directly by communities too for them to plan and implement their initiatives with the support of agencies at their local river basin using IRBM model.

Who Should Read this?

Will be useful to anyone interested especially:

- Government agencies handling river basin management with local community participation
- Department of Irrigation and Drainage (DID), Department of Environment (DOE), local authorities (LA),
- Non- governmental organisations (NGOs), Communtiy Based Organisation s (CBOs) and local communities interested in initiating a localised river care programme.
- Private sector interested and committed to initiate river rehabilitation programmes
- University/Researchers
- Local Communities, individuals and local leaders that are keen or already implementing initiatives at the local/ground level

How to use?

Can be used to develop and implement river care initiatives within Kinta River Basin. It provides an overview and summary of :

- issues within the different sub-sectors of Integrated River Basin Management (IRBM)
- information on current sttaus of Kinta River Basin
- a step-by-step guide on the execution of CbKRB-IRBM based on goals drawn

Designed to assist any party on how to promote and initiate river basin management through local community participation.

A reader may read this publication :

Chapter by chapter or alternatively, go directly to specific areas.
The chapters and sections make it easy for those interested in particular topics to review those areas of interest first without having to read the entire handbook.

CHAPTER 1: INTRODUCTION

1.1 Background

Integrated River Basin Management (IRBM) Plan is an integrated approach that need to be implemented in the holistic manner, the IRBM. It covers components of water related ecosystems, terrestrial and aquatic. Therefore, the administration of river basin should not be weighted on one single organization, although it may appear to have advantages over establishing various bodies. The reason behind, this is to ensure there is no compromises in the management and ensure its management are wisely implemented with equal weightage on the economic efficiency, equity and environmental sustainability throughout the component of Integrated Water Resource Management (IWRM).

IRBM defined by the Global Water Partnership (2000) as a "process of coordinating conservation, management and development of water, land dan related resources across sectors within a given river basin, in order to maximise the economics and social benefits derived from the water resources in an equitable manner while preserving and, wherever necessary, restoring freshwater ecosystems".

(Source: Academy of Sciences Malaysia 2014)

The adapted definition for DID Perak is as below:

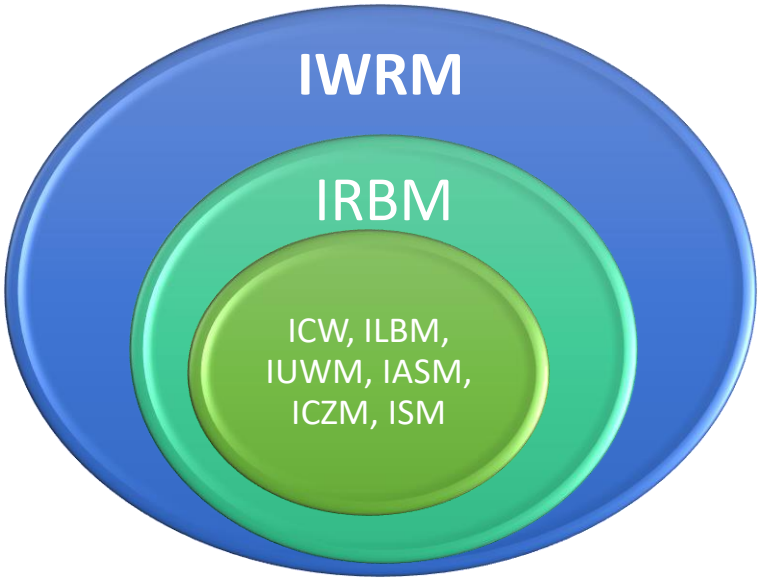
IRBM is the process of adjustment in the care, management and development of water resources, land and related resources across all sectors within a river basin. IRBM aims to maximise socio-economic benefits for sustainable water resources and at the same time preserve and restore natural ecosystem water resources. It is a sustainable management of land and water by natural geographical border regardless of the administrative boundary. IRBM objectives is to ensure that sufficient water, clean water, reducing the risk of flooding and improve the environment. Implementation of effective IRBM requires the involvement of various stakeholders to play their respective roles especially in eight (8) components of IRBM.

(Source: DID Perak,2018)

1.2 IRBM Framework

For a start, “river” is a body of inland water flowing for the most part of the surface of the land but which may flow underground for part of its course whereas “River basin” means the area of land from which all surface run-off flows through a sequence of streams, rivers and possibly, lakes into the sea at a single river mouth, estuary or delta (Adapted from EU water framework directive 2000). IRBM is also known as the spatial and ecosystem focus of IWRM, which emphasises river basins (and sub-basins) as the natural hydrological units within which sustainable water resource management.

IRBM is a sub-set of IWRM, which tends to stress the need for integration at all levels, independent of any particular spatial scale or hydrological unit. IRBM include the following management as Integrated Catchment Management (ICM), Integrated Lake Basin Management (ILBM), Integrated Urban Water Management (IUWM), Integrated Aquifer System Management (IASM), Integrated Coastal Zone Management (ICZM) and Integrated Shoreline Management (ISM).

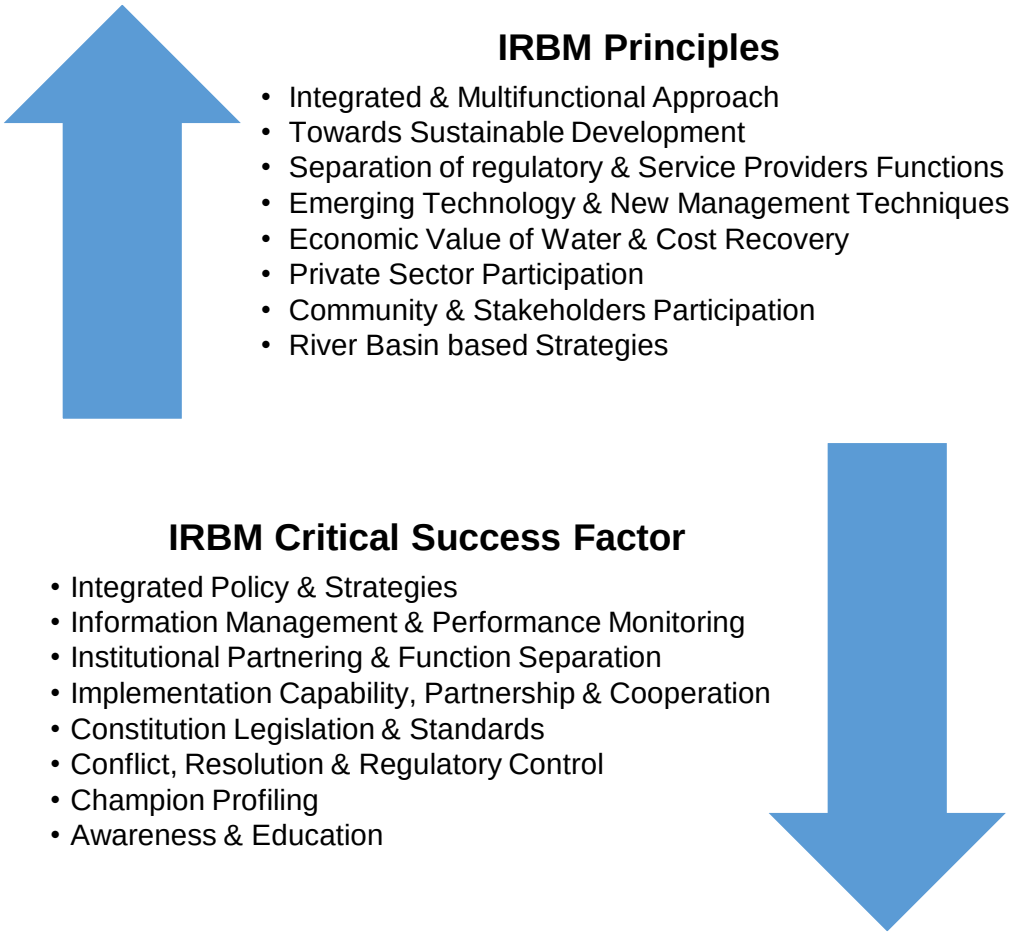


The main objective of IRBM is to ensure there is a balance between the natural functions of the river system and the current developed aspects of the system (build environment). It is an approach that takes into account all the factors linked to the resources, including social and economic activities to fulfil the expectations of the society for all the ongoing and upcoming uses of the water sources such as for the industrial use, recreation, nature management, agricultural purposes and many more.

It is a broad component that covers a wider scope not limiting to water, but also environmental management aspects such as land use issues, pollution control, development demand and pressures as well as biodiversity conservation. Thus IRBM is developed to support the government to provide input and supporting guidance to implement the management of the river basin in integrated and holistic approach.

As IRBM studies comes under the jurisdiction of respective state administrations, and mostly carried out by the consultants appointed by the respective state Department of Irrigation and Drainage (DID). The DID Malaysia, has highlighted some best practice principles captured

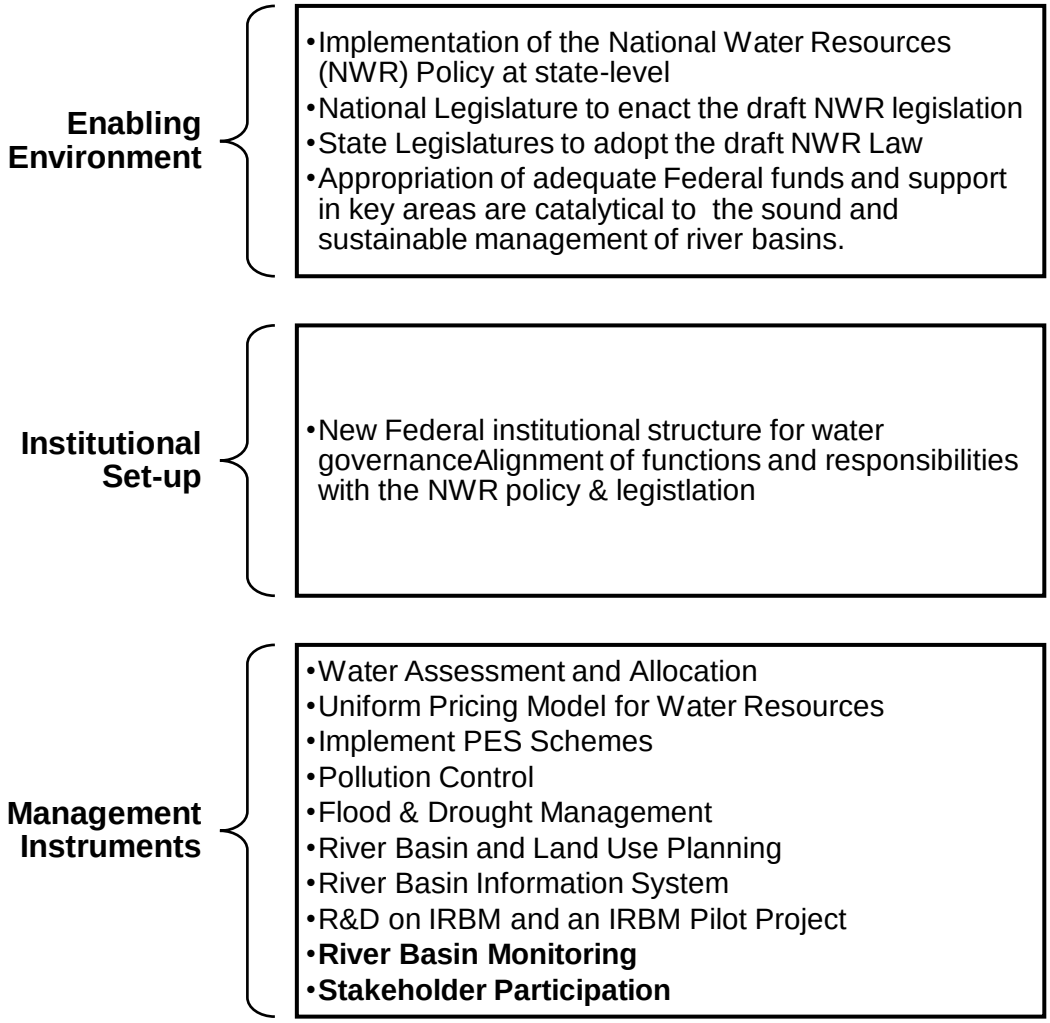
under the IRBM components and its critical success factors adapted from the Malaysia: Klang River Basin Environmental Improvement and Flood Mitigation Project (2007) focusing mainly coordination and management of the river.



Addition to DID Malaysia, Academy Science Malaysia (ASM) undertake the study to develop Strategic Plan for Integrated River Basin Management (IRBM) In Malaysia and is available as reference for the policy makers. The ASM study identified the following to be the key limiting factors in its effort to address the river basin management issues and IRBM challenges in Malaysia into three (3) main factors and proposed relevant actions plans.

Lack of a uniform water law to support IRBM implementation	Lack of institutional capacity to implement IRBM implementation	Lack of financial support to states to implement IRBM

To overcome the following key recommendation were proposed under the three components lighted by ASM based on the three limiting factors highlighted above. The ASM divided the recommendation to complement three (3) main scope (i) enabling environment, (ii) institutional setup and (iii) management instruments.

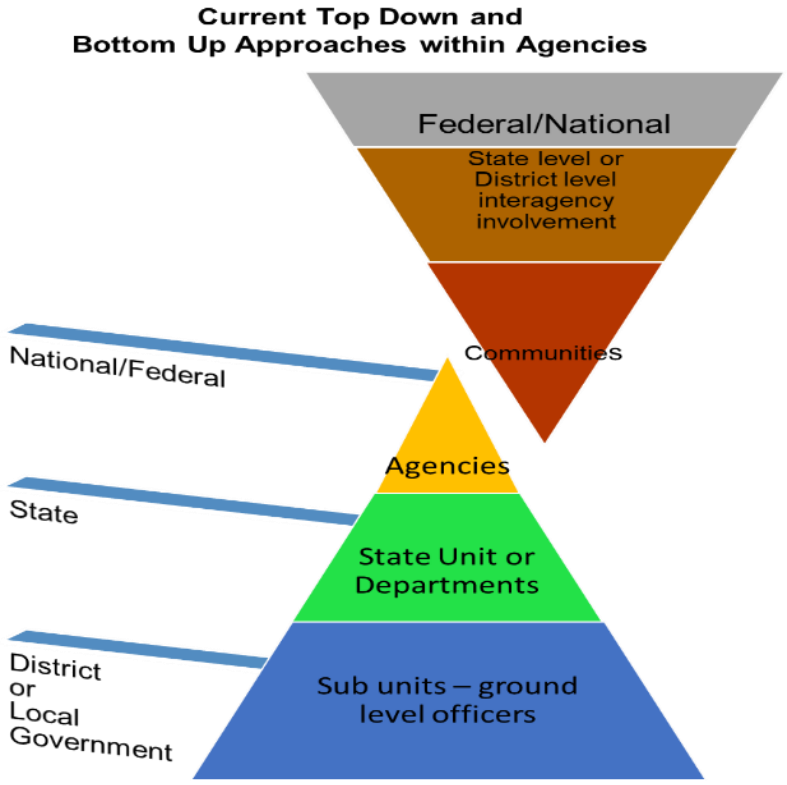


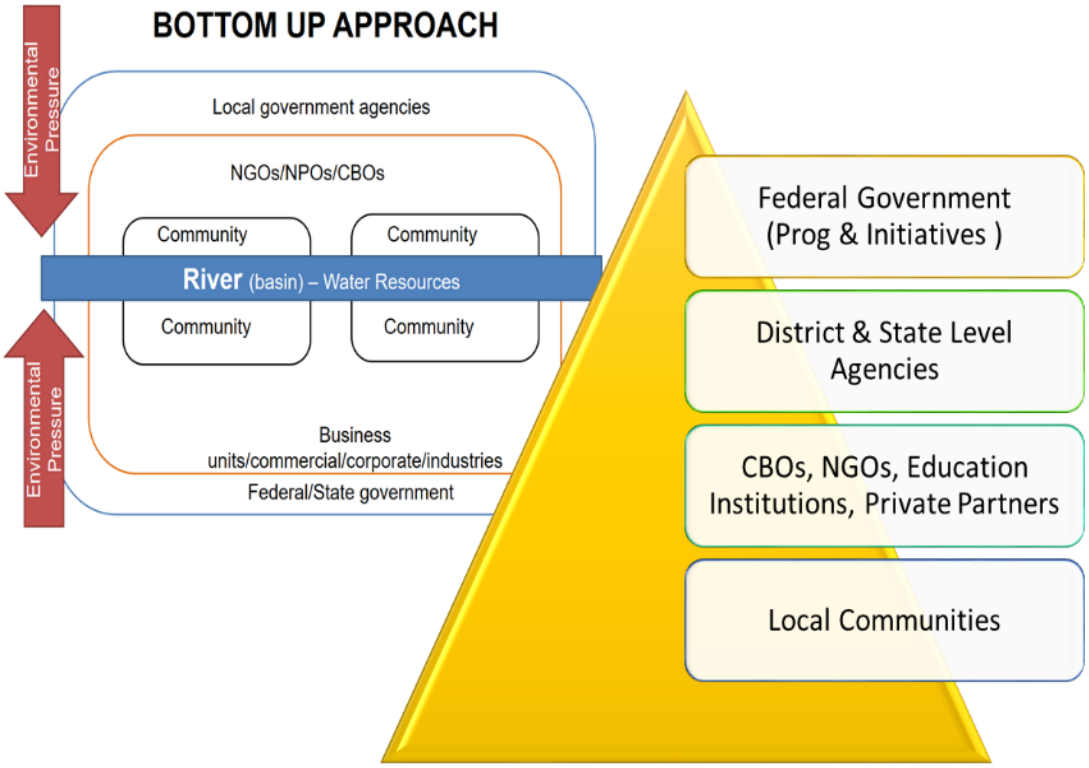
ASM also spearheaded the Water Sector Transformation Agenda 2040 (WST2040) Study as part of the 12th Malaysia Plan, by addressing eight (8) additional sub-sectors deemed vital and strategic to empower people in accelerating the implementation of the IWRM Plan. The WST 2040 study highlighted lack of ownership/respect for the country's water resources and inadequate participatory platforms resulting in deteriorating water quality and wastage as one of the five (5) focus area which need to be resolved to envisage Water Sector Transformation can be achieved by the year 2040. (Source: WST2040)

1.3 Gap Review

The review to identify the gap in the existing IRBM was carried out to ensure the CbKRB-IRBM developed will benefit all the targeted stakeholders, local communities and the environment as whole. The current IRBM Strategy by ASM and IRBM developed by engaged consultants either by DID Malaysia and state DID, State Water Regulatory or by the local governents are used as baseline reference documents for the policy makers and agencies. Governmental agencies play significant role not only on the policy level but also at the ground especailly on the riverbasin management. Technically the governmental agencies focused on the engineering approach (hard approach) to ensure the facilities and infrastructures able to support the river basin management. It is well understood that hard approaches alone is not sufficient, to ensure the issues related to IRBM is well managed. Beside that soft approach also equally important for sustainable water resourse management. Civic Science Approach that emphasise bottom up through heart approach by enhancing the awareness, knowledge and skill which will enable actions to address and solve the issues at their root causes. It is important to factor in the humanistic approach, such as the power of the community in alleviating issues at grassroot level.

There is a need to find the equilibrium between the “top down” and “bottom up” approaches. The current IRBM method are mainly spearheaded by the agencies either the top down or bottom up. While this may get the job done, it does not provide ownership to the community and therefore, there is little chance for sustainability. The CbKRB-IRBM provides a platform for the communities to instill sense of ownership and led the action plans together with relevant agencies. The communities need to entrusted by this agencies and given ownership to adopt and monitor the as well as to feel appreciated and needed to play their roles as the stakeholders. It is important to address this gap to improve the outcome of any river management project especially on the sustainability aspect.



