



PENGGUNAAN KUALITI AIR SUNGAI SARAWAK



1.0 INTRODUCTION TO THE NREB

Natural Resources and Environment Board (NREB)
was formed on 1st February, 1994
Under Section 3(1) of Natural Resources and
Environment Ordinance
Chapter 84-Laws of Sarawak (1958 Edition)



VISION

A GREEN , CLEAN AND HEALTHY SARAWAK



MISSION

LEAD AGENCY TO ADVOCATE ENVIRONMENTAL
STEWARDSHIP AND SUSTAINABILITY



RIVER : ITS FUNCTIONS



- A healthy river is one where its ecological and natural processes are
 - maintained & unpolluted,
 - have good and intact riparian vegetation along the river bank and
 - are capable of supporting the aquatic life

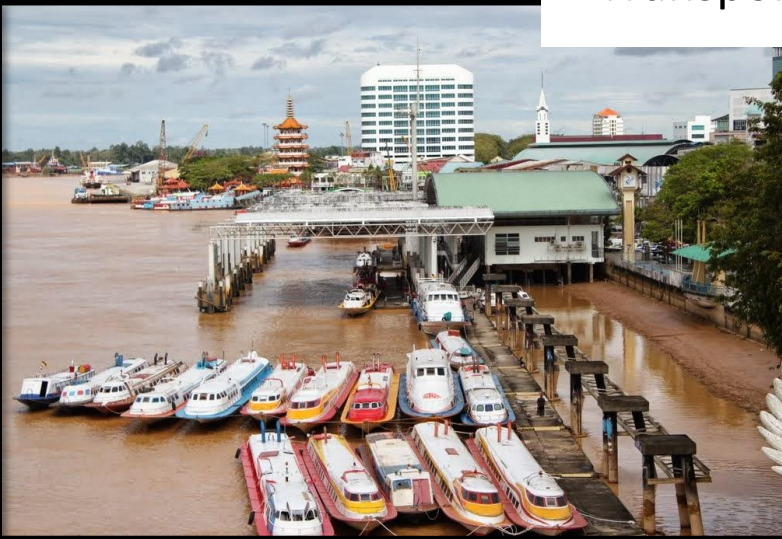
3. RIVER : ITS FUNCTIONS



Water supply



Transportation



IRRIGATION



Source of food

Recreation and tourism



2.0 RIVER WATER QUALITY MONITORING PROGRAMME

River Water Quality Monitoring Programme was established in 1999

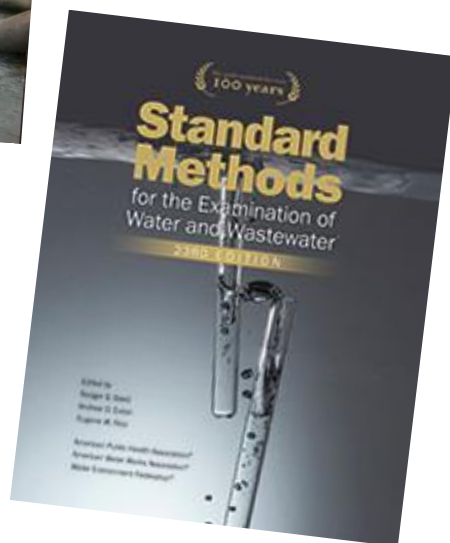
This programme provides information regarding the status and trends of water bodies in the State

In year 2023, NREB monitor

- ❖ **66** rivers and tributaries;
- ❖ **3** lakes - Tasik Biru and Tasik Bidi in Bau, and Loagan Bunut in Miri
- ❖ **6** dams - Batang Ai Dam, Bakun Dam, Murum Dam, Kelalong Dam, Gerugu Dam, & Bengoh Dam



RIVER WATER QUALITY MONITORING PROGRAMME



Involves **in-situ measurement** and **collection of water samples**.

The monitoring and sampling procedures are in accordance with:

- ❖ Standards Method for the Examination of Water and Wastewater (Part 1060 ABC) prepared and published jointly by American Public Health Association, American Water Works Association and the Water Environment Federation; and
- ❖ Department of Chemistry requirement (*Garis Panduan Penghantaran Sampel Jabatan Kimia Malaysia*)

Determination of water quality is based on:

