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CHAPTER: WETLAND

MEAK1003: Environmental Management and Sustainability

Master Eng. (Environmental Management)

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TOPIC: WETLAND

MEAK1003: Environmental Management and Sustainability

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TOPIC: WETLAND

MEAK1003: Environmental Management and Sustainability

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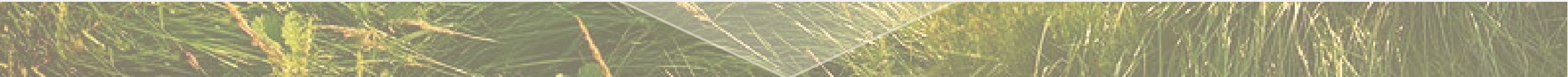

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CONTENTS **OF CHAPTER**

Some parts of this lecture have already been covered in core subjects example Environmental Management.

01 DEFINITION
What is wetland

02 CRITERIA
Characteristics of wetland

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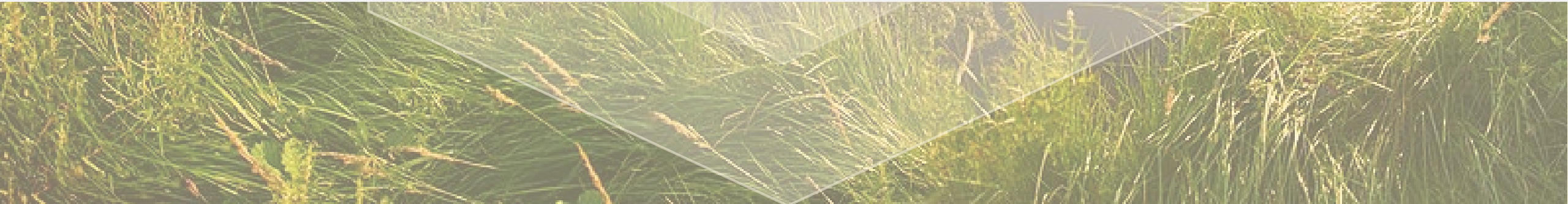
TOPIC: WETLAND

MEAK1003: Environmental Management and Sustainability

WHAT IS WETLAND?



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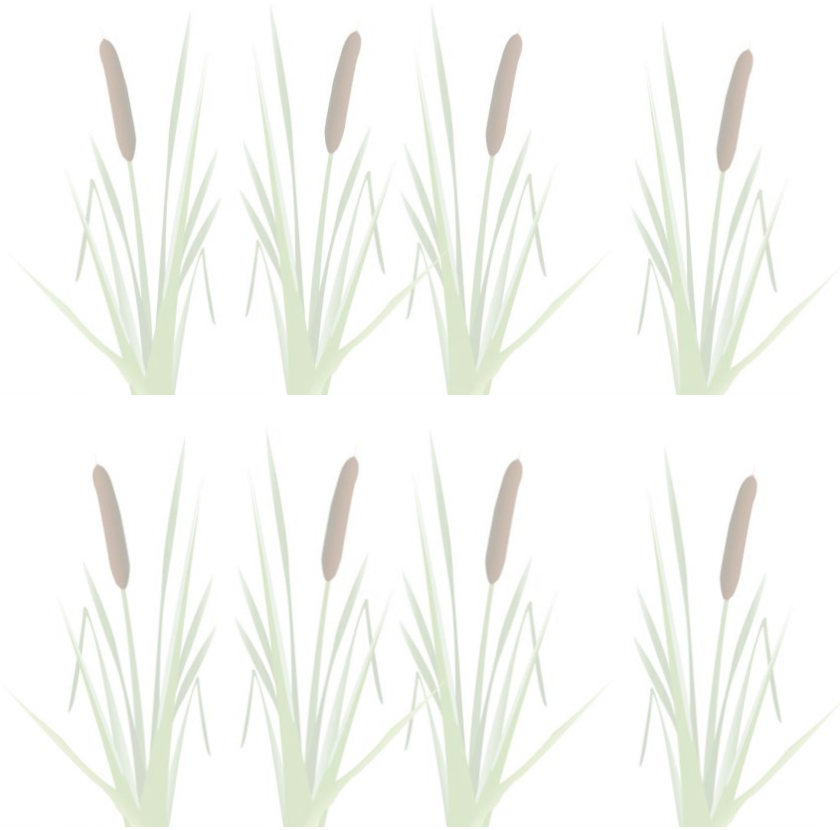
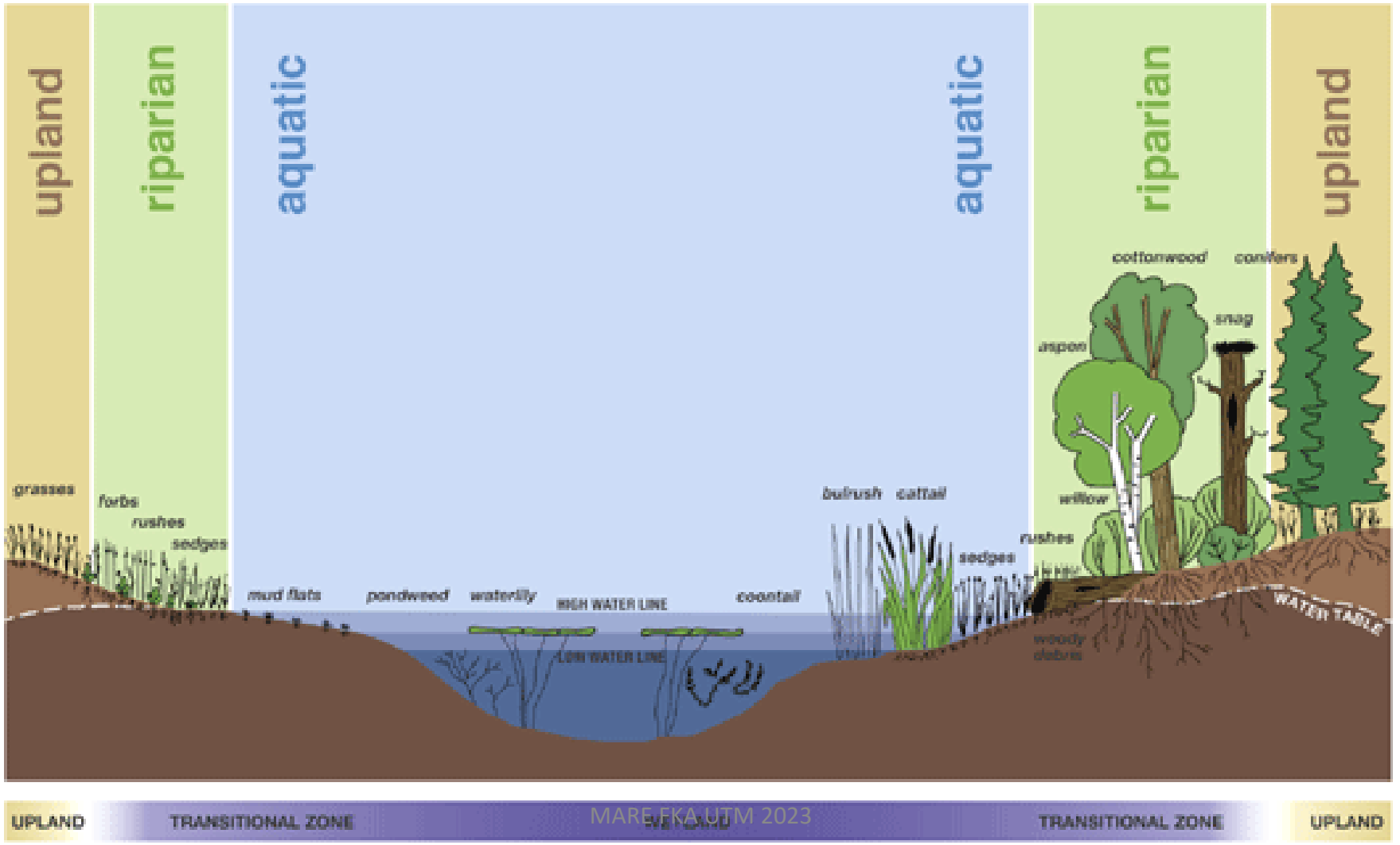
WETLANDS

Ramsar Convention 1971:

Areas of marsh, peat land, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 meters



A Typical Wetland



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TOPIC: WETLAND

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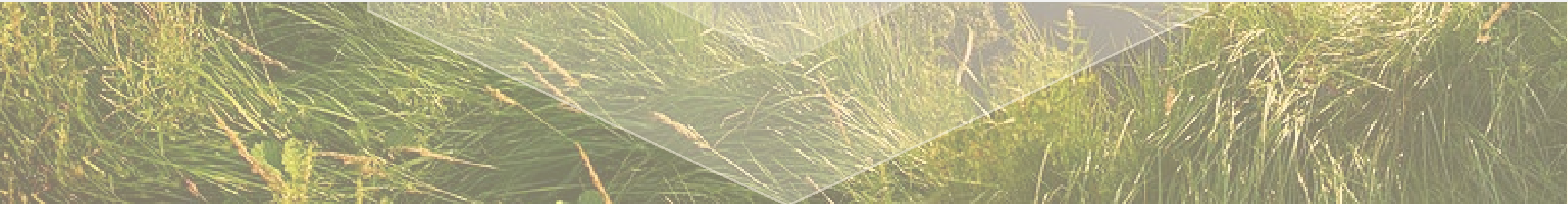
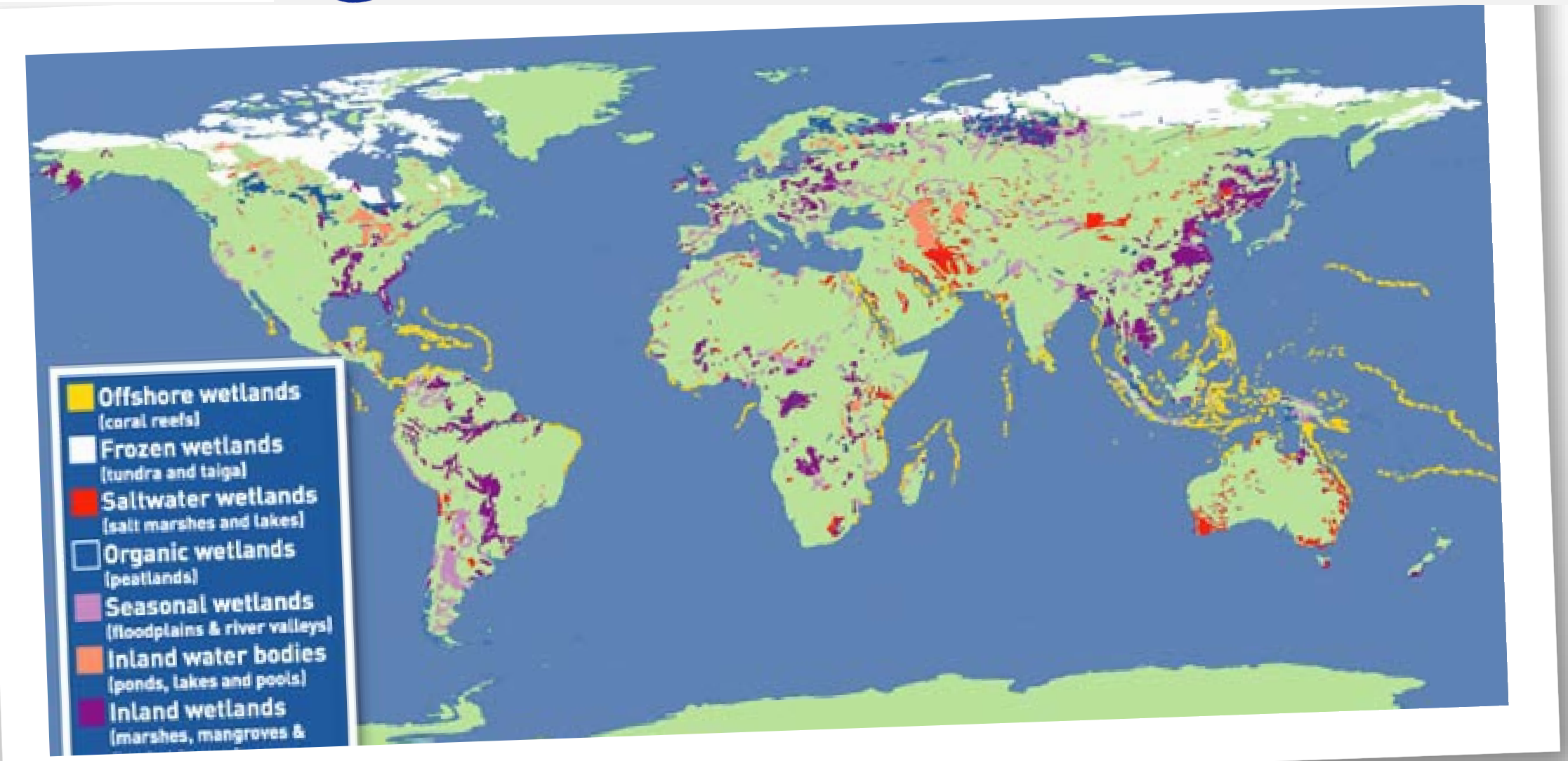
CRITERIA OF WETLAND



Criteria/ distinguishing features of a wetland:

1. The area must be permanently or seasonally inundated
2. The area must support hydrophytic vegetation
3. Soil in the area must be water-logged for a sufficient time to become anaerobic


Offshore wetlands
(coral reefs)
Frozen wetlands
(tundra and taiga)
Saltwater wetlands
(salt marshes and lakes)
Organic wetlands
(peatlands)
Seasonal wetlands
(floodplains & river valleys)
Inland water bodies
(ponds, lakes and pools)
Inland wetlands
(marshes, mangroves &

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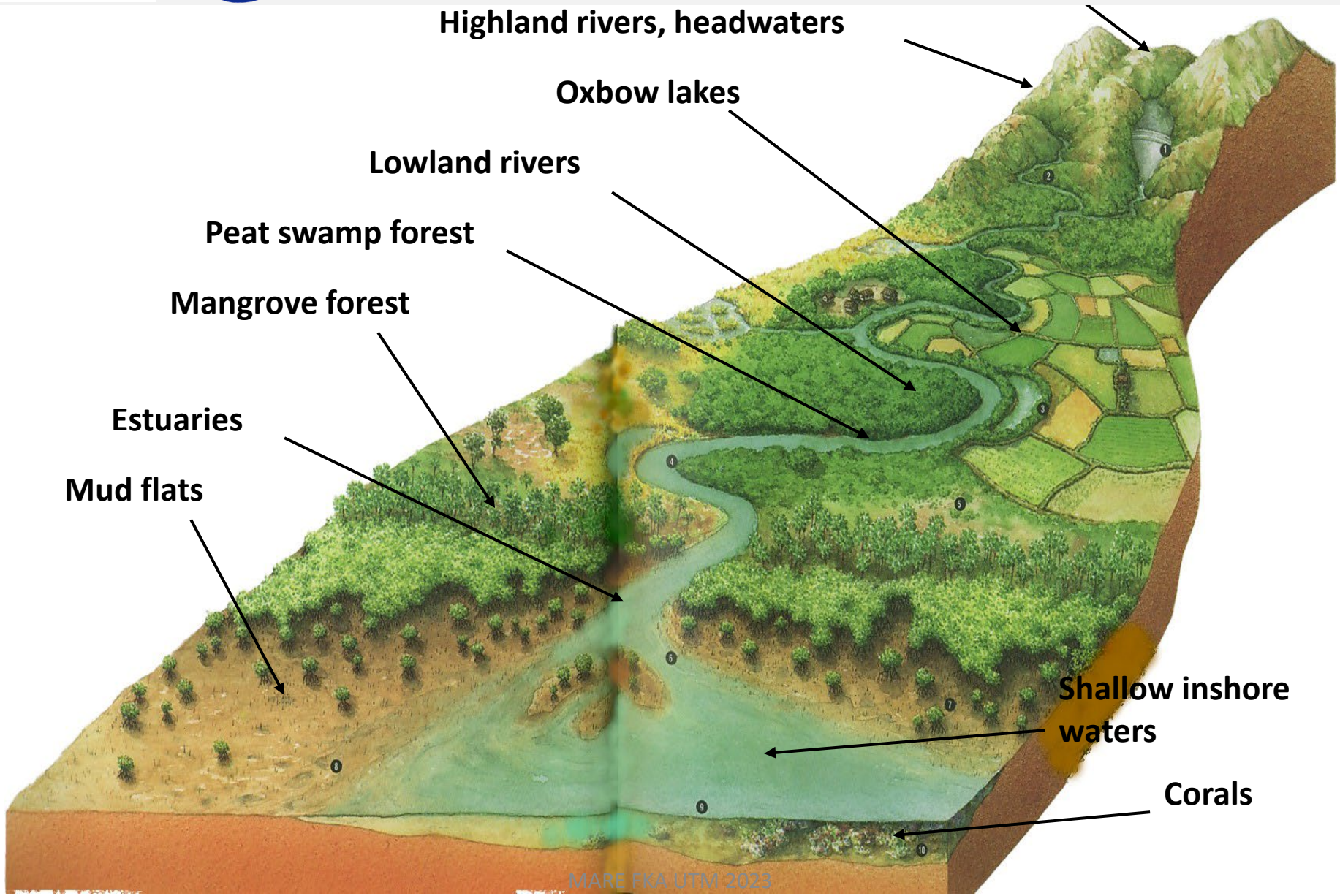
Types of Wetlands

