

Nature-Based Solution for Flood Management at Nong Sua District, Rangsit Canal, Thailand

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Objective :

To apply and evaluate concept of
Nature-Based Solution (Room for a River)
in Thailand

Outline :

01

Concept of
Nature-Based
Solution
(Room for a River)



02

Retention
Area in Chao
Phraya River
Basin



03

Case Study :
Nong Sua
District
(High Water
Channel)



04

Conclusions
and Future
Works



01 Concept of Nature-Based Solution (Room for a River)

Natural-Based Solutions

- ▶ “Actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, providing human well-being and biodiversity benefits”.

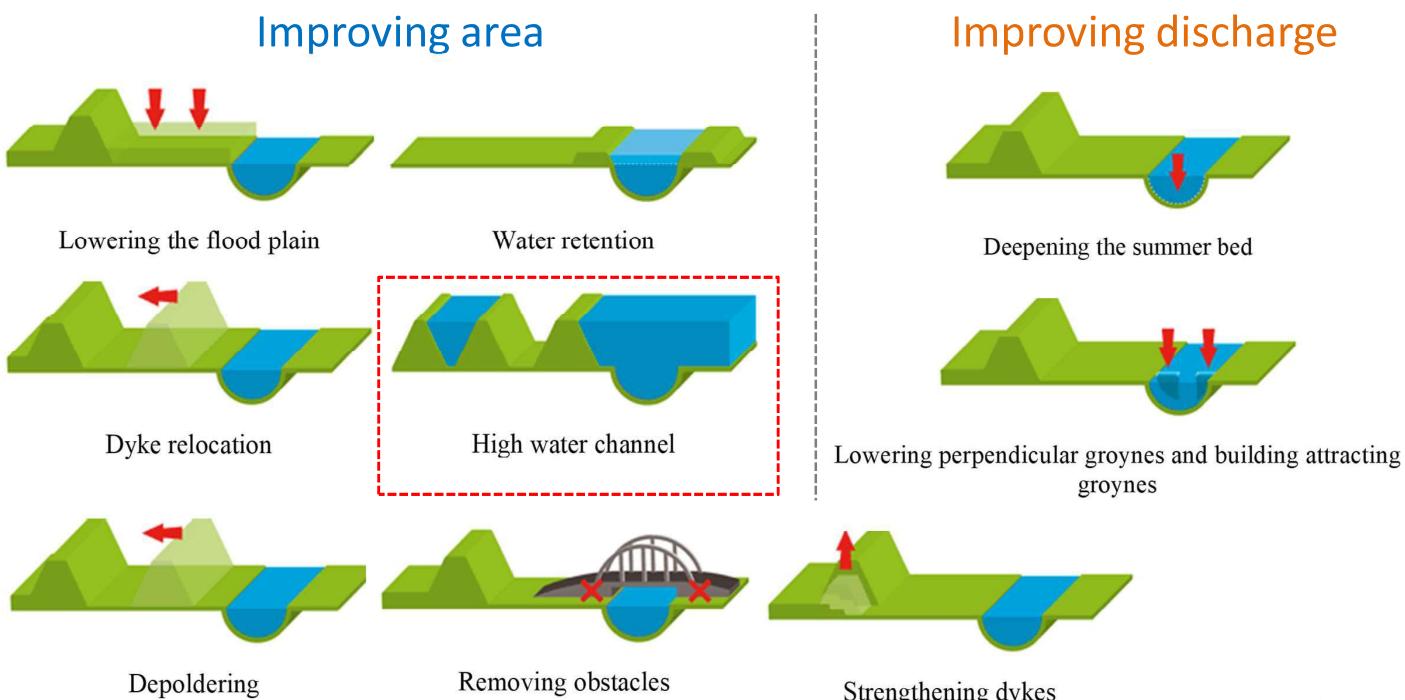
- ▶ Water Cycle



3

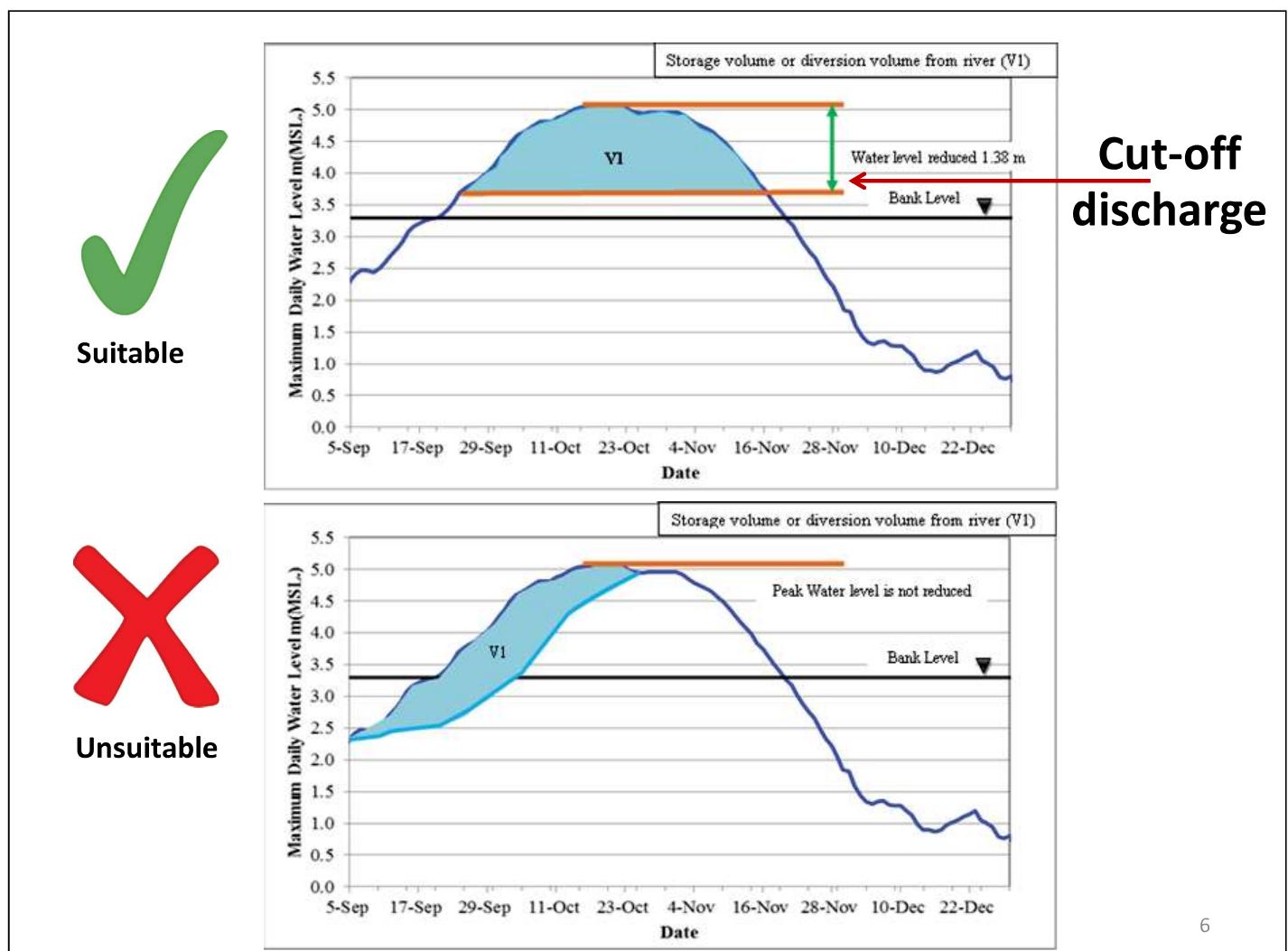
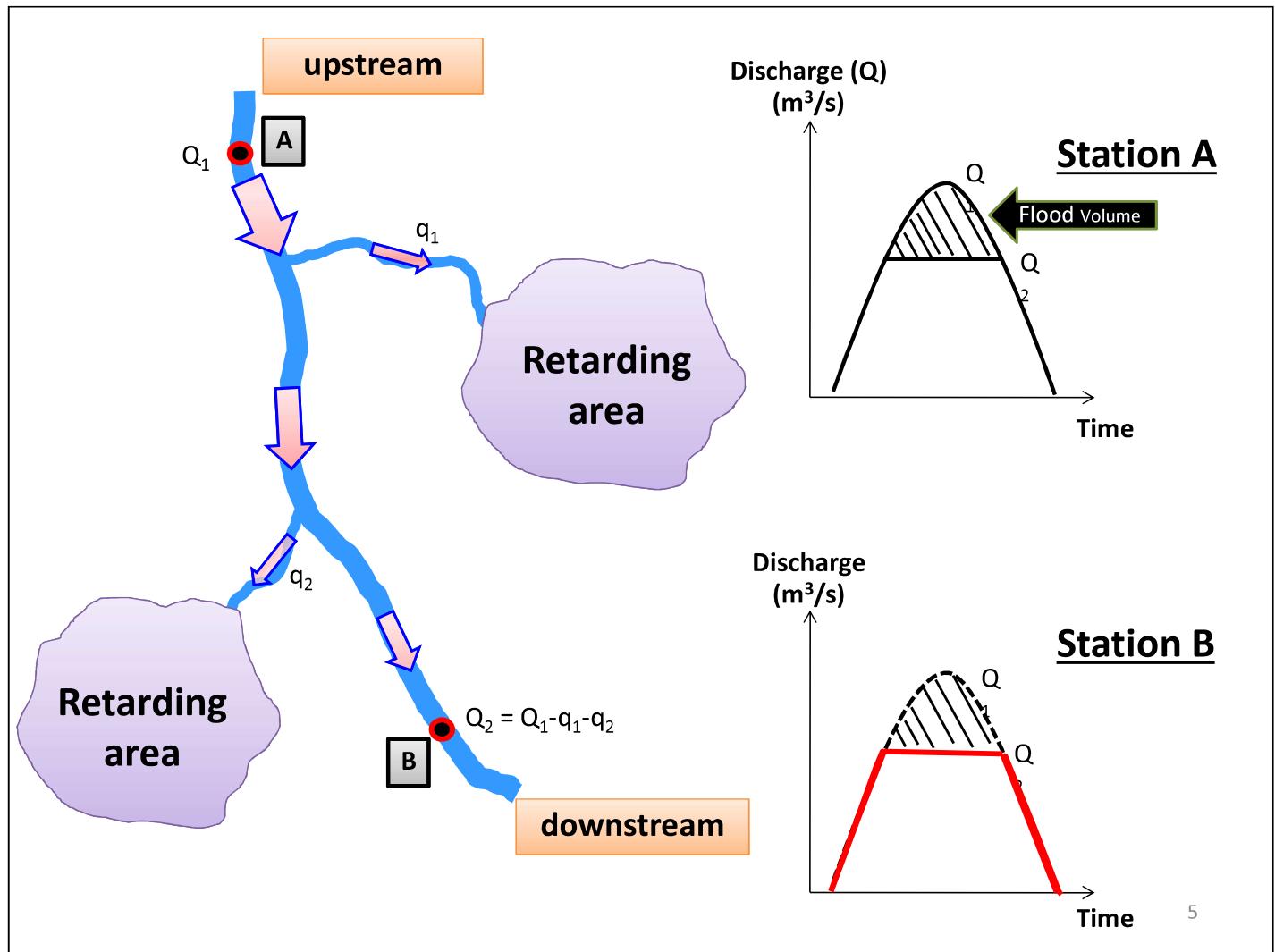
The concept of Room for the River (RFR)

