Water Quality Status of the Mekong River and Regional Collaboration for Sustainable Development in the Mekong River Basin

Dr. Pinida Leelapanang KAMPHAENGTHONG

Chief Environmental Management Officer

Mekong River Commission Secretariat

OUTLINE OF PRESENTATION

- Introduction to MRC
- Implementation of Routine Water Quality Monitoring
- Water Quality Status and Trend

01 INTRODUCTION TO MRC

1995 MEKONG AGREEMENT

"To promote and coordinate sustainable management and development of water and related resources for the countries' mutual benefit and the people's well-being".

According to the 1995 Mekong Agreement, member countries - Cambodia, Lao PDR, Thailand, and Vietnam, has agreed to:

- To cooperate in all fields of sustainable development, use, management and conservation of water and related resources of the Mekong River Basin, in a manner that optimises multiple uses and benefits of water and related resources in the Mekong River Basin including irrigation, hydropower, navigation, flood control, fisheries, timber floating, recreation and tourism (Article 1).
- To promote the sustainable development of the basin's full potential and prevent wasteful use, with an emphasis on joint and/or basin-wide development projects and programmes (Article 2).
- To protect the environment, natural resources, aquatic life and conditions, and ecological balance of the Mekong River Basin and minimise pollution and other harmful effects (Articles 3 and 7-10).
- To utilise the waters of the Mekong River system in a reasonable and equitable manner (Articles 4-6).

