Rehabilitation of Angkor Cultural Landscape: Ancient Hydraulic System

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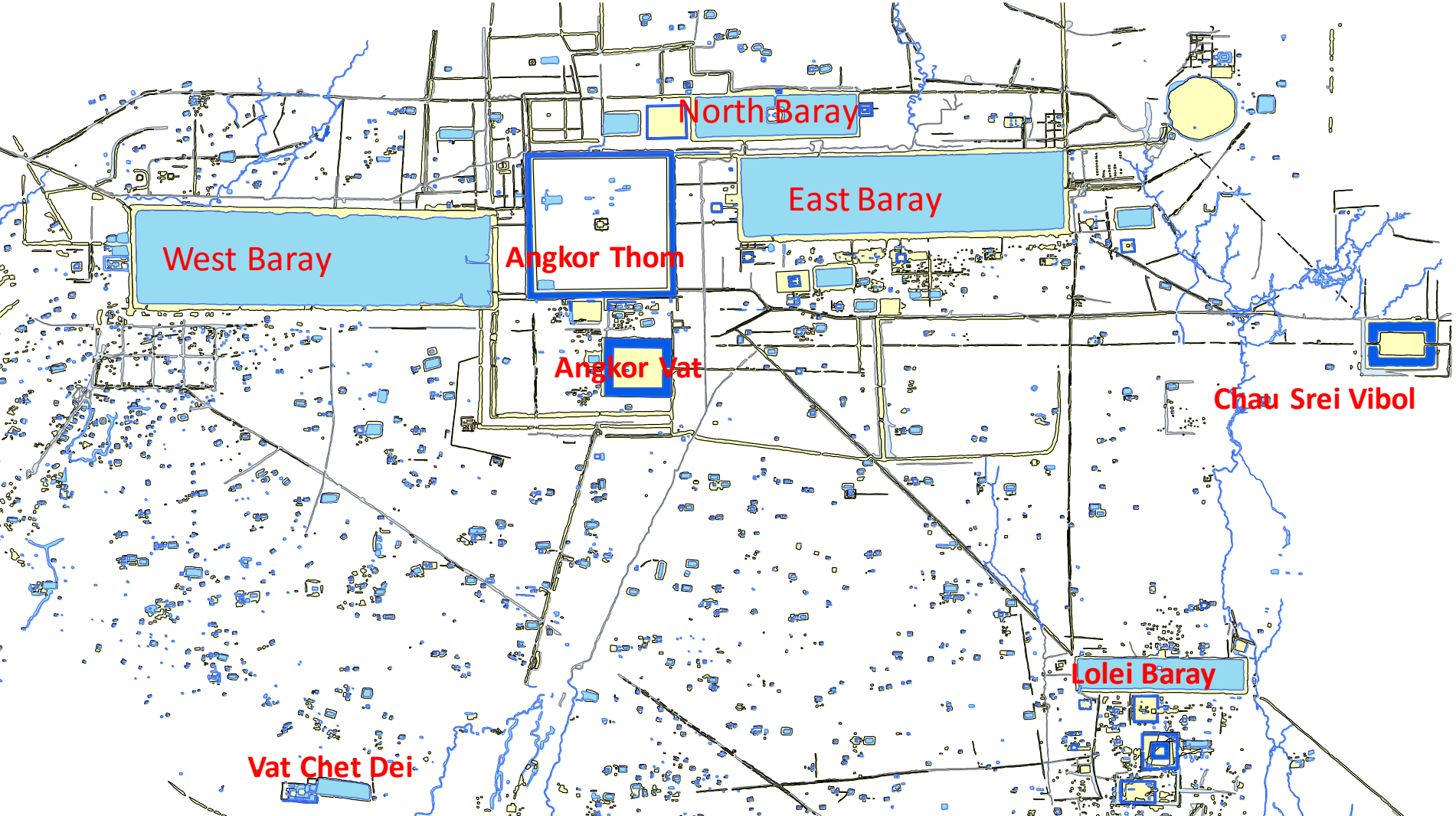
Siem Reap, January 12, 2016