- ▶ To provide the space to be able to carry and manage high water level (roomfortheriver.nl, n.d.)
- ▶ The non-structural measures to reduce and mitigate the damages from flood hazard (Francés, et al., 2008).



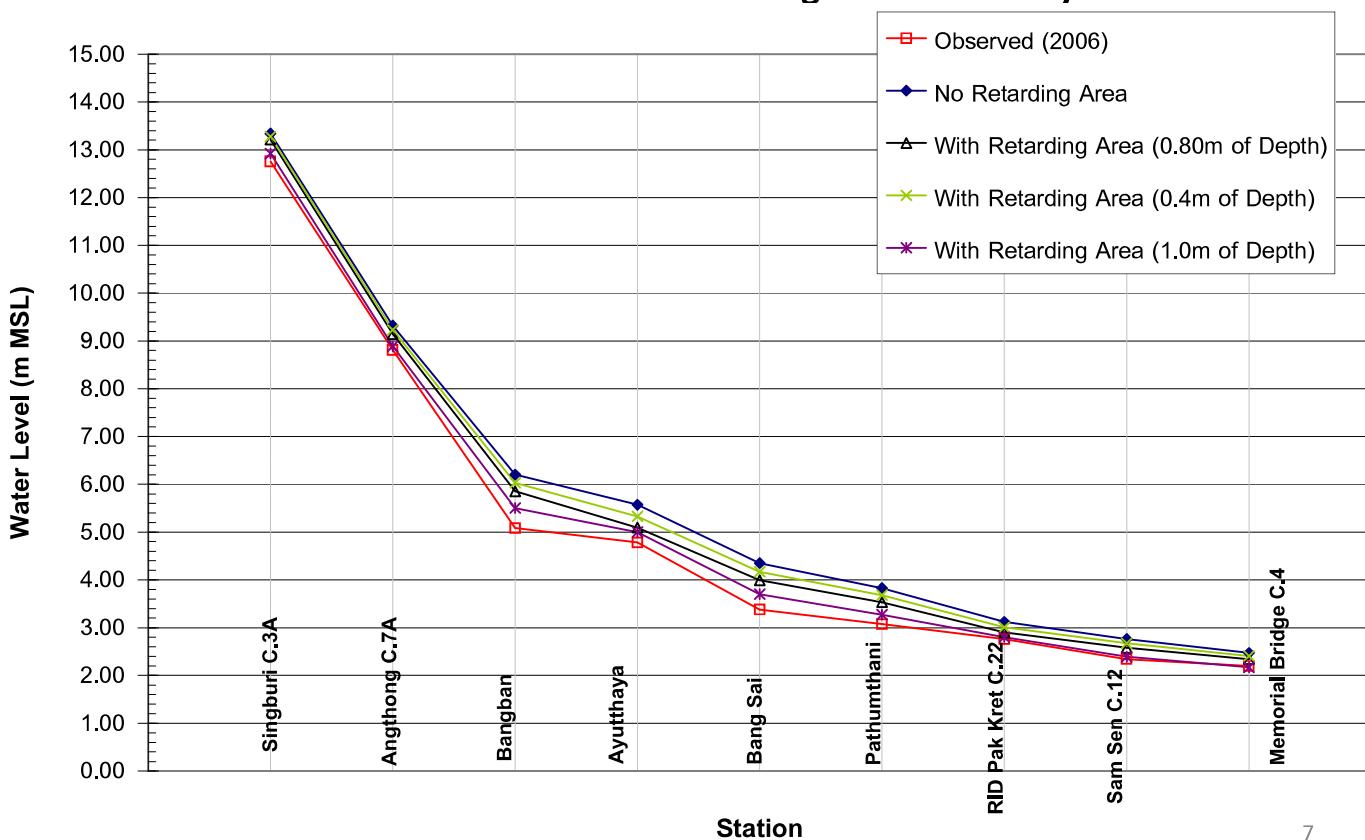
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2