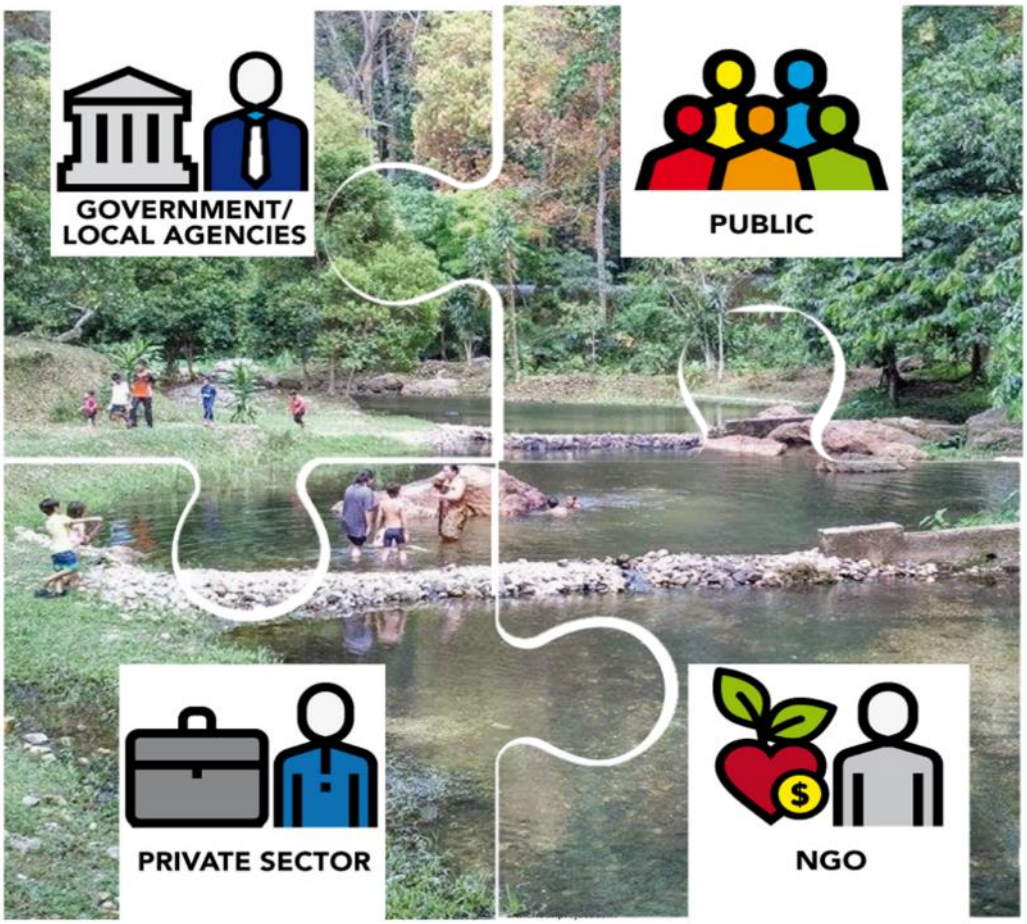


Promoted Bottom Up Approaches through the CbKRB- IRBM

Thus the key of the approach in building relationship and trust with government, highlights the need of public private partnership (PPP) which emphasizes collaboration of the CBOS, NGOs, medias and other stakeholders. Furthermore, Cross-agency involvement and support among multiple agencies is crucial for impactful results (e.g. DID, DOE, Local Authorities, other water related key agencies) as some issues require institutional reforms or policy change (e.g. sullage issues, WQI, FOG and solid waste) which requires significant time and an intimate approach. To ensure the above to be implemented successfully and sustainability, SMART Partnership mechanism is to be promoted and established as focal platform. This is important to increase awareness, develop strategies to enhance involvement of various governmental agencies, other relevant stakeholders with local communities, public and media in river basin management, linking on-going programmes among different agencies, information exchange and technical supports. The SMART partnership help to strengthen the capacity of local stakeholders (with a focus on NGOs/CBOs) to be more actively involved in protection and conservation of riverbasin.

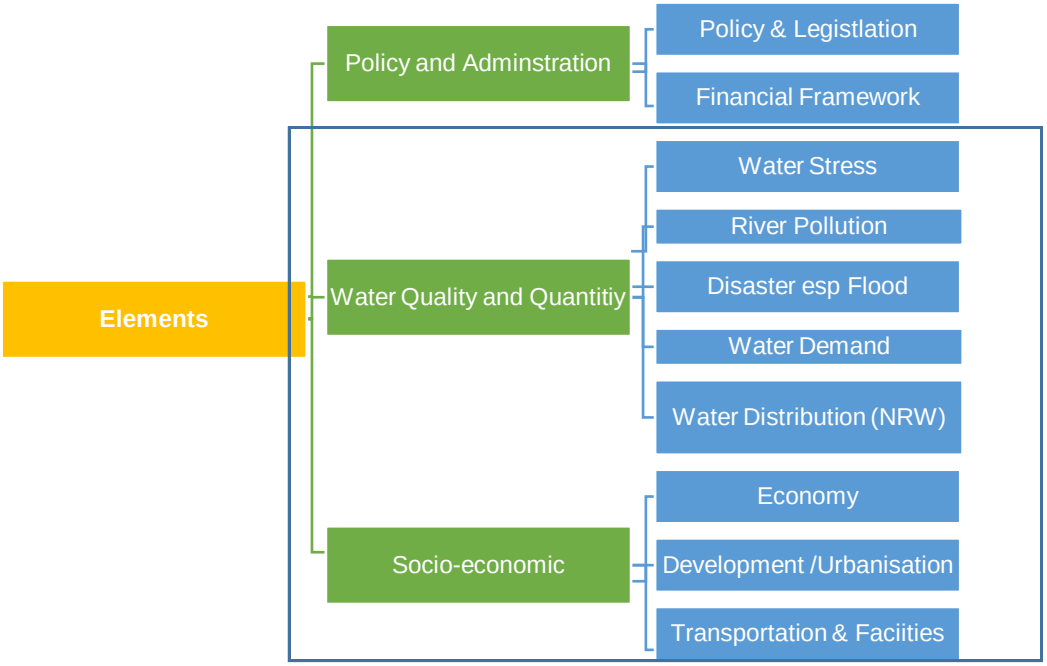
There is a need for the governmental agencies to embark advisory role, that is crucial in contributing ideas and resources to the implementation of the project, complement their technical expertise to providing technical support as well as collaboration partners and to form network with the community members and therefore, the public will have direct access/contact with real government officers in their relevant agencies.

Overall, it leads to better and more lasting results, where the integrated approach will enhance the quality of results and help ensure sustainability by enabling the development of long-term multi-stakeholder partnerships. Governmental involvement and engagement are important and must work in hand i.e. any hard – construction based initiative needs maintenance and also support of the surrounding communities. By working in hand, addition to just public hearing and option sharing before commencing a project will eventually lead to long term partnership, ownership, win – win approaches and leads to sustainability.



To ensure the proposed action plan can be implemented at grassroots level with the community engagement, a guiding community based IRBM plan is necessary to ensure the strategies and its goals are achievable. Community approach need to take into account the complexity of the water problems caused by social, hydrological, and ecological system imbalances to co-creating resilient solutions by recovering and restoring not only the ecological system, but also the social system in which all actors including hidden players are aware of their role and responsibility[1]. Some of the significant issues highlighted and not limited for the IRBM components in Malaysia which requires communities' engagement are within the element of water quality and quantity as well as the socio –economic sectors.

[1] Agramont, Afnan & Craps, Marc & Balderrama, Melina & Huysmans, Marijke. (2019). Transdisciplinary Learning Communities to Involve Vulnerable Social Groups in Solving Complex Water-Related Problems in Bolivia. Water. 11. 10.3390/w11020385.



The overarching message is that community should be given as well play significant roles towards the river ownership and as such should be a central part of Integrated River Basin Management (IRBM). The IRBM plan highlighted can be achieved in many different ways, at different scales and within different tiers of communities. This plan developed for Kinta River Basin will starts out with explaining on environment and its beneficiaries, discussion the components of the environment, the key stakeholders and drivers. Then traces down on how the strategies used in the engagement process with focused approaches centred on community led implementation and its sustainability.

This plan developed based on existing IRBM plans as refrenece guide together with Global Environment Centre's 23 years' working experience on community engagement in river care with agencies like DID, DOE, LA and other in ensuring sustainable approaches. With the support of Yayasan Hasanah through the project Stewardship for A Healthy Kinta River Basin Through Green Living Practices, the plan developed focusing for the Kinta River basin engagement is expected to be used as a model for other community based integrated river basin management approaches at other basin's in Perak.

1.4 Community based Kinta River Basin- Integrated River Basin Management (CbKRB IRBM)

The CbKRB_IRBM will establish a balance between the natural functions of the river and the built environment. Hence, the framework for the IRBM plan for Sg Kinta in the community perspective will encompasses a holistic approach that included role of communities as change agent and action oriented through Civic Science and Nature Based Solution to meet the identified key goals.

This Community based Kinta River Basin - Integrated River Basin Management (CbKRB IRBM) is as complimenting the existing finding and highlights the role of various stakeholders

i.e. government, municipalities, water regulatory bodies, academic institutions, industries, farmers, NGOs, etc., to participate in the management of river basins especially local communities into Integrated River Basin Management (IRBM). This plan highlights goals, practical strategies, and guidance on how to implement the proposed action plans with significant input and action undertaken by community at grassroots level (community perspective) within Kinta River Basin. Although communities can undertake IRBM modelled river care activities, they need support from government agencies and other players, which the role as well as management strcuture further emphasized in the coming chapters (4 and 5).

1.5 Chapter Input

Chapter 1: Introduction to IRBM and Community based Kinta River Basin - IntegrateRiver Basin Management (CbKRB-IRBM).

Chapter 2: Highligts the current state of the Kinta River Basin in term of landuse, pollution level, the governance roles as well as ongoing programmes to provide some input on how the proposed goal will benefit the communities.

Chapter 3: Focuses on the the proposed goals, with detailed input on the objectives, the proposed action plan, the key partners and supporting agencies as well as the proposed timeframe to achieve the expected outcome.

Chapter 4: This section describes roles of stakeholders relating to implementation of CbKRB-IRBM. The resources needed also highlighted in this section.

Chapter 5: This section covers KPIs measured for each goals respective to the strategies.

CHAPTER 2: KINTA RIVER BASIN (KRB)

2.1 Introduction

This chapter covers and described the general information of the project area including climate, geology and soil type, biodiversity; human use, demography and economic activities; water supply; disaster risk and governance. Beside that the current status of Kinta River Basin presented here through the summary of the Kinta River Basin Rapid Environmental Assessment study conducted by GEC (March to April 2022) in collaboration with external researchers also included here. (Refer to Kinta River Basin Rapid Environmental Assessment report for details).

2.2 Project Area

The project area is emphasized on the Kinta River Basin (KRB). The basin size of KRB is approximately 2686.12km^2. KRB have covered various sub-districts as shown in **Table 2.1**. Sg Kinta is the river passing through Ipoh city, where the river flows from Mount Pass at Simpang Pulai-Cameron Highlands Highway in Ulu Kinta with an elevation is approximately 1500m above MSL. Sg. Kinta is the most important water resource in Ipoh city and the second most important water resource in Perak state (after Perak River) used for drinking and irrigation purposes.

For the purpose of this project, zones boundary is set based on the available data to facilitate project planning, designing, implementation and monitoring as shown in **Figure 2.1**. The zones represent the different regions of the Kinta River Basin that is within the project area.

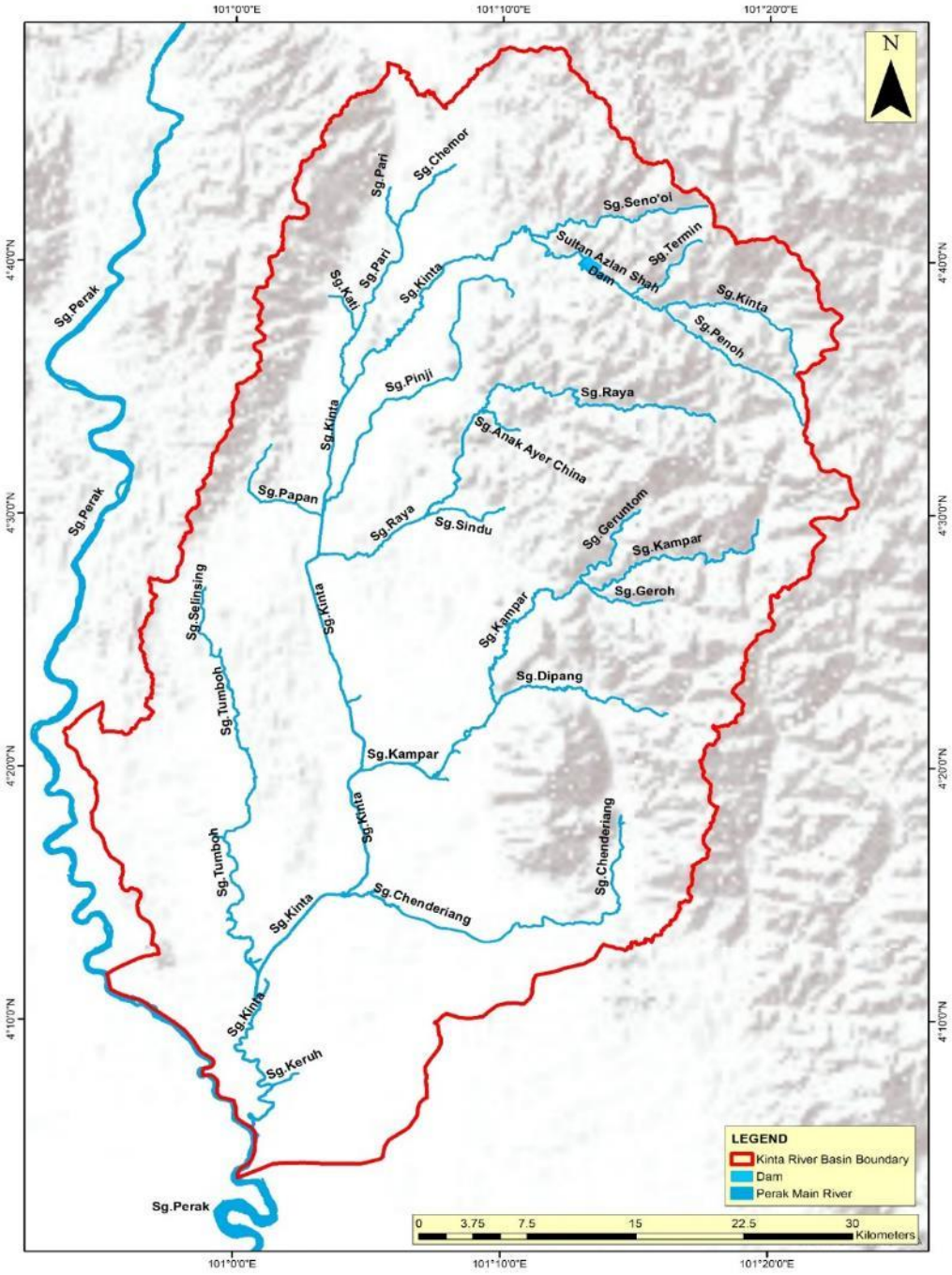


Figure 2.1: Kinta River Basin project area

Table 2.1: List of Sub-districts within KRB boundary

Sub-District	Area (km^2)
Belanja	102.58
Tanjong Tualang	143.33
Kampar	393.02
Hulu Kinta	697.52
Sungai Raya	242.63
Teja	269.29
Sungai Terap	100.62
Labu Kubong	39.38
Belanja	1.06
Layang Layang	3.11
Bota	70.88
Pulau Tiga	47.81
Kampong Gajah	43.32
Lambor Kanan	38.75
Sayung	0.86
Senggang	0.51
Sungai Siput	34.60
Batang Padang	13.44
Chenderiang	238.28
Pasir Panjang Hulu	94.54
Bandar	4.13

2.3 Secondary Data Analysis

This section covers data from past as well as latest studies done at Kinta River Basin. Secondary data covers climate, geology and soil type, human use, demography, economic activities, water supply and disaster risk within KRB.

2.3.1 Climate

The project site had experienced an abundance of sunshine and a typical equatorial climate, humid with high temperature all year round. The lowest humidity is generally recorded in February and the highest humidity is generally recorded between October to November, ranging from 63% to 99%. Generally, the climate condition within Kinta River Basin (KRB) is highly influenced by the monsoon season as tabulated in **Table 2.2**. The daily temperature varies between where low air temperature occurs from December to January and the highest air temperature usually occurs from April to May. The annual rainfall ranges from 2,000 mm to 2,400mm. For the State of Perak, the average annual rainfall from year 1980 to 2014 is about 2156.41mm. Based on the 34 years of records, the rainfall varies from 1352.93mm to 2735.49mm (Hanif *et al.,* 2022)

Table 2.2: The annual seasonal climate period within the project area

Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov
North–East Monsoon			Transitional period			South-West Monsoon			Transitional period		

The project site is sheltered from the Northeast monsoon, hence receives limited rain during this season. In contrast, the Southwest monsoon, from May to July, accumulates moderate rainfall. The peak of rainfall occurs from April to May and August to October during the transition period between the monsoons. Major floods generally occur between the months of July to December. In some events, occasional spills over the mountain range during the Northeast monsoon cause floods in November and December (Perak IRBM, 2010).

2.3.2 Geology and Soil Type

The Kinta River Basin is located in the Western Stratigraphy Belt of Peninsular Malaysia that is underlain predominantly by Palaeozoic rocks. In KRB, relatively thick limestones predominate and they range from Silurian to Permian age. There are a large number of karstic limestone outcrops on the eastern flank of the KRB, of which some are on the brink of disappearing as they are being exploited for use as raw materials for cement factories, as construction stones and aggregates, and as fillers. Besides limestone, KRB is also underlain by clastic sedimentary rocks such as interbedded sandstone and mudstone, shale, granite, and alluvium. (Meng *et al.,* 2014).

The soil major groups in the KRB site consist of marine alluvial soils in the downstream area while sedentary soils in the middle stream (DOA, 2002) and steep land soils in the upper stream (DOE, 2013). The upland soils are generally medium to fine-textured. The floodplain soils range from well-drained levee soils to poorly drained heavy clays and peat soils in very poorly drained areas. Most soils are suitable for a wide range of crops. However, the clay content was more pronounced, attaining a value of more than 30% while sand content was less than 60%. (Hamzah, 2010).

2.3.3 Human Use, Demography and Economic Activities

The population growth is one of the main drivers for increasing water consumption. Aside from consumption for survival, health and well-being, the economic activities and development that grows alongside population lead to impacts on natural resources within KRB. Therefore, knowledge on the current and future population projection is essential for resources planning and management. The demographic information of KRB is obtained from secondary data of Population and Housing Census of Malaysia (2020).

Overall, there are 8 parliaments within KRB site with 21 DUN (State Legislative Assembly) involved in this project assessment. The population composition in KRB area **(Table 2.3)** shows that Bumiputera ethnicity has the highest population which is (51.5%) followed by Chinese (35.7%), Indian (12.2%) and others (0.6%).

