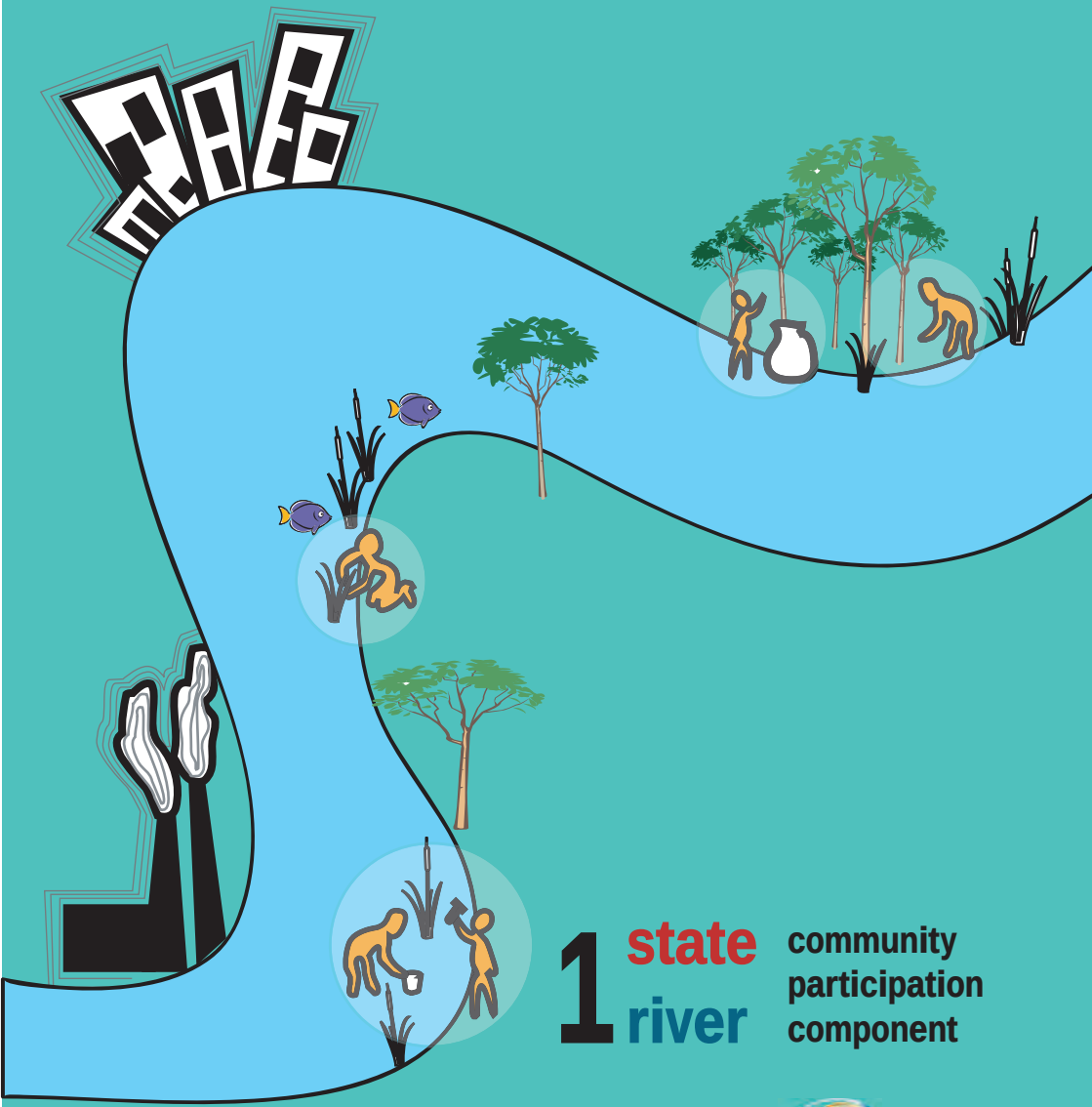
river auditing

let's get to know our rivers!



1 state river community participation component

Global Environment Centre

who owns our rivers?

AGENCY	LEGAL BASIS	RESPONSIBILITY
DID	Drainage Works Act Irrigation Areas Act	Irrigation & Drainage, Flood Mitigation, River Conservancy, Coastal, Urban Drainage and Hydrology
DOE	EQA (1974) Local Gov Act	EIA approvals Regulating Sewage and Industries Regulating Rubber and Palm Oil Industries Regulating Scheduled Waste
PBT	SDBA UBBL and other municipal by-laws	Development Control Regulating Commercial and trade Solid waste management Regulating discharge of trade effluent Regulating pollution of streams Managing urban drainage Managing Landscaping Regulating slaughter house
Land Office	National Land Code	Regulate illegal occupation of land Regulates land use Regulates sand mining
TCPD	Planning Act	Development Planning Control
State Authority	Land Conservation Act Waters Enact/Waters Act	Regulates hill land development Regulates water sources
JBA	Water Supply Enactment	Regulates water supply services Regulates activities within designated water catchment areas
JPP/DSS	Sewerage Services Act	Regulates IWK in providing sewerage services
Forestry Dept.	National Forestry Act 1984	Regulates Permanent Forest Reserves

Most importantly, it is WE, the public, who owns our rivers!

Acknowledgements
We acknowledge the sources of some of the illustrations and photos used in this booklet.

This booklet was designed and preprared by
Global Environment Centre
for the
One State One River Community Participation Component

contents

introduction

Rivers play an important role in our lives. Unfortunately, many of us have forgotten about the importance of rivers and this has led to serious degradation in our rivers today.

In this book, we have compiled information about rivers and the status of rivers in Malaysia and activities that you can do to learn more about your nearby river. The main purpose of this book is to encourage you to learn more about rivers and the importance they play in our daily lives. This book is the first of its kind in Malaysia in that it highlights the true issues and problems with rivers in a easy to read manner. It is aimed to educate and raise awareness within the Malaysian community about how our every day actions affect our rivers and in turn affects us and our environment.

Rivers are our source of life, and by understanding the issues, you can play your role in protecting our rivers and its environment.

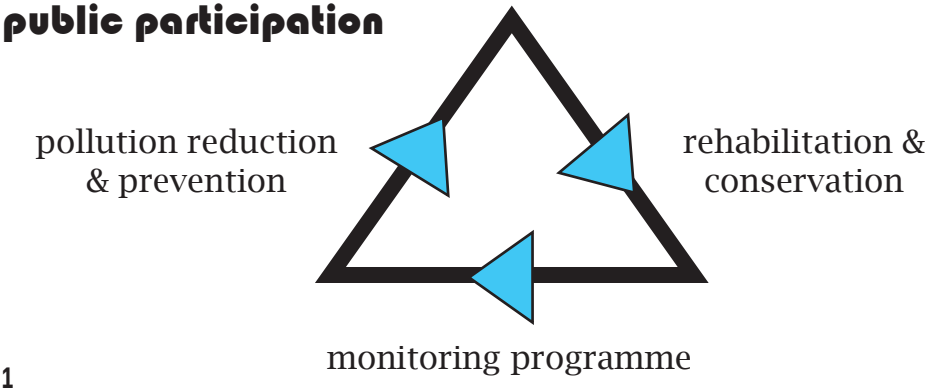
river management

problems → impacts

River management involves → government, private sector, public

in
- protection and conservation
- rehabilitation
- maintenance/monitoring

public participation



foreward

Rivers are recently facing quite a problem especially with the degradation of their water quality and the riverine environments. To alleviate such problems, the Department of Irrigation and Drainage (DID) Malaysia has launched several programs, with the 'Clean, Living and Vibrant" approach, that hopefully will achieve the ultimate goal of improving the water quality and improve the environment of most rivers.