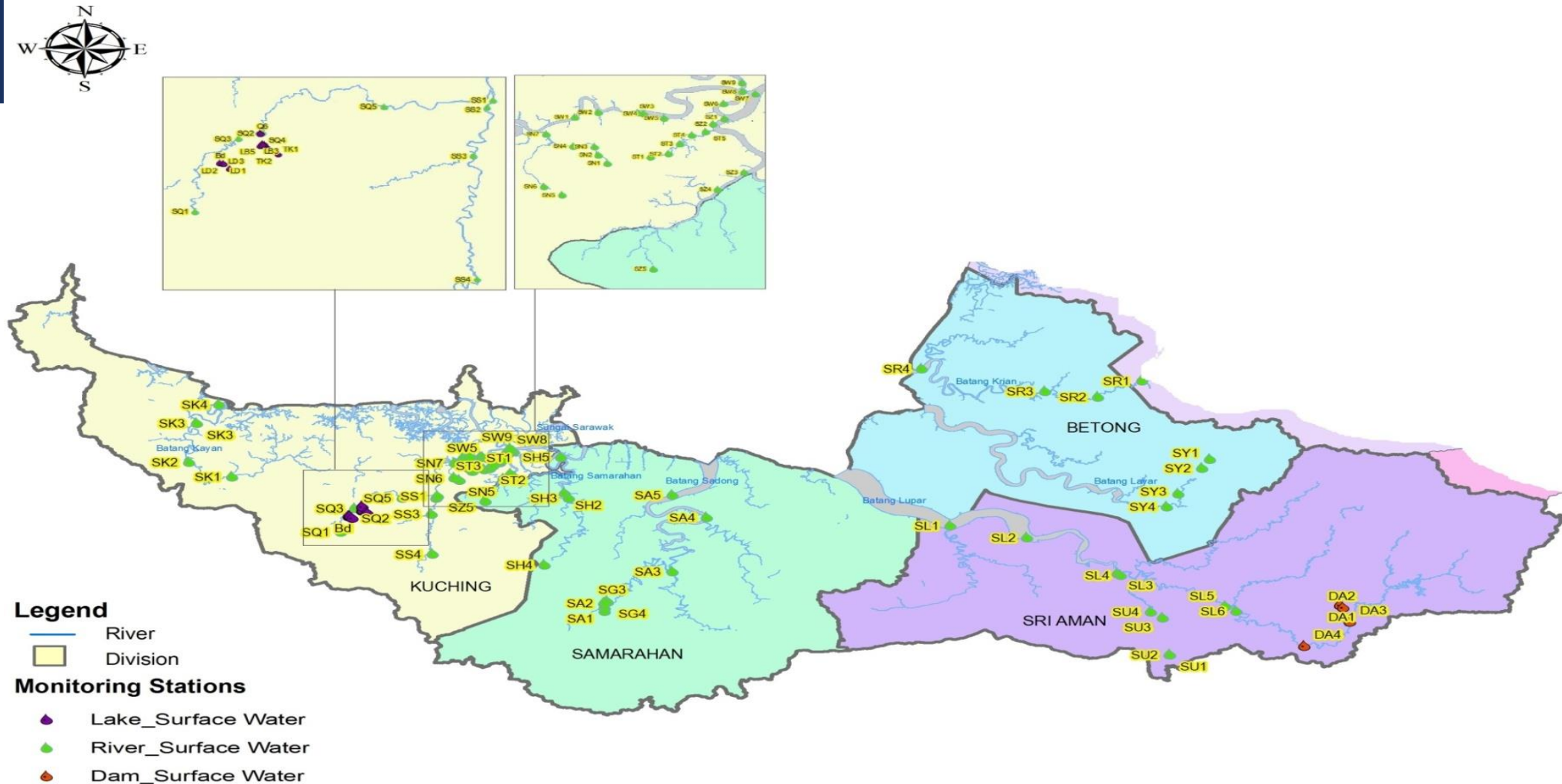
- Physical properties
 - *Turbidity and temperature*
- Biological properties
 - *Harmful bacteria (faecal coliforms)*
- Chemical properties
 - *pH, DO, BOD, COD, cond., nitrate, phosphate, pesticides, metals, and ammoniacal nitrogen*



Parameters analysed at site using in-situ equipment	Parameters analysed by the laboratory
<ul style="list-style-type: none">• pH• Dissolved Oxygen (DO)• Salinity• Conductivity• Temperature• Turbidity	<ul style="list-style-type: none">• Biochemical Oxygen Demand (BOD₅)• Chemical Oxygen Demand (COD)• Total Suspended Solid (TSS)• TCC & FCC• Heavy Metals• Oil & Grease