- **Coastal**
- **Inland**
- **Tundra**
- **Bogs and Fens**
- **Prairie**
- **Swamps**
- **Lakes and Ponds**
- **Rivers and Streams**


Highland rivers, headwaters
Oxbow lakes
Lowland rivers
Peat swamp forest
Mangrove forest
Estuaries
Mud flats
Shallow inshore waters
Corals

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Oxbow Lake

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Floodplain

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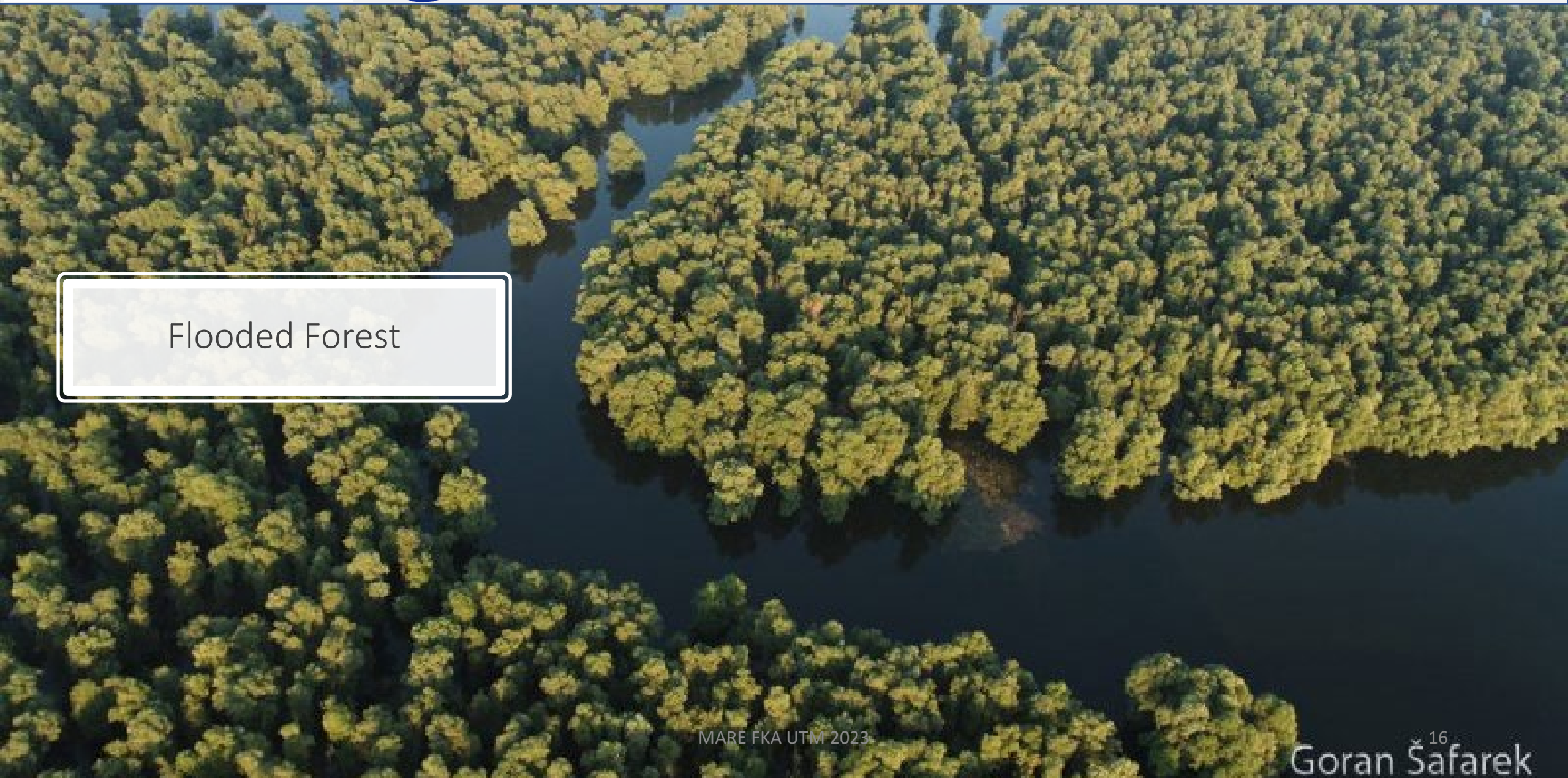

Flooded Forest

Bog

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Peat Swamp

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Peat SWamp

Mangroves

Mangrove

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Estuary

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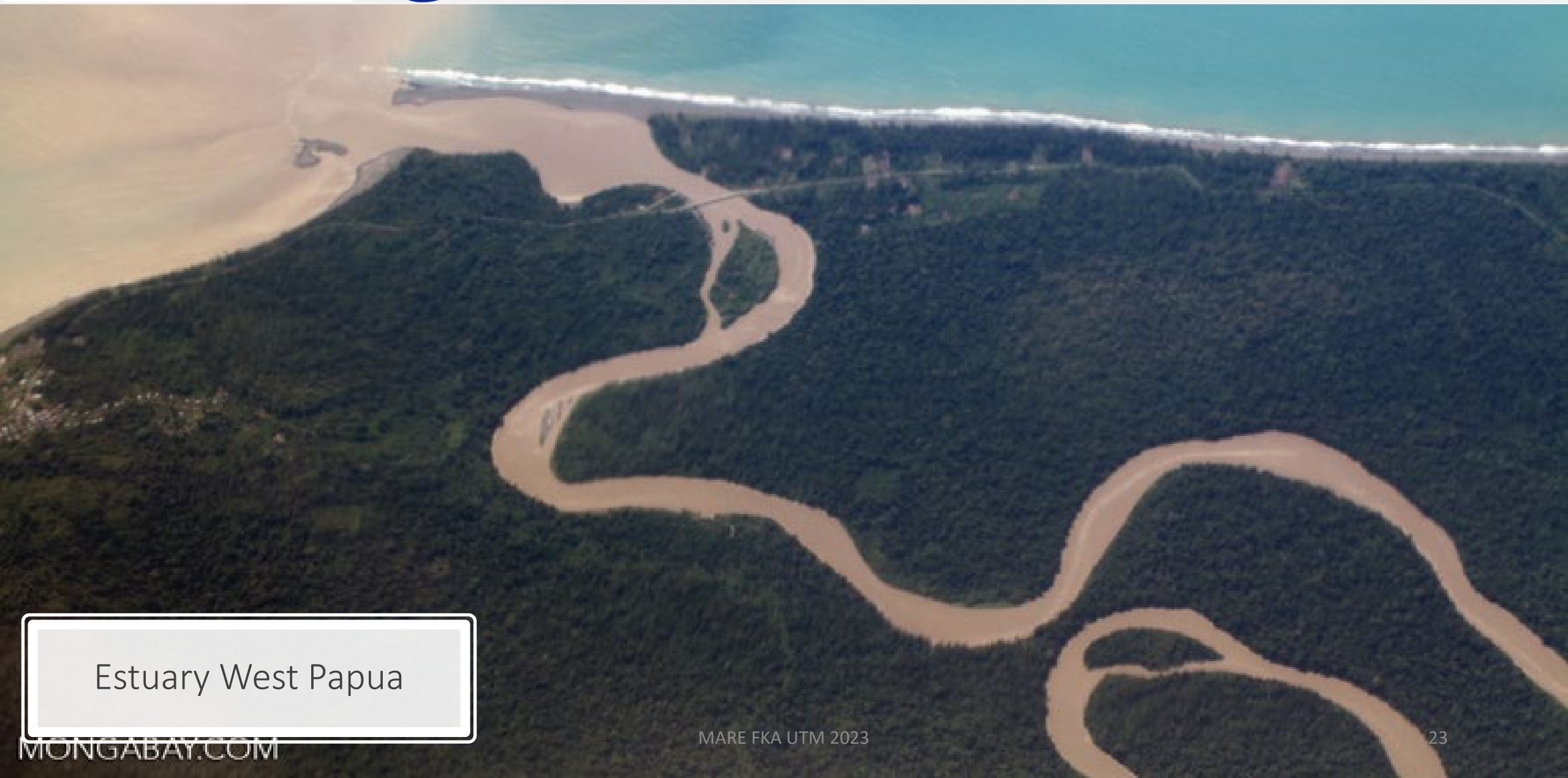

Estuary West Papua

MONGABAY.COM

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Ramsar Site

A wetland site designated to be of international importance under the **Ramsar Convention**.

The Convention on Wetlands, known as the Ramsar Convention, is an intergovernmental environmental treaty established in 1971 by UNESCO, which came into force in 1975.

It provides for national action and international cooperation regarding the conservation of wetlands, and wise sustainable use of their resources.

Ramsar identifies wetlands of international importance, especially those providing waterfowl habitat.

There are 2,300 Ramsar sites

RAMSAR SITES IN MALAYSIA

1. Sungai Pulai, Johor
2. Tanjung Piai, Johor
3. Pulau Kukup, Johor
4. Tasik Bera, Pahang
5. Kuching Wetlands National Park, Sarawak
6. Lower Kinabatangan-Segama Wetlands, Sabah
7. Kota Kinabalu Wetlands, Sabah

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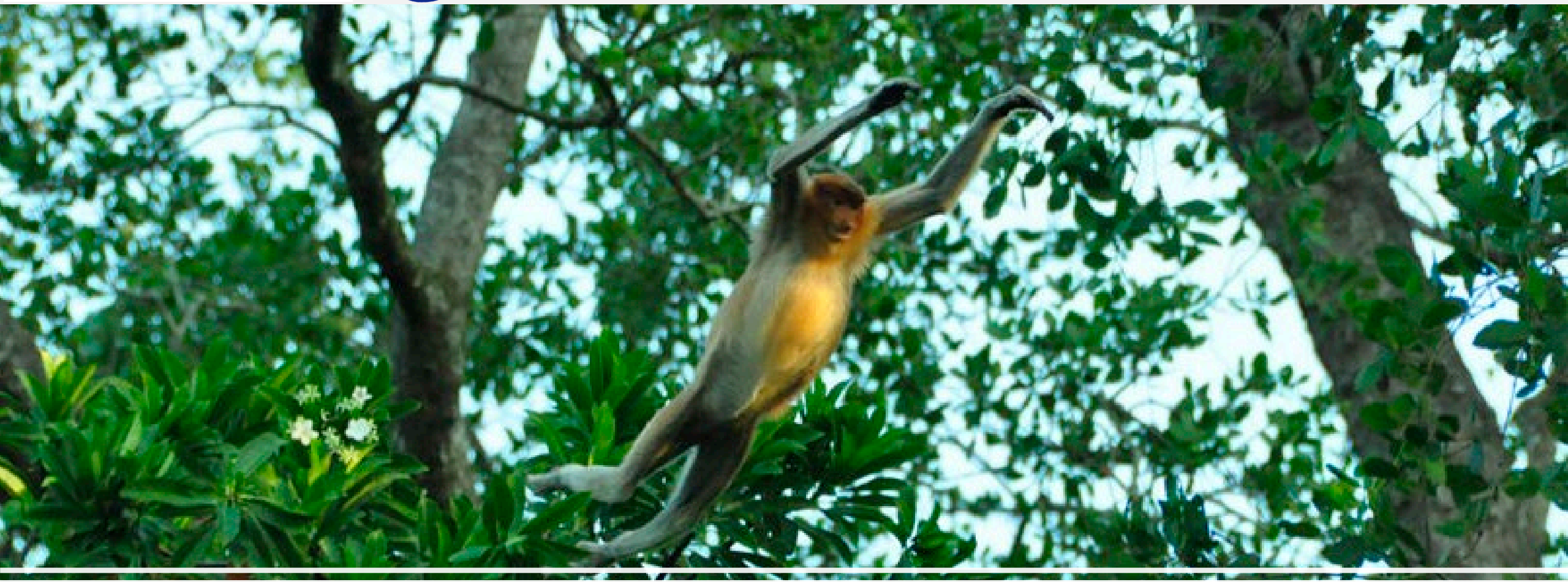

Lower Kinabatangan-Segama Wetland

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Kuching Wetlands National Park

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Ramsar Sites in Johor

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Tanjung Piai

PULAU KUKUP

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Sungai Pulai

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Seagrass at Tanjung Kupang-Merambong Shoal