02 Retention Area in Chao Phraya River Basin

Water Level at Different station along the Chao Phraya River

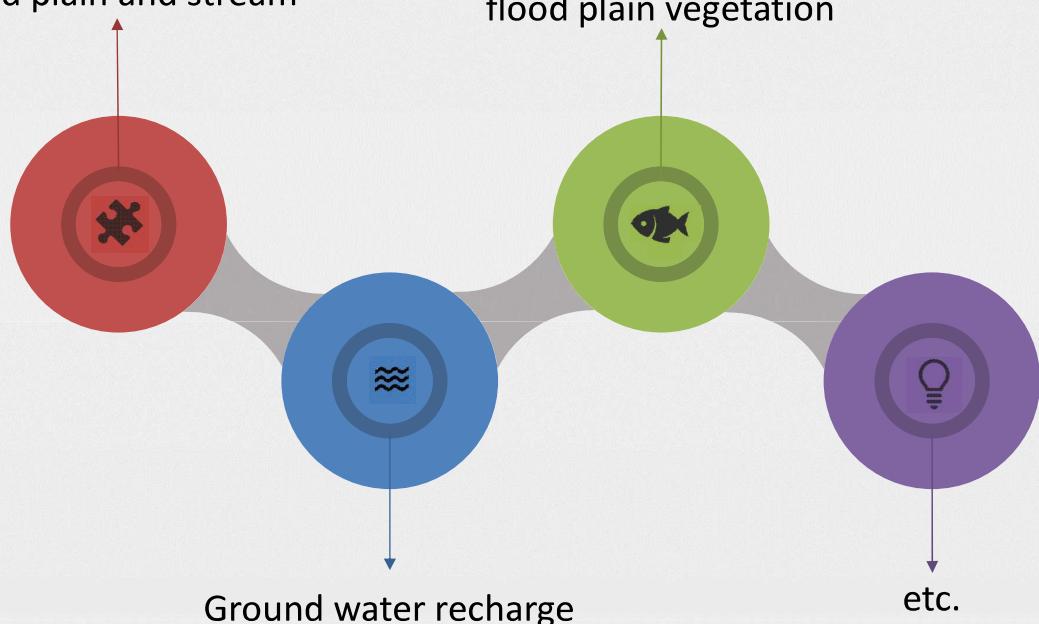


7

Benefit of flood

Transfer nutrients & organic matter better flood plain and stream

Reestablishment of aquatic , riparian and flood plain vegetation



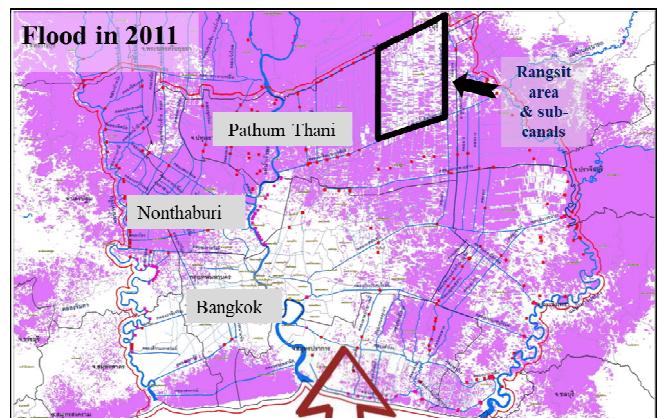
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4

03 Case Study : Nong Sua District (High Water Channel)

Background

- Rangsit canal was excavated in 1890, and the paddy cultivation started in 1895 (100 years of Rangsit canal, 1990).
- The irrigation system of the Rangsit area was the flood irrigation and changed to gravitational irrigation in 1964.
- The area has the problem with acid soil



2011

Huge flood occurred in Thailand
The community allowed flood
come into the area

1991

Epidemic of citrus disease

2004

Try to plant oil palm in furrows
instead of orange trees

2012

The income –booster
retention area project
started in Rangsit area.

1984

Started orange
orchard / Changed
paddy field to furrow

1995

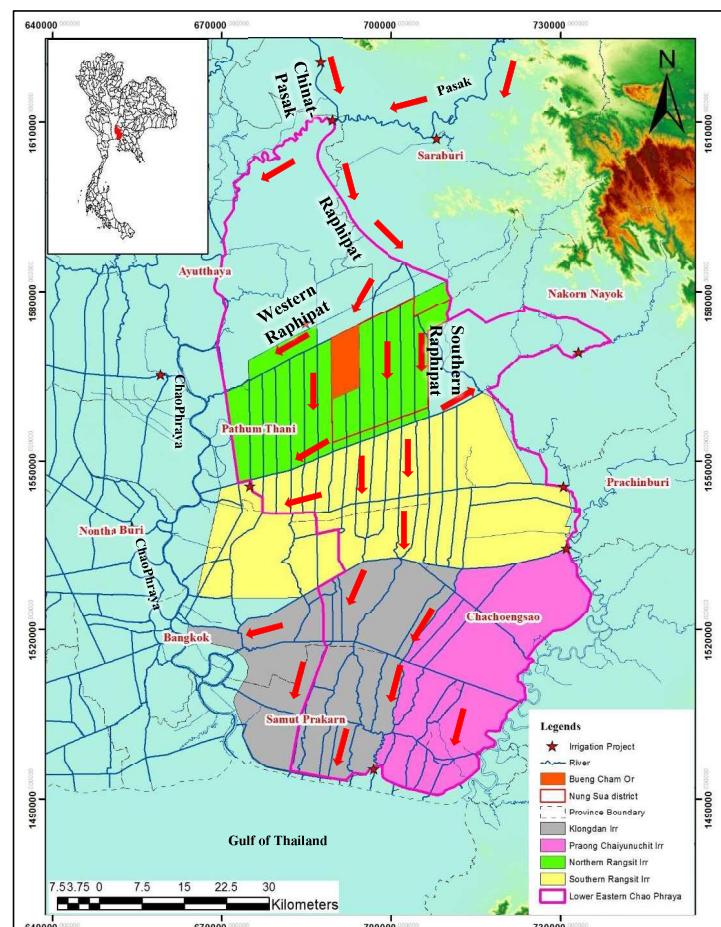
Over 150,000 Rai or 240
km² of agriculture area
were in debt.

2007

Oil palm plantation
increased due to higher
income

9

- One part of the Lower Eastern Chao Phraya river basin.
- Receive water from Pasak river in Pasak river basin
- Average annual rainfall
 - 1,290 mm.
- Flood in Pasak river
 - Average 646 m³/s
 - Max. 3,250 m³/s
 - Min. 178 m³/s
- To divert water from Western Raphipat canal and distribute to furrows and canal networks.



River system in Rangsit area

► Structure (Regulator)

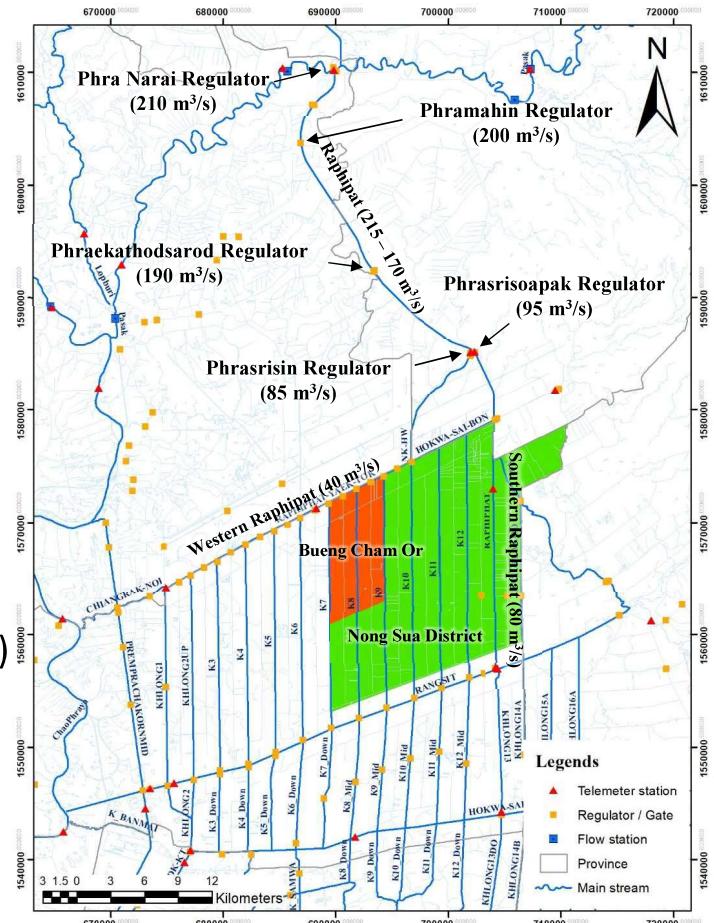
- Phra Narai (210 m³/s)
- Phramahin (200 m³/s)
- Phraekathodsarod (190 m³/s)
- Phrasrisin (85 m³/s)
- Phrasrisoawapak (95 m³/s)

► Main canal

- Raphipat canal (215-170 m³/s)
- Western Raphipat canal (40 m³/s)
- Southern Raphipat canal (80 m³/s)

► Drainage canals

- Canal 1 to Canal 12



11

Flood Retention/Detention area

The method to store the amount of water in provided space.