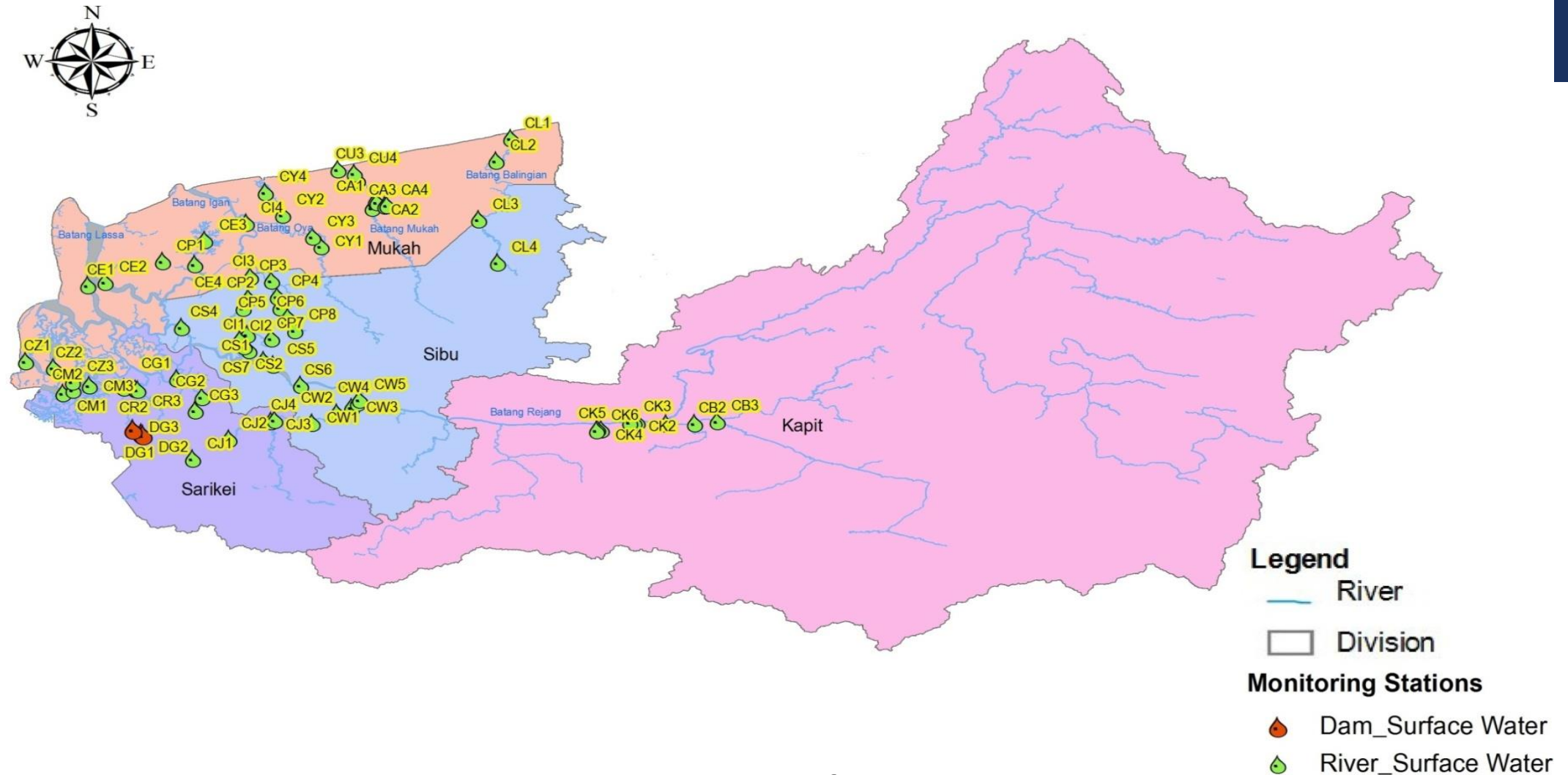


SAMPLING LOCATIONS MONITORED BY NREB UNDER THE RWQMP



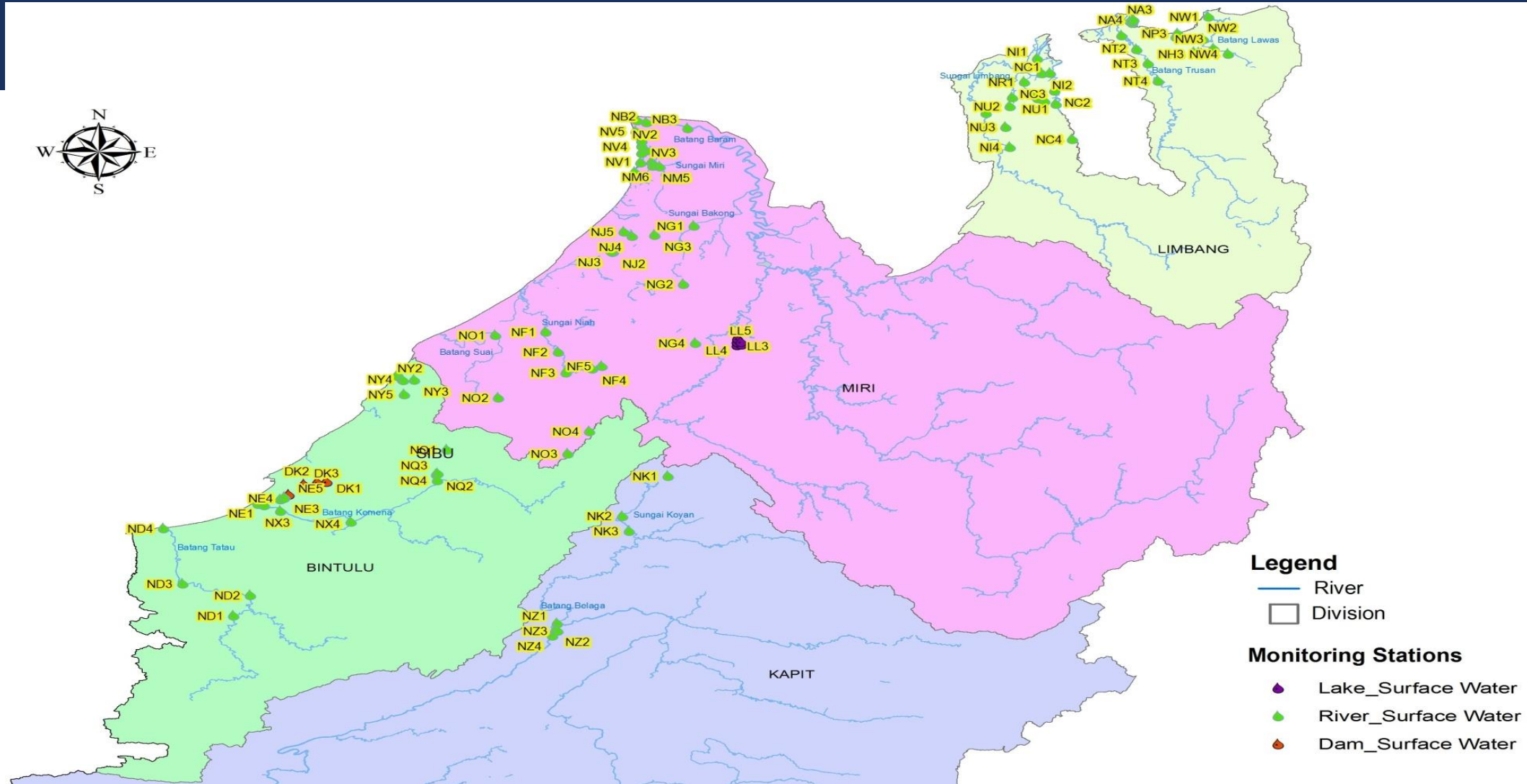
Southern Region of Sarawak

SAMPLING LOCATIONS MONITORED BY NREB UNDER THE RWQMP



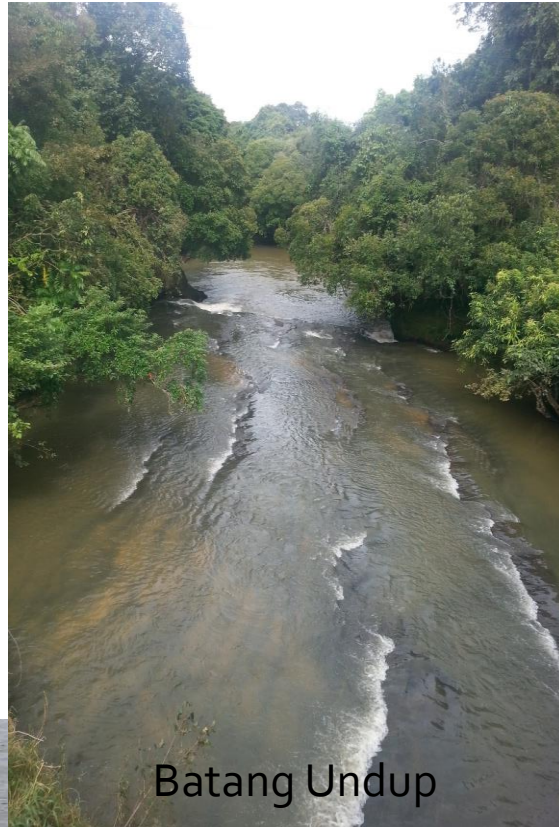
Central Region of Sarawak

SAMPLING LOCATIONS MONITORED BY NREB UNDER THE RWQMP



Northern Region of Sarawak

Rivers that are monitored by the NREB



3.0 WATER QUALITY STANDARDS

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graph TD; A[3.0 WATER QUALITY STANDARDS] --> B[Water Quality Index (WQI)]; A --> C[National Water Quality Standards for Malaysia (NWQSM)];
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Water Quality Index (WQI)

National Water Quality Standards for Malaysia (NWQSM)

- Single number that expresses the 'overall' grade of water quality based on six (6) water quality parameters: pH, DO, BOD, COD, ammoniacal nitrogen & TSS