STRUCTURE OF THE MRC

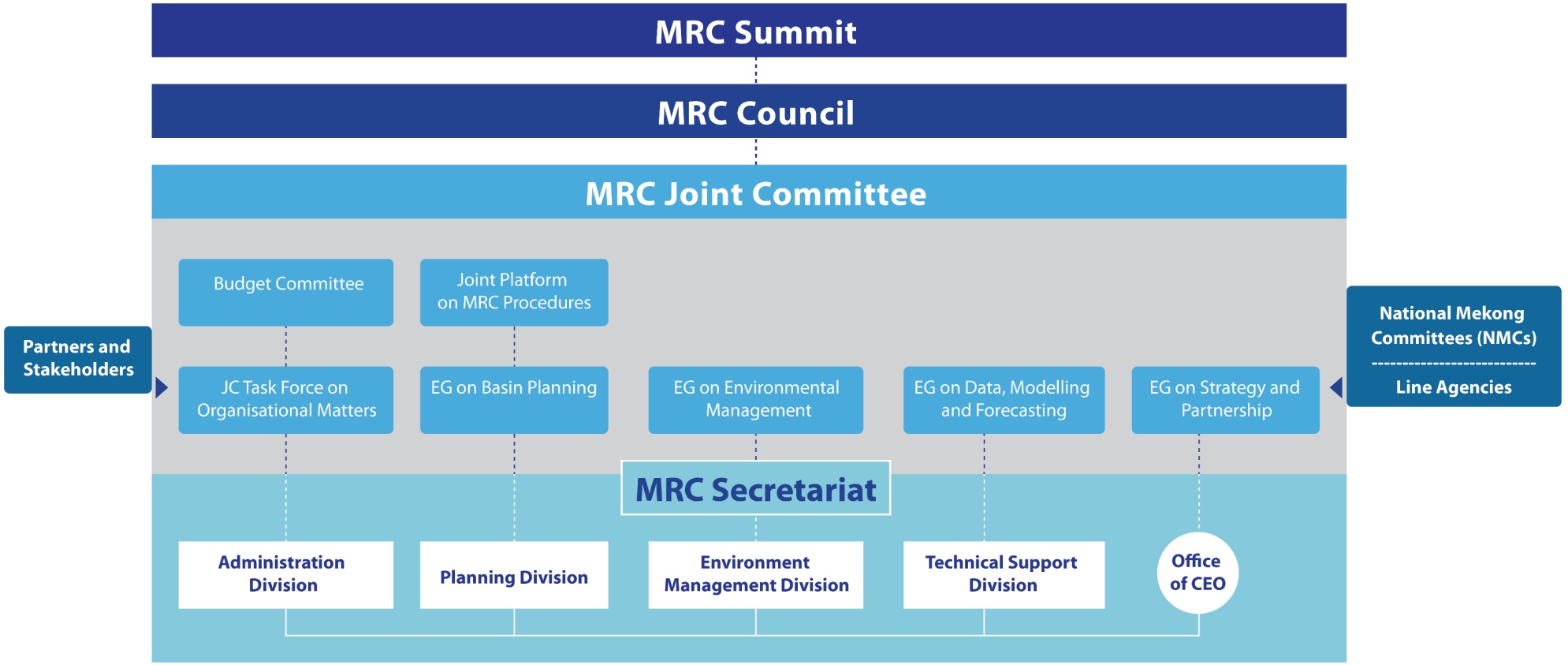
MRC Member Countries

Cambodia | Lao PDR | Thailand | Viet Nam

Dialogue Partners

China | Myanmar

Development Partners



5 MRC Procedures

PWQ
Procedures for Water Quality (2011)

PDIES
Procedures for Data and Information Exchange and Sharing (2001)

1995 Mekong Agreement

PMFM
Procedures for the Maintenance of Flows on the Mainstream (2006)

PNPCA
Procedures for Notification, Prior Consultation and Agreement (2003)

PWUM
Procedures for Water Use Monitoring (2003)

BASIN DEVELOPMENT STRATEGY 2021-2030 AND MRC STRATEGIC PLAN 2021-2025

PRIORITY 1: MAINTAIN THE ECOLOGICAL FUNCTION OF THE MEKONG

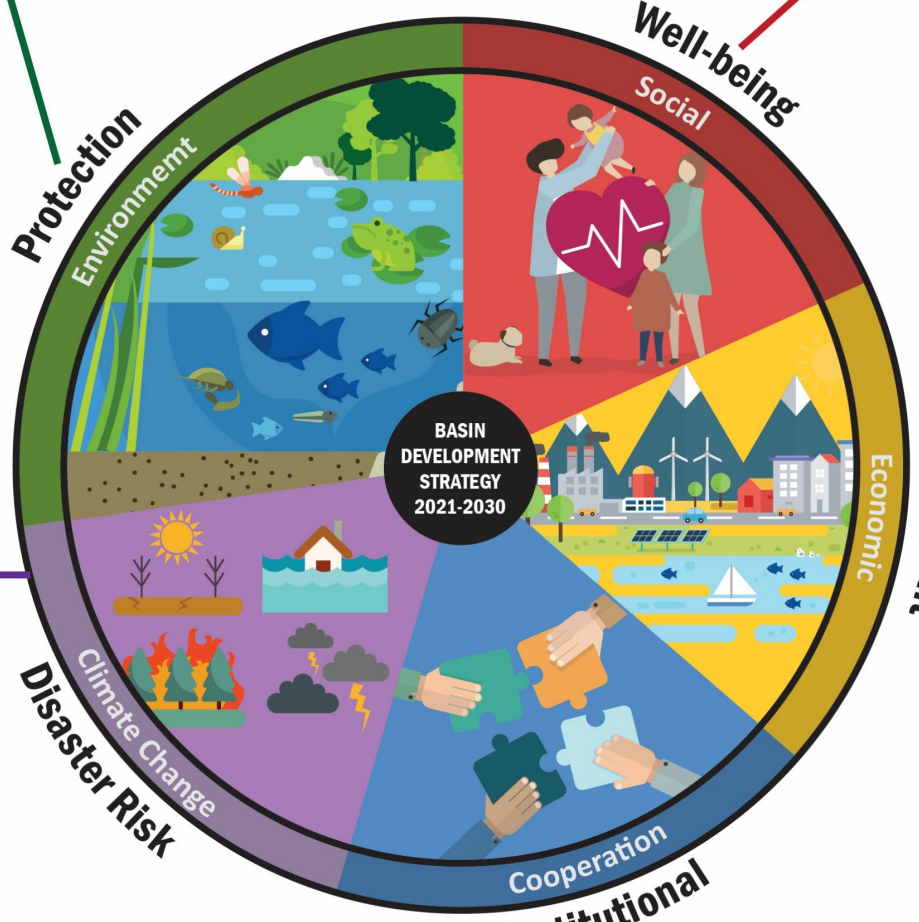
- Water flow & quality
- Sediment Transport
- Ecosystem services