Table 2.3: Population composition within Kinta River Basin

Parliament	DUN (State Legislative Assembly)	Bumiputera	Chinese	Indian	Others	Sub-population	Total Population
Tambun	Hulu Kinta	76,616	24,326	12,163	569	113,674	259,166
	Manjoi	107,810	22,697	14,549	436	145,492	
Ipoh Timur	Canning	10,654	30,836	5116	329	46,935	134,700
	Tebing tinggi	34,994	15,871	4,078	220	55,108	

	Pasir pinji	4,343	26,681	1,502	98	32,657	
Ipoh barat	Bercham	18,129	41,670	10,119	351	70,269	134,978
	Kepayang	10,852	8,023	4,197	116	23,188	
	Buntong	5,896	14,823	20,594	208	41,521	
Batu Gajah	Jelapang	6,053	25,895	13,289	228	45,509	137,227
	Menglembu	6465	31825	6920	273	45,529	
	Tronoh	22078	17367	6605	139	46,189	
Kampar	Malim nawar	12027	14468	3156	89	29,769	104,552
	Keranji	7867	25947	3896	151	37,824	
	Tualang sekah	26,721	5,137	2,994	111	36,959	
Gopeng	Sungai rapat	45,540	23,036	7,147	304	76,028	216,236
	Simpang pulai	40,787	50,884	6929	494	98,997	
	Teja	27,694	9519	3874	124	41,211	
Tapah	Chenderiang	24630	4954	4850	207	34,641	79,093
	Ayer kuning	32050	6934	5023	444	44,452	
Pasir Salak	Sungai manik	29003	8174	1965	157	39,299	80,485
	Kampong gajah	40692	82	329	124	41,186	
Overall Population	**590,901**	**409,149**	**139,295**	**5,172**	**1,146,437**	**1,146,437**	

Source adapted from: Population and Housing Census of Malaysia, 2020

Economic activities are very important as it mainly support people's livelihood. The classification of activities divides economic activities into categories which, by aggregation, make it possible to define the sectors of activity (Agriculture, Industry, Construction, Fisheries, etc.). Service sector (79%) holds highest economic activity percentage within KRB area followed by Construction (8.2%), Manufacturing (7.5%) and Agriculture, forestry and fishing (2.3%). Fisheries, Forestry, Livestock, Mining and Crops are the other remaining economic activities (MSCI, 2008; MSBR, 2022).

2.3.4 Water Supply

Sultan Azlan Shah Dam is the first in the country that adopted the roller compacted concrete construction technique, where its construction period started in 1997 and was officiated on August 2, 2007. The dam was the last phase of the Greater Ipoh Water Supply II Scheme under Lembaga Air Perak (LAP). It was constructed in order to raise the water supply of Perak by 25%. It is aimed to increase water output for the Kinta district (including Ipoh city) from 136 million litres daily (MLD) to 639 MLD to cater for 350,000 consumers.

Generally, LAP had confronted the two (2) main issues which are known as the sedimentation and water shortage stored during the dry season. Currently, the issues on the sedimentation at the Sultan Azlan Shah Dam were addressed by excavating the sedimentation from the dam (checked dam) to maintain the water storage volume in the dam. The observed sedimentation at the dam is made up from various types of materials, including fine particles of silt and clay; and larger particles of sand and gravel. The excavation processes take place in three (3) stages at the check dam. Three (3) check dams were constructed before the Sultan Azlan Shah Dam by the LAP to control sedimentation. This area is an active erosion environment because of the erodible material in the stream and check dams[2]. Check dams are commonly used to stabilize sedimentation, reduce the water velocity, limit catchment erosion, and increase the reservoir storage capacity of a dam.
Sg Kinta and Sultan Idris Shah II Water Treatment Plant (source of water: Sg Perak) mainly provides water supply to total population of 1,066,697 covering Ipoh, Kampar and Batu Gajah areas (GEC, 2021). Sg. Kinta is the main water source of the municipal water pipeline to the urban and semi-urban areas within KRB, enabled by LAP. LAP operates the Sultan Azlan Shah Dam and the two (2) water treatment facilities that provide water supply to different parts of KRB; the Sg. Kinta Water Treatment Plant (WTP) and Ulu Kinta WTP. Only these two (2) WTP are dam regulated in the Kinta district, while the rest are by the run of river scheme. The Sg. Kinta WTP is the second largest WTP in the district with a design capacity of 227 millions litres per day (MLD) **(Table 2.4)**. The major demand points are from the town areas of Ipoh, Kampar and Tapah (LAP, 2014).

[2] *LAP, 2014*

Table 2.4: Existing WTPs within KRB

Water treatment plant	Water sources	Forest reserve	Design capacity (MLD)
Ulu Kinta	Kinta River	Bukit Kinta	136.38
Sungai Kinta	Kinta River	Bukit Kinta	227.30
Sultan Idris Shah II, Parit	Perak River	NA	272.77

Source: Lembaga Air Perak, 2019

2.3.5 Disaster Risk

Slope erosion and flood are two major disaster risks faced by Kinta River Basin currently. This section gives overview on this immediate disaster risks.

2.3.5.1 Slope Erosion

Slope erosion severely impacts the river water quality and quantity, riverine biodiversity and downstream reservoir water storage capacity. The geomorphic hazard often being a result of poorly managed land use ended uploading huge amounts sediment into the water body. Left unchecked there will be also a direct subsequent social and economic crisis through water supply shortage as many water catchment areas are prone to slope erosion due to poorly managed land use by man. Within KRB specifically at upstream, the major slope erosion occurrences had been identified at Simpang Pulai-Cameron Highland Highway (Section 44-46) which contributes to the high sedimentation in the Sultan Azlan Shah Dam. The Malaysian Public Works Department (PWD) Kuala Lumpur has classified the landside at Section 44 (Km44) and Section 46 (Km46) of Simpang Pulai-Lojing Road (FT185) as a critical area. Recently, two deaths occurred whom two men buried under the landslide at the Kilometre (Section) 35 along Jalan Simpang Pulai-Cameron Highlands (Bunyan, 2021). **Figure 2.2** shows the location of the water catchment area, the highway and the Sultan Azlan Shah Dam. Sultan Azlan Shah Dam (SASD) catchment has experienced changes in land cover due to Simpang Pulai-Cameron Highlands Road Project in 2001 which crosses the catchment at the highland regions. These changes have resulted in modification and alteration in the status of land cover and cause increased upland erosion and higher concentrations of suspended sediment within the catchment (Mohd Firdaus, 2013).

Figure 2.2: Water catchment area, location of the highway and the Sultan Azlan Shah Dam on a satellite image

Figure 2.3 shows the main area in the UKB affected by slope erosion affected is the western hillside of the Gunung Pass ridge; where the eroded landslides were washed down to the Penoh River especially during the heavy downpour. The deeply-incised Penoh River is a tributary of Kinta River, leading down from the Gunung Pass which has an elevation of 1587 m above the sea level (GEC, 2020) and lately become main source of sediment into the Kinta River and finally the dam.

Figure 2.3: Satellite image and drone photo of the landslide and the erosion ending up into the Penoh River feeding into the Kinta River and finally into Sultan Azlan Shah Dam

Sultan Azlan Shah Dam provides continuous raw water supply to 2 water treatment facilities; Sungai Kinta Water Treatment Plant (WTP) and Ulu Kinta WTP that provide water supply to Kinta Valley inhabitants. Realising the issue and current limitations with anticipated future scenario from the erosion hazard, a pilot bio-engineering demonstration site established for slope erosion events at the Section 49.5, FT185 Simpang Pulai-Cameron Highlands Highway as part of national demonstration site for Perak under Mainstreaming of Biodiversity into river management project, initiated by DID Malaysia, UNDP and GEF5 and implemented by GEC with DID Perak. Following initial success of pilot bio-engineering demonstration site, it is proposed to replicate to bigger as well as critical slopes with mix bio-engineering approach.

Landslide area at KM46, FT185 Simpang Pulai-Cameron Highlands Highway(captured on 24 February 2020)

Sediment in the bed of the Sg Penoh due to eroding highway slopes (captured on 23 July 2020)

Sediment transport and turbid Sg Kinta entering Sultan Azlan Shah Dam (captured on 10 August 2020)

Figure 2.4: Landslide area at KM46, Simpang Pulai Highway, leading to sedimentation in Sg Penoh, hence to Sultan Azlan Shah Dam

2.3.5.2 Flood

Intergovernmental Panel on Climate Change (IPCC) report defined flood as the overflowing of the normal confines of a stream or other body of water or the accumulation of water over areas that are not normally submerged (IPCC, 2007). Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods. Perak has experienced 396 flood disasters between 2014 and 2020. Perak had the worst flood disaster in the year 2020, with data of 100 incidents, with 10 being a beach flood and 90 being a flash flood. The low lying terrain stretching from Sg Kinta confluence up to Pasir Salak and Kg Gajah have well documented flood problems. Most villagers or the communities affected by floods are reluctant to leave when encouraged to evacuate. From the hydraulic simulation, these areas are susceptible to floods of a 2–year ARI discharge. The simulation also indicated that the extent of flood problems reach out as far as Bota (CH.104) where its existing protection levels are either at a 2–year ARI level or lower. Along Sg Perak, there are some flood prone areas such as the upstream of Sg Kinta/Sg Perak confluence near Kg Gajah which suffer long durations of flood, sometimes inundated for a few weeks. Such long durations of flood will affect the yield of the inundated crops like oil palm and orchards (Perak IRBM, 2010). The overall flood disaster revealed that flash floods were the main cause of this disaster from 2014 to 2020. Flash floods are common in Kinta River Basin. Heavy downpour usually causes flash floods in Kinta River Basin. On 19 January 2022, Ipoh, main area of the Kinta River Basin, was hit by flash floods. The disaster's affected areas include Taman Cempaka, Bandar Botani, Tambun, and Greentown.

On 7 March 2022 and 28 November 2020, flash flood was struck in Teluk Intan because of heavy rain. Due to this incident, 18 persons from four families were forced to relocate to Temporary Migration Centre (PPS). The impact of this flash flood in Batang Padang caused the water from Sungai Bidor to overflow into Sungai Perak, resulting in a flash flood in Hilir Perak. As a result of the flash floods, 202 people and 60 families were evacuated to PPS.

The floods in Perak are caused* by:

i) Heavy rain events
ii) Internal drainage events; inadequate, imperfect, and not maintained
iii) The occurrence of overflowing river water; overcapacity, narrow, shallow and unmaintained.
iv) Flood mitigation/ control structures; inadequate, imperfect, and not maintained
v) Tidal sea events
vi) Development, land clearing, and rubbish

*Based on GEC's review of various newspaper articles.

2.4 Governance

There are ten (10) state government Excos (Committee Chairman) for Perak (Perak, 2022). There are two State Exco and portfolio very much related for overall management of Kinta River Basin. The main two are State Excos are Chairman of Science, Environment, and Green Technology Committee as well as Chairman of Infrastructure, Energy, Water and Transportation Committee. Respect to State Excos, the state government agencies are also assigned based on their jurisdiction. Whole Kinta River Basin comes under jurisdiction of four (4) local authorities. They are Ipoh City Council, Batu Gajah District Council, Perak Tengah District Council and Kampar District Council.

In respect to Kinta River Basin, currently a Project Working Group (PWG) formal established with members from a total of 29 state government agencies and invited universities, NGO as well foundation as off May 2022. Perak State Chairman of Science, Environment, and Green Technology Committee is the advisor to this PWG which headed by Director of Department of Irrigation and Drainage Perak with GEC as secretariat. The committee meet at least once a year for formal meeting while having information disseminated throughout year through WhatsApp platform. **Figure 2.5** shows the current structure of Kinta River Basin PWG.

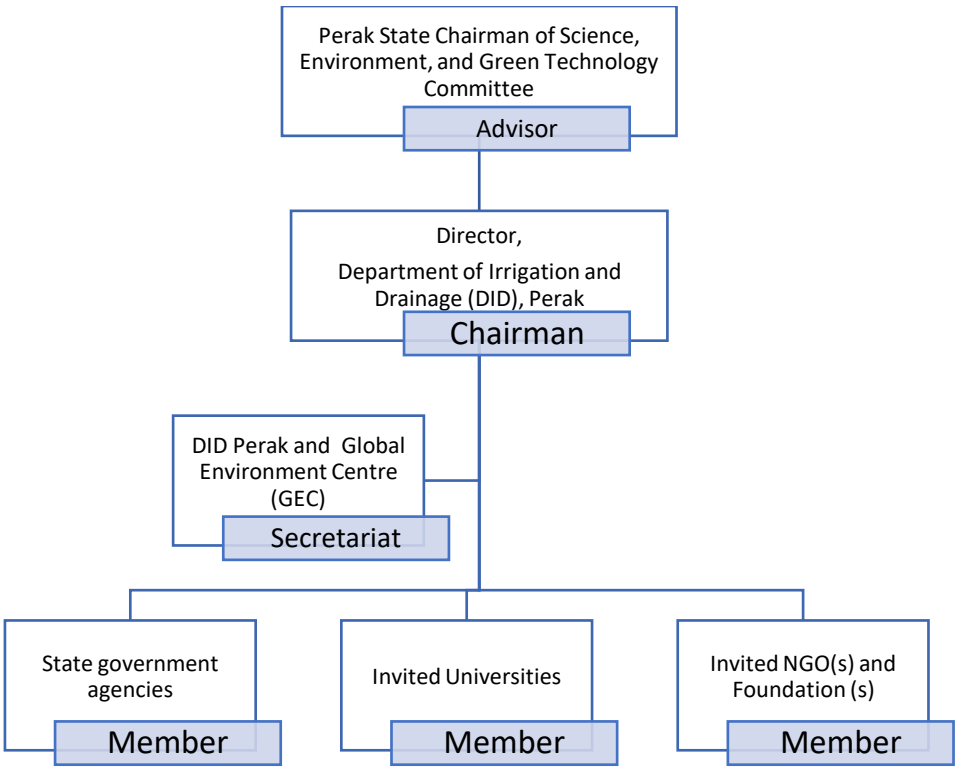


Figure 2.5: Current structure of Kinta River Basin PWG

2.5 Summary of Kinta River Basin Rapid Assessment Environment

Kinta River Basin Rapid Environmental Assessment (KRB-REA) was carried out by GEC as part of Sg Kinta Stewardship through Green Living Practices project. This section will summarize the KRB-REA report. The key components involved in the KRB-REA were water quality, aquatic and terrestrial flora, fish, small fauna, benthic macroinvertebrates, land use activities, and pollution inventory. A total of 15 sampling stations were selected to achieve the aim of the assessment. **Table 2.5** shows the sampling stations and components involved for each station. The flora and fauna sampling were carried out for 7 days from 21 March 2022 to 27 March 2022. Water quality sampling was carried out later for 3 days from 13 April 2022 to 15 April 2022. Besides GEC staffs, the assessment was supported by number of external experts and laboratory officers.

Table 2.5: Shows the sampling stations and components involved for each station

Sampling Station	Water Quality	Benthic Macroinvertebrates	Flora	Small Fauna	Fish
KRBEAS_01	√	√	√	√	√
KRBEAS_02	√	√			
KRBEAS_03	√	√	√	√	√
KRBEAS_04	√	√	√	√	√
KRBEAS_05	√	√	√	√	√
KRBEAS_06	√	√	√	√	√
KRBEAS_07	√				
KRBEAS_08	√	√	√	√	√
KRBEAS_09	√	√	√	√	√
KRBEAS_10	√				
KRBEAS_11	√	√	√	√	√
KRBEAS_12	√		√	√	√
KRBEAS_13	√	√	√	√	√
KRBEAS_14	√	√	√	√	√
KRBEAS_15	√		√	√	√

Note:

1. √ = sampling component carried out
2. = sampling component not carried out

2.5.1 Land Use within KRB

The total area of KRB is 2686.12 km². Overall, the largest land use type within KRB is forest, with total size of 893.70 km^2 (33.27%). Second largest is agriculture which covering about 815.63 km^2 (30.36%), followed by waterbodies as the third largest land use type within KRB with 351.27 km^2 (13.08%) and the least is livestock area with 18.43 km^2 (0.69%). Main types of land use within KRB are shown in **Table 2.6** and depicted in **Figure 2.6**.

Table 2.6: Breakdown of land uses within KRB area

No.	Types of Landuse	KRB Landuse		KRB Section					
				Upstream		Midstream		Downstream	
		Area (km²)	Percentage of Landuse (%)	Area (km²)	Percentage of Landuse (%)	Area (km²)	Percentage of Landuse (%)	Area (km²)	Percentage of Landuse (%)
1	Forest	893.70	33.27	396.64	50.69	357.97	38.15	139.11	14.41
2	Agriculture and related	815.63	30.36	98.61	12.60	208.93	22.26	508.05	52.64
3	Waterbodies	351.27	13.08	29.20	3.73	163.16	17.39	158.92	16.46
4	Municipal, utilities and related	259.96	9.68	159.49	20.38	59.36	6.33	41.11	4.26
5	Open Area, Shrub, Erosion Site	252.44	9.40	75.07	9.59	117.71	12.54	59.65	6.18
6	Swamp forest	49.96	1.86	1.26	0.16	4.02	0.43	44.68	4.63
7	Mixed development	44.74	1.67	17.97	2.30	19.73	2.10	7.04	0.73
8	Livestock Area	18.43	0.69	4.26	0.54	7.54	0.80	6.63	0.69
TOTAL		**2686.12**	**100.00**	**782.51**	**100.00**	**938.43**	**100.00**	**965.19**	**100.00**

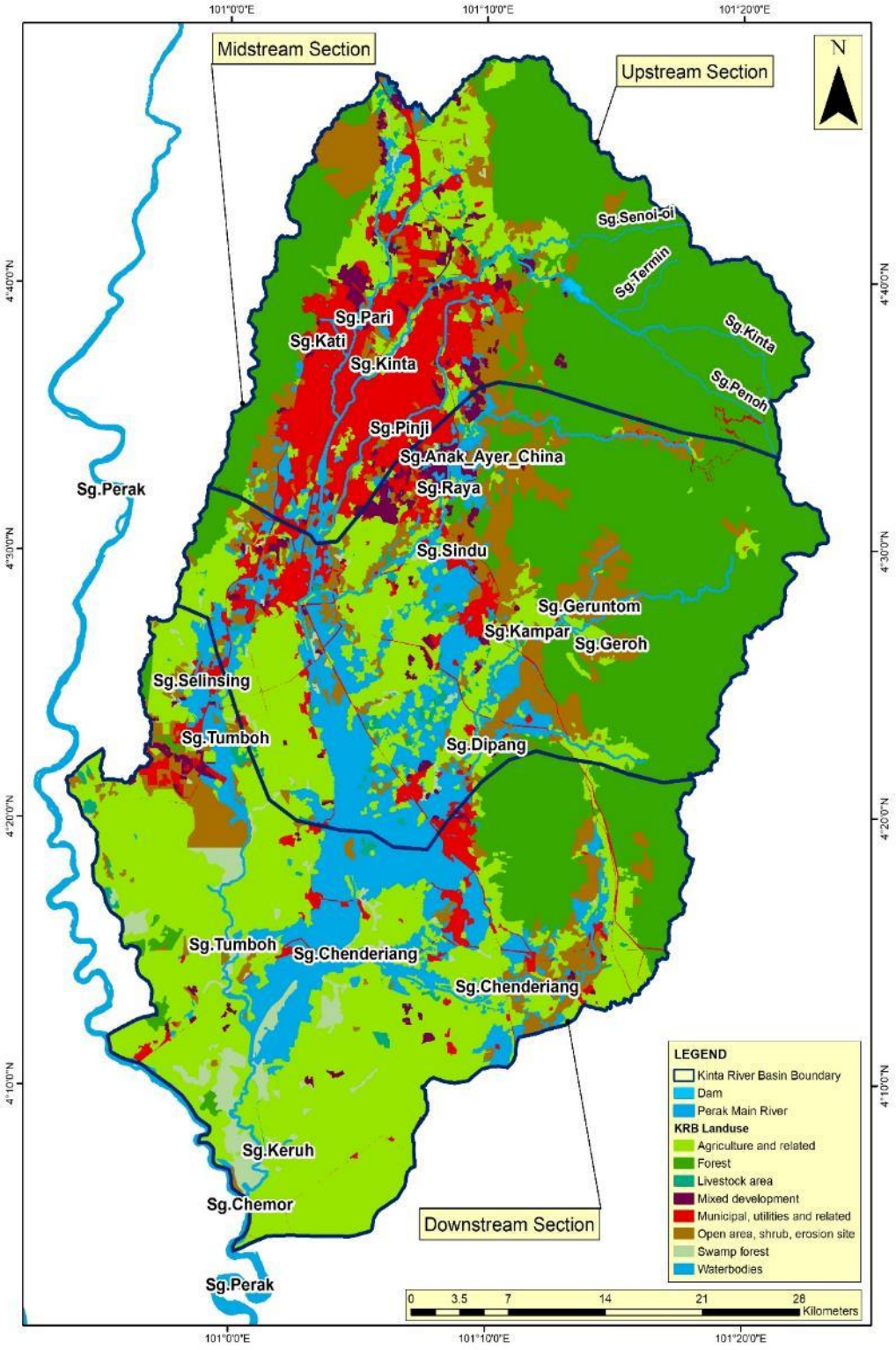


Figure 2.6: Land use of Kinta River Basin

2.5.1.1 Forest

The total area recorded within KRB as forest is 893.70 km² (33.27 %) **(Figure 2.7)**. The types of forest shown within KRB are landed forest, mangrove and moist land forest. Within this land use, the largest forested land contribution is in Bukit Kinta on the Main Range and Keledang Range, is Environmentally Sensitive Areas (ESA) in Perak where else Hutan Simpan Kekal Bukit Kinta covers an area of more than 65,000 Ha. This forest reserve is managed by Perak State Forestry Department through Kinta District Forest Officer Office. The permanent forest reserve status was given to this area on 29th August 1930 with gazette number 6158. The highest point is in Mount Korbu which more than 2183 meter above sea level and it is the second highest mountain in the Peninsular of Malaysia after Mount Tahan. Second largest forested land contribution is within Kledang Sayung forest reserve. Forest Reserve Keledang Sayung is a forest reserve in Perak and has an elevation of 551 metres. Forest Reserve Keledang Sayung is situated east of Sungai Jenereh, and west of Gunung Meru. Forested land also shown to be in the area mukim (smallest administrative district) of Sungai Raya and Teja.