The One State One River Program is targeted to return, as far as possible the vegetation, structure, hydrology, and the water quality of rivers back to their original state. The objective of the One State One River Program is to advocate the State DID to rehabilitate polluted rivers into a cleaner, living and healthy river that can bring life, a wide range of biodiversity and economic benefit to riverine communities within the river basin.

As we aware, community involvement is vital for any river management programme. Therefore, we have incorporated community participation within the One State One River Program. The objective is to engage the local community to work with us on a holistic approach. We believe this will lead to smart partnerships with local communities, CBOs and NGOs.

To assist DID on community participation, we have engaged Global Environment Centre (GEC) to develop and implement community based activities. As a first step, we developed this booklet to promote and give basic information/ knowledge about rivers and river basins. This booklet will also assist the local community on how to audit their river especially on water quality and polluter monitoring.

Through this booklet, we hope to have a better informed community and can motivate them to take the ownership of their river. We hope by organizing this program, the local community will enhance their responsibilities towards rivers and know their role in loving and safeguarding their rivers.

Finally I hope this partnership between DID, GEC and the local community can take us to greater success on improving and protecting our rivers.

Datuk. Ir. Hj. Keizrul bin Abdullah
Director General
Department of Irrigation and Drainage Malaysia

note for the public

While this book is an introduction to the general problems and issues in rivers of Malaysia today, there are many other things that may be going on in your own river basin. And remember, we ALL live in a river basin. It should not be about what state or city you live in, but which river basin you live in. Most importantly, it is also not just about rivers, but your drains, as ALL drains, big or small, lead directly to our rivers.

The government can spend millions of ringgit trying to rectify the problems with rivers, but if the community continues to pollute the river, disregard the laws for their own benefits, or even refuse to acknowledge the problems, then there will ALWAYS be a problem. The government cannot solve these issues by itself, and needs the help and cooperation of the community if there is to be any change. It is up to the community to join hands together with the government and rise above the situation to help save our rivers.

Through the One State One River Programme, community members can now be part of the river management process. The government is doing the best they can, but are you?

We hope that with the information you gain from this book, you will start to think about the environment as your own and take action for it! This could be in the form of community activities like clean ups, river monitoring, pollution monitoring or even just talking to other people about the importance of rivers.

Every little bit counts and we leave you responsible for your environment.

To Love Our River means to Love and Care for Our Drains first!

what is a river?

A river is a natural waterway on the Earth's surface, which channels freshwater from the mountains to the sea.

Rivers begin as small trickles of water up in the mountains. This is its source, and it eventually forms a small stream which then flows down the mountain. The water erodes the land, carving a bigger channel and forms the main river.

Upstream areas are characterized by steep V-shaped valleys, waterfalls, and fast flowing water among boulders and rocks. In the middle part, the river winds its way slowly through the flatter land, and continues to widen its channel by meandering and depositing material that is too heavy to carry in the water. As it makes its way out to the sea, it flows even more slowly and starts to deposit even more material in and around its own channel. At its mouth, where the river meets the sea, there is a sudden drop in velocity, and all the material that was being carried in the water column is deposited right there. As the material builds up from continuous deposition, the mouth of the river gets blocked and the river has to find new outlets into the sea by carving new streams wherever it can. This is the formation process of a delta and is characteristic of all river mouth areas.

rivers in Malaysia

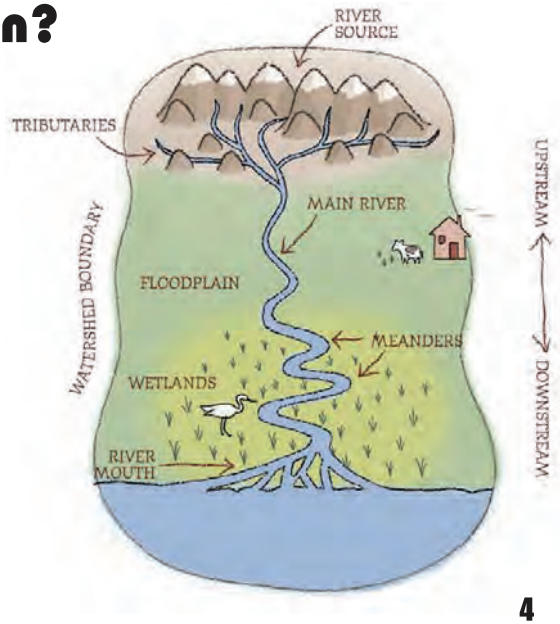
There are 189 river basin systems with about 1800 rivers in Malaysia. The total length of the rivers is estimated to be 38,000 km. Most of the rivers in Peninsular Malaysia originate from the central mountain ranges. East Malaysia contains the country's two longest rivers: the Rajang in Sarawak and the Kinabatangan in Sabah. They are each 560 km (350 mi) long and navigable for part of their courses. Peninsular Malaysia's longest rivers include the Pahang (470 km/290 mi long), the Kelantan (about 400 km/250 mi long), and the Perak (about 240 km/150 mi long).

what is a river basin?

A river basin is the entire area drained by a river including its tributaries. That means, all water in the river basin area drains into the river and its tributaries. Therefore, the flow of water sets the boundaries of a river basin.

Hydrologists sometimes refer to river basins as catchments or drainage basins. The term watershed is use synonymously with river basin, especially in the U.S.

River basins catch precipitation and accumulate water, which flows across or under the landscape. They come in many different shapes and sizes. River basins can be hilly, mountainous, or nearly flat and can be comprised of many land uses including forests, farms, towns and cities.



why are rivers so special?