The report of Natural Water Retention Measures (2013) presented the characteristics of the retention ponds

► Geographic applicability

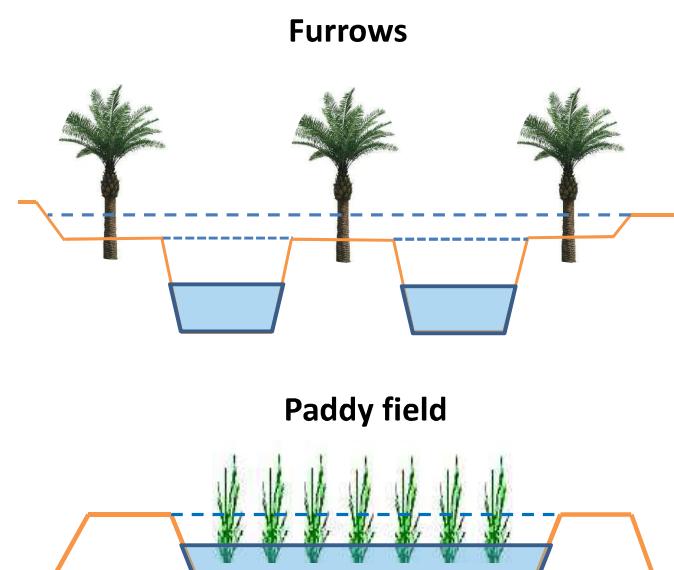
- Can apply in agriculture areas

► Biophysical impacts

- Ratings of store and slow runoff are high

► Ecosystem services benefits

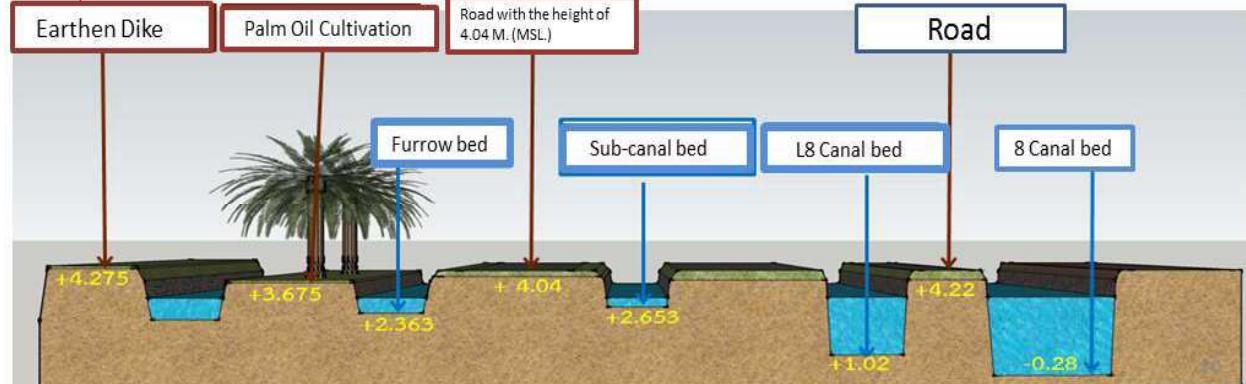
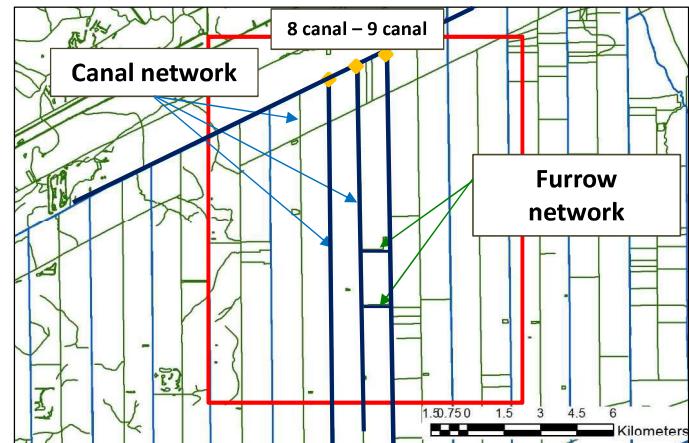
- Medium rating in water storage
- High rating in flood risk reduction



12

Canal system in Bueng Cham Or, Nong Sua District

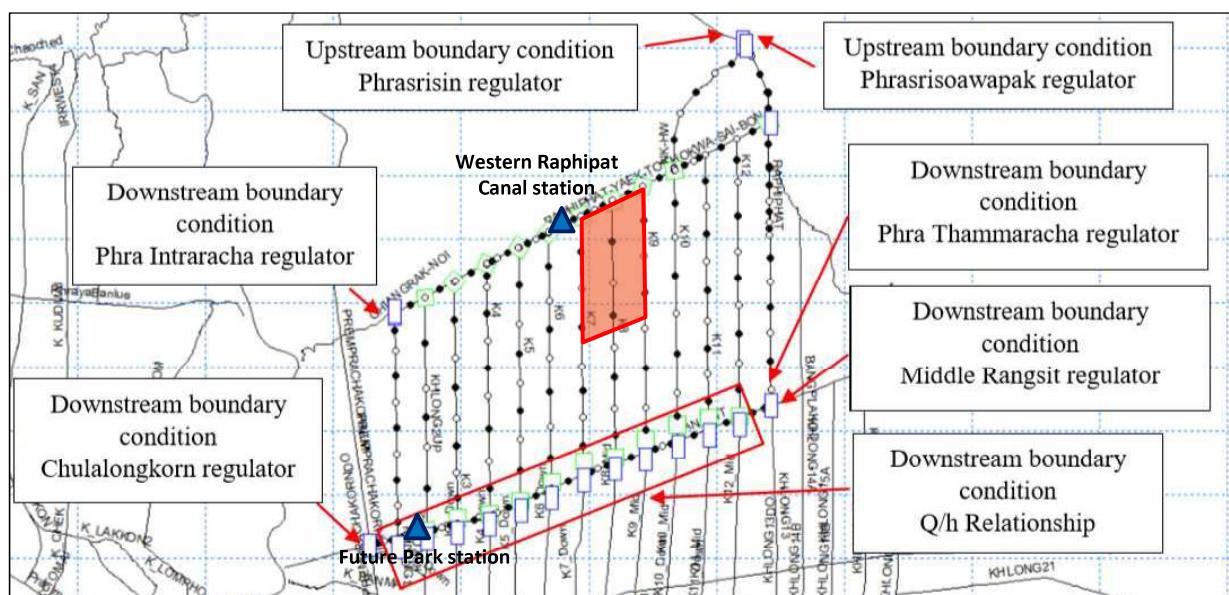
- ▶ Canal and furrows link together
- ▶ Lead to the storage that can keep the water



13

Hydrodynamic modeling

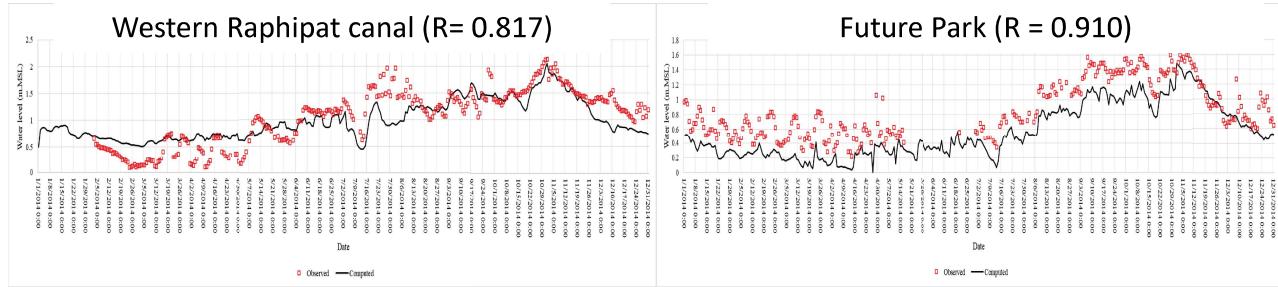
- ▶ 1D model was used to simulate River network in North Rangsit Area.