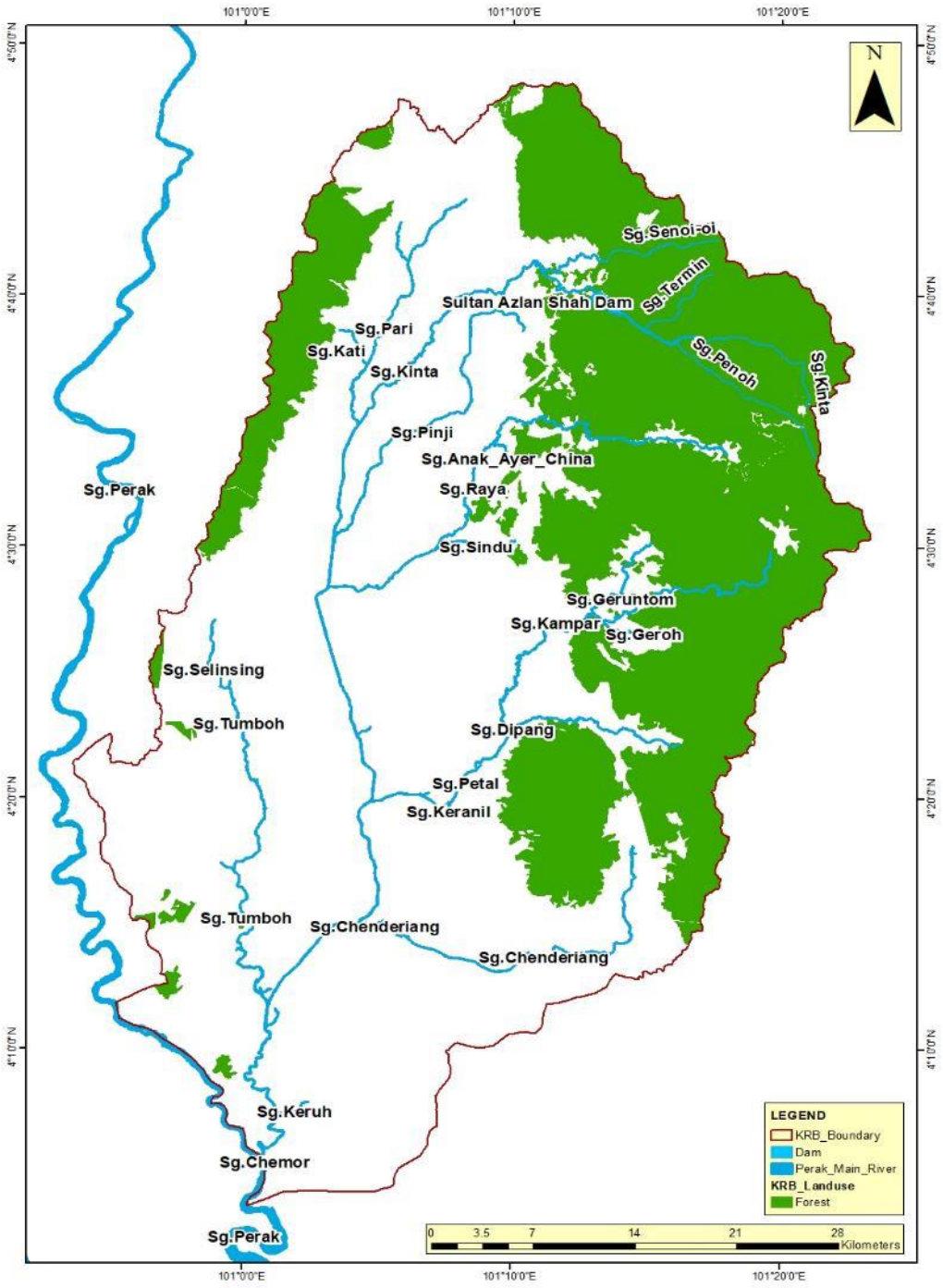


Figure 2.7: Main Forest within KRB

2.5.1.2 Agriculture with its Related and Livestock

The total area of land use within KRB for agriculture (and related) and livestock activities is about 815.63 km² (30.36%) and 18.43 km² (0.69%), respectively. Most of the agriculture activities are carried out at the midstream and downstream area, some in upstream of Kinta River Basin. The main agricultural activities include the fruit farms, rubber plantations, coconut trees plantations, palm oil plantations, mixed agriculture and others along Kinta River Basin. Where else the agriculture related activities include aquacultures, commercial agriculture and livestock farming. Almost 87% of the agricultural land within upstream is not cultivated while for midstream and downstream of Kinta River Basin, the agriculture is mostly cultivated and commercially expanded. **Figure 2.8** shows the agricultural land use activities and livestock area within KRB.

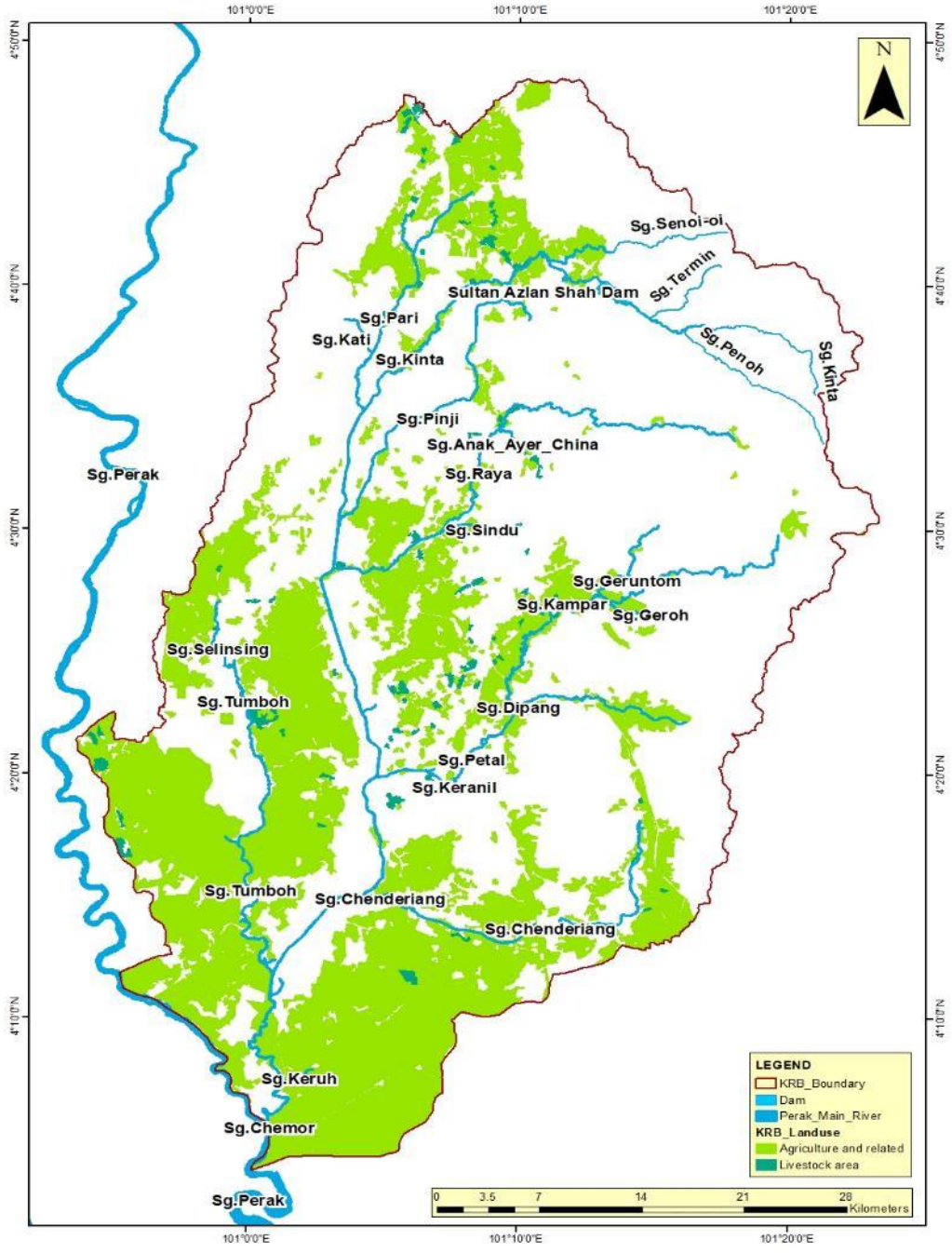


Figure 2.8: Agriculture and livestock activities within KRB

2.5.1.3 Municipal, Utilities and Related

The municipality, utilities and related (including residential and transportation facility) have covered 259.96 km² (9.68%) of overall land use in KRB **(Figure 2.9)**. KRB has Simpang Pulai-Cameron Highlands Highway running through mainly at upstream. The residential and transportation facility area is highly populated at the upstream followed by midstream and downstream of Kinta River basin. The residential composition consists of strata and non-strata housing property, illegal settlements, and villages. On the other hand, the transportation composition include land, air transportation and roads. This land uses are condensed in region at end of Ulu Kinta, Sungai Terap and Belanja.

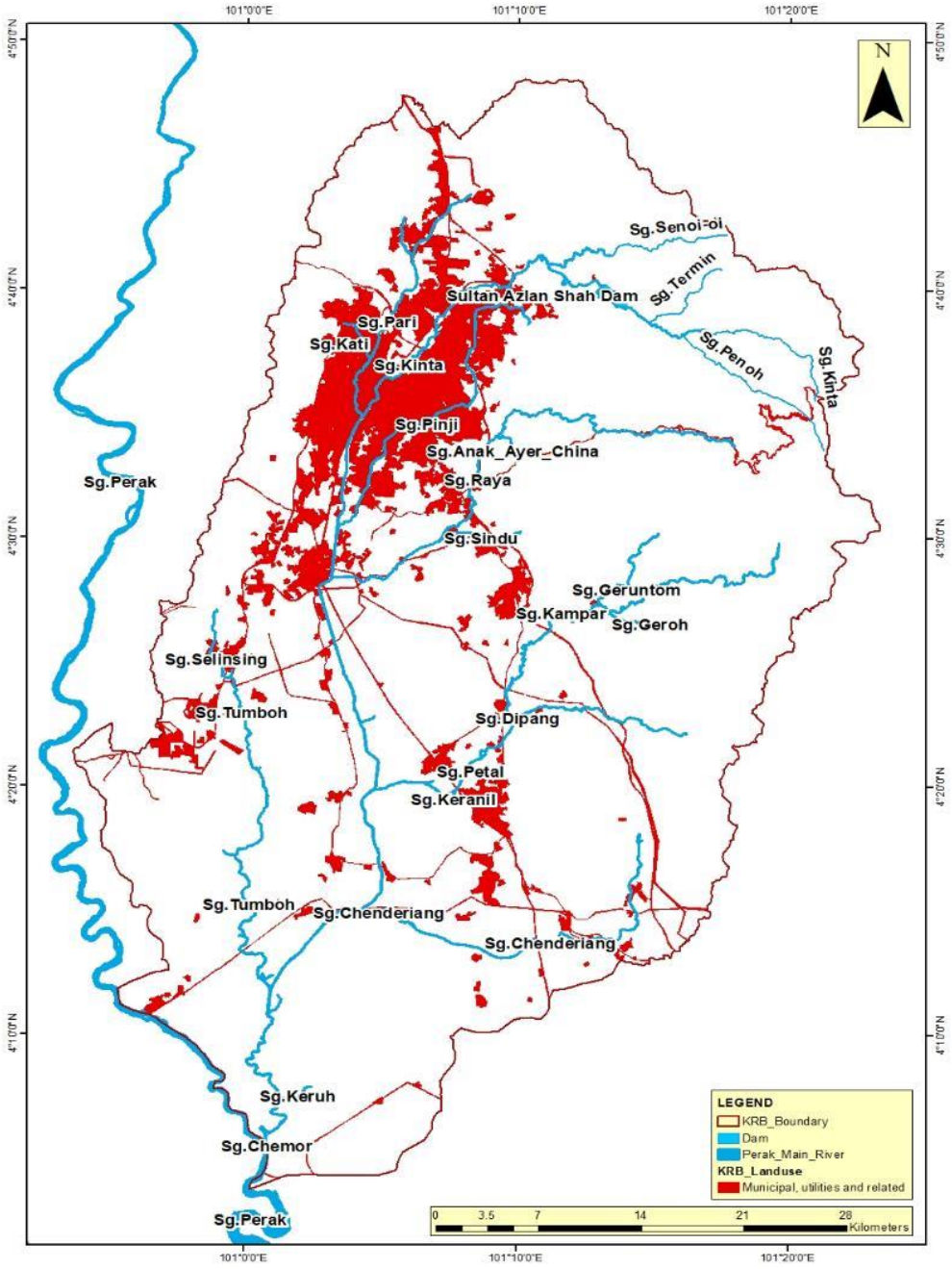


Figure 2.9: Municipality, utilities and related within KRB

2.5.1.4 Mixed Development

Mixed development within KRB hereby refers to residential, commercial and industries. Mixed development types of land use within KRB with approximately 44.74 km² (1.67%) **(Figure 2.10)**.

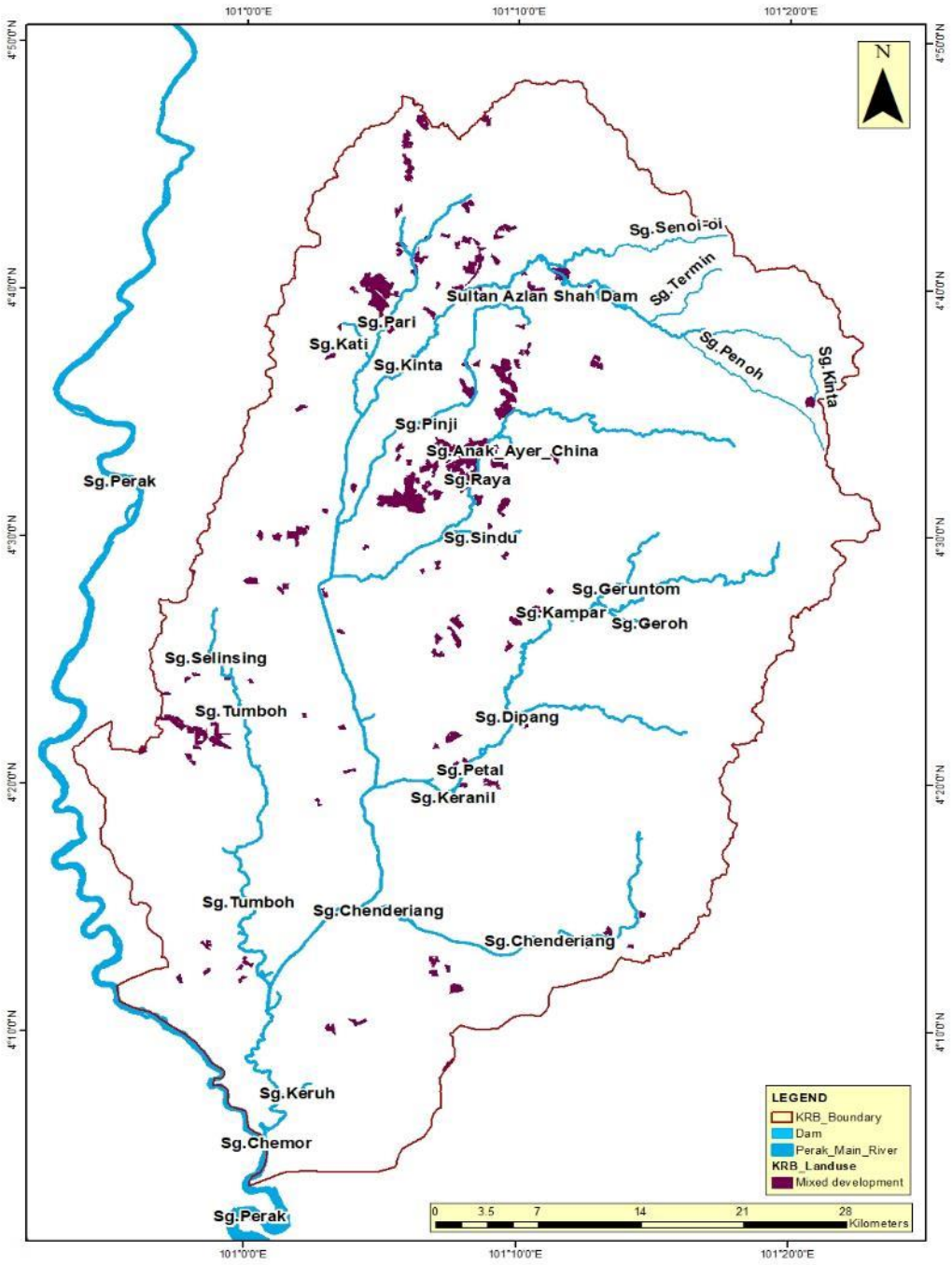


Figure 2.10: Mixed development including industries within KRB

Upstream of KRB has the most industries covered especially at mid and end of Ulu Kinta, Sungai Terap and Belanja sub-districts, respectively. There are nine (9) main industrial zones within Kinta River Basin focusing on manufacturing industries such as iron and steel, food industries, rubber and electronic and computer industries. The **Table 2.7** shows the industrial zones within KRB.