The only kind of water we can use is freshwater. There's a lot of water in the seas and oceans, but that is salt water and it cannot be used for our purposes. Rivers are the main sources of freshwater. Most of the freshwater on earth is locked up in icebergs. Rivers are not merely in the environment for aesthetic values. They are living entities that play a huge role in our lives. You may not see the relationship of rivers to us, but rivers are actually our source of life.

drinking water

In Malaysia, rivers provide 97% of our water supply. Among the 189 river basins, 30 of them function as reservoirs which supply the 25 million people living in Malaysia with clean water which flows through our taps.

domestic use

We also use the water from our taps for other things like washing plates, laundry, cars, watering our plants and bathing! Without rivers, our only other source of freshwater is rainwater!

agriculture

To grow our food, we need water. This water is usually diverted from rivers to irrigate (water) crops and plantations.

industry

Industries need water to manufacture the products that we use. Everything from computers to clothes to paper needs water at some stage of production.

transport

Before aeroplanes and other forms of transport were invented, rivers were used as the main form of transport for people all over the world. Since rivers traversed all over the land, it was the most effective way of getting around to other parts of the continent. Even today, many local communities still use rivers as a form of transport.

biodiversity

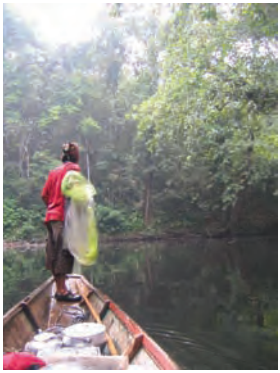
Rivers are home to a wide range of plants and animals which live in and around them. Around 40% of all fish species are freshwater forms! Imagine how many species we'd lose if our rivers became too polluted to sustain life?

recreational

These days, rivers are widely used as a recreational area. Left in its natural state, rivers and its surrounding forest area make a great place for picnics, camping, and canoeing. They are also used for other sports like white water rafting and fishing competitions. In developed countries that have large rivers flowing through its city centre, these rivers are used to run cruises that take tourists on a tour of the city.

religion

In any religion, water is always considered the purest resource on earth. Rivers, especially, are used in numerous religious ceremonies and festivals. The water from rivers is usually considered pure and a source of life as well.



livelihood

Malaysia still has a strong 'orang-asli' community. These local communities depend on the resources provided by forests and rivers. Local communities usually depend on rivers for fish which is their main source of protein in their diet, and sell fish, prawns and crabs for a living. They also use forest resources like certain plants and trees to make traditional crafts which can be sold.

natural rivers

Rivers are natural components of the environment. There are a few aspects that characterise rivers as a natural body of water.

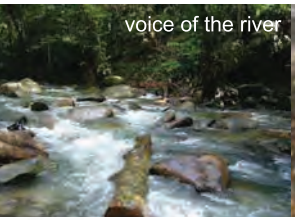
rivers: living entities?

"a product of the geology that created it, the soil that surrounds it, the marine creatures that live in it, the plants and animals that adjoin and border it, and the birds that fly over it."

"ever-changing and forever wild"

A river is an entire living entity. A river is not merely a channel for water to flow. There are living things that depend on the river for survival, both in the water and on the land the river supports. The narrow area along a river is called the riparian corridor. This area supports a variety of plants and trees that contribute nutrients, shade, soil stability, habitat, and organic materials for small organisms to eat. Rivers contain living things inside, such as aquatic plants, fish, crustaceans, and mollusks, and also supports insects and mammals which utilize the river for many purposes. As such, rivers provide a great variety of habitats and services for all living things and it is important to maintain both physical and biological diversity in and around rivers.

It is important to recognize rivers as a living entity. Without the living things that live around and within it, rivers cannot function as nature intended it to. Therefore, it is important to care for our rivers and ensure that the quality of our rivers remain in a pristine state.

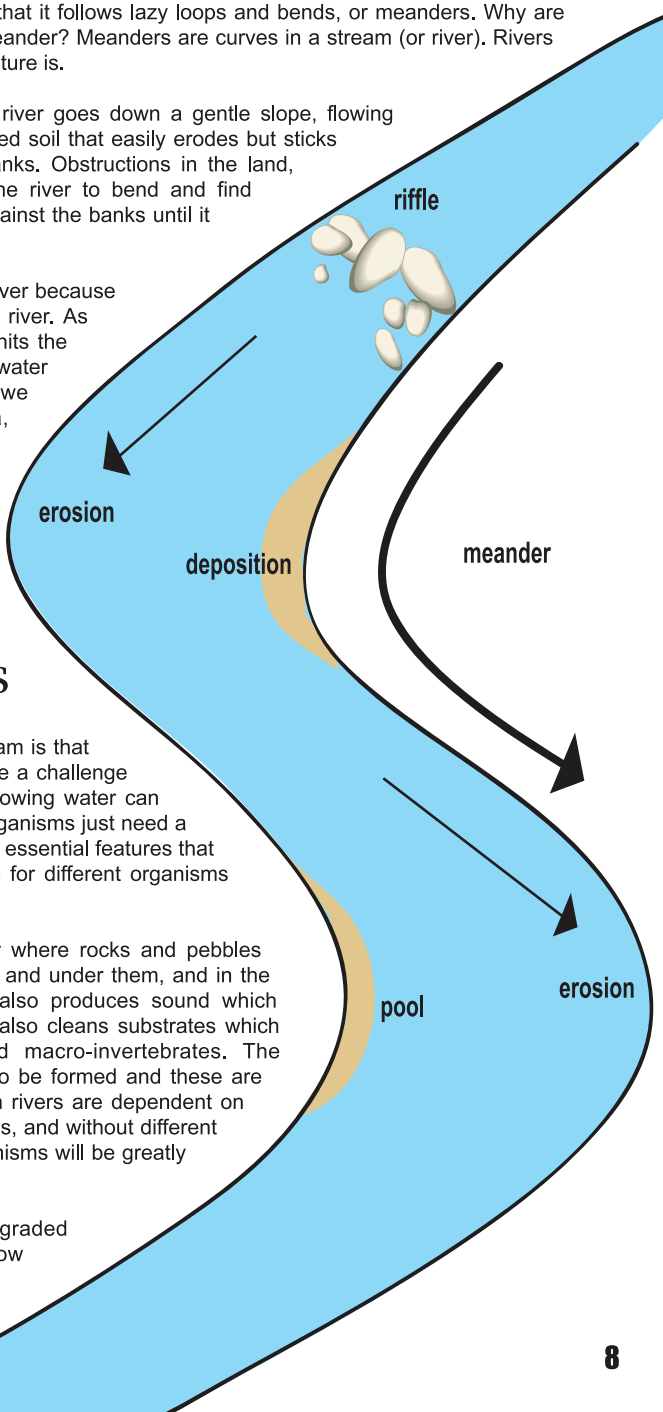


meanders

One of the characteristics of a river is that it follows lazy loops and bends, or meanders. Why are rivers crooked and why does a river meander? Meanders are curves in a stream (or river). Rivers meander because that's just the way nature is.

Meanders usually appear wherever a river goes down a gentle slope, flowing around obstructions, through fine-grained soil that easily erodes but sticks together well enough to make firm banks. Obstructions in the land, such as trees or firm land, causes the river to bend and find another path. The river begins to hit against the banks until it erodes and forms a curve.

Meanders are important features of a river because it helps to regulate the velocity of the river. As the water winds around the curves, it hits the banks and this slows the flow of the water down. One of the reasons why we experience flooding in Malaysia, especially in cities such as Kuala Lumpur, is because many of our rivers have been straightened and channelised by concrete banks. Straight rivers mean that the water has no obstructions to slow down its flow, so the water can rise very fast.



riffles and pools

Another characteristic of a river or stream is that it has riffles and pools. A stream can be a challenge for organisms that live in the water. Flowing water can move particles of all sizes and some organisms just need a place of their own. Riffles and pools are essential features that help to provide different micro-habitats for different organisms to live in.