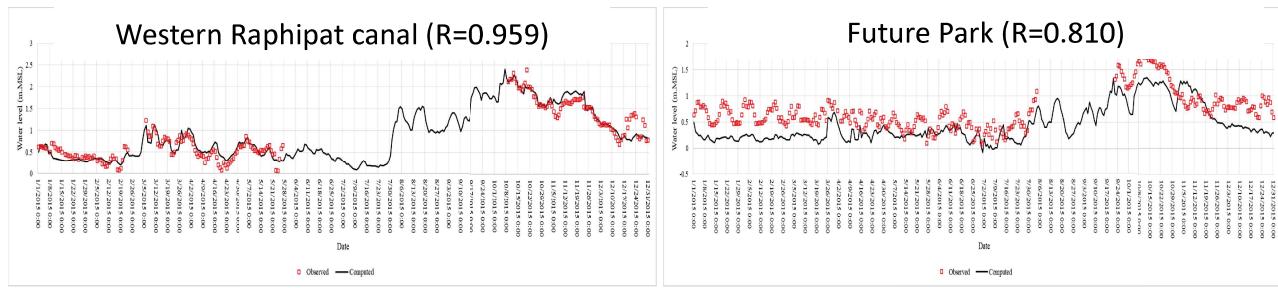
14

7

Model Calibration: Simulated the flow condition in 2014



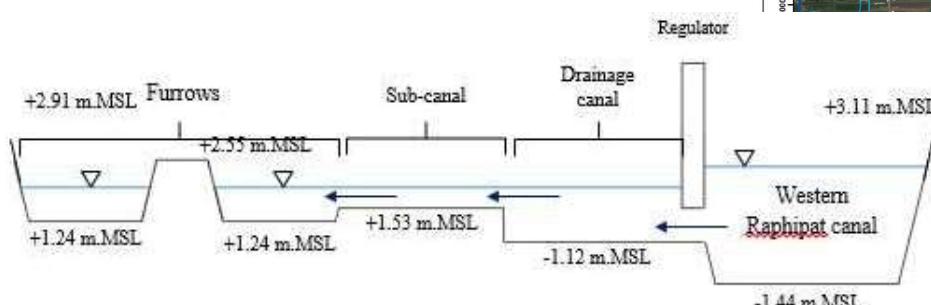
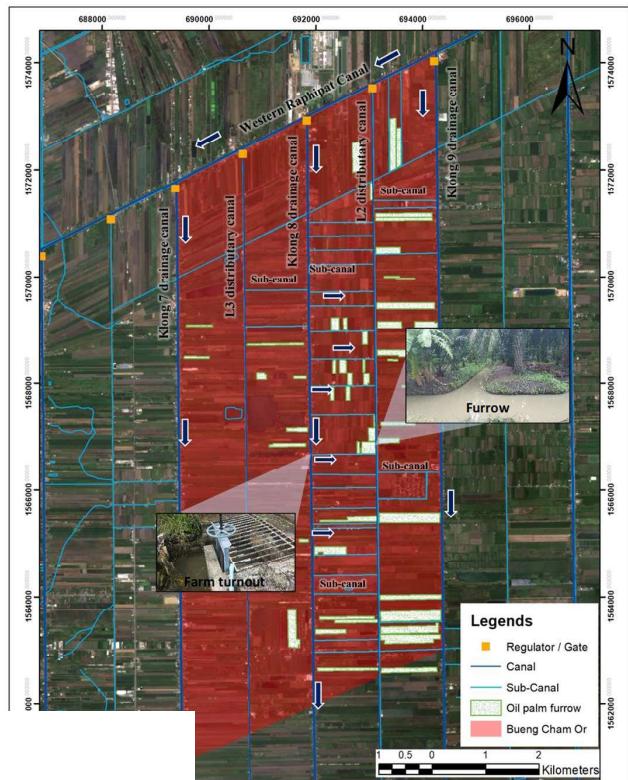
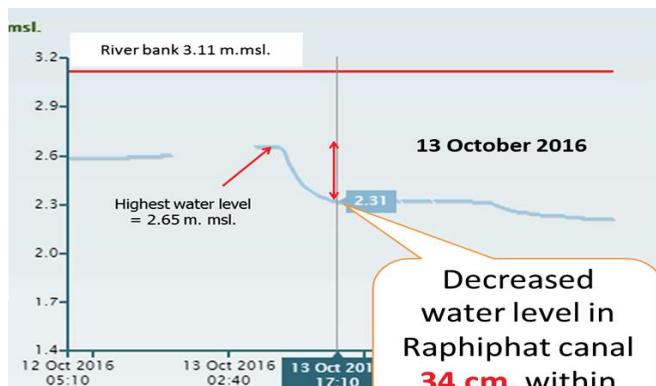
Model Verification: Simulated the flow condition in 2015



15

Crisis Operation:

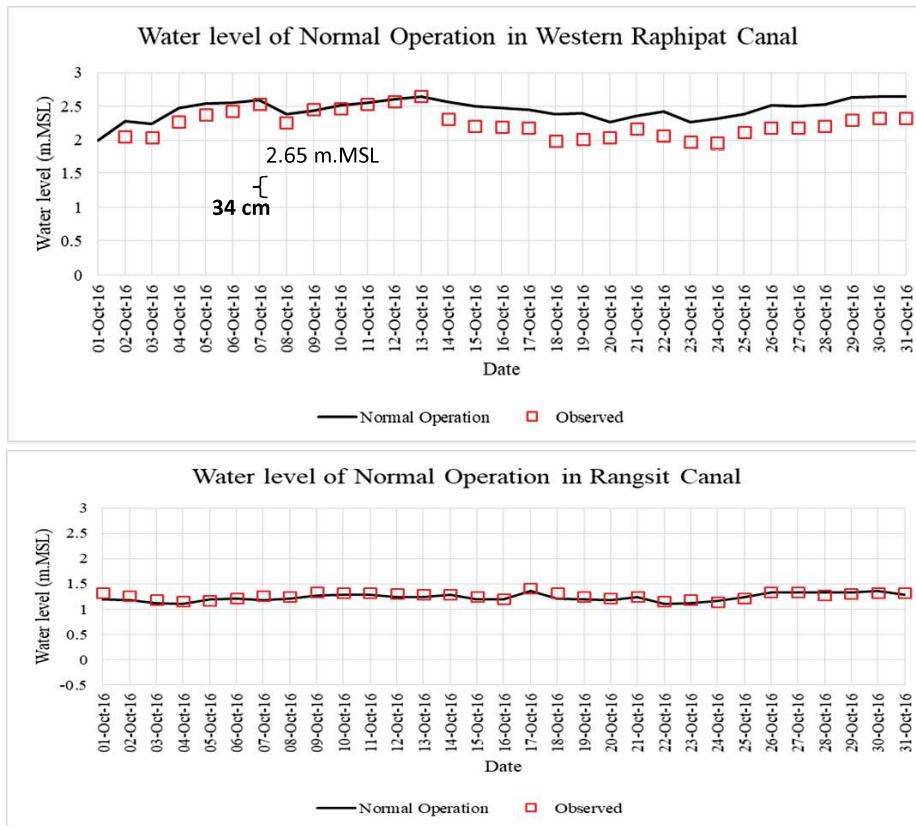
High water level occurred in Western Raphipat canal on 13 October 2016