Table 2.7: Industrial zones within KRB

Industrial zone	Types of industries	Adjacent River
IGB Industrial Zone	Electronics and computer Iron and steel Textile Cement Rubber Printing	Klebang, Kinta
Tasek Industrial Zone	Cement Iron and steel Rubber Timber and wood-based Electronic	Kinta
Bercham Industrial Zone	Tyre Iron and steel Food Metal Wood based Plastic	Kinta
Jelapang Industrial Zone	Food Robber Wood-based Iron and steel Electronics and computer Textile Wood-based Marble Plastic	Tapah
Menglembu industrial Zone	Iron and steel Textile Plastic Food Tyre	Kledang, Kinta
Silibin Industrial Zone	Plastic Iron and steel Food Pottery Electronics and computer Wood-based	Tambun
Zarib Industrial Zon	Food Plastic	Pinji (Sg.Penjih)

	Toiletries	
Gopeng Industrial Park	Chemical Rubber Furniture Wood Plastic Automobile	Kampar
Rima Lahat Industrial Area	Construction Automobile	Selinsing

2.5.1.5 Waterbodies

The overall waterbodies including rivers, ponds, lakes, mining and ex-mining areas within KRB have covered about 351.27 km² (13.08%). Kinta district is one of the richest districts that rose from tin mining production and is located strategically in the middle of Perak. The physical evidence of this former tin mining landscape which surrounds Kinta offers a narrative about this past mining history. The mining and ex-mining area are more compacted and scattered in midstream and downstream of Kinta river basin, specifically at the Ipoh Town area**.** Ipoh Town is one of the main mining areas, leaving behind ex-mining ponds turned into an aquaculture or recreational lake/pond. Some of the ex-mining sites are secured within the forest reserve area where 14 former mining pools 6 km south of Batu Gajah covers 395 ha located within the Ulu Kinta Forest Reserve and around seven (7) hot spring pools are located within the Tambun Lost World Hotspring.

Sg. Kinta is the main river where the water will flows from Mount Pass to Sg. Perak. The main function of the rivers is for water supply. **Figure 2.11** shows the waterbodies within KRB project site.

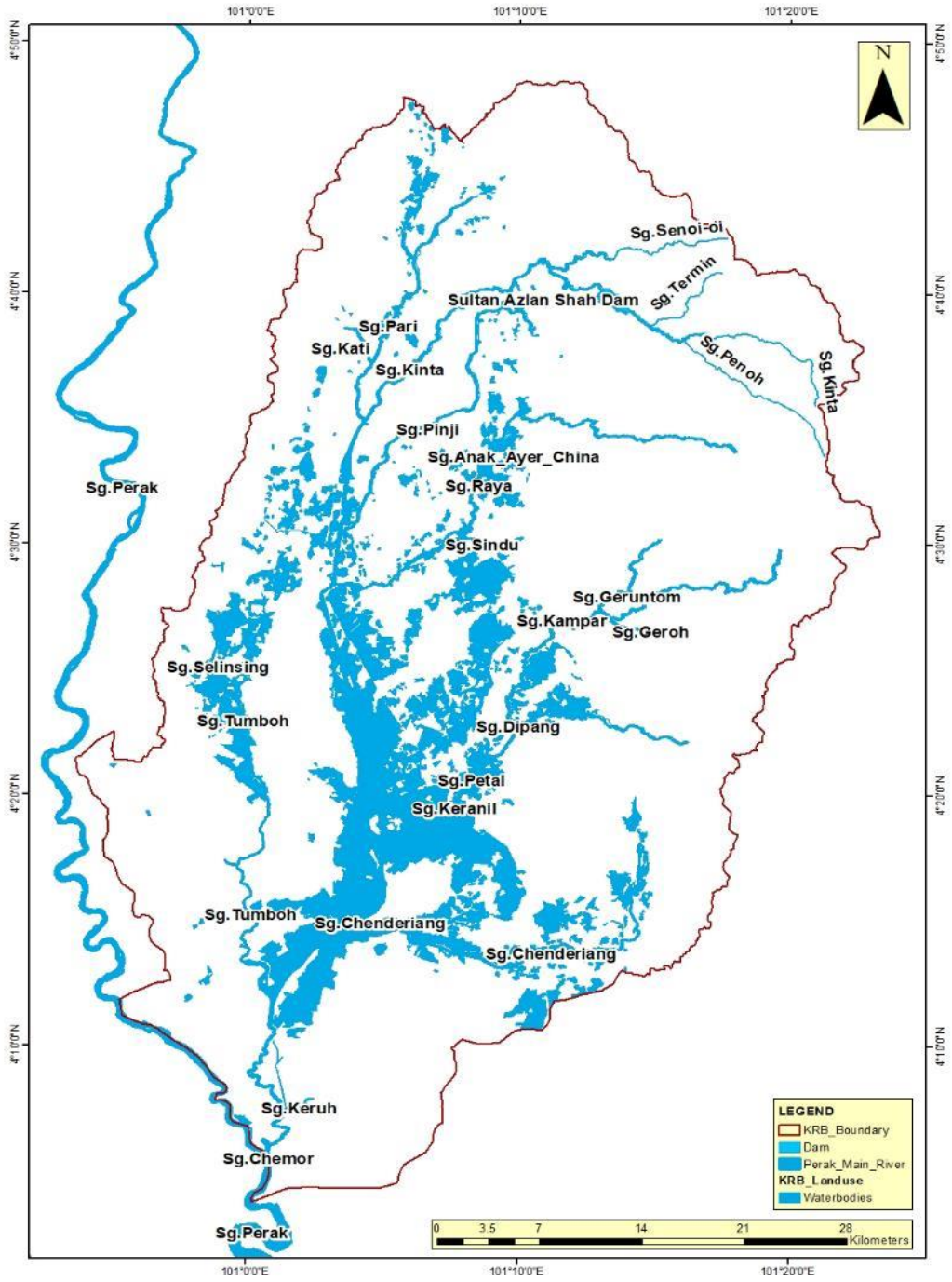


Figure 2.11: Waterbodies of within KRB project site

2.5.2 Water Quality

Water quality sampling carried out by GEC using 15 sampling stations within Kinta River Basin (KRB) covering both upstream, midstream and downstream. The water quality sampling stations are as per **Figure 2.12**. The average for overall water quality index (WQI) derived from 15 sampling stations was indicated as slightly polluted with 79 (Class II). Highest WQI was observed at KRBEAS_03 (Sg. Seno'oi) with 94 (Class I) and while the lowest WQI was observed at KRBEAS_04 (Sg.Klebang) with 61 (Class III).

Among parameters, the highest TSS concentration was observed at KRBEAS_02 (Sg. Kinta) with 153 mg/L and significantly influenced the turbidity concentration level with 141 NTU. This is mainly due to sediment movement from eroded slopes at Section 44-46, FTP185 Simpang Pulai-Cameron Highlands Highway. These two (2) water quality parameters have significantly exceeded the Class IIB of TSS (>50mg/L) and turbidity (>50 NTU) respectively. Meanwhile, the lowest DO were recorded at KRBEAS_04 (Sg. Klebang), KRBEAS_06 (Sg. Pari) and KRBEAS_08 (Sg. Pinji) with 4.25 mg/L, 4.74 mg/L and 4.86 mg/L, respectively. These values of DO were fall within Class III of NWQS (3-5 mg/L).

Based from overall sampling stations, the BOD concentration level were from 4 mg/L to 12 mg/L, which had exceeded the Class IIB of NWQS. The highest COD concentration were recorded at KRBEAS_04 (Sg. Klebang), KRBEAS_09 (Sg. Sindu) and KRBEAS_14 (Sg. Tumboh) with 41 mg/L, 53 mg/L, and 31 mg/L, respectively. The highest COD concentration may be potentially due to agriculture and industrial activities happening within this area. These values have exceeded the Class IIB of NWQS for COD (>25 mg/L).

Since the downstream area within KRB was dominantly covered with agricultural activities with 28.26 % of the total land use KRB area, the highest Ammoniacal Nitrogen (NH3-N) was observed at KRBEAS_14 (Sg. Tumboh) with 3.07 mg/L, which exceeded Class V (>2.7 mg/L) of NWQS. The sub-index of NH3-N also recorded with 11, indicating that the river is polluted based on the water quality status.

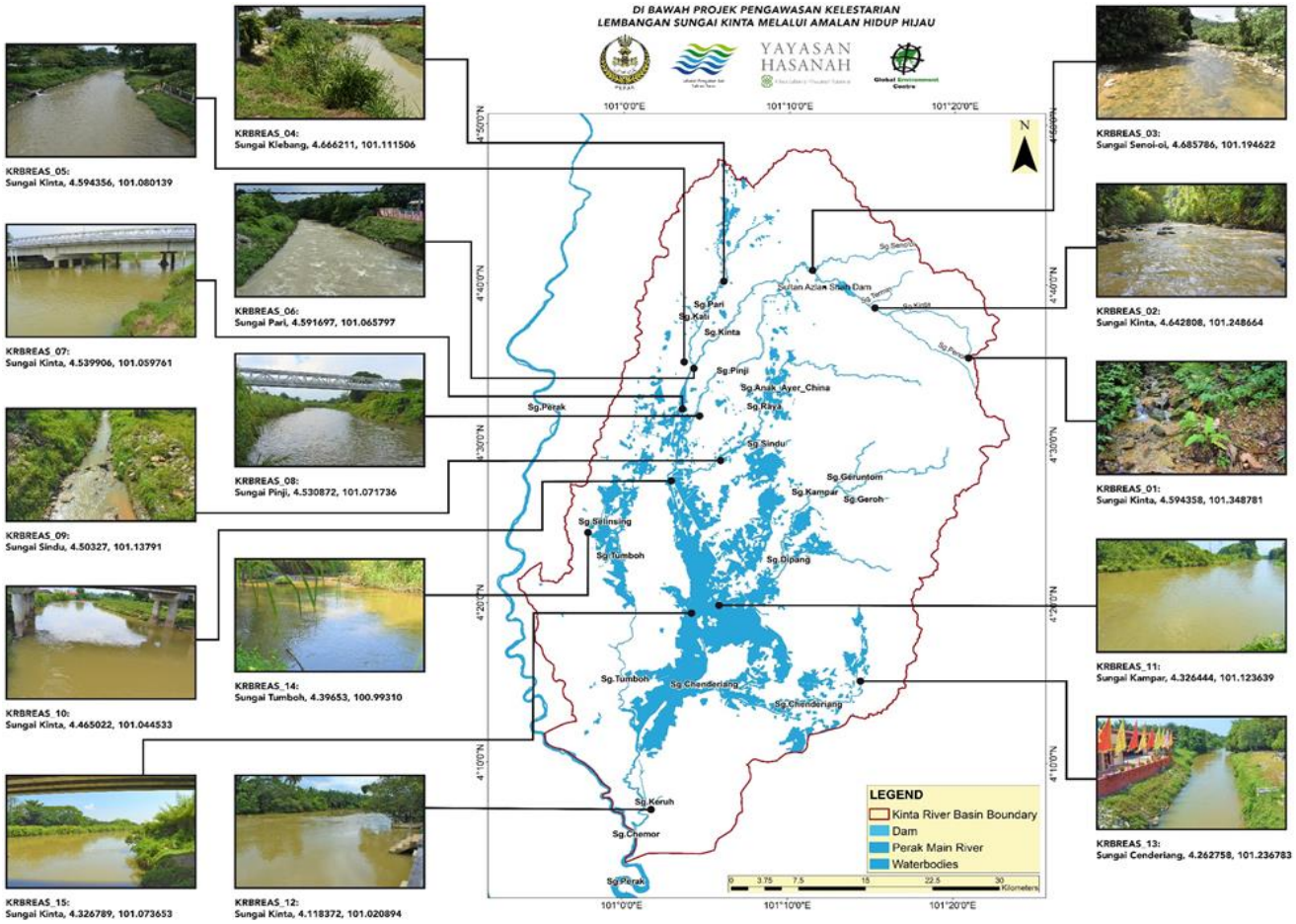


Figure 2.12: GEC water quality sampling stations within KRB

2.5.3 Pollution Mapping and Inventory

The overall pollution source inventory was carried out based on secondary data as well as through site surveys. **Table 2.8** shows the various sources of pollution existing within KRB. Based from overall observation, the environmental issues such as soil erosion and land clearing, improper of solid waste disposal, hazardous waste from industrial activities and agricultural waste were mainly derived from the lack of transparency during monitoring process, lack of cross checking with local communities, lack of law enforcement and possible due to communities don't report due to negligence. Therefore, the identification of pollution mapping and inventory was highly crucial in order to ensure the water quality status.

Table 2.8: The existing types of pollution within KRB

Sources of Pollution and Descriptions	
A) Soil erosion and land clearing	
One of the key issues is hill cutting and erosion which can lead to sedimentation of the river channel and siltation of the water supply dam. This is the main issue mainly occurred in the upstream of Kinta River Basin. This section also draws on earlier assessments undertaken by GEC of the catchment including partnership with Institute Darul Ridzuan (IDR) in 2013 and further surveys undertaken in 2018 till 2022 with support of federal agencies, state government agencies and external researchers. The following were found to be the key sources of siltation in the upstream area i) Landslide at KM (Section) 44-46 Simpang Pulai to Cameron Highland highway; ii) Highland Agriculture/Agro Tourism project in Ulu Kinta/Sg Raia catchment Perak; and iii) Land clearing activities at Markas Comondo 69 at Jalan A182, Ulu Kinta.	 **Figure 2.13a:** Stope cutting along highway route (extracted from the Landslide Study at CH23+800 Simpang Pulai – Lojing Highway Malaysia Report submitted by Andres Malone Ltd (May 2007)

I. Landslide at KM 44-46 Simpang Pulai to Cameron Highland highway

The landslide at km 44-46 Simpang Pulai to Cameron Highland started in 2003 following hillside excavation at the terrain along the highway which starting 1997. According to the study conducted by Andres Malone Ltd in 2007, movement occurred at roadside when the slope was cut in the vicinity of chainage 23+900 during the roadworks **(Figure 2.13a)**. The slope was cut tability, more extensive slope flattening was undertaken in response until the works reached the ridgeline, 200 m to 260 m above the road. This lead to the gross movements which occurred in the cut in September 2013 (Figure 2.13b) with the formation of a main scarp and associated disruption and the displaced mass has since moved continuously. This is later known as the Northern Earthflow where the main scarp of the failure extends to the north into unexcavated ground in the more weathered part of the slope where natural hillside valley existed and has now extended to road level (GEC,2020).

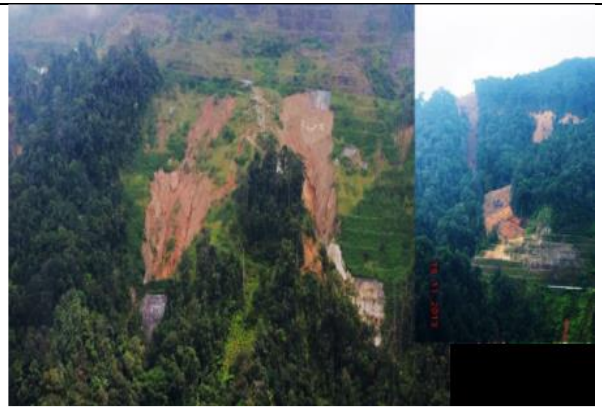


Figure 2.13b: Erosion at slope as of 2013 (extracted from GEC - IDR Report - 2014)

Figure 2.13c: Status of the landslide area along Simpang Pulai-Cameron Highland as of May 2022

II. Highland Agriculture/Agro Tourism project in Ulu Kinta/Sg Raia catchment Perak

Land opening at the highland for agro-tourism also contributes to significant siltation and high sedimentation which ends up in the dam. During the site visit on 28th May 2022 by GEC team, land opening was observed and some activities were seen focusing on the agro farming and agro tourism at an upper portion of the site (at GPS coordinate 4.601013; 101.345473 – Figure 2.14). This land clearing is in the adjacent Raia River catchment which also is classified in the National Physical Plan as an Environmentally Sensitive Area (ESA) Class 1 as it is a proposed dam catchment and it needs to be totally protected. High sedimentation during this project period will end up into the catchment. In addition to land clearance, once the site is ready for agro farming and tourism, there are possible that issues related to pesticide and fungicide will pose direct threat to the water body. Runoff from both the Agroto Business (M) Sdn Bhd and the upcoming of agro farming and agro tourism at (GPS coordinate 4.601013; 101.345473) will end up into the Kinta River.

Figure 2.14: Current land clearance activities for agro farming and tourism within adjacent Raia River catchment area (linked to access road on main Penoh/Kinta River catchment)

III. Land clearing activities at Markas Comondo 69 at Jalan A182, Ulu Kinta

Land clearing activities for development observed (Figure 2.15a). Currently, one development being carried out at Markas Comondo 69 at Jalan A182, Ulu Kinta. Sediment from the development area was observed on its discharge into the nearest stream (Figure 2.15b).

Figure 2.15a: Land clearing activity near Markas Comondo 69

Figure 2.15b: Sedimentation from development area

Table 2.8: The existing types of pollution within KRB (cont.)

Sources of Pollution and Descriptions	
B) Industrial area	
Industrial sector also are the major cause on river pollution. Inefficient waste disposal, improper disposal and discharge of radioactive material from industries may lead to pollution. As for the upstream, GEC team has identified few industrial sector based on site survey which is mining and quarrying at Simpang Pulai, near to Raia river **(Figure 2.16a).** It has potential that lead to pollution as the runoff from the quarry area may end up in Kinta River. GEC team also has observed a centralized industrial sector based in Batu Gajah which is in 'Kawasan Perindustrian Batu Gajah 3' **(Figure 2.16b)** near Kinta River Basin.	 **Figure 2.16a:** Mining and quarrying at the Simpang Pulai  **Figure 2.16b:** 'Kawasan Perindustrian Batu Gajah 3'

Table 2.8: The existing types of pollution within KRB (cont.)

Sources of Pollution and Descriptions
C) Commercial area

Based on site recce, one of the main issues is discharge from commercial area such as wet markets due to the improper waste handling and kitchen management. Solid waste accumulation within drainage of Chenderong Balai wet market **(Figure 2.17a)**, Jalan Labu Kubong **(Figure 2.17b)** and Kampung Sungai Lah wet market at Chenderiang **(Figure 2.17c)** were observed

Figure 2.17b: Chenderong Balai wet market

Figure 2.17a: Pile of garbage accumulated near Chenderong Balai wet market

Figure 2.17c: Waste dumping near Kampung Sungai Lah wet market

Table 2.8: The existing types of pollution within KRB (cont.)

<table>
<tr><th colspan="2">Sources of Pollution and Descriptions</th></tr>
<tr><td colspan="2">D) Residential I area</td></tr>
<tr><td>The number of activities that affected water quality was observed. Solid waste from human activities and waste from residential area are the main causes of pollution within KRB area. During the assessment, project team has identified few residential areas with poor waste management such as Pinji River (4.530872, 101.071736) (Figure 2.18a) and Sindu River near the ‘Taman Herba Gopeng’ within midstream of KRB area (Figure 2.18b). Direct solid waste dumping into the water bodies and at river banks were observed. Besides that, uncollected solid wastes from few locations, in the KRB area were identified as it’s degrading the urban environment and discouraging efforts to keep streets and open spaces clean (Figure 2.18c). During the site visit, there was a littering of residential waste also was observed at Kampung Chenderong Balai (Figure 2.18d).</td><td> 
Figure 2.18a: Solid waste dumping by human activities at Pinji River</td></tr>
<tr><td>  
Figure 2.18b and Figure 2.18c: Waste from residential area at river bank Sindu River and Uncollected solid wastes along Jalan Ayer Kuning</td><td> 
Figure 2.18d: Residential waste at Kampung Chenderong Balai</td></tr>
</table>

Table 2.8: The existing types of pollution within KRB (cont.)