- Parameters such as heavy metals, nutrients and coliform counts are also included to further determine the degree of pollution

Water Quality Index (WQI)

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 - 0.3	0.3 - 0.9	0.9 - 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 - 3	3 - 6	6 - 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 - 25	25 - 50	50 - 100	> 100
Dissolved Oxygen	mg/l	> 7	5 - 7	3 - 5	1 - 3	< 1
pH	-	> 7.0	6.0 - 7.0	5.0 - 6.0	< 5.0	> 5.0
Total Suspended Solid	mg/l	< 25	25 - 50	50 - 150	150 - 300	> 300
Water quality Index		> 92.7	76.5 - 92.7	51.9 - 76.5	31.0 - 51.9	< 31.0

SUB INDEX & WATER QUALITY INDEX	INDEX RANGE		
	CLEAN	SLIGHTLY POLLUTED	POLLUTED
Biochemical Oxygen Demand	91-100	80-90	0-79
Ammoniacal Nitrogen	92-100	71-91	0-70
Suspended Solids	76-100	70-75	0-69
Water Quality Index (WQI)	81-100	60-80	0-59

The formula for determining the WQI:

$$WQI = (0.22 \times SI_{DO}) + (0.19 \times SI_{BOD}) + (0.16 \times SI_{COD}) + (0.15 \times SI_{AN}) + (0.16 \times SI_{TSS}) + (0.12 \times SI_{pH})$$