PRIORITY 2: ENABLE INCLUSIVE ACCESS & UTILISATION OF WATER & RELATED RESOURCES

- Community well-being
- Poverty reduction

PRIORITY 4: STRENGTHEN RESILIENCE AGAINST CLIMATE RISKS, EXTREME FLOODS AND DROUGHTS

- Informed & prepared against flood & drought
- Disaster management & adaptation



PRIORITY 3:ENHANCE OPTIMAL AND SUSTAINABLE DEVELOPMENT

- Economic growth & benefits
- Inclusive sectoral growth

PRIORITY 5: STRENGTHEN COOPERATION AMONG ALL COUNTRIES AND STAKEHOLDERS

- MRC effective implementation of 1995 Agreement
- Joint efforts & partnerships

STAKEHOLDER ENGAGEMENT

ENHANCED PARTNERSHIP AND MUTUAL LEARNING

- BDS outcomes will be addressed by basin countries' regional organization, initiatives and programmes in collaboration with relevant counterpart organizations.
- Funding of BDS strategic priorities: by international & regional grant, supplemented by national public budgets, private sectors.
- Active, open and transparent stakeholder engagement.

02

IMPLEMENTATION OF ROUTINE WATER QUALITY MONITORING

PROCEDURE OF WATER QUALITY (PWQ)

Purpose: Maintaining water quality of the Mekong River in "good/acceptable" conditions as defined by the target values of key water quality indicators

- Chapter 1: Guideline for Protection of Human Health (HH)
- Chapter 2: Guideline for Protection of Aquatic Life (AL)
- Chapter 3: Cooperative Framework for Cooperation to Implement PWQ for HH and AL
- Chapter 4: Guideline for WQ Emergency Response and Management

Criteria and Target Values for Protection of Human Health (HH)

Direct Impact Parameters

No	Parameters	Symbol	Unit	Value	Analytical method[1]
1	Total Arsenic	Total As	mg/l	0.01	3550-As/SM
2	Cadmium	Cd	mg/l	0.005[2]	3110-Cd/SM
3	Chromium Hexavalent	Cr	mg/l	0.05	3550-Cr/SM
4	Cyanide	CN	mg/l	0.01	4500-CN/SM
5	Lead	Pb	mg/l	0.05	3110-Pb/SM
6	Total Mercury	Total Hg	mg/l	0.002	3112-Hg/SM
7	Oil and Grease	***Should not occur in such a way that:*** ▪ It can be observed as an oil film, sheen or discoloration; ▪ One can smell its odour; or ▪ It can be seen as oily deposits on the river bank and/or at the river bottom.			Observation
8	Phenol	C_6H_5OH	mg/l	0.005	5530-Phenol/SM
9	Total Organochlorine Pesticide		mg/l	0.05	6630-organochlorinePesticides/ SM
10	Faecal Coliforms		MPN/100ml	1000[3]	9230-E.coli Group/SM

Indirect Impact Parameters or Environmental Stressors

No	Parameters	Symbol	Unit	Value	Analytical Method[1]
1	Ammonia as N	NH_3 as N	mg/l	0.5[2]	4500-NH_3/SM
2	Biological Oxygen Demand	BOD_5	mg/l	4	5210-BOD_5/SM
3	Chemical Oxygen Demand	COD_{Mn}	mg/l	5	$KMnO_4$ method
4	Conductivity	EC	mS/m	70-150	2510-Ec/SM
5	Dissolved Oxygen	DO	mg/l	≥ 6[3]	4500-O/SM
6	Total Nitrite and Nitrate as N	(NO_2 + NO_3) as N	mg/l	5	4500-NO_3/SM
8	pH	pH		6-9	4500-H^+/SM
9	Temperature	T	°C	Natural	2550-Temp/SM
10	Total Coliform		MPN/100ml	5000	9221-Coliform group/SM

Criteria and Target Value for Protection of Aquatic Life (AL)