16

Model Application: Normal Operation

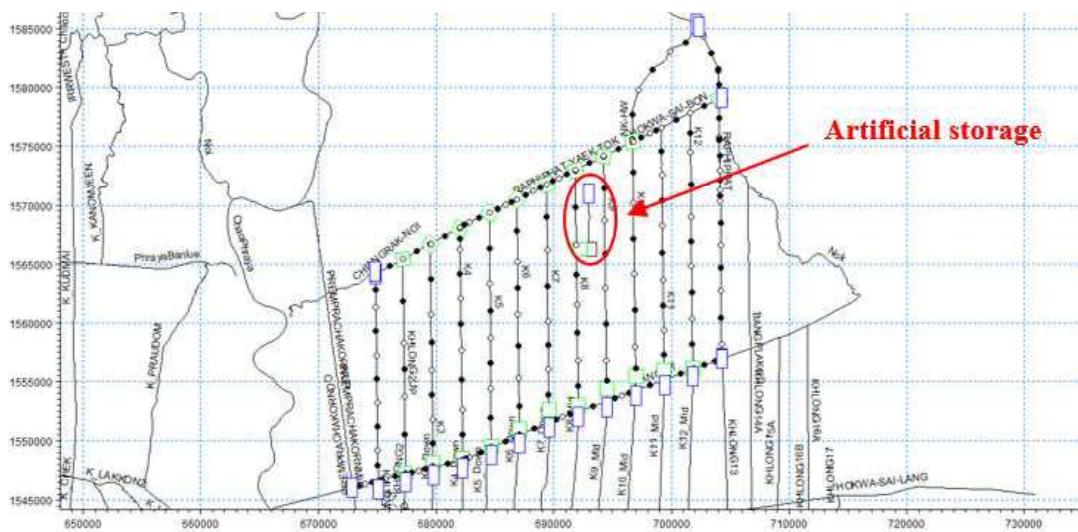
- ▶ Simulate flow in condition in October 2016
- ▶ No water diversion in Western Raphipat canal



17

Model Application: Crisis Operation

- ▶ Simulate flow in condition in October 2016
- ▶ Water was diverted from Western Raphipat canal into Rangsit community area (Klong 7 -10)



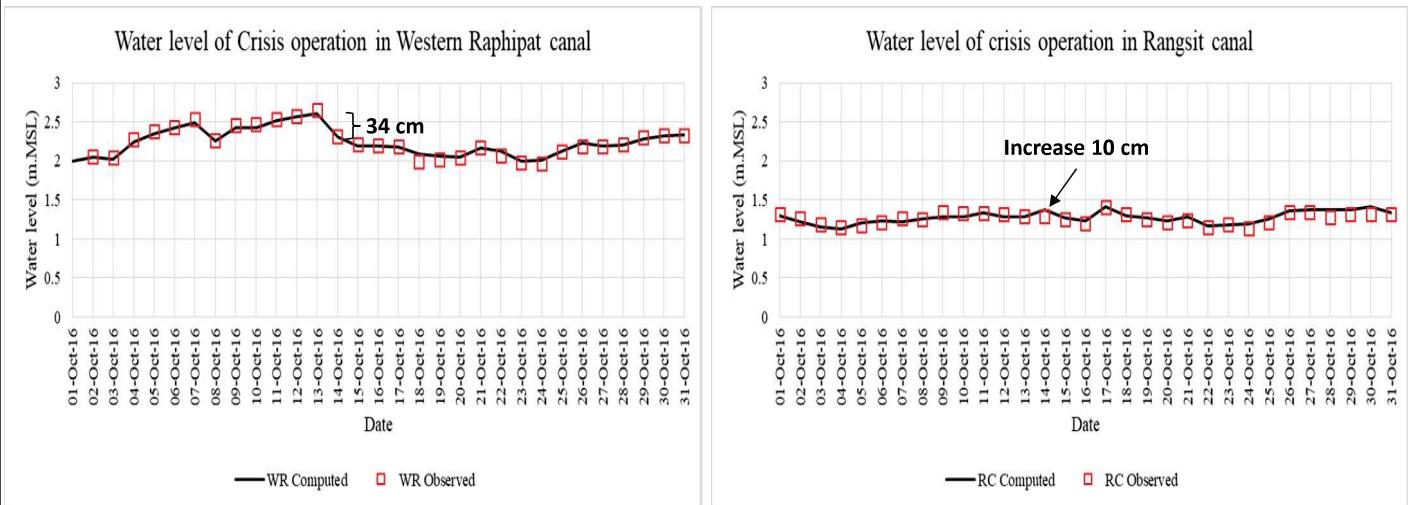
Artificial storage

- ▶ Between Klong 8 and Klong 9 drainage canal
- ▶ Initial water level +1.75 m.MSL
- ▶ 753 m³ /Rai or 0.47 m³/sq.m
- ▶ Furrow area of Bueng Cham Or 1,738 Rai or 2.78 km²
- ▶ Volume is around 1.3 MCM.