DOE- Water Quality Index

Best-fit equations

Subindex for DO (in % saturation): *SIDO*

$$\begin{aligned} \text{SIDO} &= 0 && \text{for } x \leq 8 \% \\ &= 100 && \text{for } x \geq 92 \% \\ &= -0.395 = 0.030x^2 - 0.00020x^3 && \text{for } 8 \% < x < 92 \% \end{aligned}$$

Subindex for BOD : *SIBOD*

$$\begin{aligned} \text{SIBOD} &= 100.4 - 4.23x && \text{for } x \leq 5 \\ &= 108e^{-0.055x} - 0.1x && \text{for } x > 5 \end{aligned}$$

Subindex for COD : *SICOD*

$$\begin{aligned} \text{SICOD} &= -1.33x + 99.1 && \text{for } x \leq 20 \\ &= 103e^{-0.0157x} - 0.04x && \text{for } x > 20 \end{aligned}$$

Subindex for AN : *SIAN*

$$\begin{aligned} \text{SIAN} &= 100.5 - 105x && \text{for } x \leq 0.3 \\ &= 94e^{-0.573x} - 5|x-2| && \text{for } 0.3 < x < 4 \end{aligned}$$

Subindex for SS : *SISS*

$$\begin{aligned} \text{SISS} &= 97.5e^{-0.00676x} + 0.05x && \text{for } x \leq 100 \\ &= 71e^{-0.0016x} - 0.015x && \text{for } 100 < x < 1000 \\ &= 0 && \text{for } x \geq 1000 \end{aligned}$$

Subindex for pH: *SlpH*

$$\begin{aligned} &= 17.2 - 17.2x + 5.02x^2 && \text{for } x < 5.5 \\ &= -242 + 95.5x - 6.67x^2 && \text{for } 5.5 \leq x < 7 \\ &= -181 + 82.4x - 6.05x^2 && \text{for } 7 \leq x < 8.75 \\ &= 536 - 77.0x + 2.76x^2 && \text{for } x \geq 8.75 \end{aligned}$$

WQI formula

$$\begin{aligned} \text{WQI} &= 0.22(\text{SIDO}) + \\ &\quad 0.19(\text{SIBOD}) + \\ &\quad 0.16(\text{SICOD}) + \\ &\quad 0.15(\text{SIAN}) + \\ &\quad 0.16(\text{SISS}) + \\ &\quad 0.12(\text{SlpH}) \end{aligned}$$

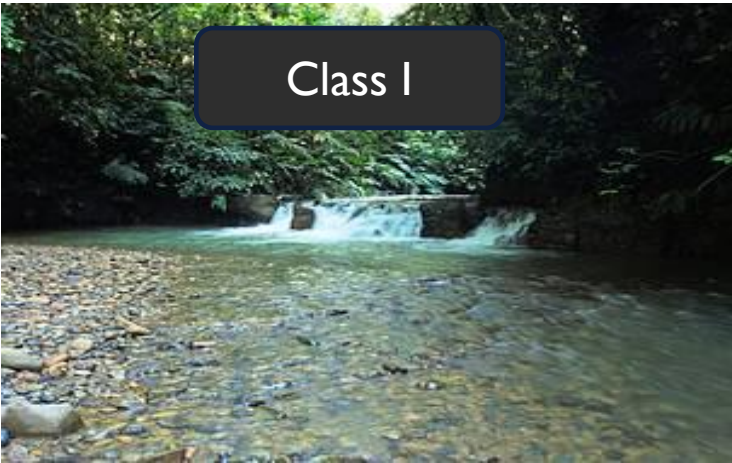
Classifications

Class	WQI range
I	>92.7
II	92.7-76.5
III	76.5-51.9
IV	51.9-31
V	< 31.0

NATIONAL WATER QUALITY STANDARD FOR MALAYSIA

- 72 parameters
- Class I to V based on beneficial uses:

Class I



Class IIA



Class IIB



Class III



Class IV



Class V



National Water Quality Standards for Malaysia (NWQSM)							
PARAMETER	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	>2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	>12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	>100
Dissolved Oxygen	mg/l	7	5-7	5-7	3-5	<3	<1
pH	mg/l	6.5-8.5	6-9	6-9	5-9	5-9	-
Colour	TCU	15	150	150	-	-	-
Electrical Conductivity*	mS/cm	1000	1000	-	-	6000	-
Floatables	-	N	N	N	-	-	-
Odour	-	N	N	N	-	-	-
Salinity	%	0.5	1	-	-	2	-
Taste	-	N	N	N	-	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Temperature	°C	-	Normal + 2°C	-	Normal + 2°C	-	-
Turbidity	NTU	5	50	50	-	-	-
Faecal Coliform**	count/100ml	10	100	400	5000 (20000) ^a	5000 (20000) ^a	-
Total Coliform	count/100ml	100	5000	5000	50000	50000	>50000

CLASS	USES
Class I	Conservation of natural environment Water supply I- Practically no treatment necessary Fishery I- Very sensitive aquatic species
Class IIA	Water supply II- Conventional treatment required Fishery II- Sensitive aquatic species
Class IIB	Recreational use with body contact
Class III	Water supply III- Extensive treatment required Fishery III – Common, of economic value and tolerant species; livestock drinking
Class IV	Irrigation
Class V	None of the above