Direct Impact Parameters

No	Parameters Name	Symbol	Unit	Value	Analytical method[1]
1	Arsenic	Total As	mg/l	0.01	3550-As/SM
2	Cadmium	Cd	mg/l	0.005[2]	3110-Cd/SM
3	Chromium Hexavalent	Cr (VI)	mg/l	0.05[3]	3550-Cr/SM
4	Copper	Cu	Mg/l	0.1	
5	Cyanide	CN	mg/l	0.005	4500-CN/SM
6	Lead	Pb	mg/l	0.05[4]	3110-Pb/SM
7	Total Mercury	Total Hg	mg/l	0.001[5]	3112-Hg/SM
8	Oil and Grease[6]	***Should not occur in such a way that:*** • It can be observed as an oil film, sheen or discoloration. • One can smell its odour, or • It can be seen as oily deposits on the river bank and/or at the river bottom.			Observation
9	Phenol	C_6H_5OH	mg/l	0.005	5530-Phenol/SM
10	Total Organochlorine Pesticide		mg/l	0.05	6630-organochlorinePesticides/ SM
11	Ammonia	NH_3 as N	mg/l	0.2[8]	4500-NH_3/SM
12	Biological Oxygen Demand	BOD_5	mg/l	3[7]	5210-BOD_5/SM
13	Dissolved Oxygen	DO	mg/l	> 5	4500-O/SM
14	pH	pH		6-9	4500-H^+/SM
15	Temperature		°C	Natural	2550-Temp/SM
16	Nitrite[9]	NO_2 as N			
17	Nitrate	$NO_{3\,as}$ N	mg/l	5	4500-NO_2-C/SM
18	Phosphate[9]	PO_4 as P			

PROCEDURE OF WATER QUALITY

Chapter 3: Cooperative Framework for Cooperation to Implement PWQ for HH and AL

- **National level:**
  - Monthly water quality data (conduct monitoring and maintaining database for sharing) **47 stations**
  - Annual water quality data assessment report **2023 Water Quality Report**
  - Participation in various studies and capacity building activities to support the ongoing monitoring and reporting improvement of the WQMN.
- **Regional level:**
  - Storage hub for water quality database (following validation) **MRC Data Portal**
  - Regional water quality assessment report **SOBR 2023**
  - Provision of support to strengthen the capacity of the Member Countries for the monitoring and assessment of water quality of the Mekong River

IMPLEMING LINE AGENCIES

National Water Quality Laboratory	Ministries	Member Countries
The Department of Hydrology and River Works (DHRW)	Ministry of Water Resources and Meteorology	Cambodia
The Natural Resources and Environment Research Institute (NRERI)	Ministry of Natural Resources and Environment	Lao PDR
The Water Quality Analysis Division, Department of Water Resources	Ministry of Natural Resources and Environment	Thailand
Southern Institute for Water Resources Planning	Ministry of Natural Resources and Environment	Viet Nam

03

WATER QUALITY STATUS AND TREND

Water Quality Index

Water Quality Index for the Protection of Aquatic Life (WQI_{al})			
Rating score	**Class**	**Parameters**	**Target values**
9.5 ≤ WQI ≤10	A: High Quality	pH	6–9
8 ≤ WQI < 9.5	B: Good Quality	EC (mS/m)	150
6.5 ≤ WQI < 8	C: Moderate Quality	NH_3 (mg/L)	0.1
4.5 ≤ WQI < 6.5	D: Poor Quality	DO (mg/L)	≥5
WQI < 4.5	E: Very Poor Quality	NO_{2-3}-N(mg/L)	0.5
		TOTP (mg/L)	0.13

Water Quality Index for the Protection of Human Health (WQI_{hh})			
Rating score	**Class**	**Parameters**	**Target values**
95 ≤ WQI ≤100	A: Excellent Quality	pH	6–9
80 ≤ WQI < 95	B: Good Quality	EC (mS/m)	150
65 ≤ WQI < 80	C: Moderate Quality	NH_3 (mg/L)	0.5
45 ≤ WQI < 65	D: Poor Quality	DO (mg/L)	≥4
WQI < 45	E: Very Poor Quality	NO_{2-3}-N(mg/L)	5
*Due to the required holding time for BOD, the MCs have agreed to only monitor BOD at stations where samples can be analyzed within the required holding time of less than 48 hours. Therefore, BOD was only included for the stations where data are available.		COD (mg/L)	5
		BOD* (mg/L)	4

Water Quality Index for Agricultural Use – general and paddy rice irrigation				
Irrigation raw water	**Unit**	**Degree of consequence***		
		None (A)	**Some (B)**	**Severe (C)**
Electrical conductivity (EC)				
General irrigation	mS/m	<70	70–300	>300
Paddy rice	mS/m	<200	200–480	>480