Riffles are areas of fast flowing water where rocks and pebbles cause the water to flow above, around and under them, and in the process oxygenates the water. This also produces sound which becomes the **voice of the stream**. It also cleans substrates which are then colonized by bacteria and macro-invertebrates. The presence of riffles also causes pools to be formed and these are areas of slow flow. Living organisms in rivers are dependent on these different areas for their own needs, and without different velocity gradients, the diversity of organisms will be greatly reduced.

Constructing riffles and runs in degraded channels restores the variety of flow velocities and micro pools necessary to support aquatic ecosystems.

classification of rivers

the designated use of water

Rivers in Malaysia may be classified according to a predetermined designated use. Malaysia has established water quality standards appropriate for each designated use. When waters are of sufficient quality to fulfill their classification requirements, they are said to support their classification. Examples of designated use are as follows:

Use	Classification
Drinking water	To be designated for human consumption, a water supply must be fit for drinking, cooking food, and other domestic purposes. Raw water criteria (water before treatment) are dependent upon the technology level at the potable water treatment plant.
Industry	Industries such as the pulp and paper industry, chemical manufacturing, and steel work extract water from rivers for processing non-food products and cooling.
Navigation	Water is used for the commercial transfer of persons, animals and goods.
Livestock	Water is used by livestock and poultry for drinking and cleansing.
Aquatic Life Support	Water quality must be sufficient to maintain the ecological integrity of rivers including the sustained growth and propagation of aquatic organisms (fish, invertebrates, macrophytes and plankton), semi-aquatic organisms, and terrestrial wildlife dependent on surface water for survival.
Irrigation	Water is used to supplement rainfall for growing crops.
Fishing	Use of water for the legal taking of fish and shellfish for the purpose of human consumption.
Recreation	Recareation water use if subdivided into 2 categories, primary and secondary contact. Primary contact refers to body immersion in water, e.g. swimming. Secondary contact refers to body contact with water, e.g. rafting and canoeing.

water quality classification

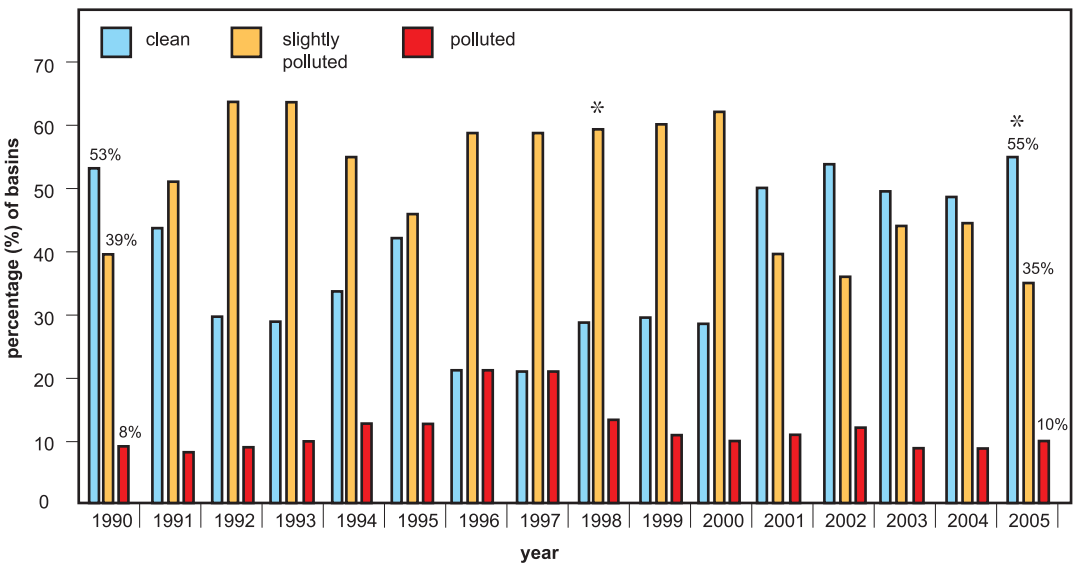
Proper classification is based on National River Water Quality Standards for Malaysia, which consists of 5 classes. The One State One River Programme aims to restore the selected rivers back to a Class II status.

Class	Usage
I	very clean; practically no treatment needed; conservation of natural environment; very sensitive aquatic species
II	clean but needs treatment before drinking; sensitive aquatic species
III	polluted water and needs extensive treatment before suitable for drinking; recreational use with body contact
IV	can only be used for irrigation
V	extremely polluted and cannot be used for any purposes


a Class II river

status of rivers in Malaysia

Graph showing the percentage of clean, slightly polluted and polluted out of the 120 river basins being monitored from 1990 - 2005.



explanation

From the graph, it can be seen that the number of clean, slightly polluted and polluted rivers today are about the same as they were in 1990. However, over the past 15 years, the number of clean rivers had declined dramatically after 1990 before they recovered starting 2001. This can be attributed to the period of industrialisation in Malaysia and large scale development. As the nation grew, environmental degradation increased, leading to increased river pollution and exploitation.

⁎ no. of basins monitored these years are different

Eventhough over half our rivers are considered clean, it doesn't mean that we can relax. We have to remember that there are still 69 other river basins that are not being monitored, and we don't know the status of these rivers. It also means we have to work hard at keeping these rivers clean and begin to rehabilitate the other 50% of rivers that are polluted and bring them back to a clean status.

It is not as easy at it sounds because with the way things are now, rivers will continue to be exploited and taken for granted until it is too late. We need to start protecting our sources of water and stop using them as dumping grounds.

source of pollution in rivers

Pollutants may be divided into two types: point and non-point, depending on their source.

- Point Source: usually a pipe that discharges effluents into a receiving water body.
  e.g. waste water discharges from industrial plants, municipal sewage treatment plants, urban storm sewer discharges, thermal discharges from power plants, animal feeding operations, boat wastes

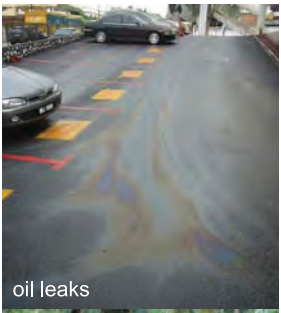
- Non-Point Source: generated by human activities all over a watershed. Surface runoff carries them over into streams, rivers, lakes, and wetlands.
  e.g. sediment, nutrients and faecal bacteria.