Notes:

N : No visible floatables or debris, no objectional odour or no objectional taste

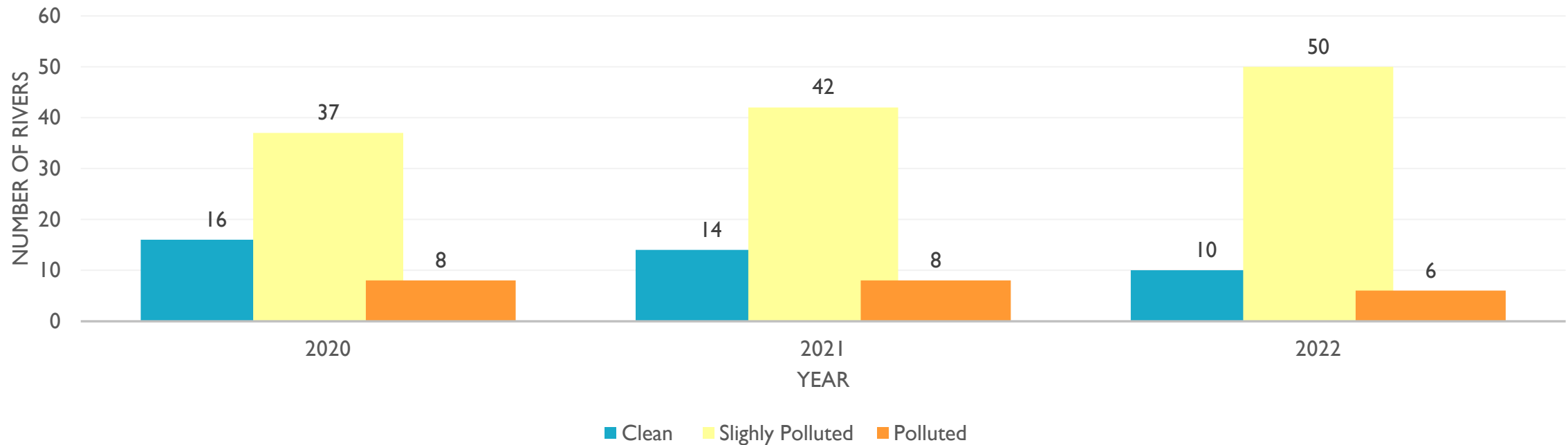
* : Related parameters, only one recommended for use

** : Geometric mean

a : Maximum not to be exceeded

4.0 STATUS OF RIVER WATER QUALITY IN SARAWAK

Ambient River Water Quality Status 2020-2022



The river water quality status in Sarawak based on WQI (2020-2022)

Source: NREB Water Quality Monitoring Programme

Note:

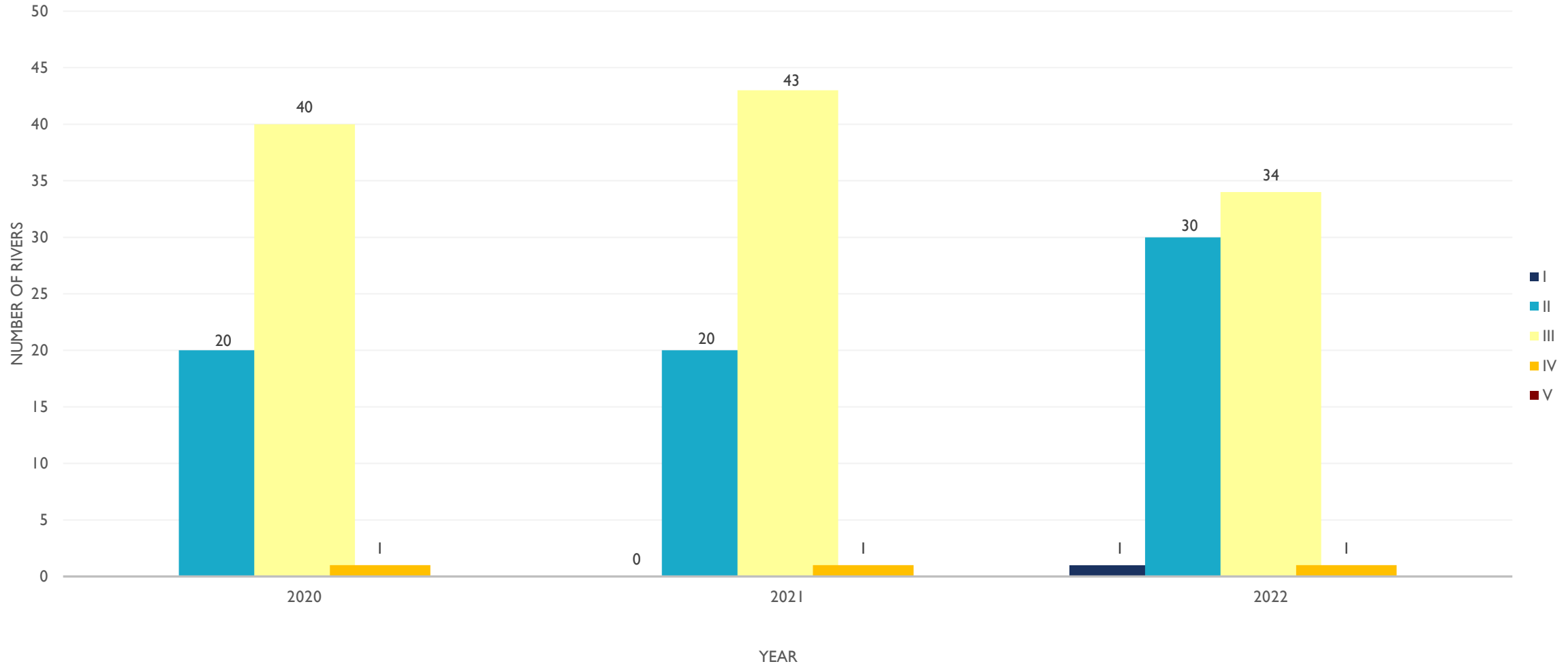
Water Quality Classification Based on Water Quality Index