Largest seagrass bed in Peninsular Malaysia

- Size = 38 hectares
- Only appears during spring low tide

Merambong Island

- Small uninhabited island
- Size = 0.3 hectares

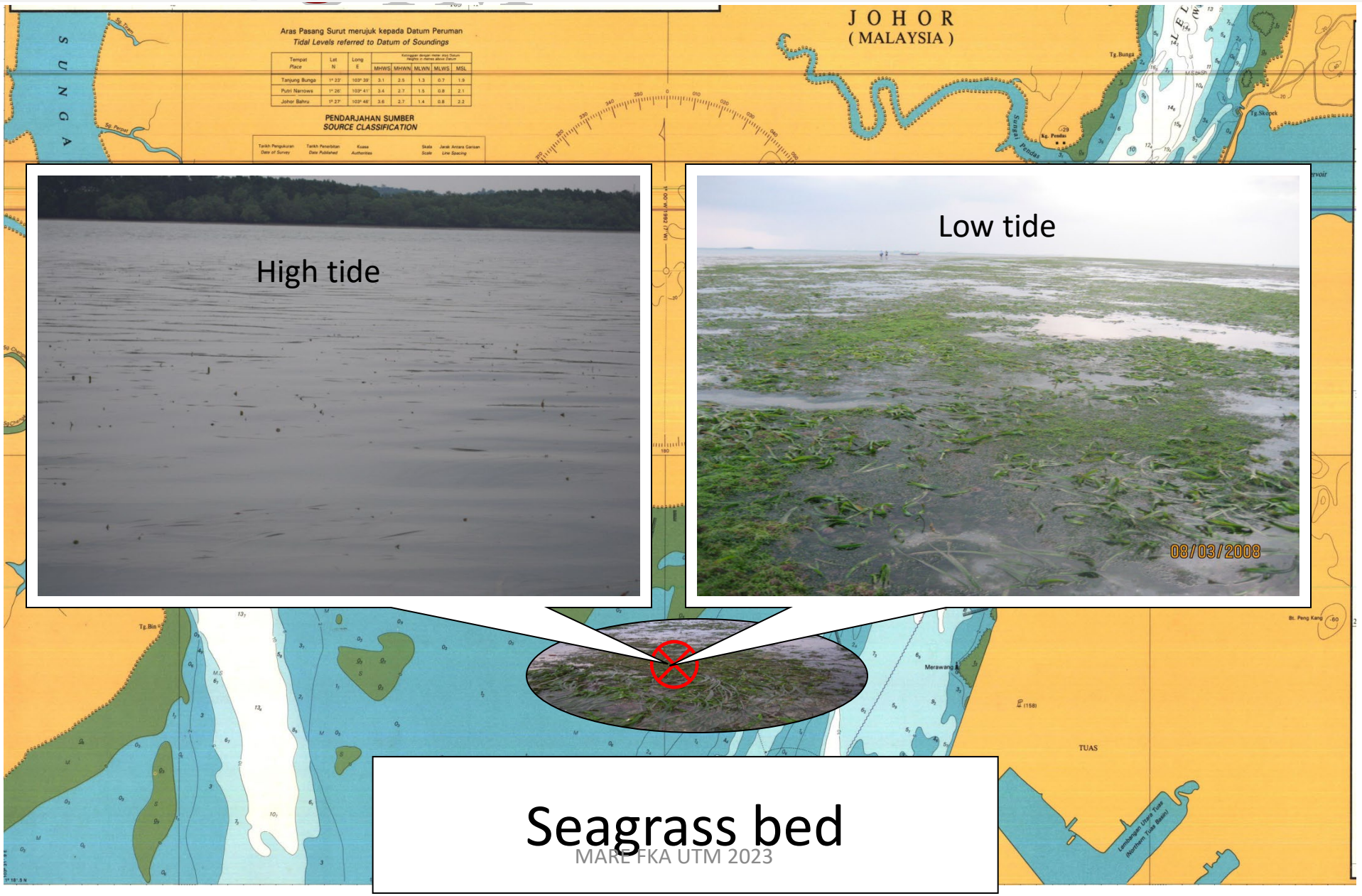
Support high diversity of marine life

- *Strombus*, seahorse, dugong
- Pipefish, sea star

Pulai River mangrove area

Tanjung Bin

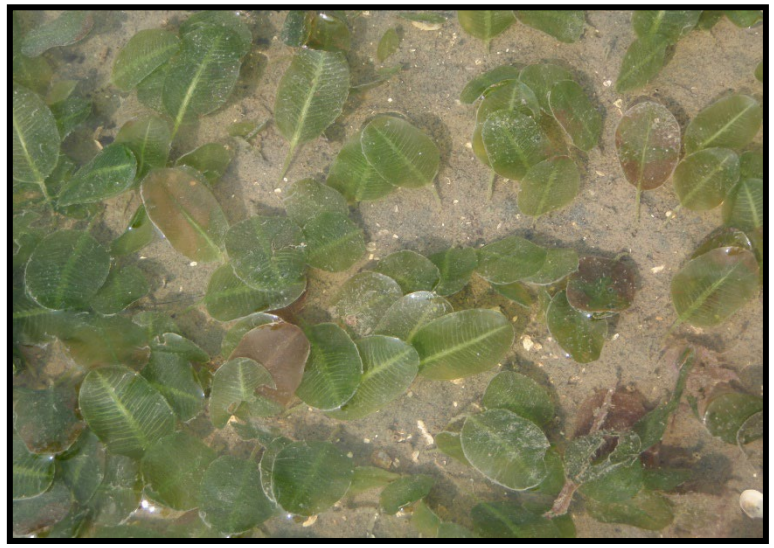
Seagrass along Pulai River

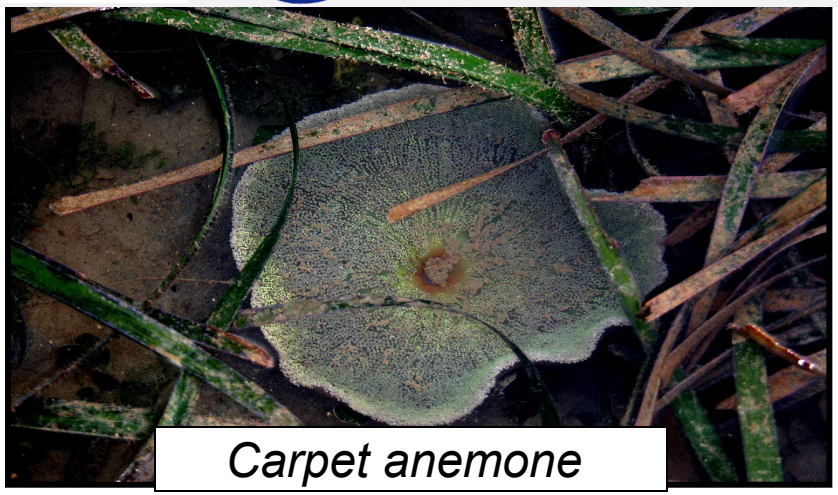


Seagrass bed

Seagrass Species

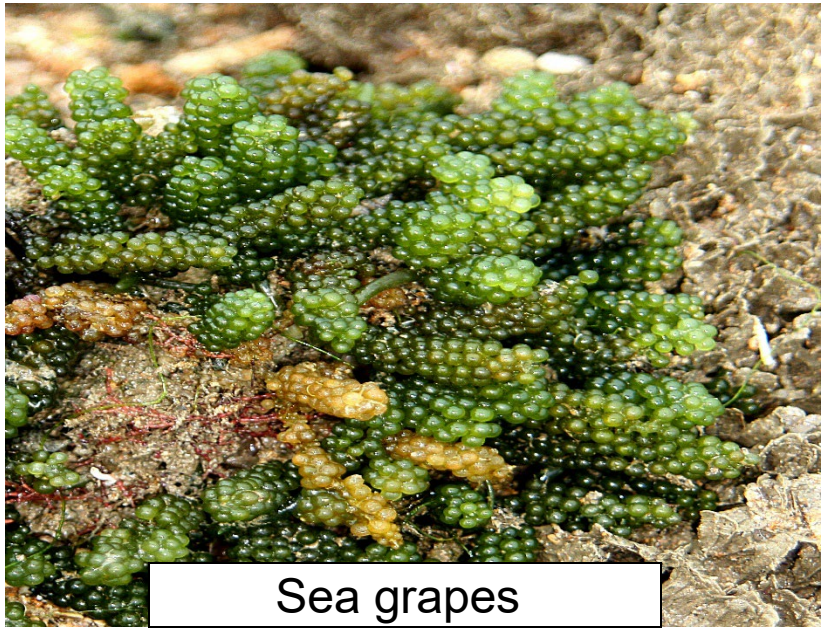
- During survey (2008), 6 species of seagrass have been identified out of 10 recorded species by previous study (2006) at Tg. Kupang:





Carpet anemone

Fan seaweed



Sea grapes

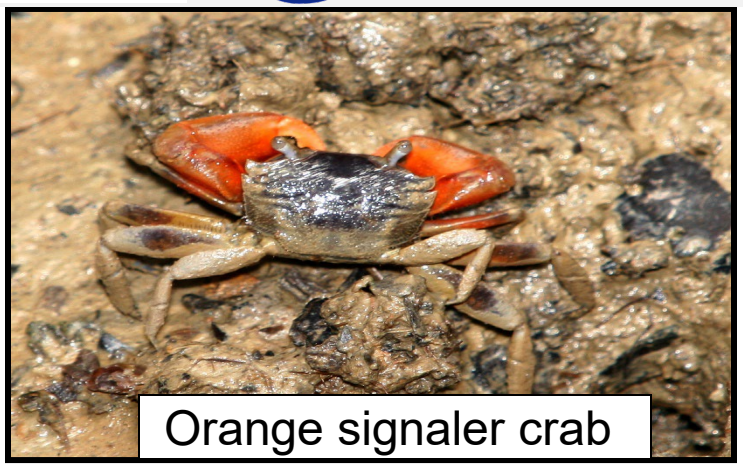
Peacock anemones

Knobbly sea stars

Brittle star

Holothuria leucospilota

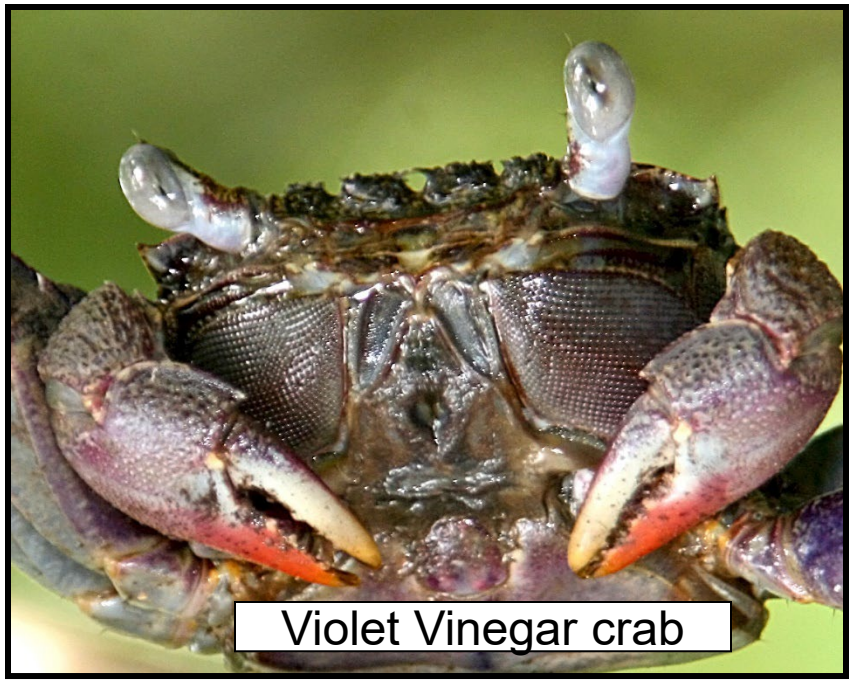
Seahorse



Orange signaler crab

Shen crab

Spider crab



Violet Vinegar crab

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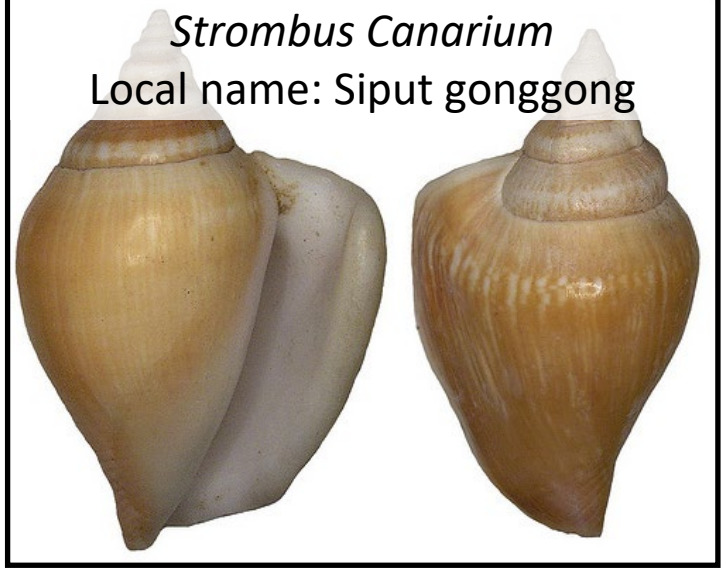
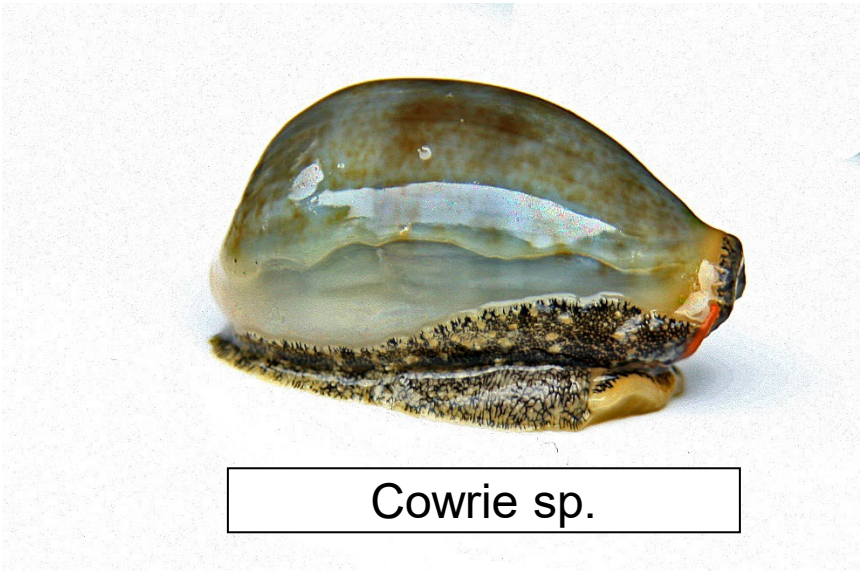
Pen shell

Strombus Canarium

Local name: Siput gonggong





Cowrie sp.