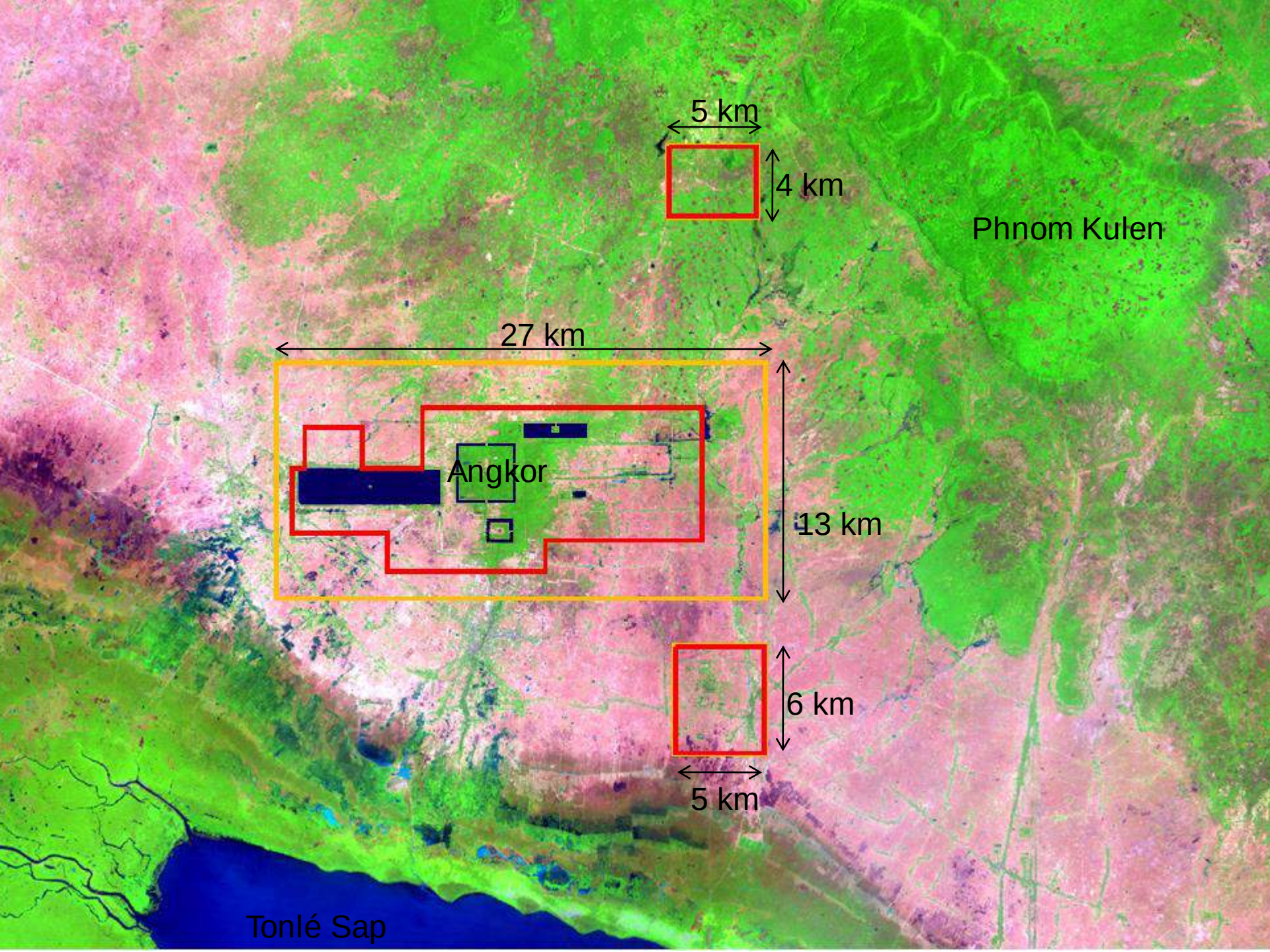
Overview of Angkor cultural landscape

Cultural landscape: Monument, Water & Forest

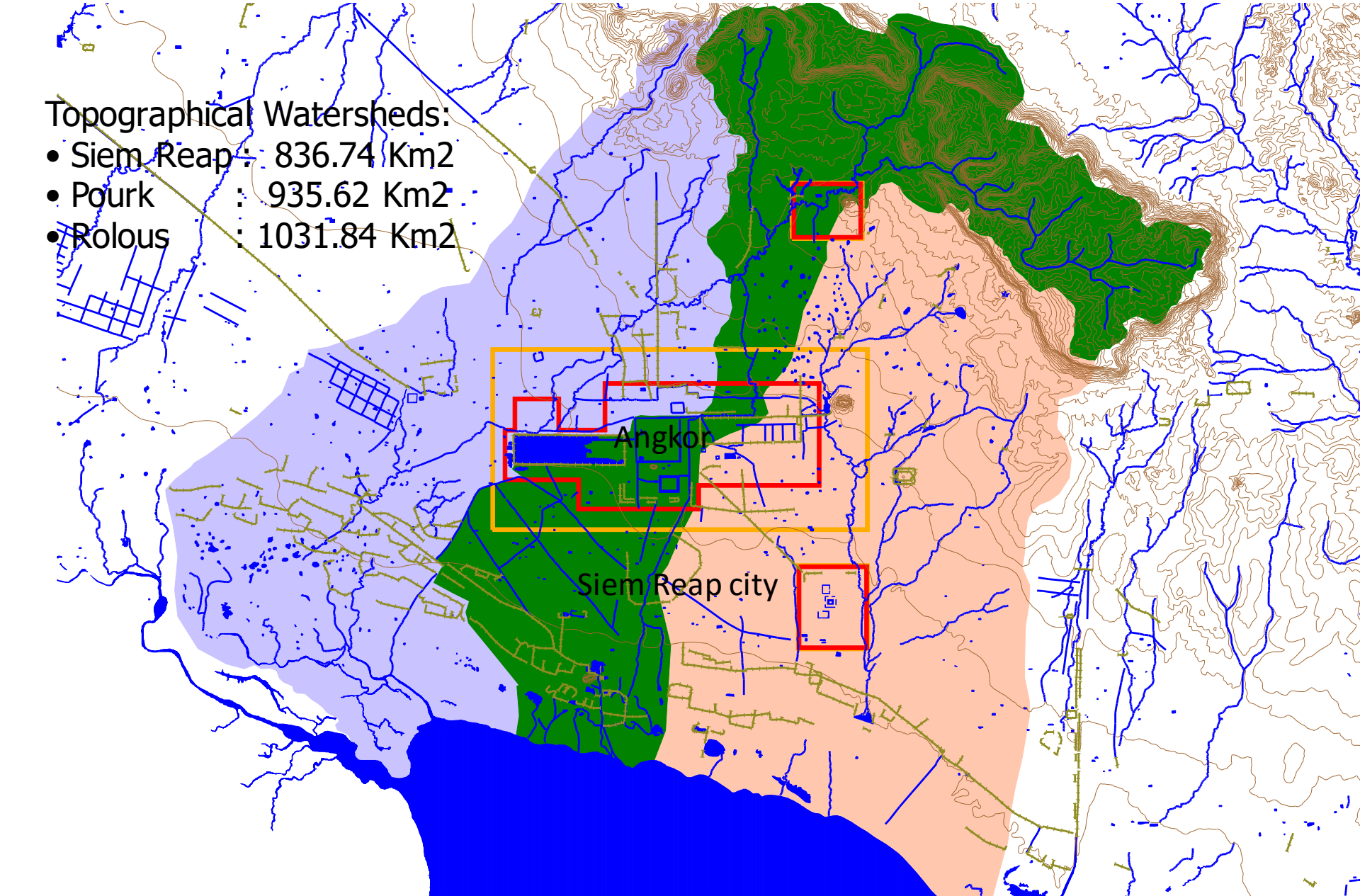
Overview of Angkor cultural landscape



LiDAR 2012

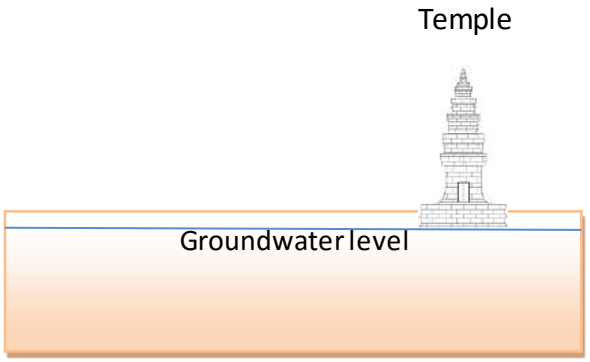

5 km
4 km
Phnom Kulen
27 km
Angkor
13 km
6 km
5 km
Tonlé Sap

GIS: Watersheds



Water and Monuments

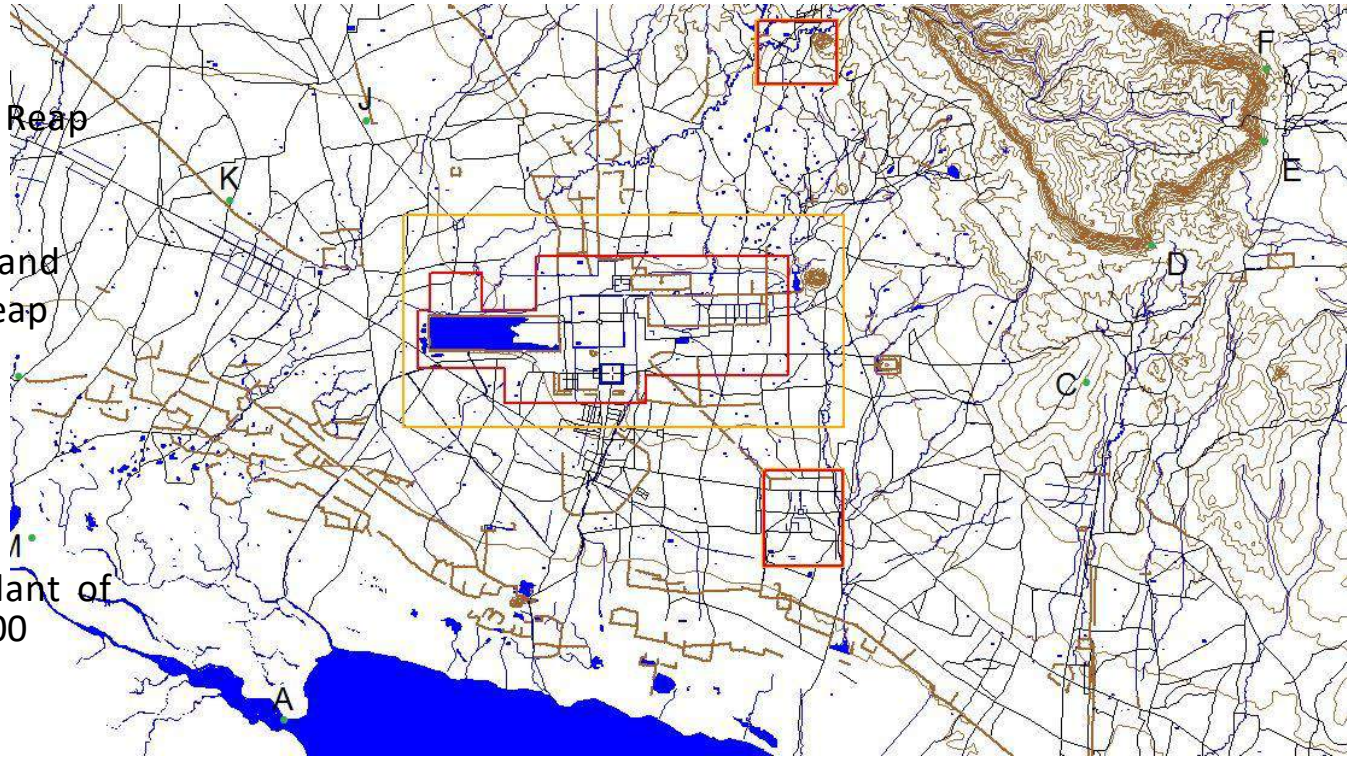
Angkor Park need the water, not only for living people inside the protected zones and visitors but also for the Temples!