Clean, WQI: 81-100

Slightly Polluted, WQI: 60-80

Polluted, WQI: 0-59

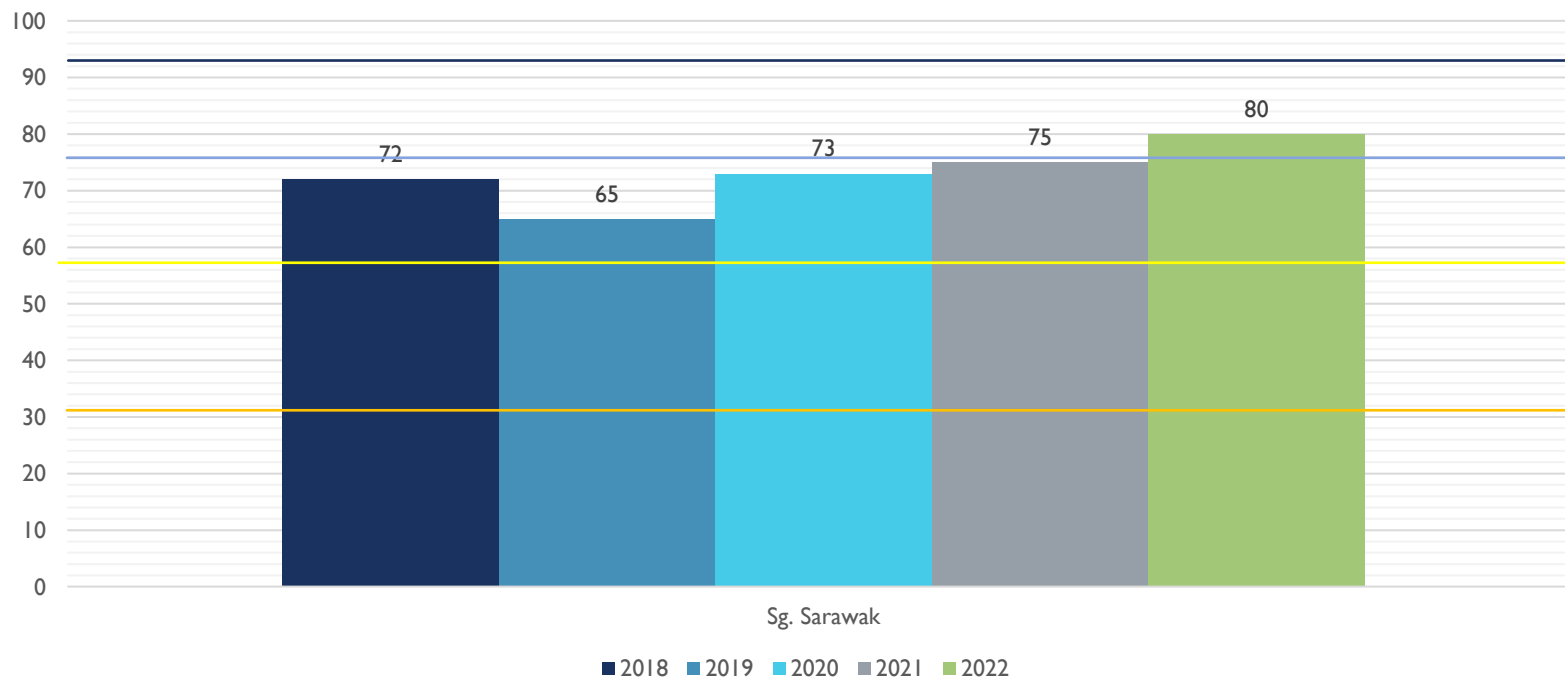
Ambient River Water Quality Based on Classes (2020-2022)



Classes based on WQI (2020-2022)
Source: NREB Water Quality Monitoring Programme

Water Quality Monitoring Results -Sg. Sarawak

Water Quality Status for Sungai Sarawak, 2018-2022



The river water quality status in Sarawak based on WQI (2018-2022)