Dead dugong washes up in Johor

Chronology

2013

March 2014

April 2014

June 2014

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March 2014

April 2014

BACK

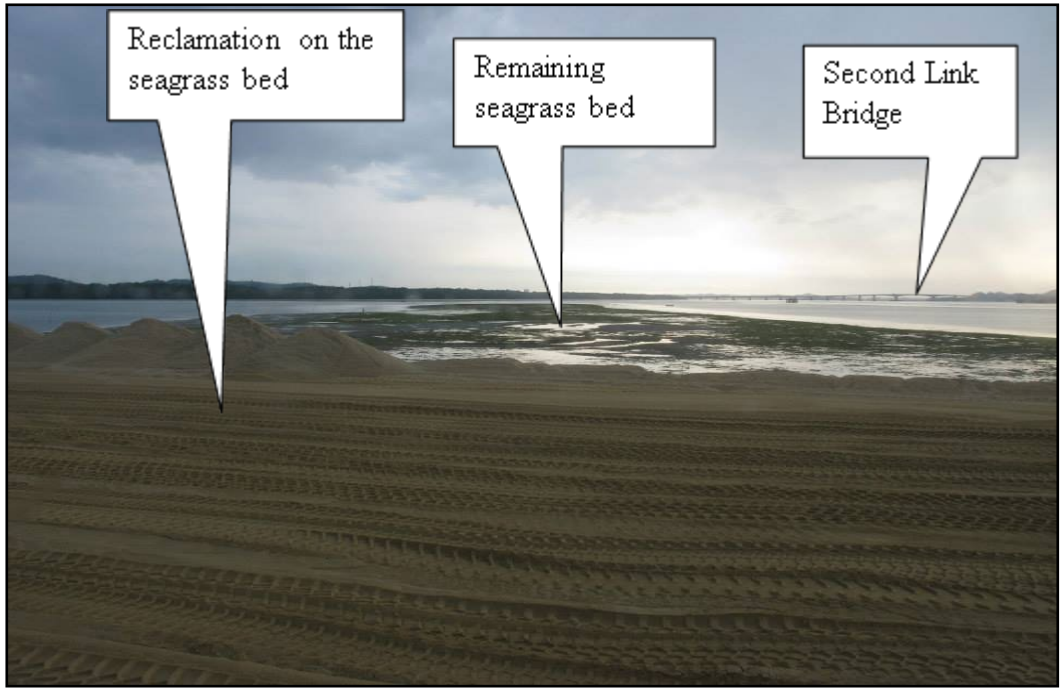

yet another useful silt curtain
between Singapore & sandpile


BEFORE
seagrass


NOW
it looks green but it's all algae


useful silt curtain between
reclamation & seagrass

June 2014


Reclamation on the seagrass bed
Remaining seagrass bed
Second Link Bridge


1 ISLAND岛
高新产业
主导区
会展中心
商务中心
度假休闲
购物中心
创新研发中心
HIGH TECH INDUSTRIAL ZONE
2 ISLAND岛
商务旅游
娱乐区
娱乐
商务中心
海关
交流中心
休闲乐园
中心公园
健康中心
CENTRAL BUSINESS DISTRICT
AND TOURISM ZONE
SINGAPORE – MALAYSIA'S 2ND LINK
马新第二通道大桥
4 ISLAND岛
国际交流
文化区
国际交流中心
酒店业
第二连接通道
城市中心区
CONFERENCE AND FORUM ZONE
3 ISLAND岛
外贸政策
优惠区
购物中心
国际港口
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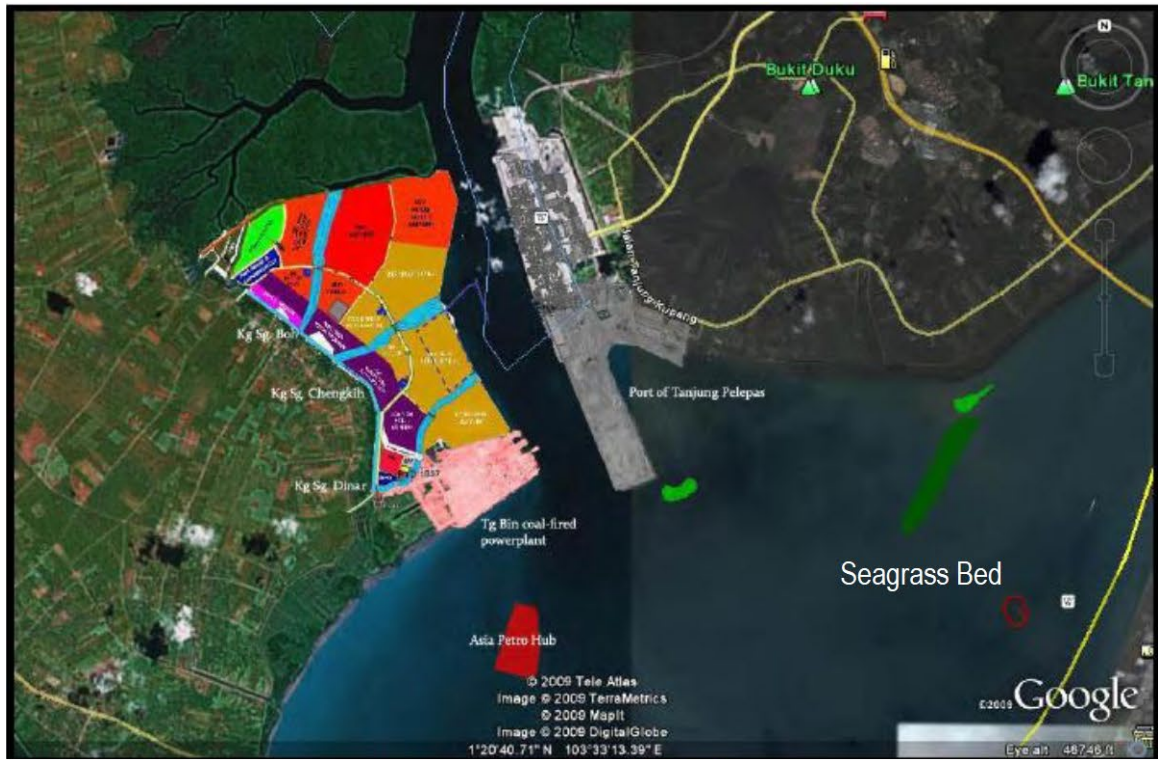
Sampling


Bukit Duku
Bukit Tan
Kg Sg. Chengkih
Kg Sg. Dinas
Tg Bin coal-fired
powerplant
Port of Tanjung Pelepas
Seagrass Bed
Asia Petro Hub
© 2009 Tele Atlas
Image © 2009 TerraMetrics
© 2009 MapIt
Image © 2009 DigitalGlobe
1°20'40.71" N 103°33'13.39" E
Google

2009*


Forest City Project Office
Forest City Sales Gallery
Seagrass Bed & Reclamation
Map
Google
Imagery ©2017 DigitalGlobe, DigitalGlobe, CNES / Airbus, CNES / Airbus, Map data ©

2017

Seagrass	2006+	2009	2011	2012	2014	2016	2017
Enhalus acoroides	✓	✓	✓	✓	✓	✓	✓
Thalassia hemprichii	✓	✓	✓	✓	✓		✓
Halophila minor	✓	✓	✓	✓	✓		✓
Halophila ovalis	✓	✓	✓	✓		✓	✓
Halophila spinulosa	✓	✓	✓	✓	✓	✓	✓
Cymodocea rotundata	✓						
Cymodocea serrulata	✓		✓	✓			✓
Halodule pinifolia	✓	✓					
Halodule uninervis	✓		✓	✓			✓
Syringodium isoetifolium	✓						

	
Cymodocea serrulata	*Halophila minor*
	
Halophila spinulosa	*Halophila ovalis*
	
Thalassia hemprichii	*Halodule uninervis*


Enhalus acoroides

CONTENTS **OF CHAPTER**

Some parts of this lecture have already been covered in core subjects example Environmental Management.

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TOPIC: WETLAND

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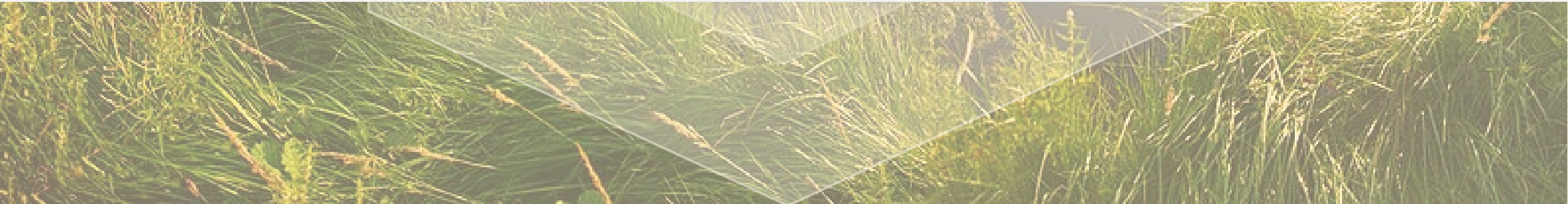
FUNCTION OF WETLAND



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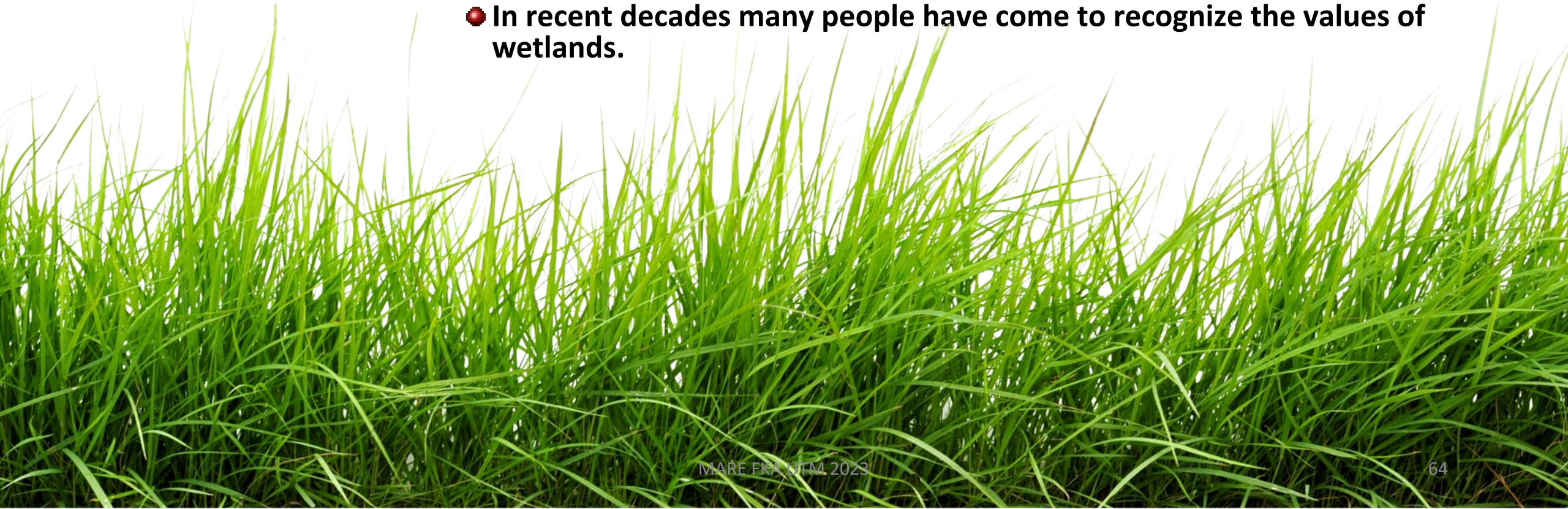
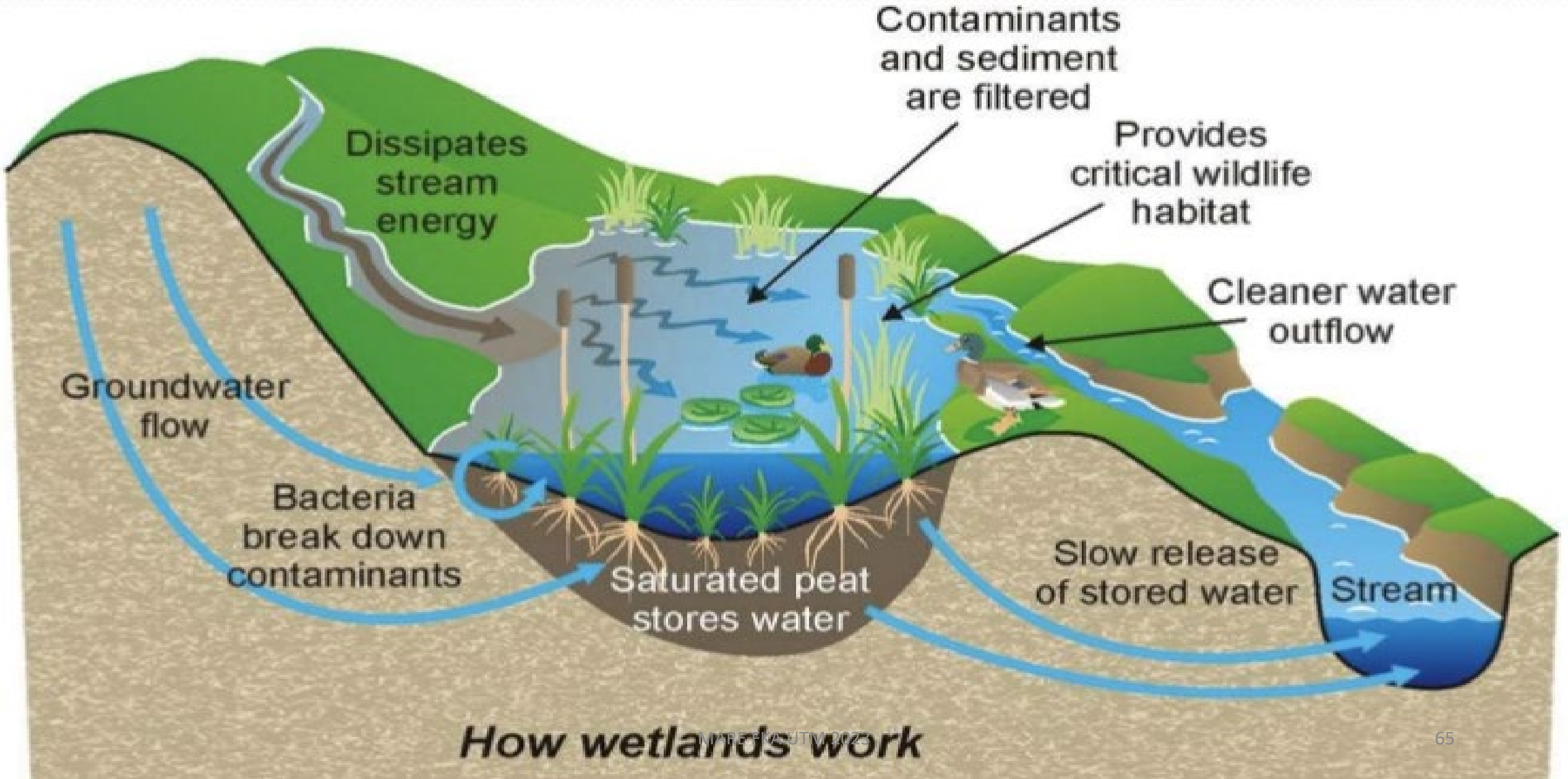
The Value of Wetlands

- In the past, wetlands were mostly considered to be wastelands.
- As people were settled, swamps and marshes were obstructions along the way. Many were drained to be replaced by farmland, railroads and road construction.
- In recent decades many people have come to recognize the values of wetlands.





How wetlands work

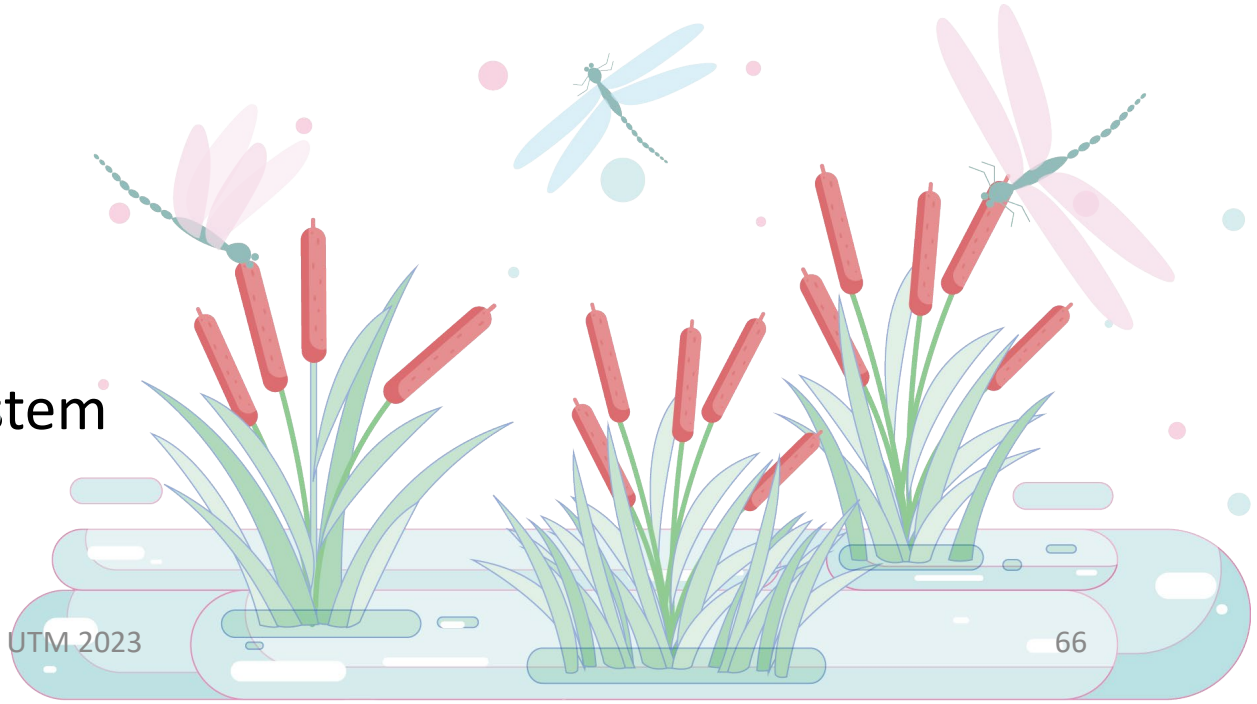
NATURAL FUNCTIONS OF WETLANDS

Climatic effects

- carbon fixation and CO_2 balance (photosynthesis)
- rainfall & humidity effects (evaporation & evotranspiration)

Biodiversity functions

- ecosystem diversity
- link between terrestrial and aquatic ecosystem
- high species and population diversity
- highly diverse microbiological activity