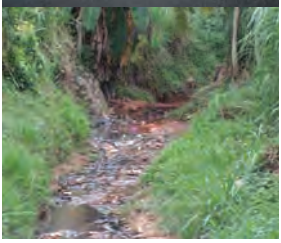
Point source pollution is easy to detect, but non-point sources come from a number of sources. Controlling non-point sources is much more complex problem because it could come from anywhere. Our individual habits and actions contribute to the non-point pollution in urban runoff. Our lawns, gardens and golf courses contribute nutrients, sediment, and pesticides; pet waste and septic tanks contribute nutrients and faecal bacteria; vehicles contribute petroleum, metals and other toxic residues; and various cleaning solvents, paints, and other household toxic substances. Not to mention that whatever rubbish that is carelessly thrown on the ground or in our drains also end up in our rivers.

three main contributors:

residential (homes/people)

- People are sometimes careless and throw rubbish such as bottles, plastic bags, cigarette butts and anything else directly into rivers.
- Sewage generated by houses or runoff from septic tanks into nearby waterways.
- Fertilizers, herbicides and pesticides used in gardens can runoff and contaminate the waterway.
- Improper disposal of hazardous chemicals down the drain introduce toxic materials into the ecosystem, contaminating the water supplies in a way that can harm aquatic organisms.
- Oil leaks from a car on a driveway can be washed off by the rain into nearby waterways.
- Restaurants use drains as their disposal unit and throw all their waste foods into the drain and let the water from their dishwashing flow straight into the drain. This ends up in the river.


oil leaks




pollution from people


it goes into our drains..


and finally into our rivers...


pollution from squatters


pollution from residential areas

business (industry/factories)

- Clearing of land can lead to erosion of soil into the river.
- Waste and sewage or dirty water containing chemicals generated by industry can get into water bodies, introducing large organic and chemical pollutants into the ecosystem.
- Many industrial and power plants use rivers, streams and lakes to dispose of waste heat or to power machinery or to cool down machinery. Changing the temperature of the water in the river has called thermal pollution and has disastrous effects on the living things in the river.
- Water can become contaminated with toxic or radioactive materials from industry, mine sites and abandoned hazardous waste sites.
- Acid rain is caused when the burning of fossil fuels emits sulfur dioxide into the atmosphere. The sulfur dioxide reacts with the water in the atmosphere, creating rainfall which contains sulfuric acid.


the dairy industry...


abandoned construction sites...


waste chemicals

agriculture (farming)

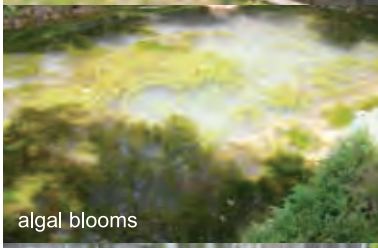
- Farmers put fertilizers and pesticides on their crops so that their crops grow better. But these fertilizers and pesticides can be washed through the soil by rain and end up in rivers.
- Allowing livestock to graze near water sources often results in organic waste products being washed into the waterways.
- Exposed soil from agricultural fields can get washed into rivers.

effects and impacts of river pollution

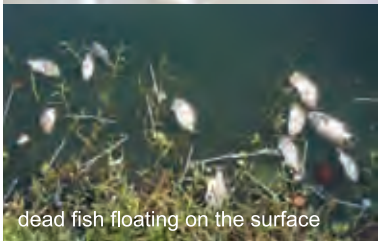
river

- smelly rivers from rotting rubbish and raw sewage
- unsightly rivers filled with rubbish
- becomes susceptible to algal blooms
- loses its natural functions and beauty


should rivers be allowed to look like this?


algal blooms


raw sewage leaking into a river


dead fish floating on the surface

water

- water supply becomes polluted
- interrupted water supply and shortages due to water treatment shutdowns caused by pollution
- water quality is reduced
- decline in the amount of freshwater available for consumption

biodiversity

- kills plants and animals living around and within the river
- loss of species diversity
- invasion of alien, tolerant species that will dominate over local species

human

- polluted river water is sometimes still used for irrigation. Therefore, the food that we eat could have been grown with polluted water. How safe do you think that is?
- quality of life is reduced due to increased health problems from unsuitable water, unhealthy surroundings, and problems caused by floods and poor management of rivers
- rivers become carriers of diseases which will directly and/or indirectly affect us
- toxic contaminants like heavy metals, organic compounds, nitrates and micro-organisms from rubbish and industrial pollution can cause acute or chronic toxicity in humans. This means we could die within 48 hours after exposure or it could cause a long term illness that cannot be detected until fatal symptoms arise

solutions?

There are many sources of pollution. But one thing remains a constant. US humans.

WE are behind all sources of pollution. We run factories that discharge waste into rivers, we throw things on the ground, we disregard the laws - WE are the cause of everything that has happened to the environment.

> "Whatever problems we are facing now or in the future is not caused by what we are doing now or what we are going to do, but what we have failed to do."

So please make sure you do your part today!

Think GLOBALLY

ACT locally

WE can make the difference!


restoring the river channel


planting wetland vegetation to stabilise the banks


clearing up the surrounding area

The bottom line is . . .

pollution affects every living thing


creating a riffle area

if the problem is human

then **the solution**

is human too!

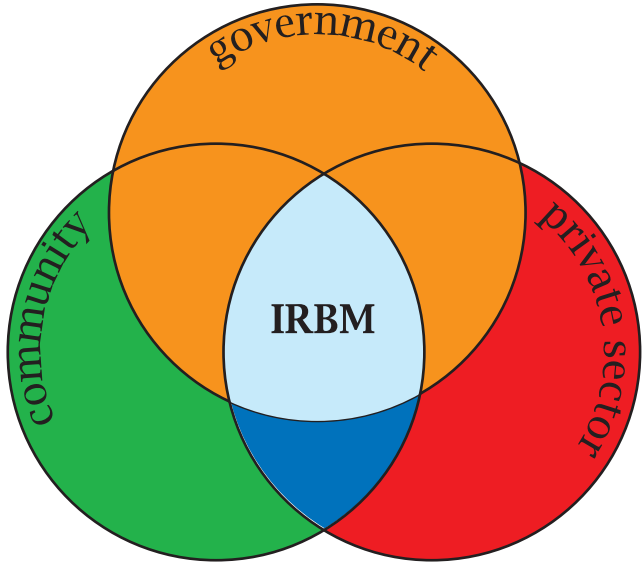
integrated river basin management

IRBM is a comprehensive and holistic method for managing our rivers. Some of the concepts include:

- looking at the management of not just the river, but the entire river basin. This includes all the land and activities within the basin boundaries.
- involving ALL stakeholders in river management. This includes private sector companies and the general public to share their views and opinions on projects and to voice their concerns.
- communication between stakeholders upstream and downstream of the river basin so that there is no conflict in planning and water resources.
- having clear guidelines and frameworks for the management of water resources at the federal, state, local and community levels.
- having a task force consisting of various experts in different fields including water supply, drainage, environmental protection, river management and engineering so that river management problems can be tackled in the best possible way.

A major cause of the state of rivers in Malaysia today is that the river basins are currently managed in a fragmented way and the management and enforcement powers are vested in the hands of numerous agencies, and there is no 'one' owner. Upstream and downstream concerns are not integrated and this has led to haphazard land use planning as well as irresponsible water resource management. IRBM is a method which should be implemented in government policies and laws and practised by government agencies. Thus far, some states have established a real 'owner' for their rivers such as LUAS, who are the guardians for rivers in Selangor.