Source: NREB Water Quality Monitoring Programme

Note:

Water Quality Classification Based on Water Quality Index

Clean, WQI: 81-100

Slightly Polluted, WQI: 60-80

Polluted, WQI: 0-59

TYPES AND SOURCES OF RIVER WATER POLLUTANT

ORGANIC MATTER

- discharges of sewage and grey water from the surrounding vicinity



BACTERIA

- overflowing septic tanks
- discharge from livestock waste, discharge of the sewage and wastewater from the vicinity of commercial buildings in cities, major towns and the settlements area



SUSPENDED SOLIDS

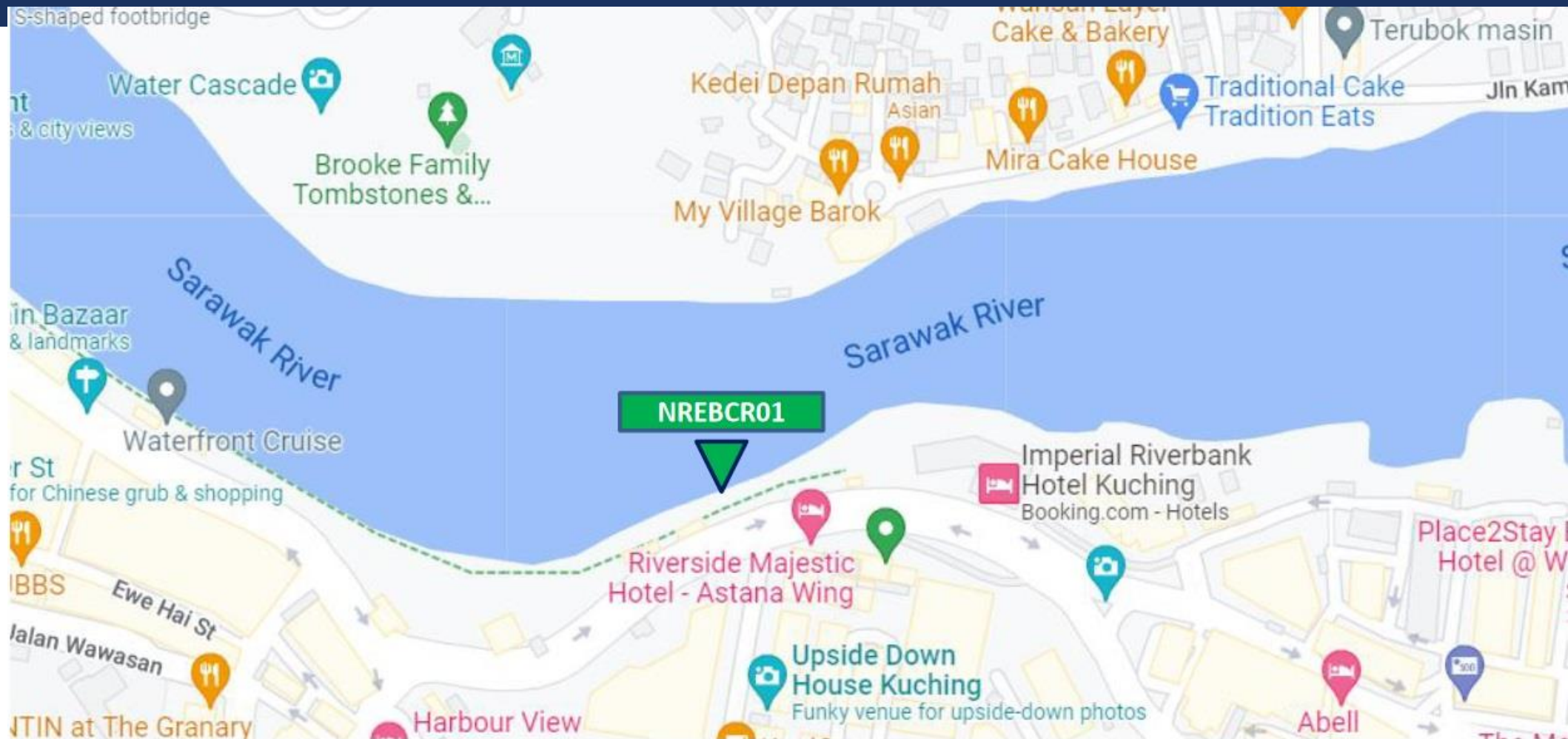
- Earthworks activities and land clearing for development activities



CONTINUOUS WATER QUALITY MONITORING STATION (CWQMS)

- One (1) unit of Continuous Water Quality Monitoring Station (CWQMS) had been installed at the Kuching Waterfront, Sg. Sarawak in 2022
- The CWQMS will provide information of the status of water quality for its beneficial use i.e. recreation activities.

LOKASI: SG. SARAWAK (KUCHING WATERFRONT)





RECOMMENDATION

1. Monitor water quality
2. Collaboration and partnership
3. Encourage water conservation
4. Implementation of centralised sewerage system for city/major towns
5. Public awareness and education programme – to instill environmental stewardship

Conclusion

- ❖ To ensure sustainable water management, rivers need to be managed in an integrated and holistic manner