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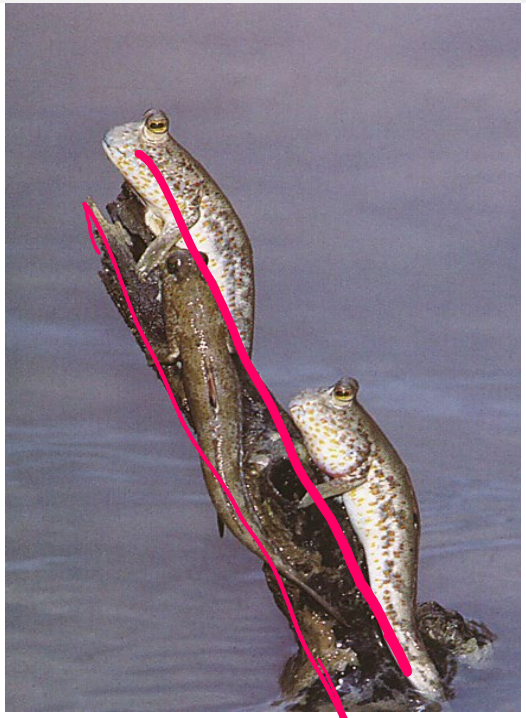
Mudskippers



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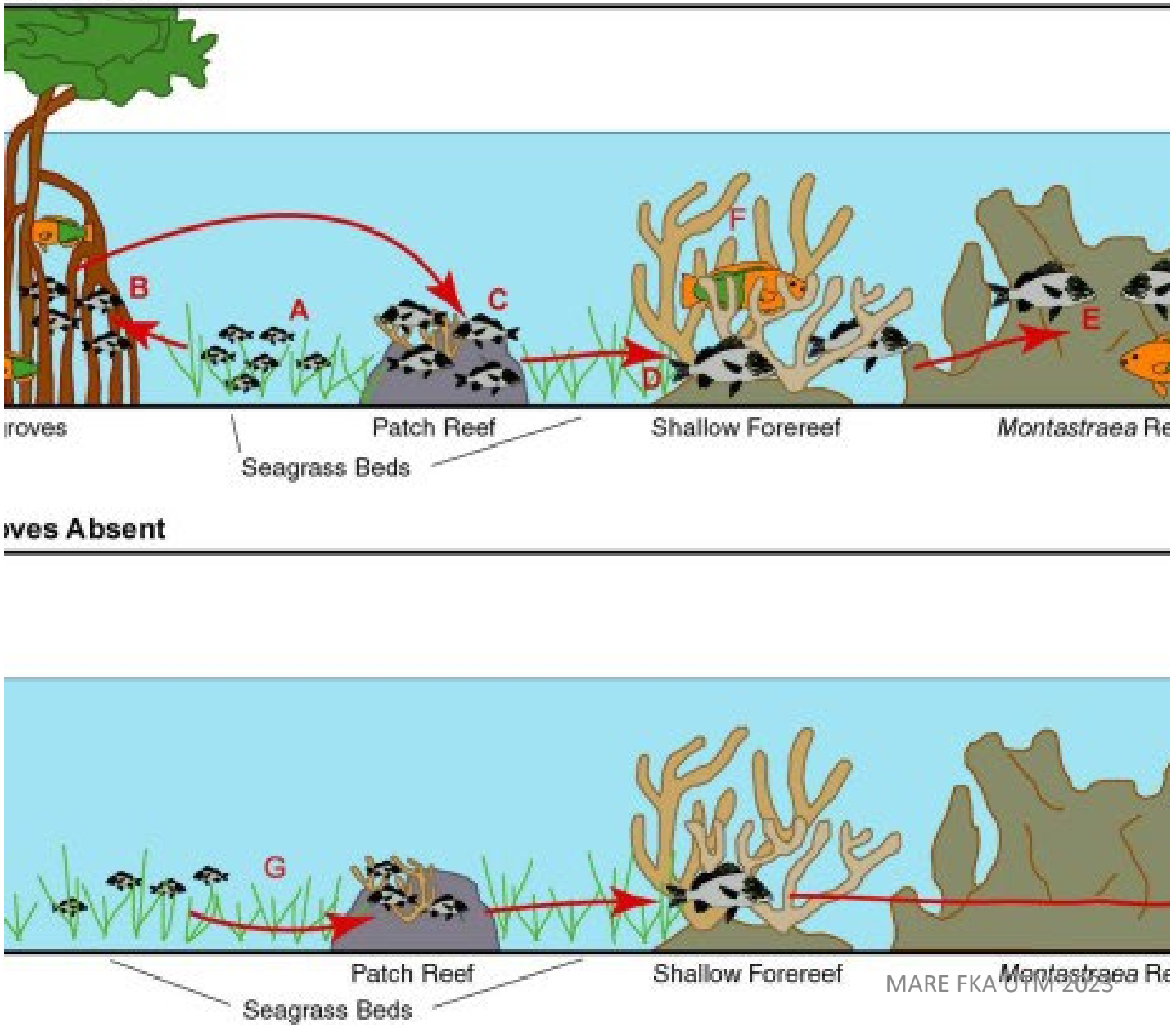

Mangroves, Seagrass beds & Coral Reefs

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Threats to Mangrove habitat

Changes to rivers seriously affects mangroves: diverting rivers, dams which affect water flow. Without inflows of freshwater, the water becomes too salty even for mangroves. Without water altogether, mangroves dry out and die.

Deforestation: results in soil erosion and massive siltation which smother the mangroves, and erratic water flows which dries out the mangroves during droughts.

Mangrove fragmentation: like rainforests, mangroves become vulnerable when they are fragmented into smaller clumps. They withstand strong waves and storms when they form a deep barrier.

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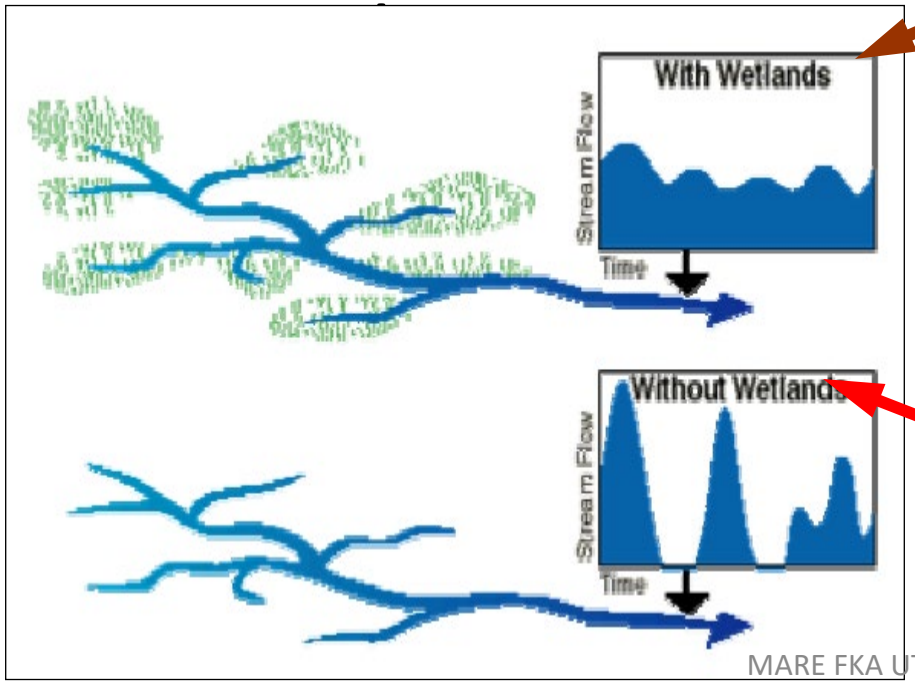
Housing developments vs. mangroves

NATURAL FUNCTIONS OF WETLANDS

Hydrological & hydraulic functions

- storm protection
- **coastal erosion protection**
- **water holding capacity**



With wetlands
- diminished peaks
- consistent base flow

Without wetlands
- exaggerated peaks (floods)
- inconsistent base flow (drought)

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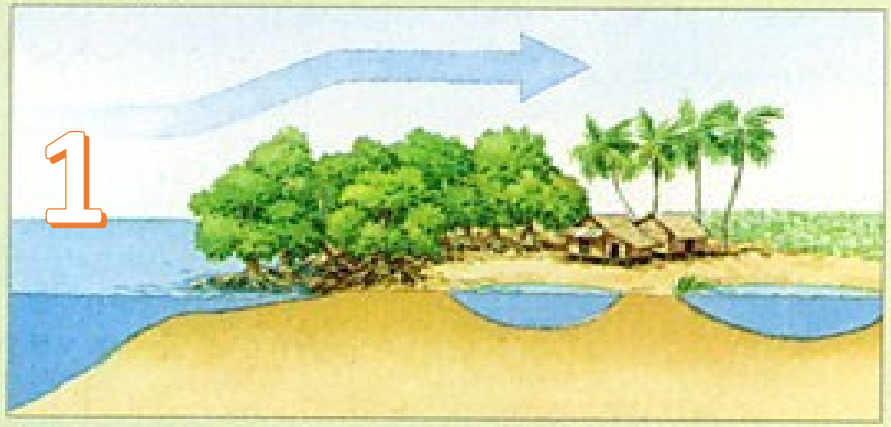
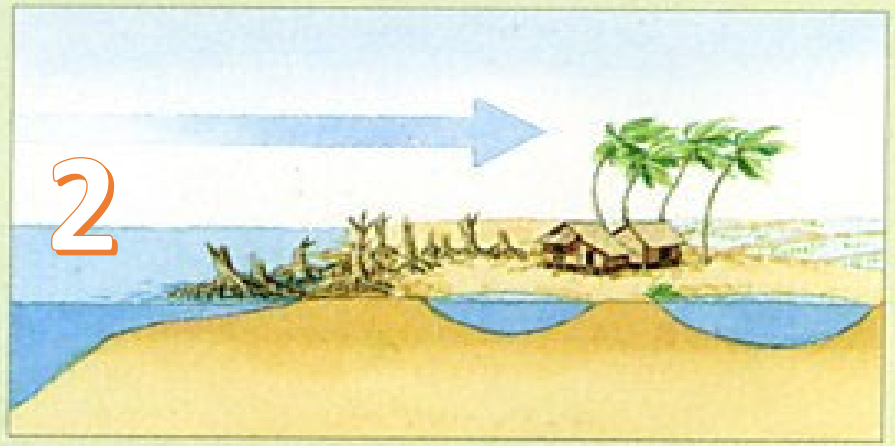
Environmental benefits of mangroves



Mangroves provide shelter from the wind.



Cutting down mangroves means exposure to storms.

Mangroves protect the shoreline.

Felled mangroves can lead to flooding and coastal erosion.

Source: After Davies and Calridge (eds.) (1993), Wetlands International

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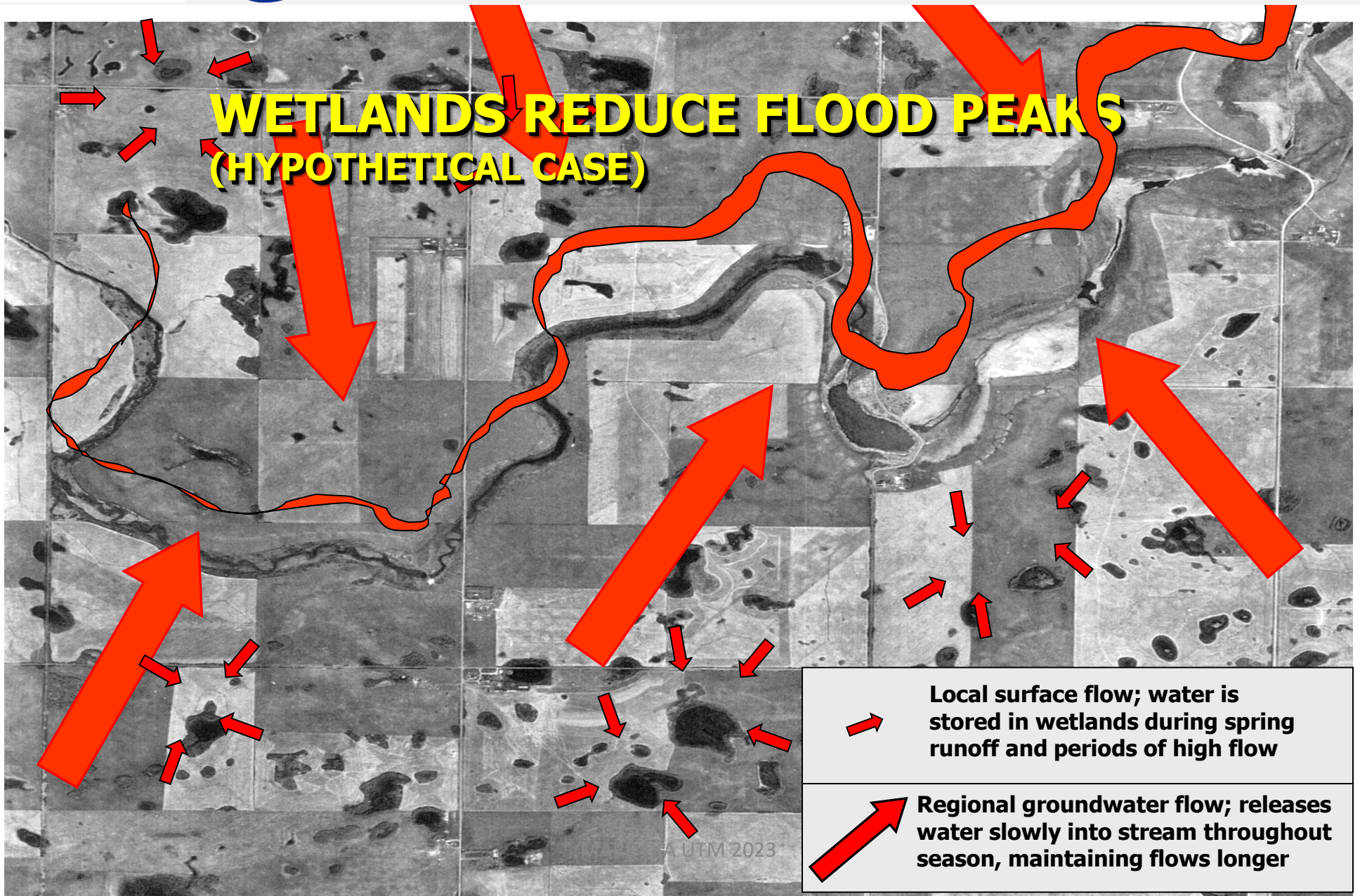
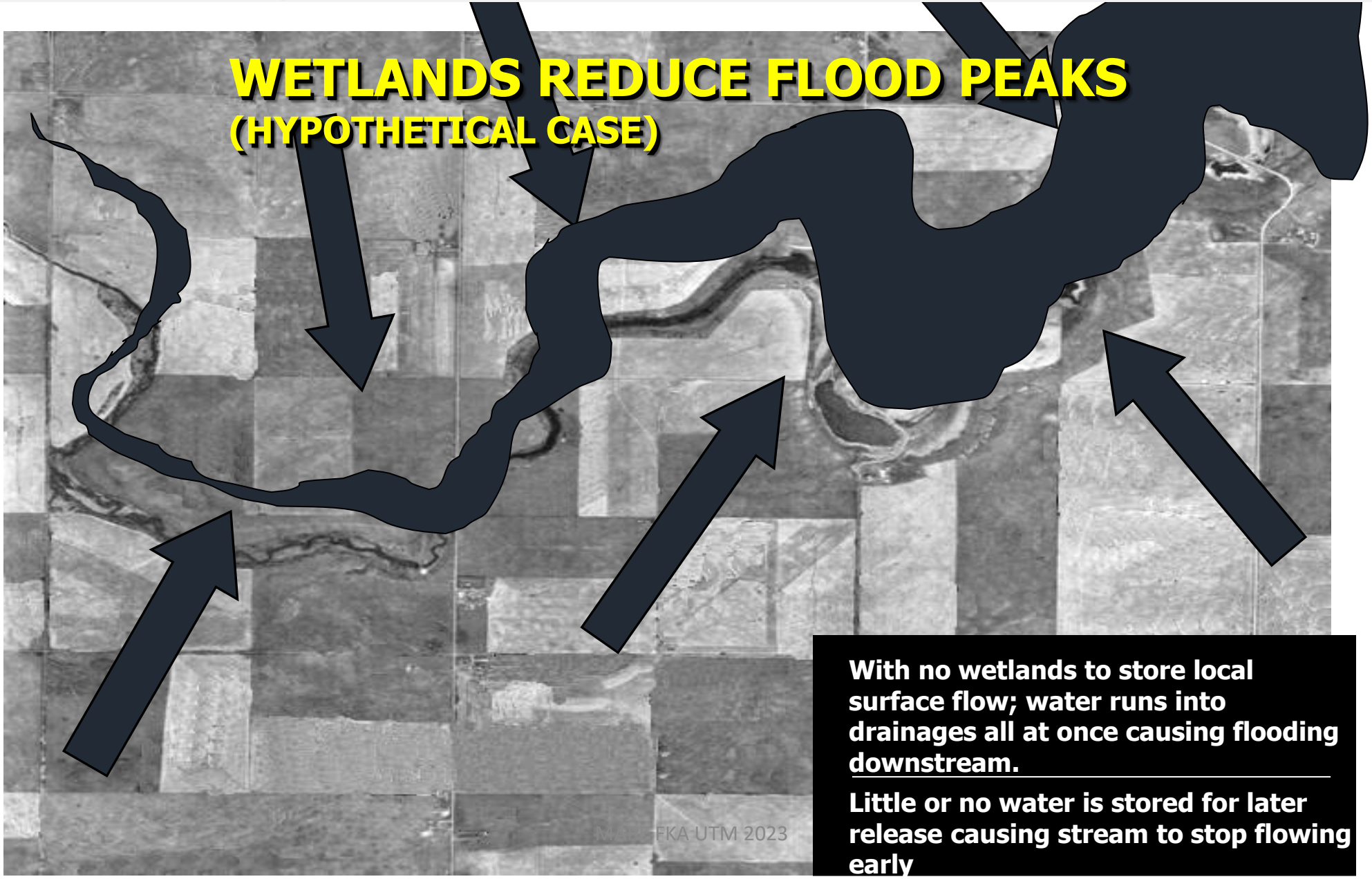


WETLANDS REDUCE FLOOD PEAKS
(HYPOTHETICAL CASE)



With no wetlands to store local surface flow; water runs into drainages all at once causing flooding downstream.