18

Model Application: Crisis Operation

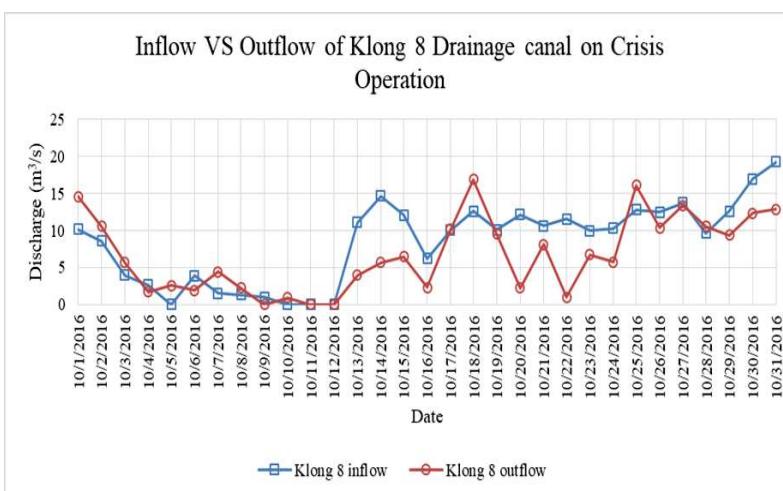
► Main canal



19

Model Application: Crisis Operation

► Klong 8 drainage canal



13th to 31st October 2016

- Inflow > Outflow
- Water was stored in the drainage canal

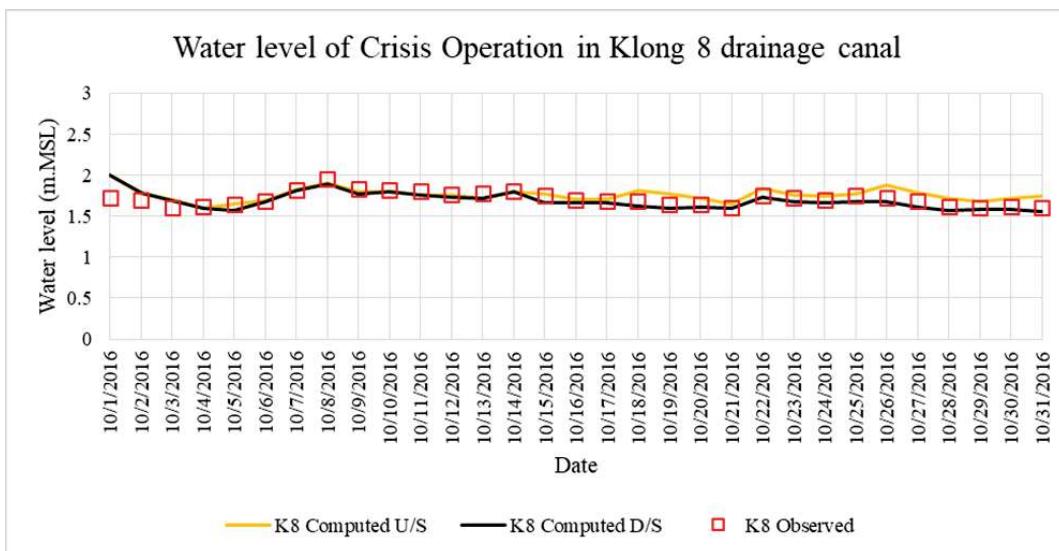
Total stored volume 5.6 MCM
For 19 Days

20

10

Model Application: Crisis Operation

► Klong 8 drainage canal



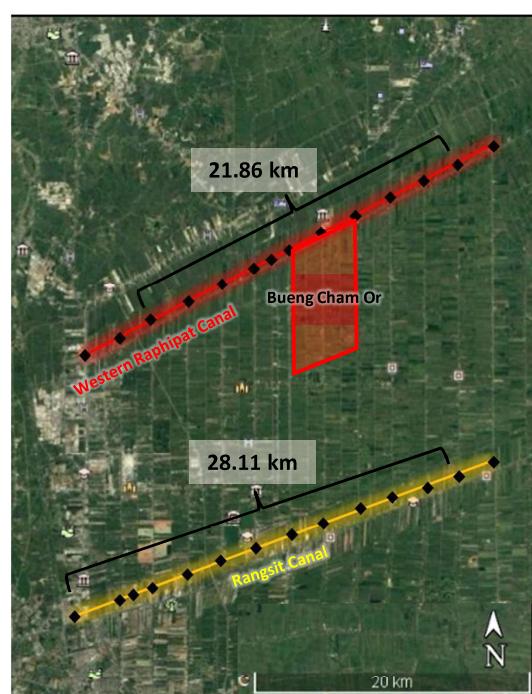
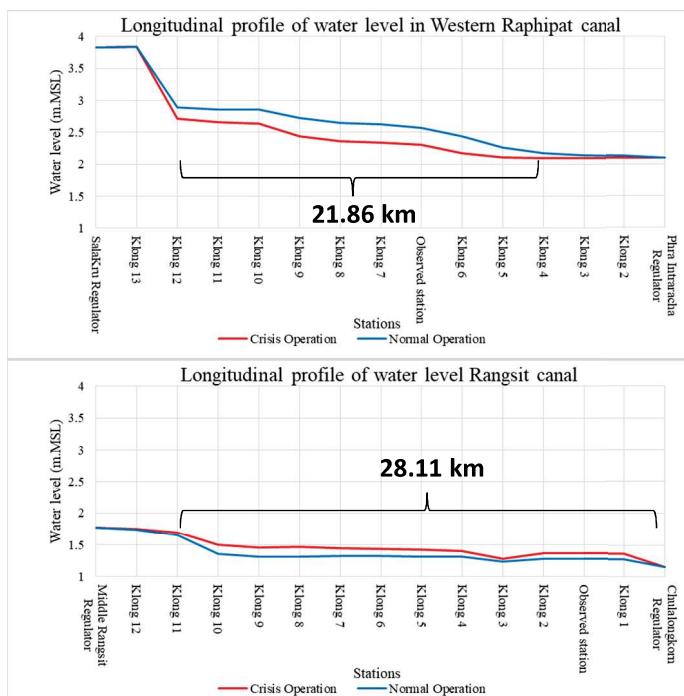
After 13th October 2016

- Water level in Klong 8 canal increase around 8 cm

21

Model Application: Normal and Crisis Operation

► The distance in water level change

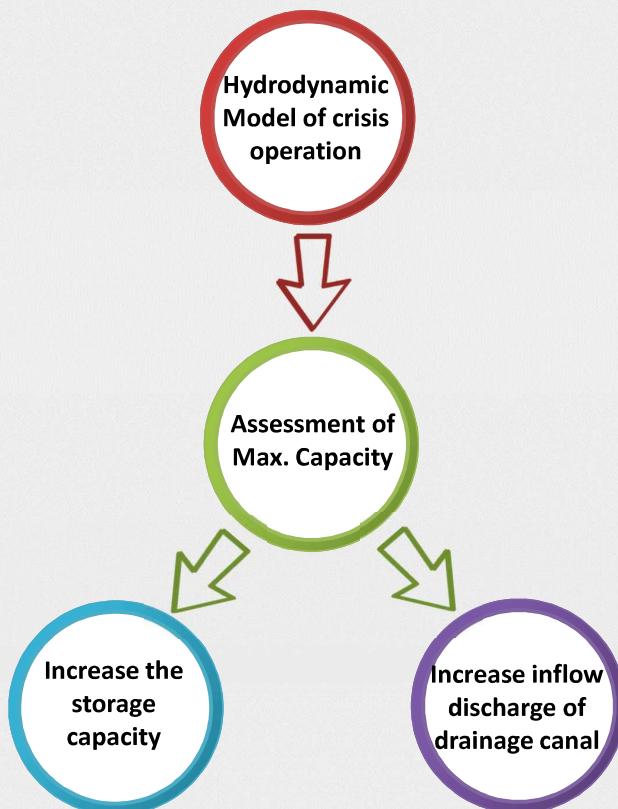


22

11

Model Application: Assessment of Maximum Capacity

- ▶ How the storage volume in furrow will be ?



23

Model Application: Assessment of Maximum Capacity

- ▶ Increase the storage capacity



Artificial storage

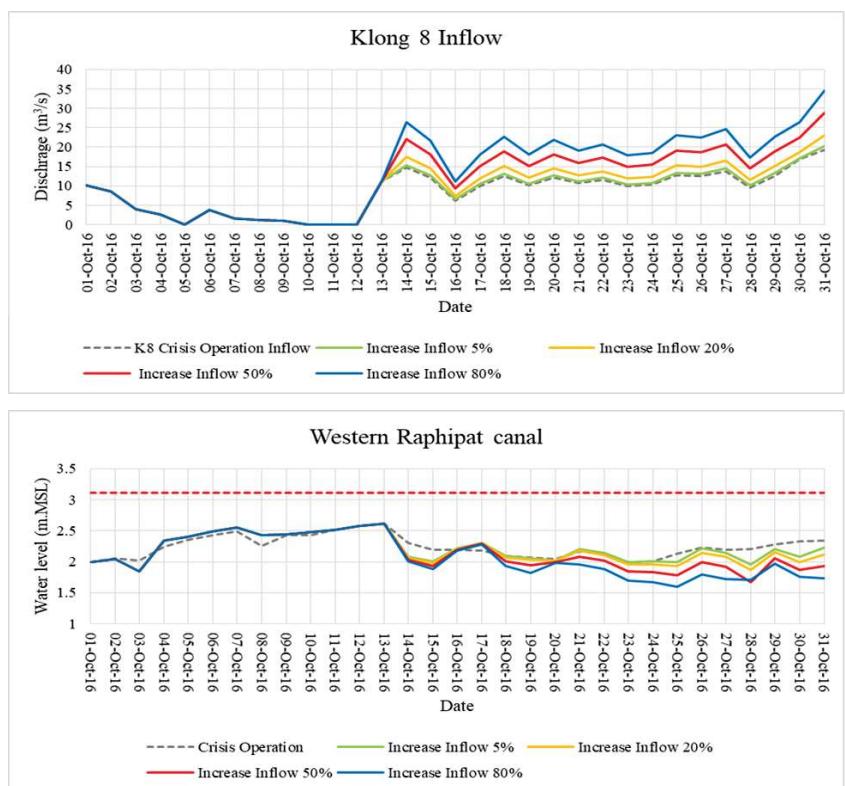
- ▶ Use the same concept with the Crisis Operation
- ▶ 753 m³ /Rai or 0.47 m³/sq.m
- ▶ Combine the Furrow area of Bueng Ka Sam (Klong 9 -10)
- ▶ Furrow area increased from 1,738 Rai to 3,085 Rai or 2.78 km² to 4.94 km²
- ▶ Volume up to 2.3 MCM