Sources of Pollution and Descriptions	
E) Agriculture	
The main agriculture pollution within KRB area observed in downstream area. Most of the agriculture activities covered by plantation such as palm oil, rubber plantation, paddy field and urban farming. The pollution identified leading to discharge issue coming from palm oil area as shown in Figure 2.19a and Figure 2.19b.	 **Figure 2.19a:** Leachate issue near palm oil plantation  **Figure 2.19b:** Palm oil and paddy plantation at downstream area

2.5.4 Riverine Biodiversity

A total of 503 plant species and 115 families were observed within 12 surveyed places. **Table 2.9** has shown the number of families and species based on riverine biodiversity component study. **Figure 2.20** has depicted the riverine biodiversity in Kinta River Basin (KRB). Among them, 26 species belonging to 17 families are aquatic plants with 25 emergent species and one floating-leaved species. No submerged aquatic plants were spotted during the survey. Other than flora, this study has recorded a total of 37 species of Odonata (dragonflies and damselflies), 43 species of butterflies, 54 species of fish, 29 species of amphibians and reptiles, and 86 species of birds. Besides native species, some non-native species have also been recorded from the Kinta River basin. The IUCN Red list status has recognized one species as endangered, *Pangasianodon hypophthalmus* (iridescent shark catfish) and four species as vulnerable, namely *Calicnemia rectangulata (*damselfly), *Cuora amboinensis* (Amboina box turtle), *Leptoptilos javanicus* (stork), and *Acridotheres javanicus* (Javan Myna). Meanwhile, most of the species recorded during this study have been categorized either near threatened, least concern or not evaluated. Although *Pangasianodon hypophthalmus* was listed as endangered, study shows the population of this species is thriving in the Kinta River. Next, there are overall 326 benthic species, with 26 families found for all the stations studied in KRB area. Average Score per Taxon (ASPT) score were calculated to indicate the biological water quality status. Most of the stations shows the score of that the river is clean (ASPT score). The species with highest indicator score (10), which are mayfly, stonefly, and caddisfly are found at few stations.

Table 2.9: Number of families and species based on biodiversity component study

No.	Biodiversity Components	Number of families	Number of species
1.	Flora	115	503
2.	Odonata (dragonflies and damselflies	8	37
3.	Butterflies	5	43
4.	Fish	22	54
5.	Amphibians and reptiles	11	29
6.	Birds	42	86
7.	Macroinvertebrates benthic	26	326

<table>
<tr>
<td> 
Dipterocarpus cornutus
Critically endangered (IUCN)
.</td>
<td> 
Calicnemia rectangulata
Vulnerable (IUCN)</td>
</tr>
<tr>
<td> 
Ancistrus sp.</td>
<td> 
Cuora amboinensis,
Vulnerable (IUCN).</td>
</tr>
<tr>
<td> 
Troides brookiana albescens,
Protected under the Wildlife Conservation Act 2010</td>
<td> 
Leptoptilos javanicus;
vulnerable (IUCN)</td>
</tr>
</table>

Figure 2.20: Riverine biodiversity in Kinta River Basin

2.5.5 Stakeholder Perception Survey

A stakeholder perception survey has been carried out in the area of Kinta River Basin (KRB) from 9th June to 27th June 2022. This study collected a total of 507 responses. After data cleaning, the total remaining responses were 497 with 10 cases excluded. 8 cases were excluded as they did not consent to take part in the study whilst 2 cases were excluded as test cases (initial test data entry). In total, 248 respondents were male with females numbering 249 which is almost a 50-50 representation of the genders. A total of 273 local communities, 106 reps from government agencies, 48 business players (industrial & agriculture) and 70 reps from NGO as well as general public.

The survey has found that the NGOs positively affect the river ecosystem (b: 0.145, t: 25.395, $p<0.05$) and the results are statistically significant. Further government agencies are also showing significant contributors to the river ecosystem where b: 0.241, t: 3.850. Government agencies are developing plans such as a River ecosystem management program, cleanliness and maintaining water quality, and doing efforts in bringing public awareness. Moreover, the results of the study confirmed the negative influence of the local community on the stewardship of the Kinta River. Findings confirmed the statistically significant negative relationship between the local community and ecosystem changes (b:-0.195, t: 2.19, p: 0.013). This might be due to a lack of interest and care regarding water conservation, people might ignore these things and do not bother regarding environmental protection while littering at tourist sites. Lastly, business operators do not have a significant effect on river ecosystem improvement (b: 0.24: t: 0.452 p: 651).

The survey also shows that the industrial, commercial, residential sources and unconscious practices are major contributors to pollute the river water quality while the agriculture sector is the least one, contributor. The findings evidenced that industries and commercial markets are feeding these rivers with dangerous chemicals as waste management systems are not up to the mark and could not completely control the flow of these harmful fluids into the river which in turn pollute the water and negatively influence the living organisms. Some part of this study also confirmed the local community is negatively influencing the river ecosystem by discharging waste, construction waste, and solid waste dumping, on the other hand, the business community did not take any solid measures to protect the river water. Hence government and NGOs should target local communities and business operators and should impart the necessary education and awareness so that they perform their obligation being as responsible citizens and protect the river water from pollution.

Overall, the perception survey showed local communities particularly have less or no understanding of their role on overall management of river basin. Hence, there is need for bottom up approach in terms of community based IRBM to start the efforts.

2.6 Summary

The total area of KRB is 2686.12 km². Overall, the largest land use type within KRB is forest, with total size of 893.70 km^2 (33.27%). Second largest is agriculture which covering about 815.63 km^2 (30.36%), followed by waterbodies as the third largest land use type within KRB with 351.27 km^2 (13.08%) and the least is livestock area with 18.43 km^2 (0.69%).Sg Kinta and Sultan Idris Shah II Water Treatment Plant (source of water: Sg Perak) mainly provides water supply to KRB. Slope erosion and flood are two major disaster risk faced by Kinta River Basin currently. In respect to Kinta River Basin, there is currently a formal established Project Working Group (PWG) and has a total of 29 state government agencies and invited universities, NGO as well foundation as members as off May 2022. This PWG is advised by Perak State Chairman of Science, Environment, and Green Technology Committee. The PWG is headed by Director of Department of Irrigation and Drainage Perak which GEC act as secretariat role. The average for overall water quality index (WQI) derived from GEC's 15 sampling stations was indicated as slightly polluted with 79 (Class II). Kinta River Basin also observed to rich with flora and fauna. However, based from overall observation, the environmental issues such as soil erosion and land clearing, improper of solid waste disposal, hazardous waste from industrial activities and agricultural waste are main issues within Kinta River Basin. The perception survey showed local communities particularly have less or no understanding of their role on overall management of river basin. Hence, this situation puts KRB need a lot of efforts, both top down as well as bottom up approach to improve and enhance its river health. Although KRB have format governance structure, it does not have any guiding document or strategy for overall basin. It only have UKBMaS (Upper Kinta Basin Management Strategy) but that focuses at upstream only. There is lack of IRBM too as Perak River already have IRBM in place dated in 2010, and maybe Kinta River Basin will have conventional IRBM in future. Therefore, there is immediate need to put things in right direction, so Community based Kinta River Basin- IRBM (CbKRB-IRBM) recommended to be drawn to serve as immediate alternative for conventional IRBM as well as to act as pilot model for bottom up approach concept based IRBM.

CHAPTER 3: CBKB-IRBM GOALS, OBJECTIVES AND STRATEGIES

Four (4) goals recommended for this CbKB-IRBM are:

Goal 1: Ensuring the Quality Clean Water and sufficient Quantity
Goal 2: Revitalizing the ecosystem through river health concept
Goal 3: Preparedness and Action for Disaster Risk Reduction (DRR)
Goal 4: Enhancing Socio-Economy through Nature based Solution (NbS)

A total of 17 strategies has been outlined for all the four goals. Each strategies has its detailed objectives, proposed action plans, key partners and supporting organisations as well as timeframes indicated. As this is community based IRBM, the lead player is the community themselves which can be categorised into Residential Association (RA), *Kawasan Rukun Tetangga (KRT)*, community based organisation (CBO), Village Development and Security Committees (JKKK) and other community groups.

Each of the strategies have respective action plans. Overall, the implementation of action plans can be divided into three terms as below and will be indicated for each action plans as per strategies:

- S – Short term (less than 2 years)
- M – Medium term (2 to 5 years)
- L – Long term (5 to 10 years)

Initial workshop with the stakeholders and partners to provide input for Chapters 3 -5 was conducted on 9th June 2022 at the Kinta Riverfront hotel. Twenty seven (27) agencies has provided their inputs to further enhance the chapters. Input from the consultation were bolded in Chapter 3.

GOAL 1: TO ENSURE THE QUALITY CLEAN WATER AND SUFFICIENT QUANTITY

Scope

The water quality of Sg Kinta falls at Class II based on latest EQR 2020 report. However, this status is being threatened by the increasing point source pollution and non-point source pollution within basin. These pollution sources will affect both the quality and quantity of clean water of Sg Kinta. Hence, the scope of this goal is to ensure targeted quality and quantity of clean water achieved within Kinta River Basin (KRB) through community engagement.

Objectives

The main objectives are

i) To ensure quality of clean water in KRB.
ii) To meet sufficient amount of clean water in KRB.

Strategies

Strategy	Details
Strategy 1.1	Assess and map the pollutant sources in KRB
Strategy 1.2	Monitor river basin using Citizen Science Approach
Strategy 1.3	Promote, encourage and implement pollution control measures at source
Strategy 1.4	Promote and implement community based river rehabilitation and restoration measures
Strategy 1.5	Promote and implement water demand management measures

Strategy 1.1: Assess and map the pollutant sources in KRB

Description

The rapid environmental assessment within KRB by earlier studies and GEC identified that KRB is affected by both point source as well as non-point source pollution. These studies were undertaken through one off as well as through scientific approach. As pollution is an ongoing process, continuous pollution mapping need to be carried out and this can be done by communities using available methods or with collaboration with experts.

Action plans

1. Use iRIVER Ranger 2.0 pollution mapping method. (S)
2. Undertake community based pollution inventory.(S)
3. Identify and report existing pollution sources to relevant authorities. (S)
4. Carry out pollution mapping of river basin and develop action plans. (S)
5. Awareness Campaign among the communities on river pollution. (S)
6. Promote mitigative and corrective action among communties on river pollution. (S)

Supporting Organization (s)

a. Agencies*

- ***Department of Environment (DOE) Perak***
- *Department of Irrigation and Drainage (DID) Perak*
- *Perak State Forestry Department (FD)*
- *Perak Water Board (LAP)*
- *National Water Service Commission (SPAN)*
- *Perak State Economy Planning Unit (EPU)*
- *Local Government (PBT)*
- *Land and District Office (PDT)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others

- Businesses (Industry and Corporate Players)
- Research Institutions
- NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)

Strategy 1.2: Monitor river basin using citizen science approach

Description

Kinta River Basin is actively monitored by agencies such as DID and DOE. However, the sampling stations usually are limited to represent whole river basin. Hence, community can come in to fill the gaps by monitoring the whole river basin from respective premises using citizen science approach. Communities also can put pressure and encourage industries and businesses to monitor their discharge into rivers too. Global Environment Centre (GEC) have been championing on the community based River empowerment and had developed successful RIVER Ranger 2.0 program for communities to use as guide to monitor river.

Action plans

1. Identification of committed group within community to monitor river. (S)
2. Establish monitoring platform with proper facilities and signage. (S)
3. Collect and report monitoring data. (S)
4. Promote and collaborate on monitoring with other players. (M)
5. Establish and promote data sharing platform among stakeholders and communities. (M)

Supporting Organization (s)

a. Agencies*

- Land and District Office (PTD)
- *Department of Irrigation and Drainage (DID) Perak*
- *National Water Service Commission (SPAN)*
- ***Department of Environment (DOE) Perak***
- *Local Government (PBT)*
- *Department Of National Unity And Integration (JPNIN)*
- *Department of Orang Asli Development (JAKOA)*
- *Village Development & Security Committee (JKKK)*
- *Community Leader/Ketua Kawasan*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others

- Businesses (Industry and Corporate Players)
- Research Institutions
- NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
- Offices of MPs and ADUNs

Strategy 1.3: Promote, encourage and implement pollution control measures at source

Description

Pollution control measures at source are the best initiatives to ensure healthier as well as living river basin. Communities also can implement pollution control at source particularly from their houses. Used cooking oil collection, connecting to sewerage line, and recycling are some of the examples for pollution control at source. Besides this, communities also can promote and encourage other players such as developers, industries and so on to implement pollution control at respective premises.

Action plans

1. Audit pollution generated from house or relevant premises.(S)
2. Identify proper mitigation action for pollutant generated. (S)
3. Monitor disposal mechanism and quantify waste disposed. (S)
4. Promote and encourage pollution control by other players. (M)
5. Explore generation of income through waste to wealth concept. (M)

Supporting Organization (s)

a. Agencies*

- Land and District Office (PDT)
- *Local Authority*
- ***Department of Environment (DOE) Perak***
- *Lembaga Urus Air (LAP)*
- *Local Government (PBT)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others

- Businesses (Industry and Corporate Players)
- NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
- Offices of MPs and ADUNs

Strategy 1.4: Promote and implement community based river rehabilitation and restoration measures

Description

Impaired rivers need to be rehabilitated while clean ones need to be preserved. Sometimes, clean rivers or streams especially in upstream need to be restored to its original state for better biodiversity. Community based rehabilitation activities here includes river clean up, river bank enhancement, wetland plants island creation and so on, depending on objective of rehabilitation. Restoration activities can lead to establishment of river open classrooms where that particular stream/river stretch can be turned into educational site besides being the habitat for riverine flora as well as fauna. These initiatives also can be promoted by communities to other players.

Action plans

1. Map local sub-basins and rivers/stream and categorise them to those needed restoration as well as rehabilitation. (M)
2. Get technical expert and advise to undertake community based river rehabilitation or restoration. (M)
3. Document and measure the overall changes at pre, during and post stages of any intervention by local authorities and communities . (L)
4. Promote and participate in river restoration or rehabilitation initiatives by other players. (M)
5. Maintain and monitor restored or rehabilitated river for long term (continous). (L)

Supporting Organization (s)

a. Agencies*

- ***Department of Irrigation and Drainage (DID) Perak***
- *Perak State Forestry Department*
- *Department of Environment (DOE)*
- *Local authority*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others

- Businesses (Industry and Corporate Players)
- Research institutions
- NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
- Offices of MPs and ADUNs

Strategy 1.5: Promote and implement water demand management measures

Description

In order to ensure sufficient amount of clean water for long term, water demand management measures need to be undertaken at community level. This is because when population increases, water demand increases as well. Hence, there will be need of exploitation for more resources to meet growing water demand. So, water demand management options like water conservation activities, tapping on alternative water supply and water reuse can help to control growing water demand. Communities also can participate and encourage water demand management measures by other players such as government, private players and so on.

Action plans

1. Carry out water auditing at household level. (S)
2. Implement water conservation activities through behavior change approach. (M)
3. Install or use low cost water saving tools. (S)
4. Participate in water demand management initiatives by other players. (S)
5. Explore, aware and act based on virtual water concept or indirect water footprint. (M)
6. Explore and use alternative water supply systems such as rainwater harvesting, water reuse, recycled water and so on. (M)

Supporting Organization (s)

a. Agencies*

- ***National Water Service Commission (SPAN)***
- *Perak Water Board (LAP)*
- *Local authority*
- *Perak State Health Department*
- *Department of National Unity and Integration (JPNIN)*
- *Department of Orang Asli Development (JAKOA)*
- *Village Development & Security Committee (JKKK)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others

- Businesses (Industry and Corporate Players)
- Research institutions
- NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
- Offices of MPs and ADUNs

GOAL 2: REVITALIZE ECOSYSTEM THROUGH RIVER HEALTH CONCEPT

Scope

Currently, Sg Kinta is only evaluated through DOE's WQI which latest report recorded 83 (Class II, clean) (EQR, 2020). However, this strategy want to redefine the definition of healthy river in line with living river concept as promoted and adopted globally as well by Department of Irrigation and Drainage (DID) Malaysia in near future. Therefore important to know the river address including sub-basins within KRB, for more detail monitoring and implementation of river care initiatives. Healthy Kinta River Basin consists of four (4) components which are physical components, chemical components, biological components, and community participation components.

Objectives

The main objectives are

i) To redefine healthy river basin based on four components.

ii) To carry out actions within four components to meet healthy river basin vision.

Strategies

Strategy	Details
Strategy 2.1	To enhance physical components of river basin
Strategy 2.2	To enhance chemical components of river basin
Strategy 2.3	To enhance biological components of river basin
Strategy 2.4	To promote community participation on river care

Strategy 2.1: To enhance physical components of river basin

Description

Physical components of river basin include river geomorphology, hydrology, river physical attributes and riverbank elements. These components can be improvised or preserved if it's already in intended state, through community actions. Communities need to work in line with stakeholders to protect this important component of river health.

Action plans

1. Identify and monitor the usage of river reserve. (S)
2. Create awareness and outreach on river addresses including sub-basins. (L)
3. Identify and aware on river flow, level and its flow. (M)
4. Map physical aspects and monitor those aspects. (S)
5. Support and contribute to community participation program that emphasize river health index and river health targets. (L)
6. Recognise and support suitable activities within/along the river (M)
7. Establish support from relevant agencies for maintenance/beautification of the river (M)
8. Establish a community / industrial river monitoring team (S)

Supporting Organization (s)

a. Agencies*
   - ***Department of Irrigation and Drainage (DID) Perak***
   - *Perak Water Board (LAP)*
   - *Perak State Forestry Department*
   - *Department of Environment (DOE)*
   - *Local Authorities*
   - *Department of National Unity and Integration (JPNIN)*
   - *Department of Orang Asli Development (JAKOA)*
   - *Village Development & Security Committee (JKKK)*
   - *Land and District Office (PDT)*
   - *Ministry of Tourism, Arts and Culture Malaysia (MOTAC)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - Businesses (Industry and Corporate Players)
   - Research institutions
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Offices of MPs and ADUNs

Strategy 2.2: To enhance chemical components of river basin

Description

Chemical characteristics such as pH, nutrients, BOD, COD, heavy metals constituents and so on are important to ensure survival of riverine flora and fauna besides ensuring clean river status. Chemical characteristics of river will change mainly due to non-point source and point source pollution. Improvement of chemical parameters in a river needs effort from all stakeholders including communities.

Action plans

1. Select chemical parameters and low cost yet effective methods for monitoring. (S)
2. Set proper monitoring plan. (S)
3. Undertake community based measures such as river clean up, river rehabilitation and low scaled constructed wetland systems to improve chemical water quality. (S)
4. Be the eyes and ears for agencies to monitor and report pollution events. (S)
5. Support and participate in Communication, education and public awareness (CEPA) program that emphasize river health index and river health targets.(S)
6. Promote visual monitoring of rivers (examples: foam, color, dead fish) (S)
7. To increase members capacity building (M)

Supporting Organization (s)

a. Agencies*
   - ***Department of Environment (DOE) Perak***
   - *Perak Water Board (LAP)*
   - *Department of Irrigation and Drainage (DID) Perak*
   - *National Water Service Commission (SPAN)*
   - *Department of Agriculture (DoA)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - Businesses (Industry and Corporate Players including agriculture sector)
   - Research institutions
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)

Strategy 2.3: To enhance biological components of river basin

Description

Biological health of rivers is well given importance and attention globally as holistic measurement of river health cannot be done without these aspects. Fish and benthic macroinvertebrates are two common biological indicators used to access river health. However, choices of biological indicators will vary according to rivers as there are many deciding factors such as convenience of sampling, geomorphology and access. Communities can involve at all levels of biological components of river health as it's still new in Malaysia when IRBM concerned.