Little or no water is stored for later release causing stream to stop flowing early

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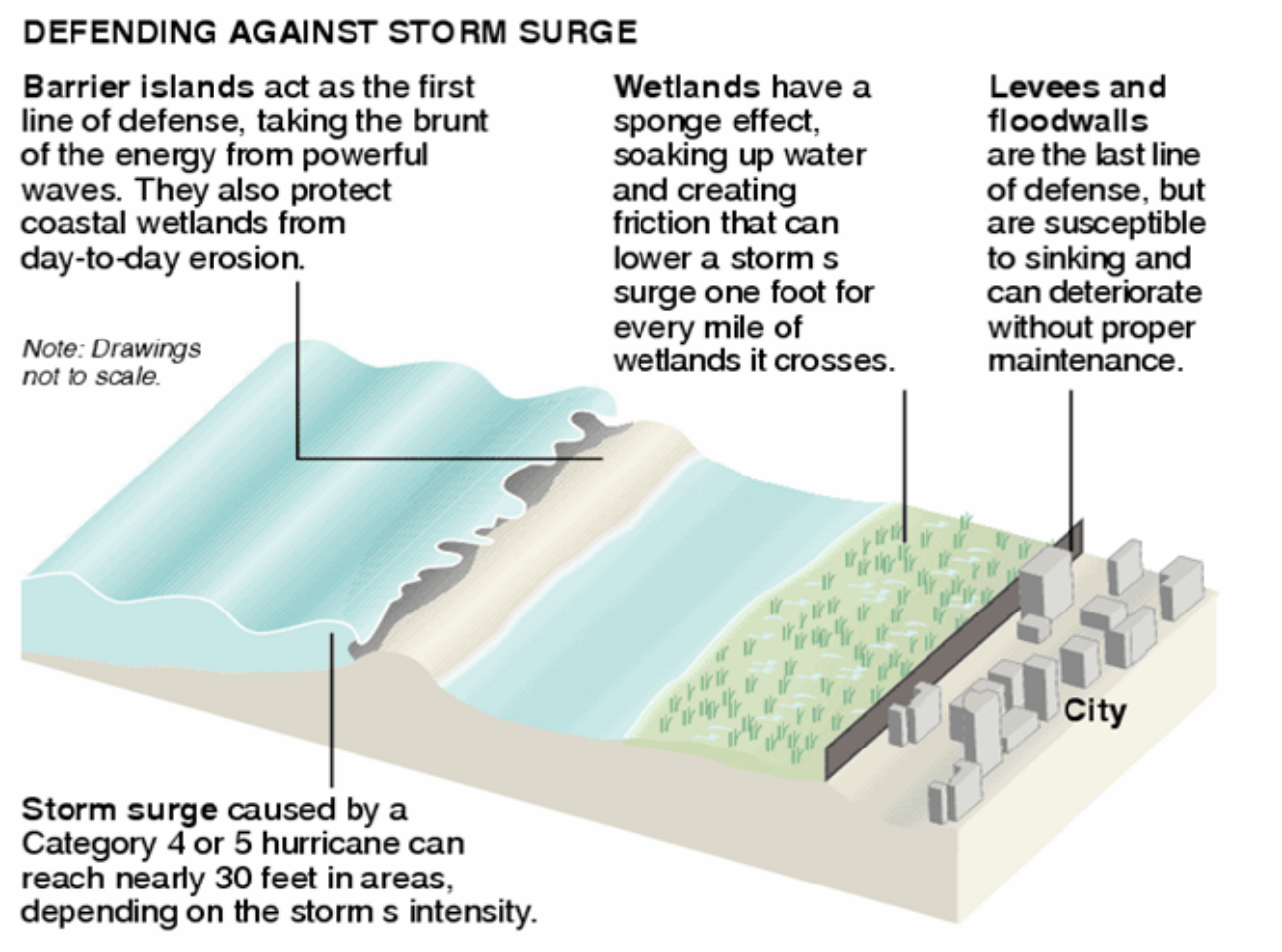
Coastal wetlands act like giant sponges

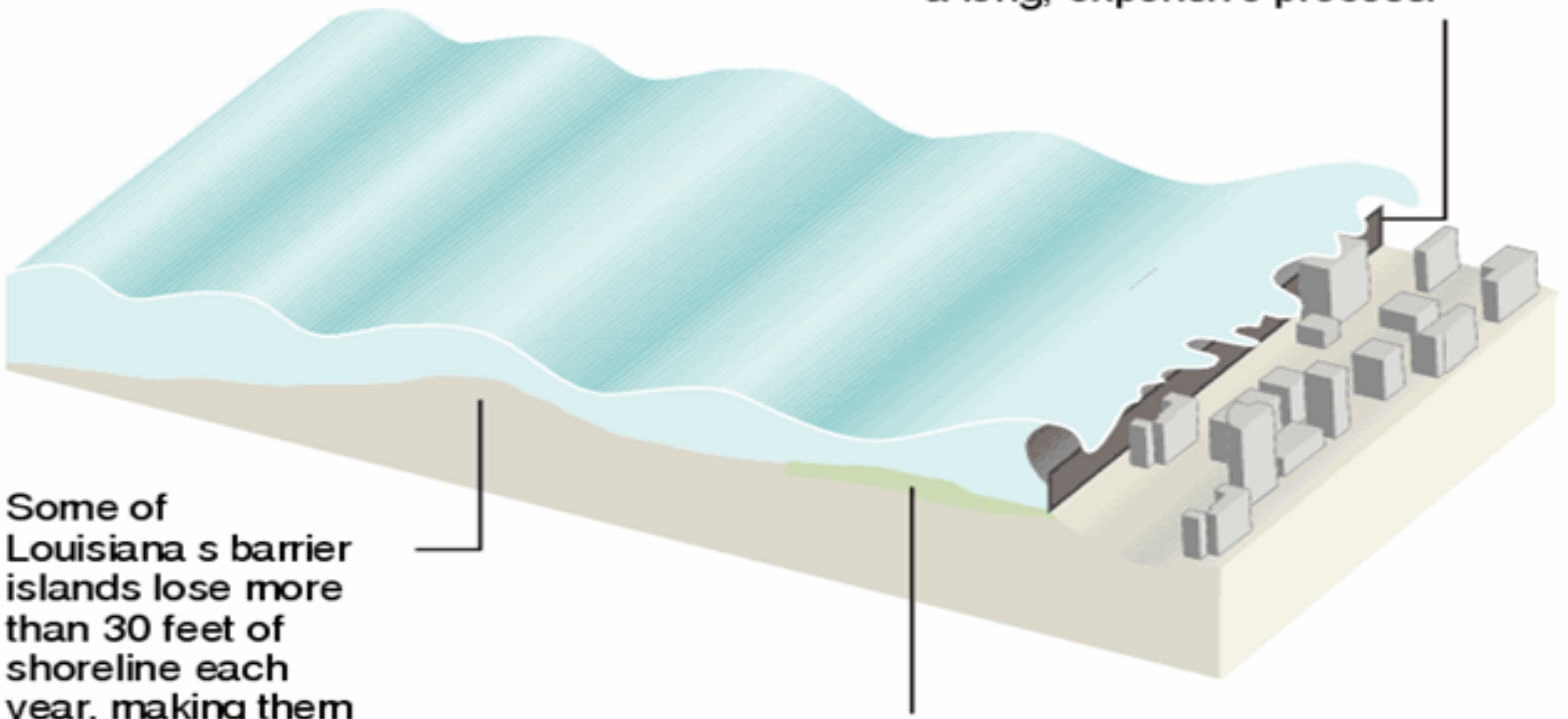
- Soaking up storm water
- Reduces the chance of flooding
- A single acre of wetland, saturated to a depth of one foot

wetland could defend against storm surge such as the Katrina ……



WHEN NATURAL DEFENSES FAIL

As natural barriers disappear, levees and floodwalls must be built higher and stronger a long, expensive process.



Some of Louisiana s barrier islands lose more than 30 feet of shoreline each year, making them less effective in minimizing the waves from a storm surge.

Louisiana is losing an estimated 25 square miles of wetlands each year. Without the absorption of the wetlands, the surge races unimpeded toward the coast.

Shrimp Farms

GROUP WORK: LET'S DISCUSS!

Discuss the negative effect of:

- Prawn Aquaculture at estuary
- Fish Aquaculture at wetlands
- Tourism at mangrove
- Housing area at wetlands
- Human interaction with Intertidal area

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WETLANDS ARE THE CRITICAL LANDSCAPE NEXUS BETWEEN

Land and water • Oceans, rivers, lakes, and streams • Human-dominated and natural landscapes

WETLAND PROTECTIVE ECOSYSTEM SERVICES

- **Groundwater replenishment**
- **Flood control and storage**
- **Shoreline stabilization**
- **Erosion control**
- **Storm protection**
- **Fire protection**

Other ecosystem services:

Hunting, fishing • Birdwatching
Water purification • Carbon storage

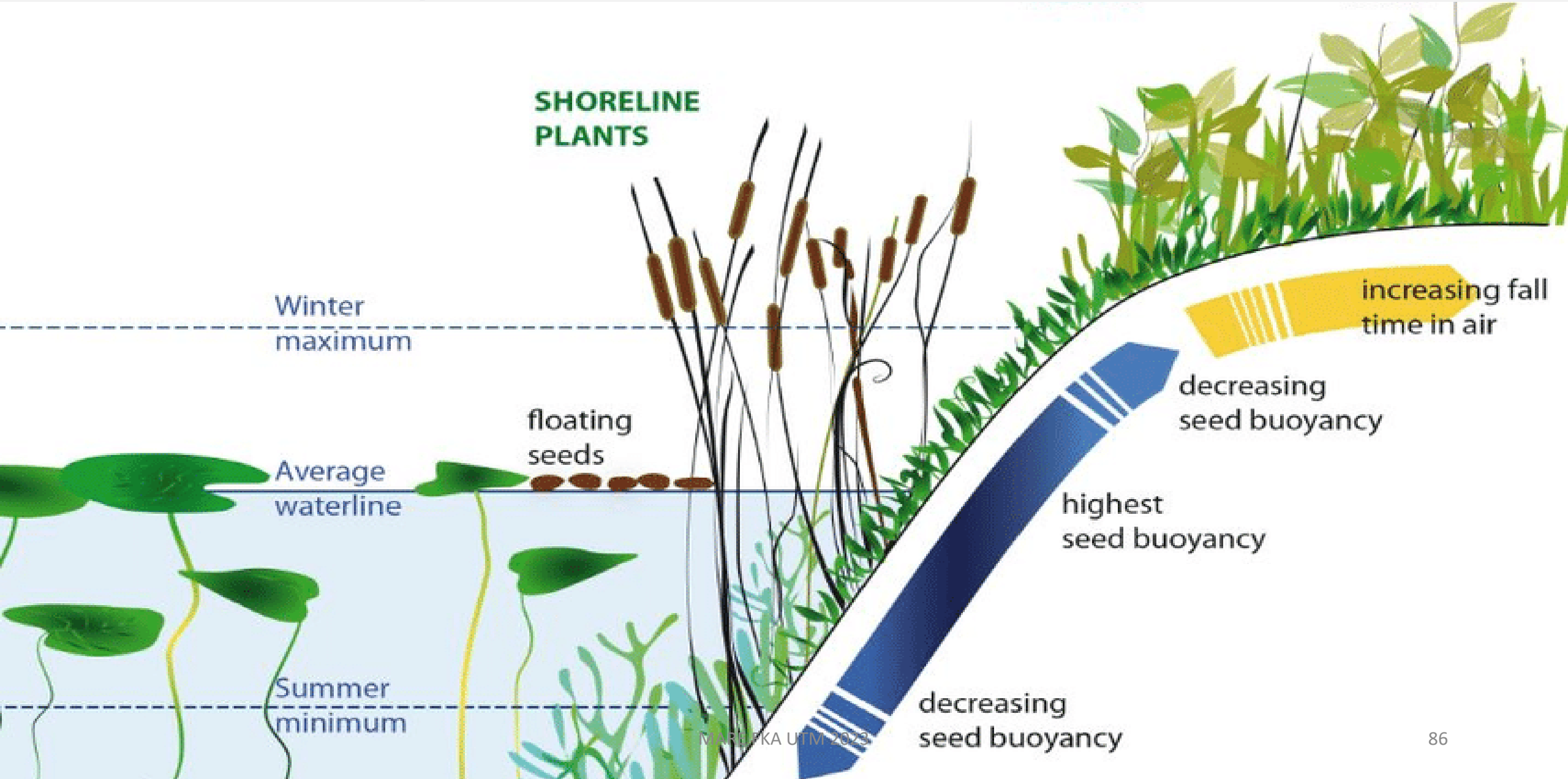
INTERAGENCY WETLAND COMMISSION

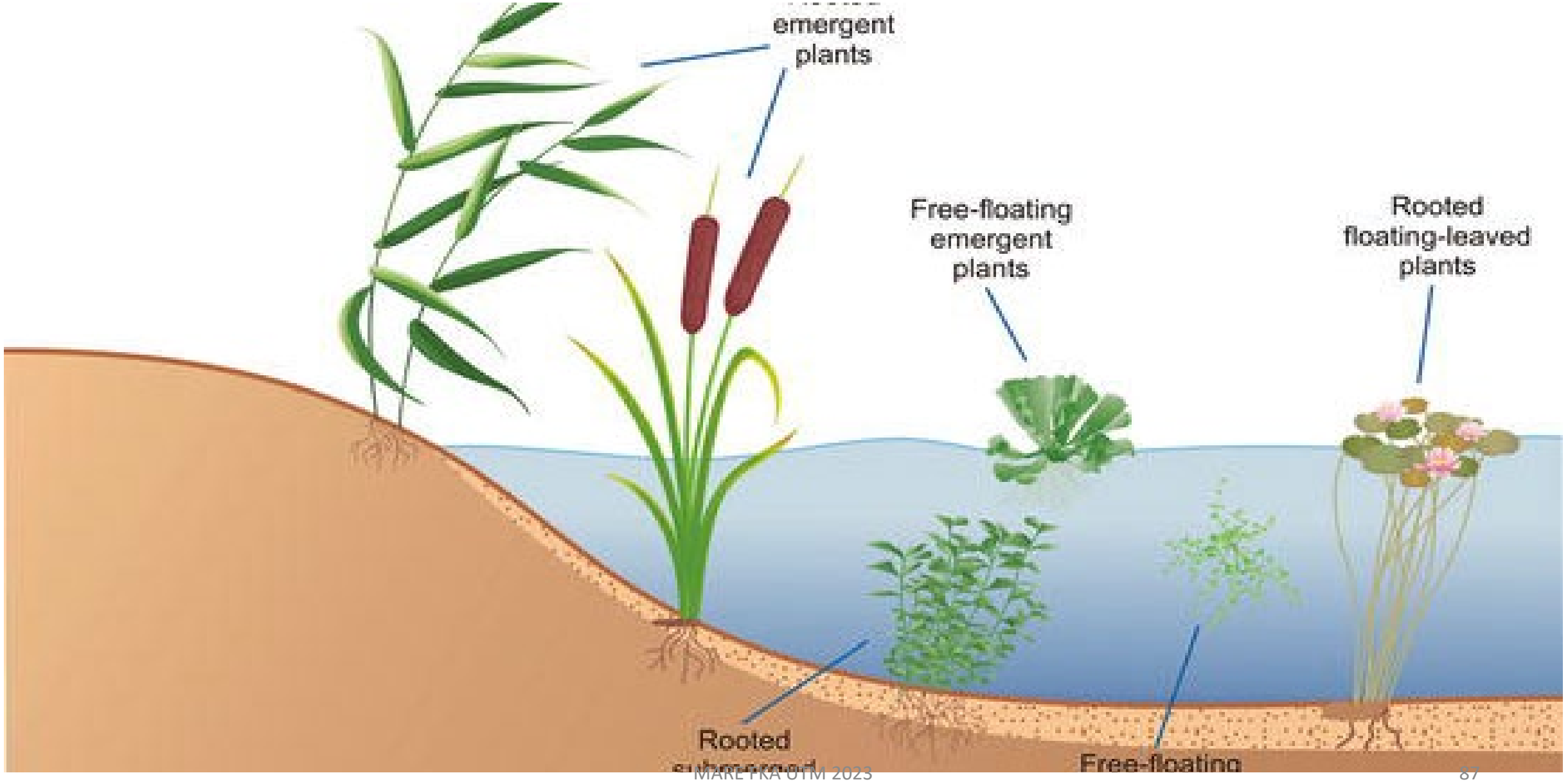
Wetland integrated planning acro

- Land and water resources
- Environmental management
- Human communities and infrastructur
- Disaster risk reduction

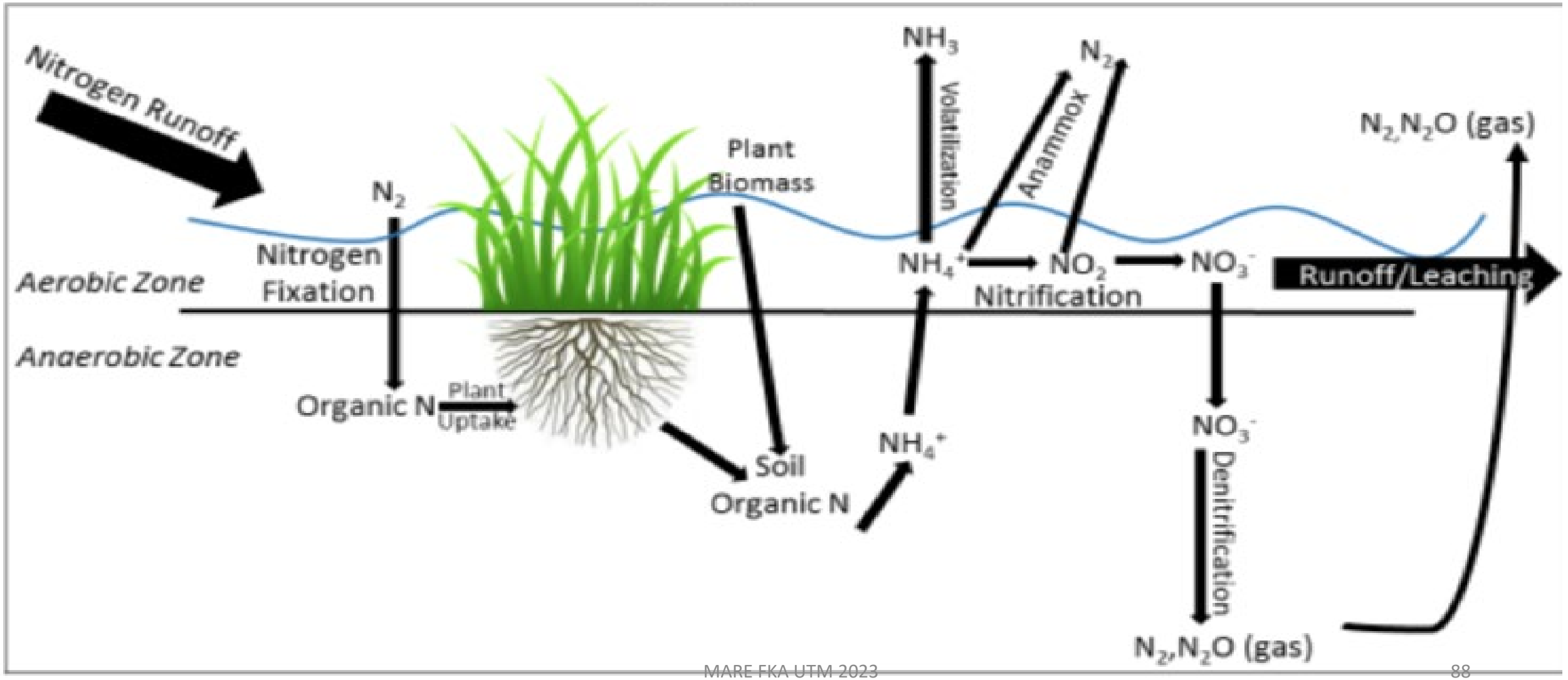
Wetland-relevant agencies and programs from:

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Homeland Security
- Department of Housing & Urban Development
- Department of Interior
- Department of Transportation
- Environmental Protection Agency

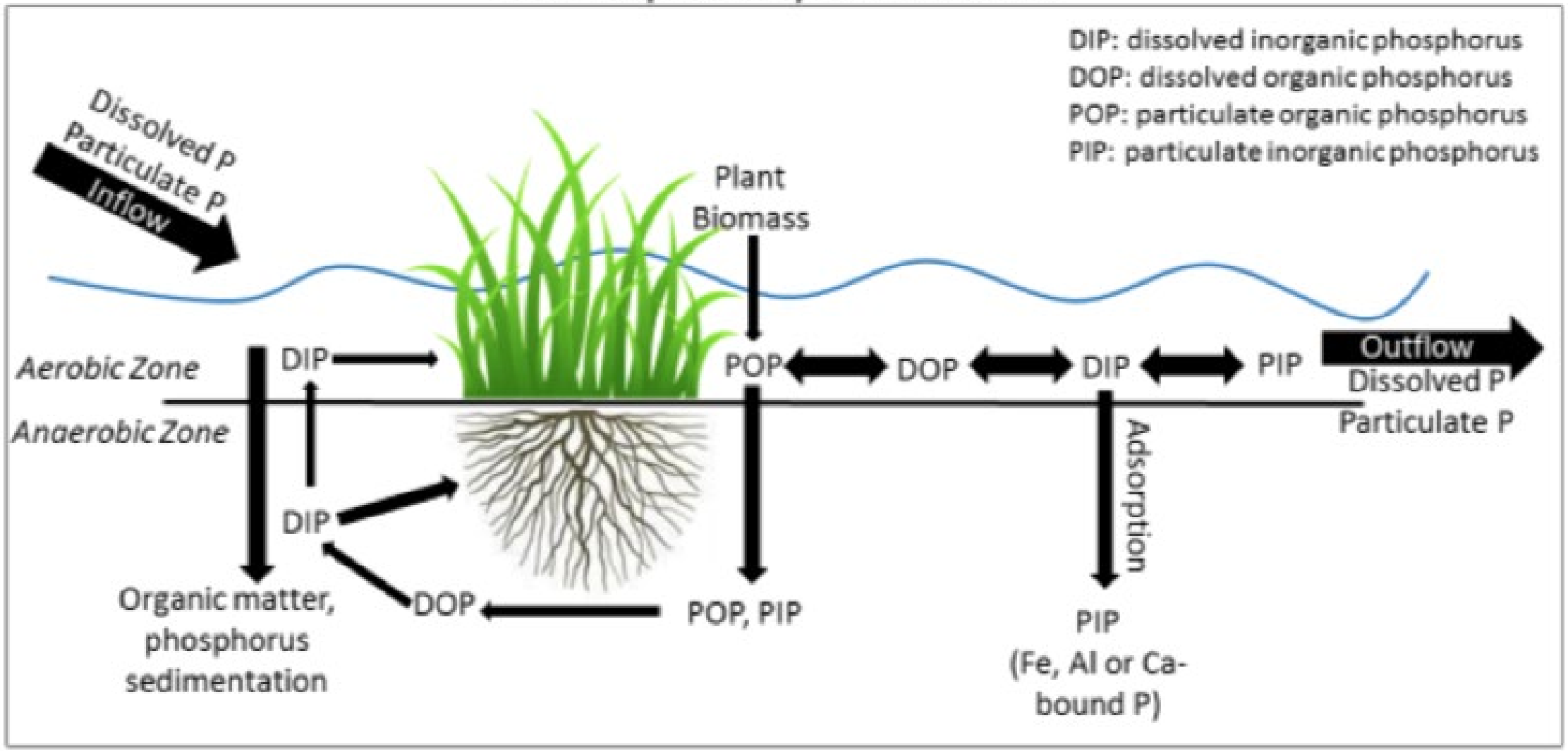

SHORELINE
PLANTS
Winter
maximum
floating
seeds
Average
waterline
Summer
minimum
increasing fall
time in air
decreasing
seed buoyancy
highest
seed buoyancy
decreasing
seed buoyancy

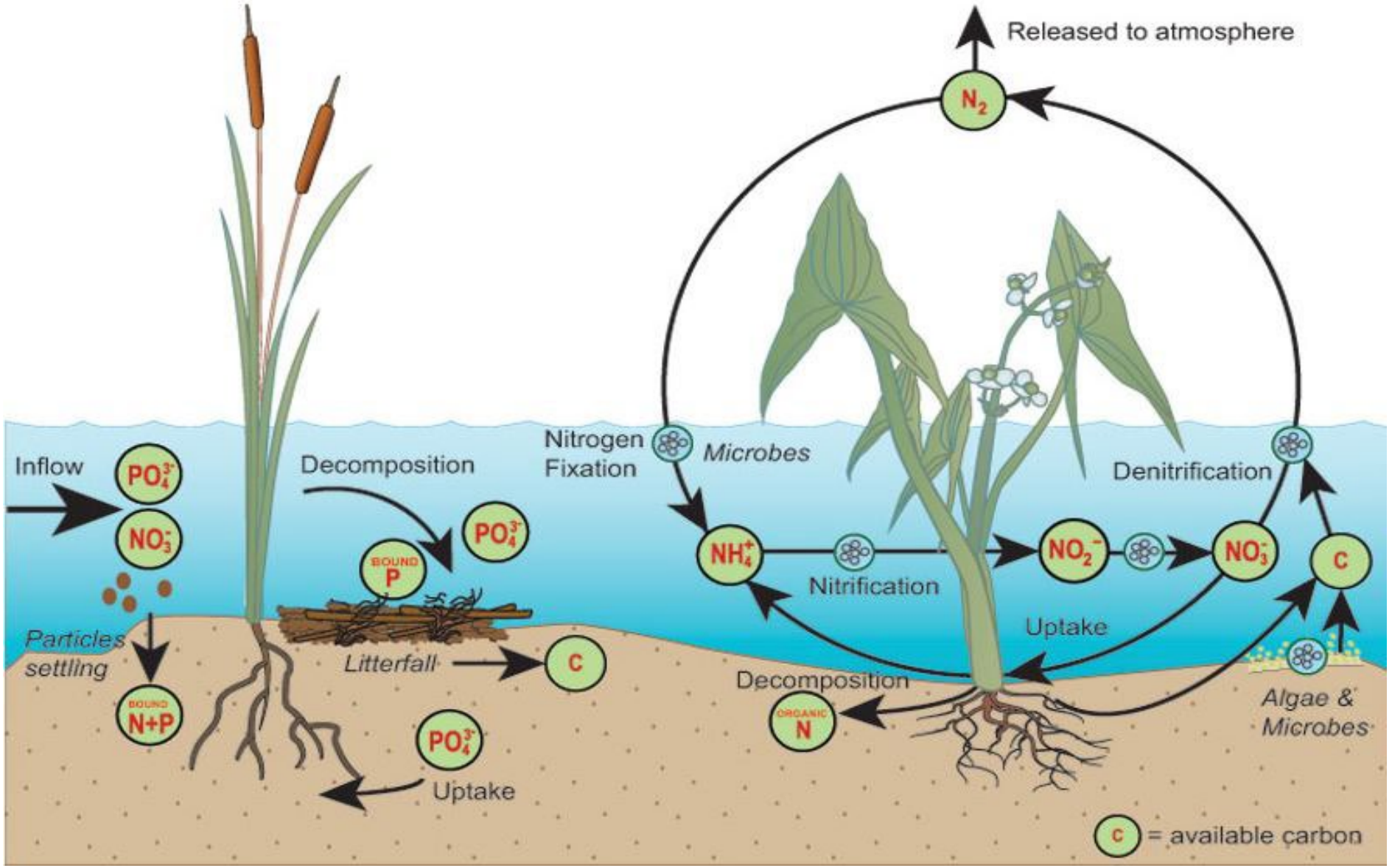

emergent
plants
Free-floating
emergent
plants
Rooted
floating-leaved
plants
Rooted
Free-floating

The Nitrogen Cycle in Wetlands



The Phosphorus Cycle in Wetlands




Released to atmosphere
N_2
Inflow
PO_4^{3-}
NO_3^-
Particles settling
BOUND N+P
Decomposition
PO_4^{3-}
BOUND P
Litterfall
C
PO_4^{3-}
Uptake
Nitrogen Fixation
Microbes
NH_4^+
Nitrification
NO_2^-
NO_3^-
Denitrification
C
Uptake
Decomposition
ORGANIC N
Algae & Microbes
C = available carbon

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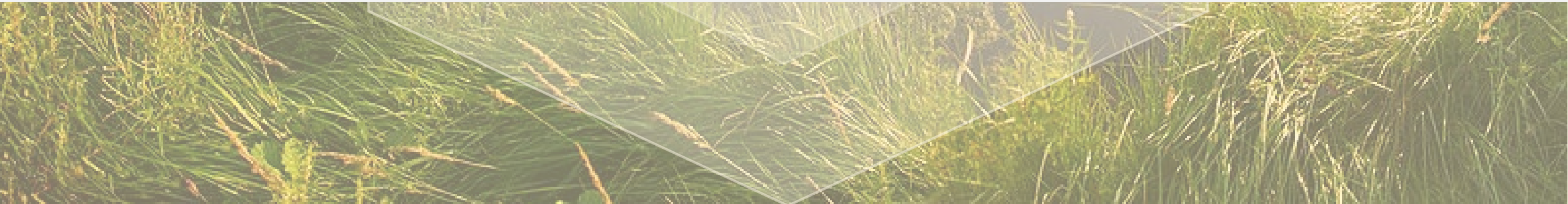
MARE

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

TOPIC: WETLAND

MEAK1003: Environmental Management and Sustainability

CONSTRUCTED WETLAND



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What are constructed wetlands?