Water Quality Status and Trend 2010 – 2021: Protection of Aquatic Life

Protection of Aquatic Life

No.	Station Names	Rivers	Countries	Class											
				2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	Houa Khong	Mekong	Laos	A	A	B	B	B	B	B	B	B	A	A	A
2	Chiang Saen	Mekong	Thailand	B	A	B	B	A	B	B	B	B	A	B	B
3	Luang Prabang	Mekong	Laos	B	A	A	B	B	B	A	B	A	A	A	A
4	Vientiane	Mekong	Laos	A	A	A	B	B	A	A	A	A	A	A	A
5	Nakhon Phanom	Mekong	Thailand	B	A	B	B	A	A	B	B	B	A	A	A
6	Savannakhet	Mekong	Laos	A	A	A	B	B	B	A	A	B	A	A	A
7	Khong Chiam	Mekong	Thailand	A	A	A	B	A	A	A	B	A	A	A	A
8	Pakse	Mekong	Laos	A	A	A	B	B	B	A	A	B	A	A	A
9	Stung Treng	Mekong	Cambodia	B	B	B	B	B	B	B	A	A	A	A	A
10	Kratie	Mekong	Cambodia	B	B	B	B	B	B	A	B	B	B	A	A
11	Kampong Cham	Mekong	Cambodia	B	B	B	B	A	B	A	A	B	B	A	A
12	Chrouy Changvar	Mekong	Cambodia	B	B	B	B	B	B	A	A	B	B	A	A
13	Neak Loung	Mekong	Cambodia	B	B	B	B	B	B	A	A	B	A	A	A
14	Krom Samnor	Mekong	Cambodia	B	B	B	B	B	B	A	A	B	A	A	A
15	Tan Chau	Mekong	Viet Nam	B	B	B	B	B	B	B	A	B	B	B	B
16	My Thuan	Mekong	Viet Nam	B	B	B	B	B	B	B	B	B	B	B	B
17	My Tho	Mekong	Viet Nam	C	C	B	C	C	C	D	C	B	C	C	C
18	Takhmao	Bassac	Cambodia	B	B	B	B	B	B	B	B	B	B	B	B
19	Koh Khel	Bassac	Cambodia	B	B	B	B	B	B	B	B	B	B	B	A
20	Koh Thom	Bassac	Cambodia	B	B	B	B	A	B	B	B	B	A	B	A
21	Chau Doc	Bassac	Viet Nam	B	B	B	B	B	B	B	B	C	C	C	B
22	Can Tho	Bassac	Viet Nam	C	C	C	C	B	B	B	B	B	C	C	C

A	Excellent
B	Good
C	Moderate
D	Poor
E	Very Poor

Water Quality Status and Trend
2010 – 2021: Protection of Human Health

Protection of Human Health

No.	Station Names	Rivers	Countries	Class											
				2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	Houa Khong	Mekong	Lao PDR	B	A	B	B	C	A	A	B	B	A	A	A
2	Chiang Saen	Mekong	Thailand	B	A	B	B	B	B	B	B	B	A	A	B
3	Luang Prabang	Mekong	Lao PDR	B	A	B	A	B	B	B	A	B	A	A	A
4	Vientiane	Mekong	Lao PDR	B	A	B	B	B	B	B	A	B	A	B	A
5	Nakhon Phanom	Mekong	Thailand	B	B	B	B	B	B	B	B	B	B	A	B
6	Savannakhet	Mekong	Lao PDR	A	A	B	B	C	B	B	A	A	A	A	A
7	Khong Chiam	Mekong	Thailand	B	A	B	B	B	B	B	B	B	A	B	B
8	Pakse	Mekong	Lao PDR	A	A	A	B	A	B	B	A	A	A	B	A
9	Stung Treng	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	B	A
10	Kratie	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
11	Kampong Cham	Mekong	Cambodia	A	A	A	A	A	B	A	A	A	A	A	A
12	Chrouy Changvar	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
13	Neak Loung	Mekong	Cambodia	A	A	A	A	A	B	A	A	A	A	A	A
14	Krom Samnor	Mekong	Cambodia	A	A	B	A	A	B	A	A	A	A	A	A
15	Tan Chau	Mekong	Viet Nam	B	B	A	A	A	A	A	A	B	B	A	B
16	My Thuan	Mekong	Viet Nam	C	A	A	B	A	A	A	B	B	A	B	B
17	My Tho	Mekong	Viet Nam	C	B	B	B	B	A	B	B	B	B	C	C
18	Takhmao	Bassac	Cambodia	A	A	A	B	C	A	B	A	B	B	B	B
19	Koh Khel	Bassac	Cambodia	B	A	B	B	A	B	A	A	A	A	A	A
20	Koh Thom	Bassac	Cambodia	A	A	B	B	A	A	A	A	A	A	A	A
21	Chau Doc	Bassac	Viet Nam	C	B	B	A	A	A	A	B	B	B	A	B
22	Can Tho	Bassac	Viet Nam	C	B	A	A	A	A	A	A	B	A	A	B