Action plans

1. Use citizen science approach for sampling, identification and monitoring. (S)
2. Develop inventory for biological components of particular or targeted river stretch. (S)
3. Identify suitable biological indicator to represent river health at particular stretch. (S)
4. Support and participate in CEPA program that emphasize river health index and river health targets. (S)
5. Promote awareness programme especailly on the impact of releasing invasive species (fishes and tortoises) into water bodies for religious practices (S)
6. Be eyes and ears for agencies to monitor and report the presence of invasive species (S)

Supporting Organization (s)

a. Agencies*
   - ***Department of Fisheries, Perak***
   - *Department of Irrigation and Drainage (DID) Perak*
   - *Perak State Forestry Department*
   - *Department of Environment (DOE)*
   - *Department of Wildlife and National Park*
   - *Veterinary Department*
   - *Department of Health*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - Businesses (Industry and Corporate Players including agriculture sector)
   - Research institutions
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)

Strategy 2.4: To promote community participation on river care

Description

River health is sustained by both river and human ethics. Covid19 and MCO showed quality of rivers managed to improve without human movement/activities. This indicates people or human are bringing main change in a river basin and they are responsible for improvement of Particular River to meet its intended beneficial usage. Hence, community participation components hereby refers to involvement as well as participation of them in a river basin, hence it marked as an indicator to assess river health of that particular river basin. For instance, River Basin A with five (5) active river care communities can be considered as healthy compared to River Basin B with zero (0) active river care communities.

Action plans

1. Identify your river address and sub-basins within the KRB. (S)
2. Form and establish river care communities/groups/ Friends of Kinta River Basins (S)
3. Participate in recognition platforms by government agencies or NGOs. (L)
4. Recognition by government agencies or NGOs. (M)
5. Enhance economic and financial literacy related to green economy among communities. (M)
6. Support and participate in CEPA program that emphasize river health index and river health targets as well as **human health – river health connection**. (S)
7. Establish incentive and recognition platfrom for the community (M)
8. Promote participation of the youth groups / educational institutions for river care activities. (S)

Supporting Organization (s)

a. Agencies*
   - *Department of National Unity and Integration (JPNIN)*
   - ***Department of Irrigation and Drainage (DID) Perak***
   - *Perak State Forestry Department*
   - *Department of Environment (DOE)*
   - *Local Authority*
   - *Department of Orang Asli Development (JAKOA)*
   - *Village Development & Security Committee (JKKK)*
   - *Department of Agriculture (DoA)*
   - ***Department of Irrigation and Drainage (DID) Kinta***

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - Businesses (Industry and Corporate Players including agriculture sector)
   - Research institutions
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)

GOAL 3: PREPAREDNESS AND ACTION FOR DISASTER RISK REDUCTION (DRR)

Scope

Kinta River Basin do face disaster risk in terms of slope erosion, flash floods and storm. Although current water scheme through Sultan Azlan Shah dam and Sg Perak river scheme do support water supply in Kinta River Basin, climate change will give impacts in future for water supply sustainability. Rapid urbanisation and climate change due to the anthropogenic activities increases uncertainty on disasters especially unpredictability of extreme weather. Therefore, it is in time and important to empower the local communities and public through the FLOOD Ranger Programme as part of the preparedness towards Flood Disaster– (before-during-after) to be able to survive the catastrophe. It is time to address climate change; especially the flood disaster among through adaptation, mitigation and implementation, focusing to the community empowerment and enhancement.

Objectives

The main objectives are

i) To catalyst changes by enhancing the communities to evoke appropriate actions (from both disaster management agencies and victims)

ii) To create platform and support for the communities to undertake initiatives to strengthen and mitigate actions towards flood preparedness (risk assessment and mitigation measures).

Strategies

Strategy	Details
Strategy 3.1	Promote awareness on flood and drought mitigation – community preparedness through the FLOOD Ranger
Strategy 3.2	Develop communities based flood hazard map
Strategy 3.3	Promote, enhance alternative water resources and potable water supply during flood
Strategy 3.4	Work in hand with agencies to mitigate and address hazard through community as eyes and ears

Strategy 3.1: Promote awareness on flood and drought mitigation – community preparedness through the Flood Ranger

Description

The Flood Ranger training is a highly effective approach that can be adopted by all levels of the community and it's a community based initiative. Its main aim is to empower the key stakeholders especially local communities through workshop/training customized to suite the local condition, setup and needs. The training organised for communities with the support and partnership of local communities, local government agencies focused at increased awareness on flood disaster preparedness among local communities. Through the civic science approach the risk of flash floods and socio-economic losses can be mitigated through the local action. Furthermore the local communities will be uplifted through the awareness and skill training as local trainer as well as to facilitate localised peer-to-peer session. The training session will promote not only the use of grab bag, 72hrs kit and community checklist but also provide insight to develop town watching map.

Action plans

1. Develop flood maps for each sub-basin in the KRB (S)
2. Training of Trainers on FLOOD Ranger/RiIVER Ranger trained as FLOOD Ranger (S)
3. Establish local/operational OSC for hazard management through PREPARE APPROACH (S)
4. Promote early warning systemn (i.e siren or announcement system in community centers) (M)
5. Provide skill and knowledge on Flood & Drought Preparedness (Community Checklist) (S)
6. Outreach, Educate and Create Awareness to wider community groups (M)

Supporting Organization (s)

a. Agencies*
   - ***Land and District Office (PDT)***
   - *Department of Irrigation and Drainage (DID) Perak*
   - *National Disaster Management Agency (NADMA)*
   - *Perak State Forestry Department*
   - *Department of Environment (DOE)*
   - *Department of Health*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority/Pejabat Daerah/Majlis*
   - *Fire & Rescue Department*
   - *State Education Department (SED)*
   - *Malaysia Volunteers Corps Department (RELA)*
   - *Malaysia Civil Defence Force (JPAM)*
   - *Department of Town and Country Planning (PLANMalaysia)*

***** *the lead supporting agencies as discussed during the consultation work were* ***bold and underlined***

b. Others
   - Businesses (Industry and Corporate Players)
   - Research institutions
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)

Strategy 3.2: Develop communities based flood hazard map

Description

Town Watching Activity which enlightened to the communities during the FLOOD Ranger training will be localised as site based initiatives to enable the communities to develop their own flood hazard map. The localised town watching activity will engage the communities to develop escape routes and mitigation measures to be undertaken as prevention esp. during flood. The flood Hazard Map is developed to enable the communities to play their roles in identifying the areas prone to have risk of danger and to ensure possible routes safe to travel during flood in the community residential area. In additional to just developing the map, the communities will work in hand to advice relevant agencies to ensure the mitigation measures are in place, its maintained and managed through the Neighbourhoods Watch. Localised action such as drainage marking and storm water management as part of education and maintenance of the neighbourhoods (mitigation actions) will be undertaken as part of community empowerment and continous measures.

Action plans

1. Develop localised Community based Flood Hazard Maps (M)
2. Identify risk factors and provide possible action plan//mitigation measures (S)
3. Advice, support**,** and cooperate with the local government and other relevant agencies to enhance the infrastructure or/and in addressing the proposed action plan (L)
4. Ensure the safe route and emergency access managed and maintained (M)
5. Drainage Marking and localised Storm water Management (M)

Supporting Organization (s)

a. Agencies*
   - ***Land and District Office (PDT)***
   - *Department of Irrigation and Drainage (DID) Perak*
   - *National Disaster Management Agency (NADMA)*
   - *Perak State Forestry Department*
   - *Department of Environment (DOE)*
   - *Department of Health*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority/Pejabat Daerah/Majlis*
   - *Fire & Rescue Department*
   - *Malaysian Meteorological Department (METMalaysia)*
   - *Department of Minerals and Geosciences Malaysia (JMG)*
   - *Department of Town and Country Planning (PLANMalaysia)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Neighbourhood Watch

Strategy 3.3: Promote, enhance alternative water resources and potable water supply

Description

Ensuring availabity of alternative water resources duing water stress and availability of clean water access during the flood is significantly important in ensuring the water supply is reachable to the communities during the time of need. The initiatives highlighted under this strategies will also benefit the water stress issues in long run by ensuring alternative water supply is availabe for use. The alternative supply by enhancing the exisitng water source will be promoted and enhances especially through the rainwater harvesting system as well as through the greenroof and rainwater garden concept. This in additon to ensure availabity of the alternative supply will also incorporate on how this can be channel as groundwater or potable water suitable during flood and drought. In additon action plan will also focusing on how water saving and conservation efforts can be undertaken to reduce water wastage and actions that will protect the water catchment and soil moisture content through current daily practices. Communites will be rekindled through the action plan to revisit the action plan practices by their grandparents/ancesters which depend of the nature for the resources by ensuring the nature are feed and protected accordingly.

Action plans

1. Build Rainwater Harvesting Systems (S)
2. Designated localised greenroof and rainwater garden (S)
3. Water Reuse and Recycling Water (S)
4. Establish pockets of garden/bushes (pocket forest patches) (M)
5. Identify lakes and ponds for potential alternative water resource. (S)
6. Establish Alternative Water Supply - groundwater source: tubewell and pumping system (M)
7. Establish water storage tank (water bank) for emergency purpose (M)

Supporting Organization (s)

a. Agencies*
   - ***Department of Irrigation and Drainage (DID) Perak***
   - *National Disaster Management Agency (NADMA)*
   - *Perak State Forestry Department*
   - *Department of Health*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority*
   - Land and District Office (PDT)
   - *Department of Minerals and Geosciences Malaysia (JMG)*
   - *Land and mineral Office (PTG)*

***** *the lead supporting agency as discussed during the consultation work was **bold and underlined***

b. Others
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Neighbourhood Watch

Strategy 3.4: Work in hand with agencies to mitigate and address hazard through community (eyes and ears)

Description

FLOOD PREPARE Approach promoted through the Flood Ranger was develop to compliment Malaysian government's (NADMA) framework which balance the role and responsibility of all stakeholders i.e. Government, Statutory body, Private sector, NGOs and volunteers. It is timely manner for communities to be the change agent and to also contribute significantly to the need of the communities and to protect the wellbeing, nature and to ensure their livelihood are not impacted with the climate hazards. Besides flood, drought and slope mitigation/landslide preparedness also will be emphasized. Therefore a platform to address, to share , discuss and implement wisely managed action or solution is required with the support of all the relevant players.

Action plans

1. Public awareness on issues and mitigation (S)
2. Establishment of the community based respond team (S)
3. Formation of communication network with stakeholders (two way communication between community and local authorities) (S)
4. Action Plan to include monitoring and evaluation of reports from experts on potential disasters in community areas (M)

Supporting Organization (s)

a. Agencies*
   - ***Land and District Office (PDT)***
   - *Department of Irrigation and Drainage (DID) Perak*
   - *National Disaster Management Agency (NADMA)*
   - *Perak State Forestry Department*
   - *Department of Health*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority/Pejabat Daerah/Majlis*
   - *Fire & Resque Department*
   - *Information Department*
   - *Works Department (JKR)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Neighbourhood Watch

GOAL 4: ENHANCES SOCIO-ECONOMY THROUGH NATURE BASED SOLUTION

Scope

Kinta River Basin is home for various group of communities, flora and fauna. With rich flora and fauna, there are various opportunities for communities to improve their socio economy status through nature based solutions (NbS). Moreover, economy viability and social equity are the other two pillars besides environmental protection in a sustainability model. It is important to showcase and promote NbS concept, as living solutions for enhancing community resilience and sustainable solution to mitigate environmental issues. Furthermore NbS concept encompasses benefits of restoration and rehabilitation of ecosystems, carbon neutrality, improved environmental quality, health and well-being. To ensure its sustainable and propagated, there is a need to create sense of ownership from the targeted group through heart approach to sustain mankind.

Objectives

The main objectives are

i) Promote WASH, economic and financial literary among communities
ii) Support alternative or even main income generation through food secuirty and nature based activities.

Strategies

Strategy	Details
Strategy 4.1	Promote Water, Sanitation and Hygiene (WASH) education programs within communities
Strategy 4.2	Enhance economic and financial literacy among communities.
Strategy 4.3	Promote local food production and security
Strategy 4.4	Generate income through NbS Approach

Strategy 4.1: Promote Water, Sanitation and Hygiene (WASH) education programs within communities.

Description

WASH - "water, sanitation and hygiene" is an important component which less stressed on river water management. It is important to infuse WASH into the river care and management, as river are the arteries of the water resources. WASH is significantly effecting the quality of the water supply, therefore to ensure the supply is protected it is vital to incorporate awareness on WASH and its impact to the river basin, furthermore together with WASH, the Zero Waste Approach and Living Lab approaches can promoted and localised through community participation.

Action plans

1. Conduct socioeconomic assessment of communities (M)
2. Promote Water, Sanitation and Hygiene (WASH) education programs within communities. (M)
3. Roadshow on Alternative livelihood and Zero Waste Approach (M)
4. Enhance visibility through awareness and information materials such as social media, pamphlet, banner etc. (S)
5. Joint force with local authorities (info shared by agencies for communities to be the eyes an ears) – Community Watch (L)

Supporting Organization (s)

a. Agencies*
   - ***Land and District Office (PDT)***
   - *Department of Irrigation and Drainage (DID) Perak*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority*
   - *Perak Helath Department*
   - *MBI Health Unit*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Neighbourhoods Watch

Strategy 4.2: Enhance economic and financial literacy among communities

Description

Economic and financial literacy is an important tool and communities need to be empowered. The Payment for Ecosystem Services (PES) and Financial Framework developed under the Upper Kinta Basin (UKB) project earlier to be localised and restructures through developing the training modules, providing the skills and capital to establish pilot sites to practice and enhance the theoretical mechanisms. Furthermore possible platform and support partners to be explore to provide significant opportunity to propagate the economic and financial literacy as tool for community participation and empowerment.

Action plans

1. Develop training packages focused on ESE (environment & socio – economy) (S)
2. Provide skill training especially for after school/ipt programme focusing environmental skills (school leavers) (M)
3. Establish pilot sites for community based socio –economic enhancements (M)
4. Collaborate with partners to establish Payment for Ecosystem Services (PES) for community based initiatives (L)

Supporting Organization (s)

a. Agencies*
   - ***State Economic Planning Unit***
   - *Department of Irrigation and Drainage (DID) Perak*
   - *Department of Health*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Neighbourhoods Watch
   - SME Banks
   - Education and Research Institutions

Strategy 4.3: Promote local food production and security

Description

Promote the establishment of Community Garden along the river bank/reserve as a medium for community to create a sense of ownership to care, monitor, and protect their riverbank. By this way the local community can protect the river and its surroundings from illegal dumping and pollution besides improving their socio-economic and the environment. Furthermore carrying out a series of activities or long-term initiatives such as community garden instead of one-off activity increases the level of participation and interest from the local communities such as continuous clean-up and awareness programmes to keep up the momentum of interest among community. Indirectly this helped to generated localised low cost food supply for the communities in addition to enhance the communities wellness (health - nutritious food and nutrition awareness). By providing a platform, it generate sense of ownership which will lead to sustainability by increasing locally grown food, reducing transportation costs, promoting composting, and exploring other food-related environmental sustainability strategies; and provide alternative job/income as well at local level.

Action plans

1. Promote community gardens in general and on public lands (S)
2. Promote community wellness (S)
3. Promote environmental sustainability (L)
4. Promotion of businesses and jobs (L)

Supporting Organization (s)

a. Agencies*
   - ***State Economic Planning Unit***
   - *Department of Irrigation and Drainage (DID) Perak*
   - *Department of Health*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority*
   - *Department of Agriculture*
   - *Land and mineral Office*
   - *Ministry of Agriculture and Food Industries (MAFI)*

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Neighbourhoods Watch

Strategy 4.4: Generate income through NbS Approach

Description

Socio – economic growth through NbS Approaches has slowly lost its value among the communities with the economic growth and development. It is important to find a balance between the rapid growth by injecting the NbS into its action plans. The NbS element can be promoted into business opportunity were the core/materials for NBS concept channeled or packaged by the communities . For examples the type of trees used for rehabilitation of riverbank, slopes management and carbon neutralisations as well as in reintroducing wetland species as filtration element can be harvested in the community based nurseries. It is also important to ensure the communities are informed on the benefits of the NbS and how to promote it to safeguard the environment and at the same time generate income for the communities.

Action plans

1. Awareness on NbS Advantages and Business Opportunities. (S)
2. Establish Community based Nursery and business hub (L)
3. Promote and propagate community based ecotourism with NbS elements (M)
4. Develop community NbS economic model (M)

Supporting Organization (s)

a. Agencies*
   - *Department of Irrigation and Drainage (DID) Perak*
   - *Department of National Unity and Integration (JPNIN)*
   - *Local Authority*
   - *Economic Planning Unit*
   - ***Ministry of Tourism, Arts and Culture Malaysia, Perak***

***** *the lead supporting agency as discussed during the consultation work was* ***bold and underlined***

b. Others
   - NGOs (GEC, Friends of Kinta River Basin, KUASA etc.)
   - Neighbourhood Watch
   - Village Development and Security Committees (JKK)

CHAPTER 4: IMPLEMENTATION STRATEGY

4.1 Institutional Arrangements - Outlining Responsibilities And Integration

For effective implementation of CbKRB-IRBM, institutional organization is important and vital. **Table 4.1** shows the proposed list of institutions that are key for CbKRB-IRBM implementation and monitoring.

Table 4.1: Proposed Institutional list for CbKRB-IRBM implementation

No.	Ministries/Agency	Type of institution
1	Ministry of Energy Transition and Water Transformation (PETRA)	Federal Government
2	Ministry of Natural Resources and Environmental Sustainability (NRECC)	Federal Government
3	Department of Irrigation and Drainage (DID) Malaysia	Federal government
4	Department of Environment (DOE) Malaysia	Federal government
5	Department of Mineral and Geoscience Malaysia (JMG)	Federal government
6	Department of Survey and Mapping Malaysia (JUPEM)	Federal government
7	Public Works Department (PWD)	Federal government
8	National Water Services Commission (SPAN)	Federal Government
9	Perak State Government (Exco for Science, Environment, and Green Technology & other related Exco)	State government
10	Department of Irrigation and Drainage (DID) Perak	State government
11	Department of Town and Country Planning Perak (PLANMalaysia@Perak)	State government
12	Department of Environment (DOE) Perak	State government
13	Perak State Forestry Department	State government
14	Perak State Education Department (SED)	State government
15	Department of Orang Asli Development	State government
16	Perak State Office of Land and Mines	State government
17	Perak State Agricultural Development Corporation	State government
18	Department of Fisheries Perak	State government
19	Department of Mineral and Geoscience Perak	State government
20	Perak Water Board (LAP)	State government
21	Perak Economic Planning Unit (UPEN)	State government
22	Perak State Health Department	State government
23	Perak State National Solid Waste Management Department (NSWMD).	State government
24	District Forestry Offices	Local government
25	Ipoh City Council	Local government
26	Kampar District Council	Local government
27	Batu Gajah District Council	Local government
28	Perak Tengah District Council	Local government
29	Land and District Offices	Local government
30	District Departments of Irrigation and Drainage	Local government

31	Businesses, Industries and Developers	Private players
32	Global Environment Centre (GEC)	NGO
33	KUASA	NGO
34	Friends of Kinta River Basin	CBO
35	Orang Asli communities	Communities
36	Local communities in Kinta River Basin	Communities

The stakeholders mentioned above have been identified as key stakeholders within the KRB and potentially playing very important role as lead and supporting role in implementing CBKRB-IRBM sustainably. They need to be integrated together under one framework so that all are able to work together to achieve common goals.