Constructed wetlands are designed and built similar to natural wetlands to treat wastewater.

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Why Build Wetlands

- Constructed wetlands provide simple and effective wastewater treatment.
- They can be used to treat domestic, agricultural, industrial and mining wastewaters.
- Their construction costs are much less (50 to 90%) than conventional systems and their operating costs are very low.
- Constructed wetlands are also pleasant to look at, attract desired wildlife, and provide environmental education opportunities.

Types of Constructed Wetland

There are two types of CWTSs.

- Free Water Surface System (FWS)
- Subsurface Flow System (SF)

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Types of Constructed Wetlands

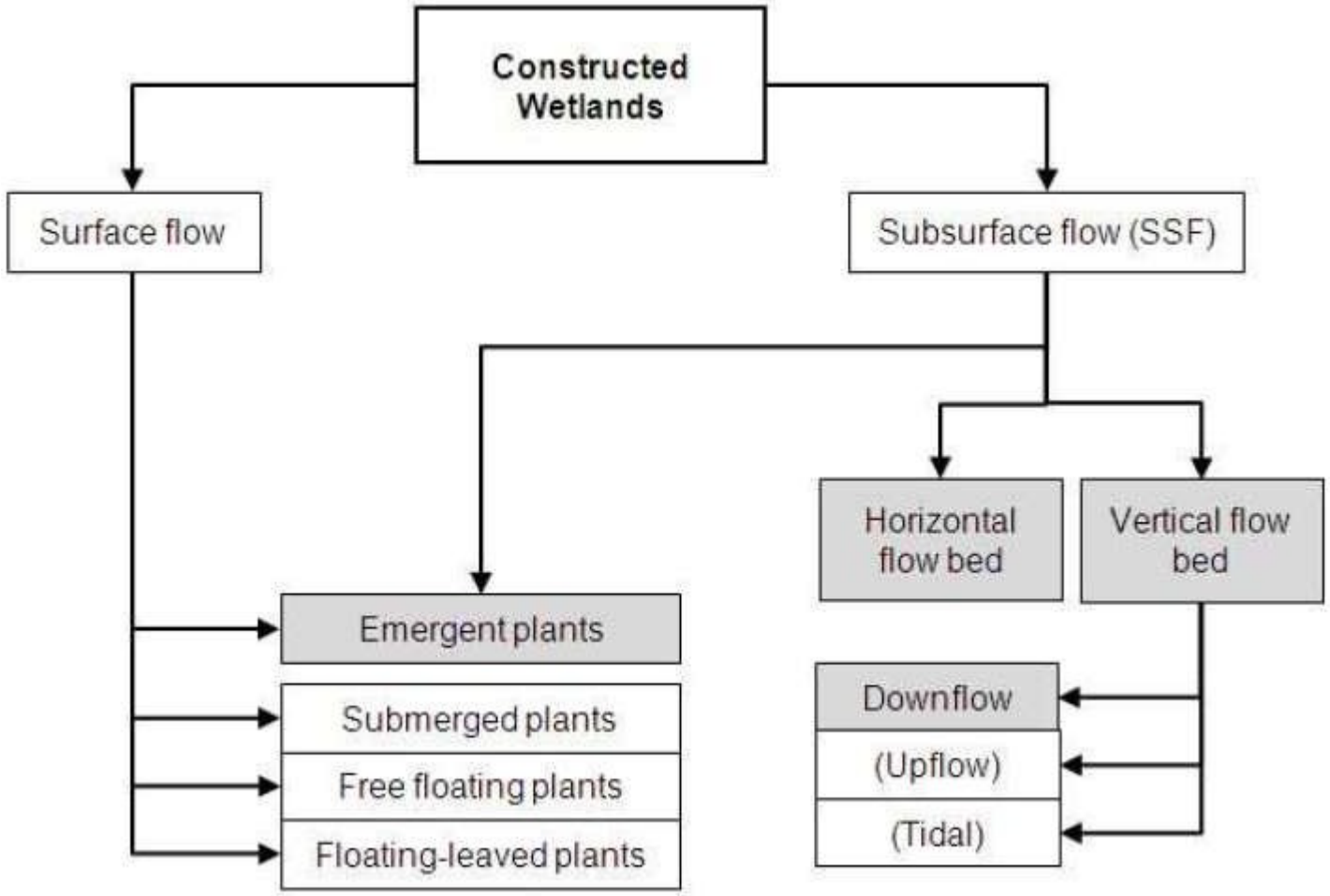
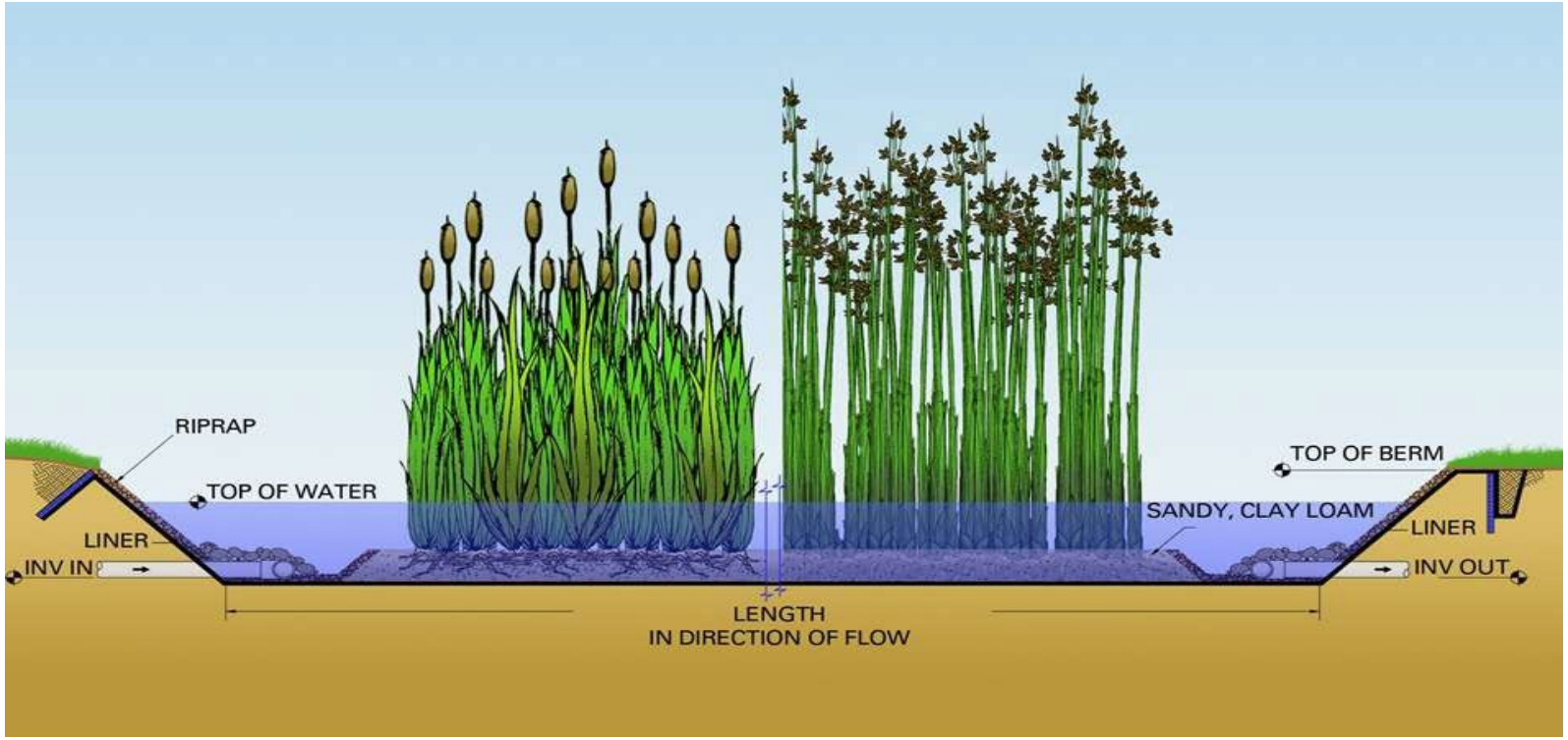


Image courtesy of GIZ Sustainable Sanitation Ecosan

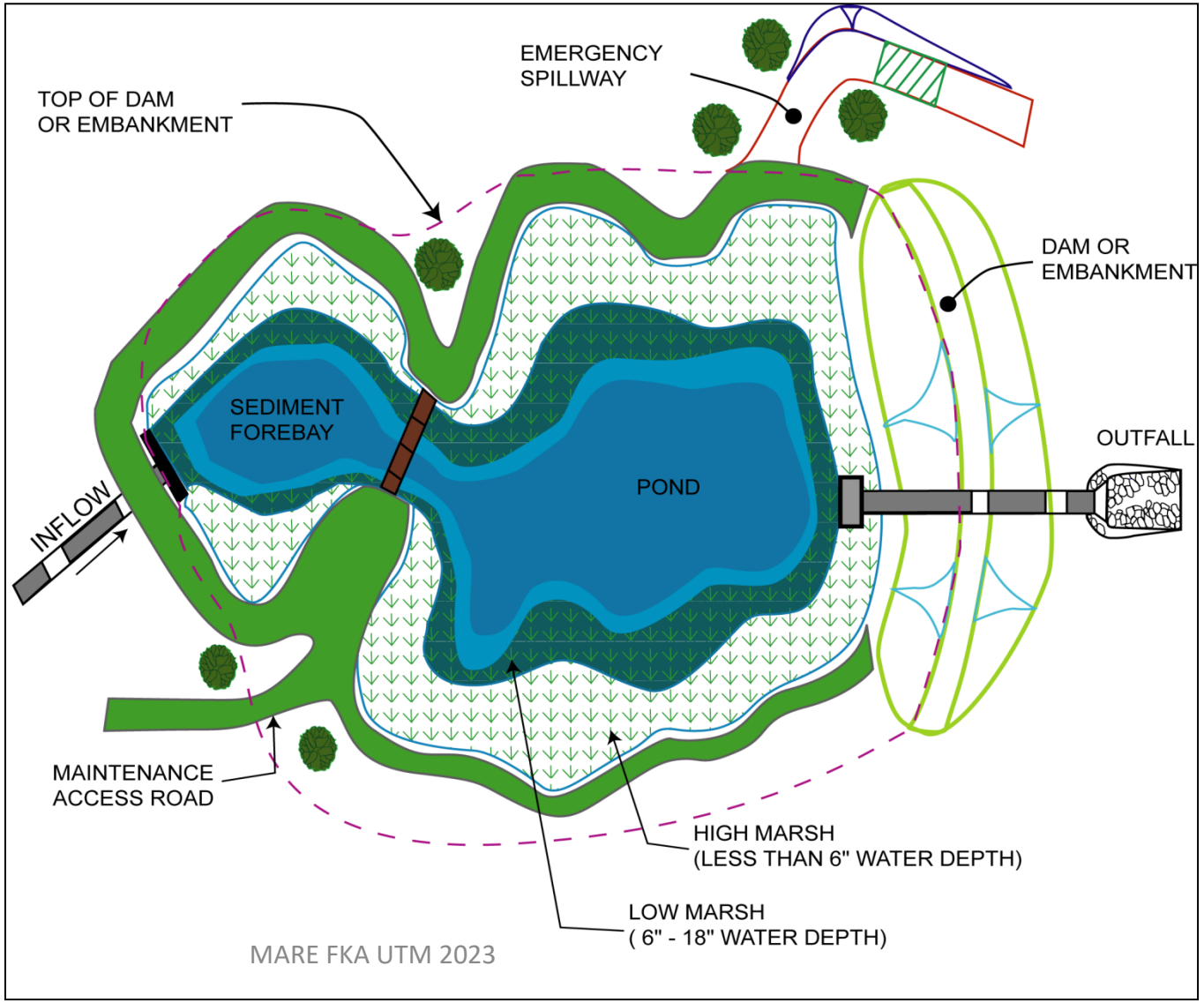
Free water surface system (FWS)



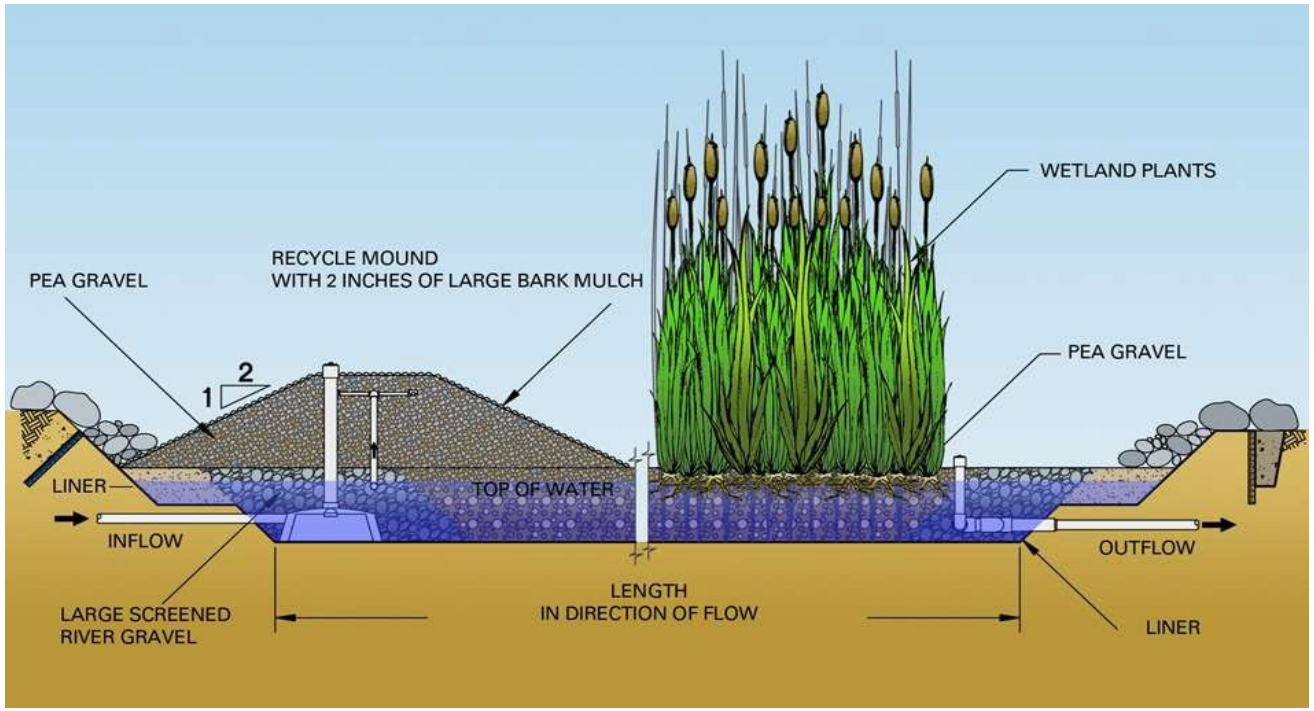
- A shallow bed or channel with aquatic vegetation.
- The contaminated water to be treated in this system is exposed to the atmosphere.

Constructed Stormwater Wetland

- **Generally surface flow**
- **Low levels of contaminants**



Subsurface Flow System (SF)



- Water to be treated is not exposed to the atmosphere.
- An SF wetland is a bed of permeable media that supports the root system of vegetation.
- The water level is maintained below the top of the treatment media (subsurface).
- A complex matrix of distinct aerobic and anaerobic treatment zones becomes established, which improves wastewater treatment.

REFERENCES

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- 3. Gannmon, P. Introduction to Energy, Environment and Sustainability, Kendall Hunt Publishing Company. 2013
- 4. Kerr, J.A. Introduction to Energy and Climate: Developing a Sustainable Environment. CRC Tailor and Francis Group. 2017.

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Thank you