24

Model Application: Assessment of Maximum Capacity

- ▶ Increase inflow of drainage canal

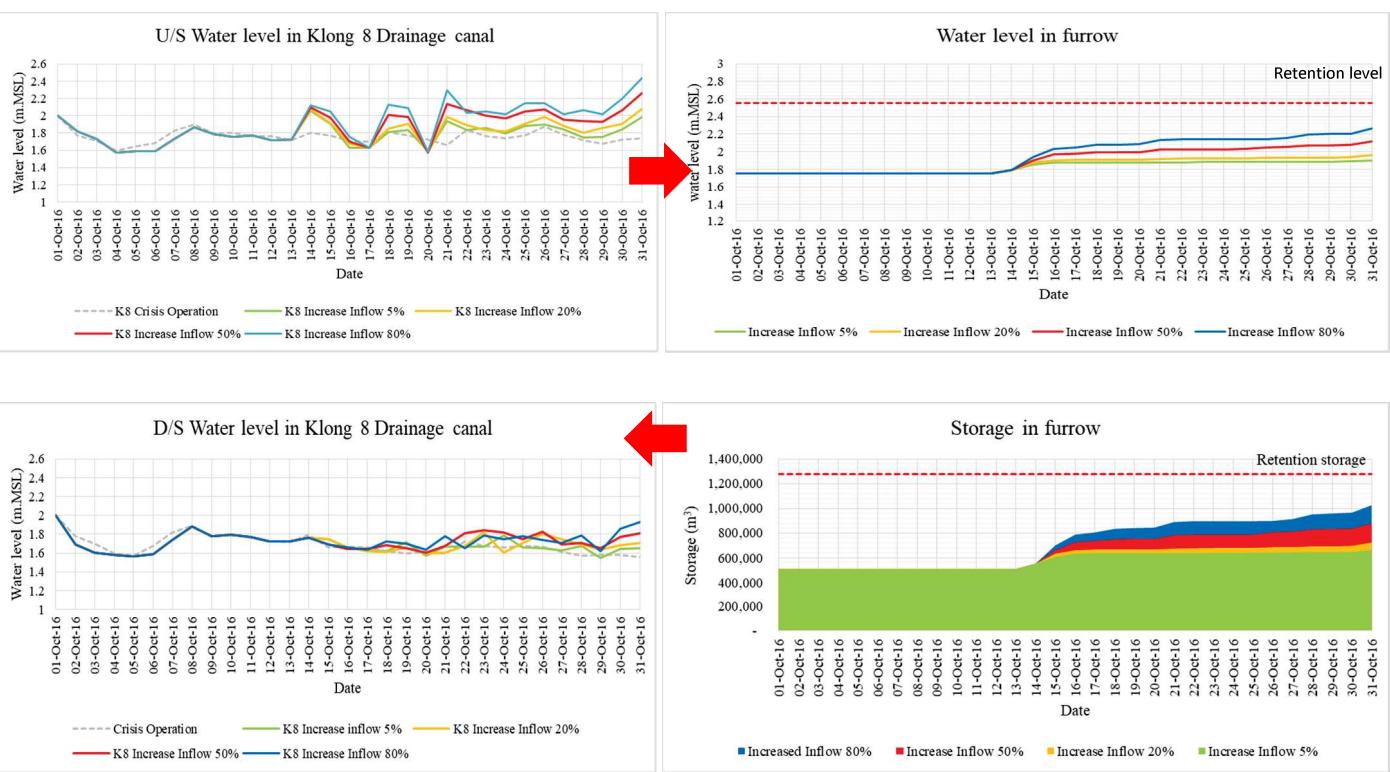
- ▶ Use the same all concept with the Crisis Operation
- ▶ Artificial Volume is 1.3 MCM
- ▶ Increase inflow of Klong 8 drainage canal
 - 5%, 20%, 50% and 80% of crisis operation
 - Inflow increased from $12.03 \text{ m}^3/\text{s}$ to
 - $12.63 \text{ m}^3/\text{s}$
 - $14.43 \text{ m}^3/\text{s}$
 - $18.04 \text{ m}^3/\text{s}$
 - $21.65 \text{ m}^3/\text{s}$



25

Model Application: Assessment of Maximum Capacity

- ▶ Increase inflow of Klong 8 drainage canal



26

13



Achievement

Multifunction natural infrastructure

Achievements

Mutual Benefit >> natural & man-made infrastructure

Water & Food Security

- Can totally store water for 137 MCM.
- Enough for yearlong usage

Strengthen of community-based sustainable water development and management

Production & Sustainability >> Increase palm oil productivity, create **Community's Fund (Increase income THB 656,000/village/year)**

Expand CWRM network to 9 sub-districts within 4 years

Comparison	Rangsit	Other
Palm oil production (times/year)	24	19
Average Palm oil yield (tons/time)	8	4.5



04 Conclusions



Crisis Operation : For the crisis operation, The application of NbS for use canal system to be a retention area can reduce water level in Western Raphipat canal 34 cm.



Furrow Storage : The furrow storage 753 m³/Rai or 1.3 MCM of capacity in Klong 8 drainage canal can received water and stored 577,000 cubic meter of water.



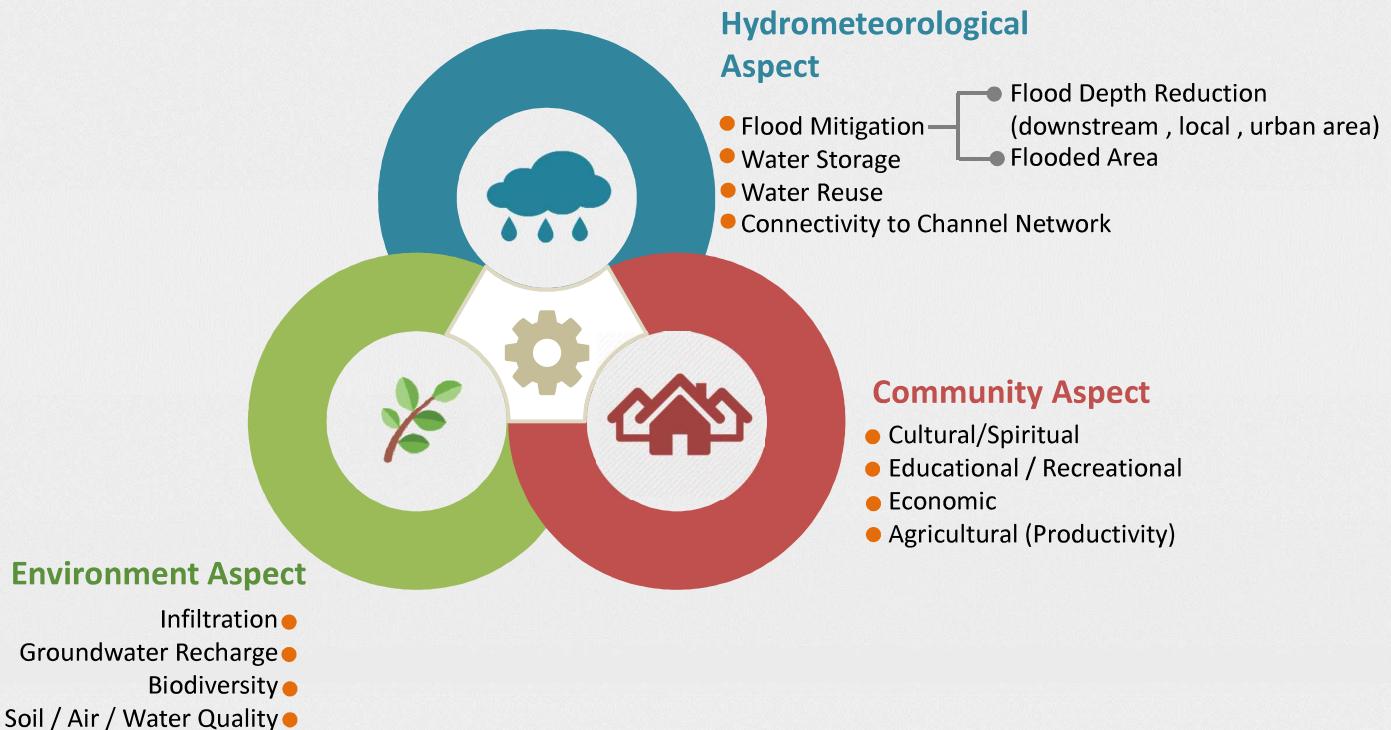
Increment of Furrow Area : Increment of furrow area can increase the efficiency for storing the water.



Reduce Water level : Increment of amount of water into the area can help to reduce water level in Western Raphipat canal, but the stage in drainage canal rise and more water flow into furrow area.

Future Works

- ▶ Hydrodynamic – more cases for return period
- ▶ Past – Evaluation of BNS



29

THANK YOU
for your attention



30

15

Furrow volume

Side slope: z	1						
Rectangular width	2.5 m						
Area	Furrow length (m)	Depth		Cross section Area		Storage (m ³)	Oil palm area (Rai)
Buong Cham Or	254,800.00	1.312	1.677	5.00	7.00	1,274,342.45	1,738.00
Buong Bon	184,400.00	1.312	1.677	5.00	7.00	922,247.83	843.00
Burng Ba	96,800.00	1.312	1.677	5.00	7.00	484,130.10	951.00
Buong Kasam	199,000.00	1.312	1.677	5.00	7.00	995,267.46	1,347.00
sum 735,000.00						3,675,987.84	4,879.00
				m³/Rai		753.43	

31

Artificial Storage

1.3 MCM



Length 4,228 m

2.3 MCM



32