A	Excellent
B	Good
C	Moderate
D	Poor
E	Very Poor

Water Quality Status and Trend 2010 – 2021: Agriculture Use

Agricultural Use

No.	Station Name	Rivers	Countries	Class											
				2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	Houa Khong	Mekong	Lao PDR	A	A	A	A	A	A	A	A	A	A	A	A
2	Chiang Saen	Mekong	Thailand	A	A	A	A	A	A	A	A	A	A	A	A
3	Luang Prabang	Mekong	Lao PDR	A	A	A	A	A	A	A	A	A	A	A	A
4	Vientiane	Mekong	Lao PDR	A	A	A	A	A	A	A	A	A	A	A	A
5	Nakhon Phanom	Mekong	Thailand	A	A	A	A	A	A	A	A	A	A	A	A
6	Savannakhet	Mekong	Lao PDR	A	A	A	A	A	A	A	A	A	A	A	A
7	Khong Chiam	Mekong	Thailand	A	A	A	A	A	A	A	A	A	A	A	A
8	Pakse	Mekong	Lao PDR	A	A	A	A	A	A	A	A	A	A	A	A
9	Stung Treng	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
10	Kratie	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
11	Kampong Cham	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
12	Chrouy Changvar	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
13	Neak Loung	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
14	Kaorm Samnor	Mekong	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
15	Tan Chau	Mekong	Viet Nam	A	A	A	A	A	A	A	A	A	A	A	A
16	My Thuan	Mekong	Viet Nam	A	A	A	A	A	A	A	A	A	A	A	A
17	My Tho	Mekong	Viet Nam	A	A	A	A	A	A	B	A	A	A	C	B
18	Takhmao	Bassac	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
19	Khos Khel	Bassac	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
20	Khos Thom	Bassac	Cambodia	A	A	A	A	A	A	A	A	A	A	A	A
21	Chau Doc	Bassac	Viet Nam	A	A	A	A	A	A	A	A	A	A	A	A
22	Can Tho	Bassac	Viet Nam	A	A	A	A	A	A	A	A	A	A	A	A

A	Good
B	Fair
C	Poor

Overall Summary of the WQ Conditions

- The overall classification of water quality conditions is based on the reference values for each water quality parameter defined in the PWQ. Over the 2010–2021 period, reference levels for five key water quality parameters were only rarely exceeded.

- DO levels were generally higher than the reference level of ≥ 6 mg/L for human health, indicating better water quality.

- Nitrate-nitrite (NO_{3-2}) concentrations were consistently well below the reference values for human health and aquatic life (5 mg/L) in all years where average median values across all stations were between 0.17 mg/L and 0.25 mg/L during the 2010–2021 period.

- Ammonium (NH_4N) concentrations were mostly below, the reference values for the protection of human health (0.05 mg/L), with average median values ranging between 0.04 mg/L and 0.06 mg/L across all stations between 2010 and 2021. Occasionally high in some stations.

Overall Summary of the WQ Conditions

- The chemical oxygen demand (COD) reference value of 5 mg/L for the protection of human health was only rarely exceeded; some stations occasionally exceeded.

- Since 2010, at mainstream stations, there have been statistically significant trends ($p < 0.05$) over time in the annual median values for water temperature (increasing trend), total suspended solids (decreasing trend) and total phosphorous (decreasing trend).

- Since 2010, across all LMB water quality stations, there are statistically significant trends in the average median water quality parameters for pH (increasing tend), electrical conductivity (increasing trend), NO3-2 (increasing trend) and total nitrogen (increasing trend).

- Average mainstream water temperature increased at an alarming rate, i.e. 1.8 °C between 2010 and 2021 (or 0.16°C per year). Over the same period, mainstream total suspended solids decreased by around 40%, and total phosphorus concentrations by around one-third.

Thank you!