The government cannot solve river management problems on its own. It is essential to gain private sector and community participation. Only then can any difference be seen.



river health check form

This form allows you to record your physical, chemical and biological observations of the site and its environment. It is important to keep good notes on each site, recording the location, date and details on anything special that might vary from visit to visit.

You can then compare different rivers or different sites along the same river. This is important so you can compare your scores if you visit the site over time.

Summarise your results and send us a simple report on the health of your river every 3 months.

address	Global Environment Centre 2nd Floor, Wisma Hing, No. 78 Jalan SS2/72 47300 Petaling Jaya, Selangor D.E., Malaysia.
phone	+603 7957 2007
fax	+603 7957 7003
email	kalithasan@genet.po.my

Site Description

Name of waterway / site :

Date :

Time :

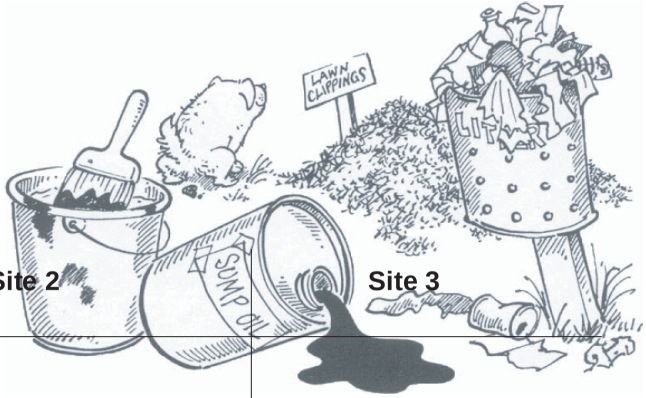
Weather :

Has it rained in the past 24 hours?
(if yes, was it heavy?)

Global Environment Centre

Name :
Contact details :
School / organisation :
Crew size :

physical monitoring



Please draw your local area map first (see back cover)

Now, look around you and describe what you see according to the different attributes.

Attribute	Site 1	Site 2	Site 3
Colour & Appearance			
Smell			
Vegetation			
Animals			
Activities *(land use, human activities, points of interest e.g. construction, industry, drain feeding river)*			

chemical monitoring

Record your results from the water quality tests here.

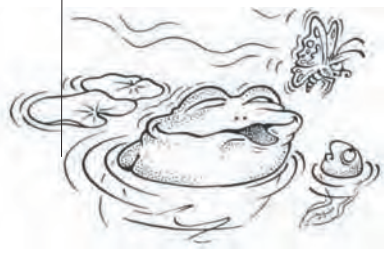
Variable	Site 1	Site 2	Site 3
pH			
DO			
Turbidity			
Phosphate			
Nitrate			
Temperature			
Ammonia			

biological monitoring

Global Environment Centre

Identify the organisms you have found using the biomonitoring cards and list them down here.

	Species	Indicator	Water Quality
Site 1			
Site 2			
Site 3			



river auditing

ecology studies

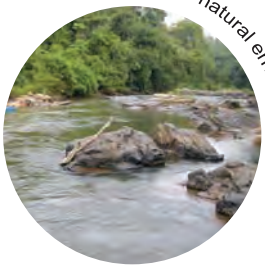
The first thing is to study the ecology of your river basin. Are there many trees left along the riverbanks? Are there living things in the rivers? Rivers support living organisms, and it also depends on them for certain functions. If rivers are polluted, they are unable to support life, and our water quality will be affected too.

water quality

There are 3 methods that are most commonly used to check the condition of the river water - visual observations, chemical monitoring and biological monitoring.

visual observations

The physical characteristics of a stream can give clues to the health of the stream. Healthy streams have lush riparian buffers, clear water and plenty of wildlife. Some of the physical characteristics of water quality are: water clarity, water colour, smell/odour, general land use, description of the stream origin & type, riparian vegetation (algae, wetlands), aquatic life (fish, prawns), and measurements of in-stream parameters such as width, depth, flow & substrate, drains, erosion and garbage.



chemical monitoring

Chemical monitoring and testing is one of the most accurate and reliable testing methods. Chemical testing is used to analyze drinking water. It is extremely useful for determining sources of pollution, as well as determining specific pollutants. For example, high concentrations of nitrogen and phosphorus may indicate fertilizer runoff from a nearby farm.

biological monitoring of rivers and streams

Biological monitoring of river and stream life provides remarkable insight into the functional quality of the environment studied. It can reveal important changes in the composition of biological communities caused by human activities. It asks the question: "Is this aquatic community showing evidence of harm?" The approach relies on the great diversity of benthic macroinvertebrate life in rivers and streams to determine how suitable a waterbody is for the support of aquatic life.

water quantity

Good hydrology is also important for the health of our rivers and quality of our water. This includes aspects such as depth, width, velocity and volume of water (discharge). There should be different varieties of all these in a river to maintain its natural flow.

velocity

The velocity of a river is the speed at which water flows along it (distance/time). The velocity will change along the course of any river, and is determined by factors such as the gradient (how steeply the river is losing height), the volume of water, the shape of the river channel and the amount of friction created by the bed, rocks and plants.

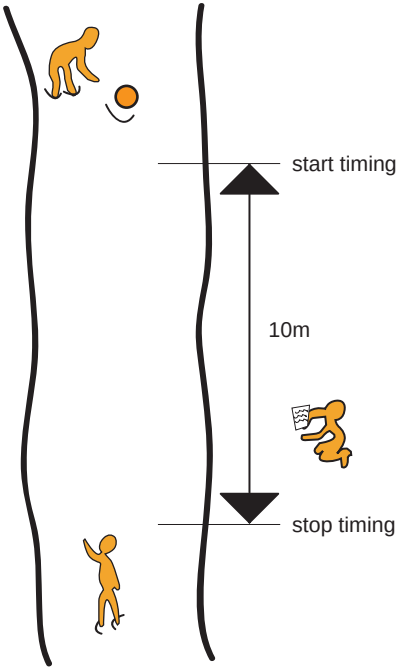
measuring velocity

It's very easy to measure the velocity of the water in an area. First, find a good stretch of the river and make sure the river is shallow and safe enough to walk into. You will need 2 people to do this - one upstream with the orange and one downstream to catch the orange. The third person on land has to measure out a distance of 10m (this can change according to what you want to measure) and take note of the time it takes for the orange to flow over the 10m.