4.2 The Role of Stakeholders

Once relevant stakeholders are identified, specific task and role in implementing CbKRB-IRBM for each of them need to be developed agreed and assigned upon. Their proposed roles need to be drafted primarily based on their existing jurisdiction.

The **Table 4.2** and **Table 4.3** which indicates the list of stakeholders relating to four (4) goals in CbKRB-IRBM and the roles of the respective agencies/departments respectively were developed as the outcome of the initial stakeholders and partners which was conducted on 9 June 2022 at the Kinta Riverfront hotel.

Note: There is a need to highlight that the stakeholders were selected through the discussion on the workshop and still at the initial stage, the selective may wary (reduced or increased) during the implementation period and enhances during the phase as well.

Table 4.2: List of identified stakeholders relating to CbKRB-IRBM goals

No.	Agency	Goal 1					Goal 2				Goal 3				Goal 4			
	Strategy	**S1**	**S2**	**S3**	**S4**	**S5**	**S1**	**S2**	**S3**	**S4**	**S1**	**S2**	**S3**	**S4**	**S1**	**S2**	**S3**	**S4**
1.	Ministry of Energy Transition and Water Transformation (PETRA)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
2.	Ministry of Natural Resources and Environmental Sustainability (NRECC)	√	√	√	√	√	√	√	√	√				√	√	√	√	√
3.	Department of Irrigation and Drainage (DID) M'sia	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
4.	Department of Environment (DOE) M'sia	√													√			√
5.	Department of Mineral and Geoscience (JMG)	√																
6.	Department of Survey and Mapping (JUPEM)	√																
7.	Public Works Department (PWD)										√		√	√				√
8.	National Water Services Commission (SPAN)	√	√	√	√	√	√	√	√	√								√
9.	Perak State Government (Exco for Science, Environment, and Green Technology & other related Exco)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
10.	Department of Irrigation and Drainage (DID) Perak	√	√	√	√	√	√	√	√	√	√	√	√	√	√			
11.	Department of Town and Country Planning Perak (PLANMalaysia@Perak)										√	√	√	√	√			
12.	Department of Environment (DOE) Perak	√	√	√	√	√					√	√	√	√				
13.	Perak State Forestry Department	√		√	√				√	√				√	√	√	√	√
14.	Perak State Education Department (SED)			√	√	√				√					√			
15.	Department of Orang Asli Development	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
16.	Perak State Office of Land and Mines							√	√									
17.	Perak State Agricultural Development Corporation														√	√	√	√
18.	Department of Fisheries Perak			√	√	√	√	√	√	√				√	√	√	√	√
19.	Department of Mineral and Geoscience Perak							√	√									
20.	Perak Water Board (LAP)	√	√	√	√	√	√	√	√	√								
21.	Perak Economic Planning Unit (UPEN)														√	√	√	√

Table 4.3: Roles of stakeholders relating to CbKRB-IRBM goals (cont)

No.	Agency	Goal 1					Goal 2				Goal 3				Goal 4			
Strategy		**S1**	**S2**	**S3**	**S4**	**S5**	**S1**	**S2**	**S3**	**S4**	**S1**	**S2**	**S3**	**S4**	**S1**	**S2**	**S3**	**S4**
22.	Perak State Health Department									√				√	√		√	√
23.	Perak State National Solid Waste Management Department (NSWMD).									√	√	√		√	√			√
24.	District Forestry Offices													√				√
25.	Ipoh City Council	√		√	√	√				√	√	√	√	√	√	√		√
26.	Kampar District Council	√		√	√	√												√
27.	Batu Gajah District Council	√		√	√	√				√	√	√	√	√	√	√		√
28.	Perak Tengah District Council	√		√	√	√				√	√	√	√	√	√	√		√
29.	Land and District Offices	√			√					√	√	√	√	√				√
30.	District Departments of Irrigation and Drainage	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
31.	Businesses, Industries and Developers			√	√	√			√					√	√			√
32.	Global Environment Centre (GEC)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
33.	KUASA													√	√			
34.	Friends of Kinta River Basin	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
35.	Orang Asli communities	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		
36.	Local communities in Kinta River Basin	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√

Table 4.3: Roles of stakeholders relating to CbKRB-IRBM goals

No.	Agency	Common Proposed Role
1.	Ministry of Energy Transition and Water Transformation (PETRA)	To support the idea and allocate funds CB-IRBM and for riverbank beautification (Denai Sungai). To conduct studies on water availability and groundwater pollution (NAHRIM) To monitor the rate of naturally occurring radioactive in the river due to land clearing and dredging activity. To implement projects focused on reducing the impact of climate issues, as flood and drought To safeguard the water catchment area To ensure the enforcement team is activated and regular monitoring being implemented
2.	Ministry of Natural Resources and Environmental Sustainability (NRECC)	To establish funding for Cb-IRBM initiatives To implement projects focused on reducing the impact of climate issues, as forest clearance and logging activities To have detailed inventory for the flora and fauna To safeguard the forest as water catchment reserve/gazetted area
3.	Department of Irrigation and Drainage (DID) Malaysia	To enhance and restore the riverbanks To build Eco trails and public amenities along the riverbank To support with the water quality and related river monitoring data To implement action plans focusing on flood mitigation, community empowerment and disaster risk management To ensure available technology and methods are systematic, environmental friendly and sustainable
4.	Department of Environment (DOE) Malaysia	To support on the education and awareness Programme To be part of the enforcement to monitor pollution and river health
5.	Department of Mineral and Geoscience Malaysia (JMG)	To conduct sampling of the soil minerals, funding for relevant studies and support as well as to identify hazardous heavy metal loads. To explore potential areas as the source of alternative water supply

Table 4.3: Roles of stakeholders relating to CbKRB-IRBM goals (cont.')

No.	Agency	Common Proposed Role
6.	Department of Survey and Mapping Malaysia (JUPEM)	To support with Landuse mapping dan relevant data To ensure the river reserve boundaries being mapped accordingly
7.	Public Works Department (PWD)	To provide infrastructure and ensure its maintenance are carried out regularly To monitor and implement slope mitigation plan To include flood escape and emergency route in the planning To identify and mitigates slopes that have impact on water catchment areas
8.	National Water Services Commission (SPAN)	To ensure the rules and regulation readily available on water related matters implemented To support on the licensing of the water operators To promote water conservation and saving initiatives To provide incentive to support water conservation efforts
9.	Perak State Government (Science, Environment, & Green Technology Exco & related Exco)	To monitor the scope of work, and manage fund allocation, to expose and promote the programme among communities
10.	Department of Irrigation and Drainage (DID) Perak	To enhance and restore the riverbanks, eco trails and public amenities along the riverbank To support with the water quality and related river monitoring data To implement action plans focusing on flood mitigation, community empowerment and disaster risk management To ensure available technology and methods are systematic, environmental friendly and sustainable
11.	Department of Town and Country Planning Perak (PLANMalaysia@Perak)	To provide input on the current and upcoming country planning plan as required To incorporate the risk of flood in upcoming development and city planning
12.	Department of Environment (DOE) Perak	To lead enforcement at ground To empower the communities on the WASH and River Care Action Plan

Table 4.3: Roles of stakeholders relating to CbKRB-IRBM goals (cont.')

No.	Agency	Common Proposed Role
13.	Perak State Forestry Department	To promote plants and trees suitable for erosion control and landslide To gazette forest as water catchment To enforce forest encroachment act
14.	Perak State Education Department (SED)	To include syllabus related to river protection / conservation from primary education To promote existing competitions and awards such as Sekolah Lestari To promote awareness campaigns among schools
15.	Department of Orang Asli Development	To promote WASH and River Care Programme To report to DOE or Forestry on illegal encroachments
16.	Perak State Office of Land and Mines	To coordinate the proposed action plans To play the role of the project owner To support enforcement on land usage and ownership
17.	Perak State Agricultural Development Corporation	To sharing updated and current technologies for the communities related to agriculture To provide licence for farming and land development (related to agriculture)
18.	Department of Fisheries Perak	To provide awareness on the ban of releasing alien fish, non-indigenous fish species on genetically modified organism into public water / water bodies. To revise fisheries (Riverine) Perak Rules 1992 To enhance and promote the fish try restocking programs in public water. To licence the fishing activity according to carrying capacity. To licence the aquaculture activity along the river and regulate the activity with term and conditions. To purpose a sanctuary for indigenous species at the upstream of the water. To support and share current aquaculture technology to the farmer and contractors (Buffer zone). To enforced fisheries (Riverine) Perak Rules 1992 – 2024
19.	Department of Mineral and Geoscience Perak	To identify potential groundwater sources as reserve alternative water supply

Table 4.3: Roles of stakeholders relating to CbKRB-IRBM goals (cont.')

20.	Perak Water Board (LAP)	To support for the awareness and education programme To identify and promote technologies on water saving initiatives /gadgets To establish and promote incentives for the users on water conservation /saving initiatives
21.	Perak Economic Planning Unit (UPEN)	To secure and support funding for Cb-IRBM initiatives To develop environmentally friendly development plan for the state
22.	Perak State Health Department	To conduct roadshow / campaign / activity related to river protection in community level To continue monitoring the drinking water qualities
23.	Perak State National Solid Waste Management Department (NSWMD).	To support for the awareness and education programme To identify flood friendly system to reduce impact of flash floods or clogged drainage system
24.	District Forestry Offices	To implement the action plan developed by the department To empower local community rangers to be the eyes and ears of the department
25.	Ipoh City Council	To support drainage management and monitoring through act /enforcement To support the implementation of the proposed action plans through the relevant departments/unit within the council To ensure the ongoing development and city planning highlights water catchment and integrated river management through community participation
26.	Kampar District Council	
27.	Batu Gajah District Council	
28.	Perak Tengah District Council	
29.	Land and District Offices	To enforce the regulations especially those related to the river reserve area
30.	District Departments of Irrigation and Drainage	To plan and implement projects that focused on flood risk management To secure budget to upgrade and maintain the infrastructures related to river management To upgrade the flood management system
31.	Businesses, Industries and Developers	To support CSR programmes To control pollution at source
32.	Global Environment Centre	To support awareness and action plan To guide and support the implementation plan with the agencies

Table 4.3: Roles of stakeholders relating to CbKRB-IRBM goals (cont.')

33.	KUASA	To promote awareness and advocate for the environment
34.	Friends of Kinta River Basin	To promote awareness and propose initiatives
35.	Orang Asli communities	To promote and be part of the awareness campaigns To take ownership and initiatives for source protection To be the eyes and ears of the environment and the agencies
36.	Local communities in Kinta River Basin	To promote and be part of the awareness campaigns To take ownership and initiatives for source protection To be the eyes and ears of the environment and the agencies

4.3 Institutional Arrangements

Institutional arrangement for CbKRB-IRBM implementation is as per Figure 4.1. Chief Minister proposed to chair the state environmental committee which CbKRB-IRBM implementation can be reported, monitored and reviewed. Besides government agencies, grassroots voices also proposed to be taken in account by giving one seat for representative from coalition of NGOs, local communities and private agencies respectively.

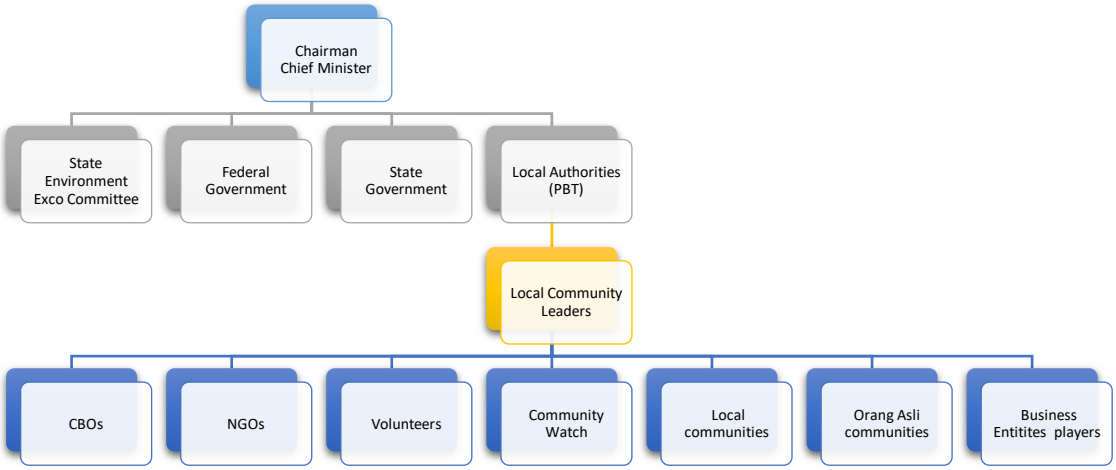


Figure 4.1: Proposed CbKRB-IRBM institutional arrangement

4.4 Resources and Support for Implementation

There need to be proper resources and support for successful implementation of CbKRB-IRBM. Table 4.4 shows the potential resources and support needed for CbKRB-IRBM implementation.

Table 4.4: Resources and support for CbKRB-IRBM implementation

No.	Resources	Support
1	Human resources	• Allocate personnel from existing agencies • Additional budget for personnel from state and federal governments • Involve local communities for monitoring
2	Logistic arrangement such as vehicles, information center etc.	• Explore unused and unoccupied buildings/facilities • Additional budget from state and federal government
3	Digital technology (Website. Mobile application etc.)	• Agencies to agree for one common platform • Either Federal/State government takes lead on setting up this mechanism
4	Monitoring tools and facilities	• Allocation for new purchase and maintenance from relevant agencies • Repair and use existing ones that can be used
5	Capacity building programmes & initiatives	• Agencies to support continuous capacity building programmes for key personnel involved in CbKRB-IRBM
6	Open access platform for data repository and reference	• Either state/federal government lead on setting up the open access for stakeholders to refer progress of CbKRB-IRBM
7	Funding for implementation of the strategy	• Federal allocations (RMK12 etc.) • State agency allocations • User pay/polluter pay schemes • Payment for Ecosystem Services • Private sector contributions

CHAPTER 5: KEY PERFORMANCE INDICATORS

5.1 Introduction

This section covers Key Performance Indicators (KPI) for the goals outlined in CbKRB-IRBM. KPI drawn based on respective strategies and proposed action plan under respective goals. Monitoring methods through stakeholders: either communities, or agencies emphasized for easier adoption, implementation and monitoring. Reporting mechanisms also described within this section**.**

5.2 Scope

KPI mainly drawn based on strategies highlighted in each goal in chapter 3. KPIs will be in line with goal's measurable outcomes in long term. KPIs set follows SMART concept that stands for Specific, Measurable, Attainable, Relevant and Time-bound.

5.3 Key Performance Indicators (KPIs)

Overall a total of 26 KPIs proposed to be monitored. Table 5.1 shows the breakdown of KPIs for strategies under each goal identified from the workshop session

Table 5.1: Number of KPIs for each goals

Goal	Number of strategies	Number of KPIs
1	**5**	**4**
2	**4**	**6**
3	**4**	**6**
4	**4**	**10**
Total	**17**	**26**

5.3.1 KPIs for Goal 1: To Ensure the Quality Clean Water and sufficient Quantity

Table 5.2 shows the proposed four (4) KPIs for Goal 1.

Table 5.2: Proposed KPIs for Goal 1

Strategies	Indicators for KPI	KPIs	Monitoring Methods	Monitoring Mechanism/Tool	Leading Supporting Agency
Assess and map the pollutant sources in KRB	• Milestone Schedule • Project Implementation and monitoring meetings • Year End Evaluation report • Enhancement of existing implementation plan	• % Achievement of tasks as per milestone schedule • Number of project implementation and monitoring meetings conducted in a year • Submission of year end evaluation report • Yes/No of enhancement of existing implementation plan	• Documentation • Minutes of Meetings • Year End Evaluation Report	• Workshops and Training • Clean Up programmes • Activities focusing key groups- religious and youth programme	DOE PERAK
Monitor river basin using Citizen Science Approach					
Promote, encourage and implement pollution control measures at source					
Promote and implement community based river rehabilitation and restoration measures					DID PERAK
Promote and implement water demand management measures					SPAN

5.3.2 KPI for Goal 2: Revitalize ecosystem through river health concept

Table 5.3 shows the proposed six (6) KPIs for Goal 2.

Table 5.3: Proposed KPIs for Goal 2

Strategies	Indicators for KPIs	KPI	Monitoring Methods	Monitoring Mechanism/Tool	Leading Supporting Agency
To enhance physical components of river basin	• Participants • Activities • Trees planted	• Number of participants • Number of activities initiated • Number of trees planted and its survival rate • Achievement of river class as per river health target • Number/frequency of native fishes released • Number of living aquatic organism within the river body and the riverine compound.	• Physical observation Date sheet/monitoring Sheet/Inventory	• Physical observation Monitoring Form/ Data Collection	DID
To enhance chemical components of river basin	• Achievement of desirable river class as per targets		Chemical Monitoring	Water Quality Index	DOE
To enhance biological components of river basin	• Participants • Activities • Local fishes released • Living organism within the river system		• Physical Observation • Fish and Benthic Macroinvertebrates sampling	• Biological Monitoring (RIVER Ranger 2.0) Local fish species Identification/distribution	DOF
To promote community participation on river care	• Number of participants • Number of activities		• Physical observation •	• Date sheet/Reporting	DID District/State

5.3.3 KPI for Goal 3: Preparedness and Action for Disaster Risk Reduction (DRR)

Table 5.4 shows the proposed six (6) KPIs for Goal 3.

Table 5.4: Proposed KPIs for Goal 3

Strategies	Indicators for KPI	KPIs	Monitoring Methods	Monitoring Mechanism/Tool	Leading Supporting Agency
Promote awareness on flood and drought mitigation – community preparedness through the FLOOD Ranger	• Environmental awareness programs • Engagement and Consultation	• Number of environmental awareness programs • Number of engagement and consultation • Number of flood hazard maps developed. • Number of alternative water resources and potable water supply systems established • Number of questionnaires on stakeholder awareness of the environment. • Number of reports received from the community as the eyes and ears of local authorities.	• Regular Monitoring • Project Working Group Meeting	• Community Social media such as WhatsApp's group, telegram, facebook, • Physical observation • Monitoring Form	PTD/DID
Develop communities based flood hazard map	• Flood hazard maps developed.				
Promote, enhance alternative water resources and potable water supply during flood	• Alternative water resources and potable water supply systems				
Work in hand with agencies to mitigate and address hazard through community as eyes and ears	• Questionnaires • Reports				

5.3.4 KPI for Goal 4: Enhances Socio-Economy through Nature based solution

Table 5.5 shows the proposed ten (10) KPIs for Goal 4.

Table 5.5: Proposed KPIs for Goal 4

Strategies	Indicators for KPIs	KPIs	Monitoring Methods	Monitoring Mechanism/ Tool	Leading Supporting Agency
Promote Water, Sanitation and Hygiene (WASH) education programs within communities	• Awareness level • WASH initiatives implemention •	• Rate of awareness among communities to increase by 50% in 5 years • Number of communities implementing the WASH initiatives • % Reduction on Waste within the Kinta River basin	• Survey/ Questionnaires • Regular Monitoring • Project Working Group • Joint Monitoring • Monitoring sheet	• Platform of sharing of materials • Peer to Peer Sharing • Data Analysis for economic improvement	PTD/DID
Enhance economic and financial literacy among communities.	• Agencies involved • Activities • Participants	• No of agencies involved • No of activities No of Participants			MAFI
Promote local food production and security	• Community gardens • Nutritional food • Centre or KIOSK	• Number of Community garden established within the basin • To promote nutritional food to different age group • Number of centre or kiosk for business and job opportunities			MAFI
Generate income through NbS Approach	• Campaigns and promotional activities • Initiative sites	• Number of campaigns and promotional activities carried out • Number of initiative sites			PTD

[i] www.riverranger.my