Equipment:
- Orange/ping pong ball
- stop watch
- measuring tape
- 3 people

Tips:

- place the orange in the middle of the water flow to gain the most accurate readings as water flow near the banks is usually slower.
- do this test at least 3 times to get an average reading.



calculating velocity

e.g. Let's assume that we measured the float four times over a distance of 10m. Our results were:

First time	36 seconds
Second time	28 seconds
Third time	34 seconds
Fourth time	30 seconds

Since we want to find the average velocity we also need the average time. Therefore:

$$\text{average time} = \frac{36 + 28 + 34 + 30}{4} = 32$$

$$\textbf{average velocity} = \frac{\textbf{distance}}{\textbf{average time}}$$

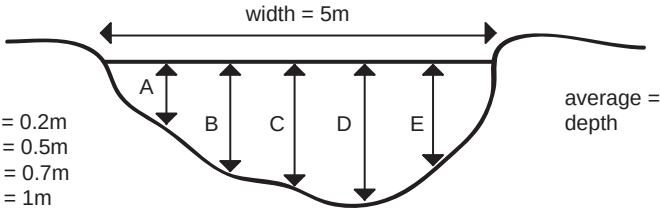
$$= \frac{10}{32} = \textbf{0.3125m/sec}$$

The surface velocity is found to be 0.3125 metres per second.

discharge

Discharge = amount of water flowing past a point in a given unit of time

Discharge (m3/sec) = Cross-sectional Area (width x average depth) (m2) x Average Velocity (m/sec)



average depth = $\frac{A+B+C+D+E}{5}$

e.g. A = 0.2m
B = 0.5m
C = 0.7m
D = 1m
E = 0.6m

average depth = $\frac{0.2 + 0.5 + 0.7 + 1 + 0.6}{5}$

= 0.6m

discharge = (5 x 0.6) x (0.3125)

= 0.9375m3/sec

The river's discharge at that location depends on the rainfall on the catchment or drainage area and the inflow or outflow of groundwater to or from the area, stream modifications such as dams and irrigation diversions, as well as evaporation and evapotranspiration from the area's land and plant surfaces. The discharge of a river is useful to find out if there is enough water for a business or industry. It can also help you to predict flood extent downstream using data on flood waters upstream from you

river mapping

Rivers, streams, and lakes are more than just parts of the environment - they are living entities that provide homes for wildlife and sustain life in this world. In Malaysia, they also happen to provide 97% of our water supply, and are used as places of recreation and enjoyment.

There must be a balance when we are using such fragile ecosystems for other purposes, as minor disturbances may cause problems within the system and may be detrimental to the environment. This is because each river does not work alone. They are all part of a bigger network called a river basin. All water will eventually flow into the waterways contained in this river basin area. Therefore, anything that happens within the basin will affect the rest of the basin because they are all connected.

The purpose of River Mapping is to encourage you to:

- Learn about your local environment
- Develop skills in investigating the local environment
- Acquire a concern for the environment

Through the investigations in River Mapping, RIVER Rangers will collect information which may identify a problem or issue in their local area. For example, after identifying that a local stream is heavily littered, RIVER Rangers will need to ask a number of questions, such as:

- Where did the litter come from?
- What can be done about this?
- Who should i inform?

Structure of River Mapping

River Mapping makes use of your natural senses, such as sight and smell to identify the physical attributes of the river and its surroundings. The first step is to map out your local area and the location of the river within this area (use back page). Once you have done this, you can add in all the different types of land use you see in the area and activities that may affect the river.

Next, you should go to the river itself, and record its appearance. What colour is the water? Is there any oily sheen on its surface? Think about what could be causing this and refer to the table on the last page for help. Other things you should note is the type of vegetation found near the river, and how much there is, as well as whether there is any smell coming from the river.

Through the River Mapping programme, RIVER Rangers will learn how the action they take in their home, school or street can impact on their wider environment. By testing the quality of water in their local area, RIVER Rangers will be encouraged to investigate their environment and actively participate in improving the quality of their environment. The River Mapping activities will also encourage an interest in other environmental issues. These may include:

- The interaction between natural and developed environments
- Waste disposal and recycling
- Sustainable resource management

polluter monitoring

Acts of pollution are happening everywhere. One of the reasons why this is happening is because there is a lack of enforcement, and there just isn't anyone there at that point in time who will tell them otherwise. As a citizen, you have the right to report any acts of pollution. It is not only your right, but your DUTY as well. We need people on the ground (you) to help us catch the culprits because it is impossible for authorities to monitor every single household or factory. So here are some steps that will help you monitor any illegal pollution from people or industries and report such acts. Note: Please be careful and try to be discreet. Ensure your safety first.

1. Take note of the registration number of the vehicle or which company it is from.
2. Take note of the day, date, time and site where the act occurred.
3. If you have a camera or camera phone with you, take as many pictures as you can of the act happening, or the effects.
4. Make a description of the site, and describe the impacts of the pollution and any other information that would be useful to the authorities.
5. Report everything you have seen to the DID, DOE, local government, Indah Water Konsortium, Alam Flora/Southern Waste Management/Northern Waste Management, local NGOs (e.g. GEC) and local politicians.

Map your river inlets and outlets

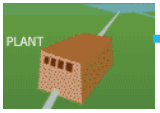
River auditing is like being a private investigator or policeman. You have to find out where all the water in the river is coming from and where it's going to and where the pollution is coming from. To do this, you have to take a tour of the river and locate and record all the inlets and outlets of the river.

My River Basin Map

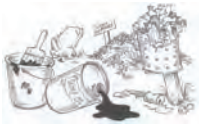
rainwater

drains

irrigation



water treatment plant



people

residential homes

industries

drains

sewage treatment plant

longhouse/squatters

sea

survey design & safety

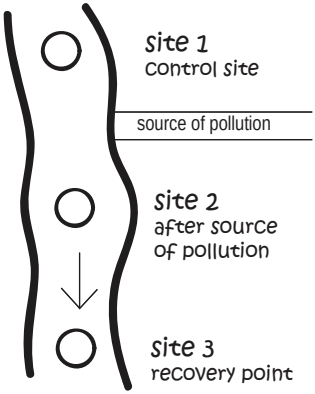
Carry out a survey like a real scientist! A good scientist should make a plan for monitoring, so read on to find out how to be a good scientist!

survey design

1. If you suspect pollution entering the river from a point source, then you should have 3 sampling sites (see diagram).

2. If you are interested in how your river changes from the headwaters to the mouth, sampling sites should be dispersed along the length of your river so that changes in water quality can be noted.

3. If you are interested in a local water quality monitoring programme, sampling sites should cover areas before, within and immediately after your subcatchment area.



rule of thumb

It is best to sample midway across the river and below the surface. It is best if you can sample in the main current, as long as it is safe to do so.

where to sample

Before you begin your survey, you need to find a suitable area along the river to do this. Just make sure it is safe and that you are allowed to enter the area. Find out if you need a permit as you do not want to be trespassing. Also be wary of wildlife habitats, nearby land uses which may be releasing toxic chemicals and avoid deep water or fast currents.

It is important to exercise care in the way samples are collected for analysis. A collected sample should be representative of the river reach being tested. Analytical values derived from river samples may vary with depth, velocity of current and the distance the sample was taken from source/shore. Samples taken are called grab samples, which are single samples representative of the river at a particular time and place.

safety precautions

Ensure that students and others understand from the beginning the danger of treating chemicals casually or endangering others during "horseplay."

Wear safety goggles, particularly when running water quality tests that require shaking or swirling a chemical mixture.

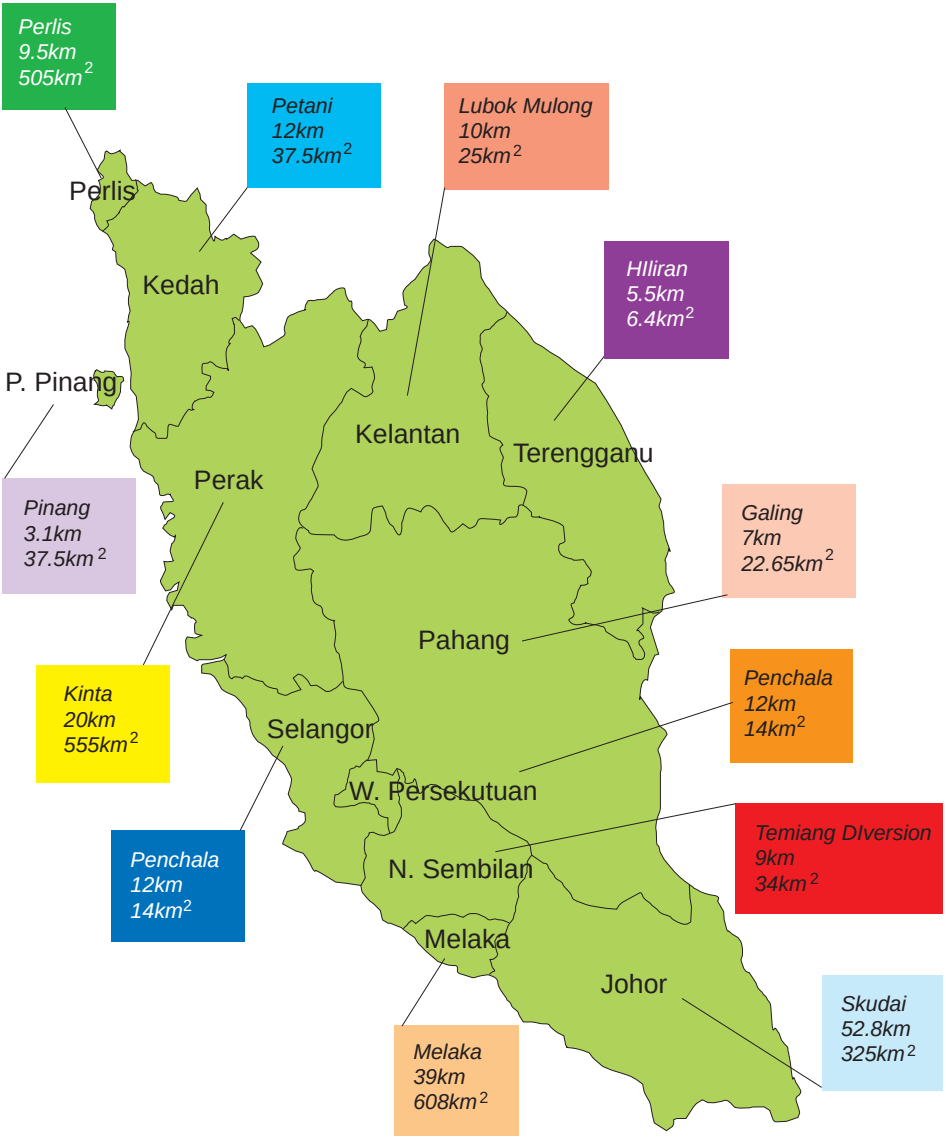
Wash your hands after conducting water monitoring. Avoid placing hands in contact with eyes or mouth during monitoring.

Dispose of spent chemicals in an environmentally sound manner; hazardous waste should be deposited in accordance with the hazardous waste guidelines.


briefing

one state, one river

The One State, One River (1S1R) Program was launched in 2005 and is aimed at helping the State DID organize a river restoration and water quality improvement program for one river in their state, with full stakeholder participation. The idea is to involve everyone in the management of just one river in each state and pool all resources into the rehabilitation and protection of that river.



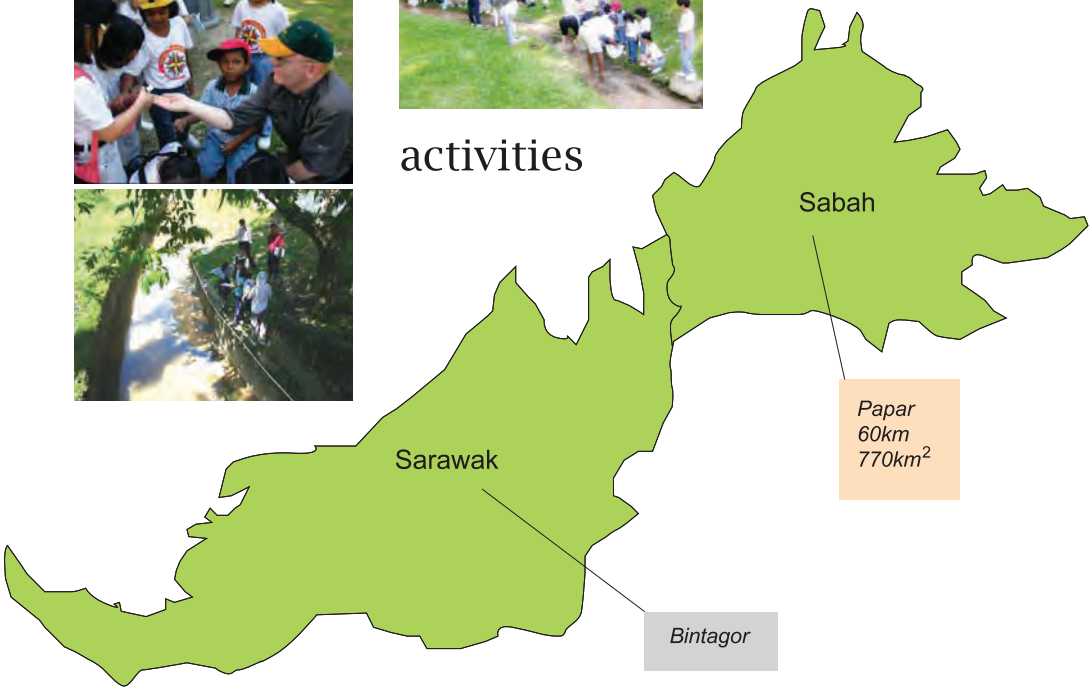
community participation component

One of the key factors that have led to the detrimental state of our rivers is the lack of community participation in river management. By raising the level of awareness and understanding on the issues and problems faced by rivers, the government can stimulate the community to change their behaviour and habits which negatively impact river systems, and help them to develop trust and ownership toward the development and planning of project activities and solutions regarding rivers.

Through the community participation component, the government can run on-ground activities and workshops for the public and involve them in decision-making processes for their river basin.

education & awareness

activities



map the land use

Global Environment Centre

Draw your local area map here and record the land use on your map. A 'key' would be useful to identify the different types of land use and other points of interest.