Water play a role very important in the stability of temple especially the groundwater because all the temples in the Angkor Park are built on the sand layer and the resistance of sand is depend on its degree of saturation (water) and the sand layer has direct connection with the groundwater and the Moats.

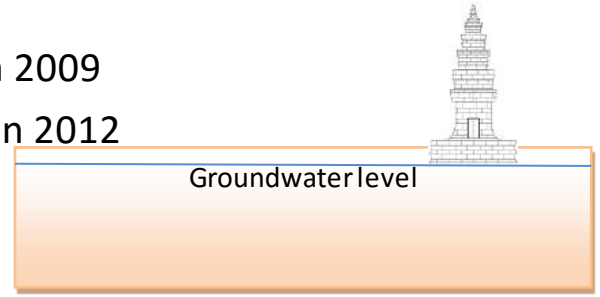
Siem Reap Water Supply

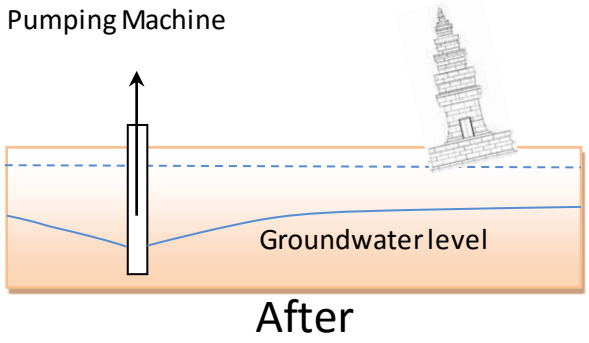
- Before 1995:
  - Small town
  - Water source from Siem Reap river
- From 1995:
  - Increasing of water demand
  - Limit capacity of Siem Reap river in dry season
  - Change water source to **Groundwater**
  - 1,440 m^3/day
- In 2005: Groundwater
  - New Water Treatment Plant of SRWSA with actual 14,000 m^3/day
  - Private wells



Angkor: 130 000 (estimation in 2013)

- Siem Reap:
  - Population : 203 483 in 2009
  - Tourism : 2 000 000 in 2012
- Projection (JICA 2009)
  - 2015 : 27,900 m^3/j
  - 2030 : 83,300 m^3/j





Rehabilitation of Angkorian water structures

The moat:

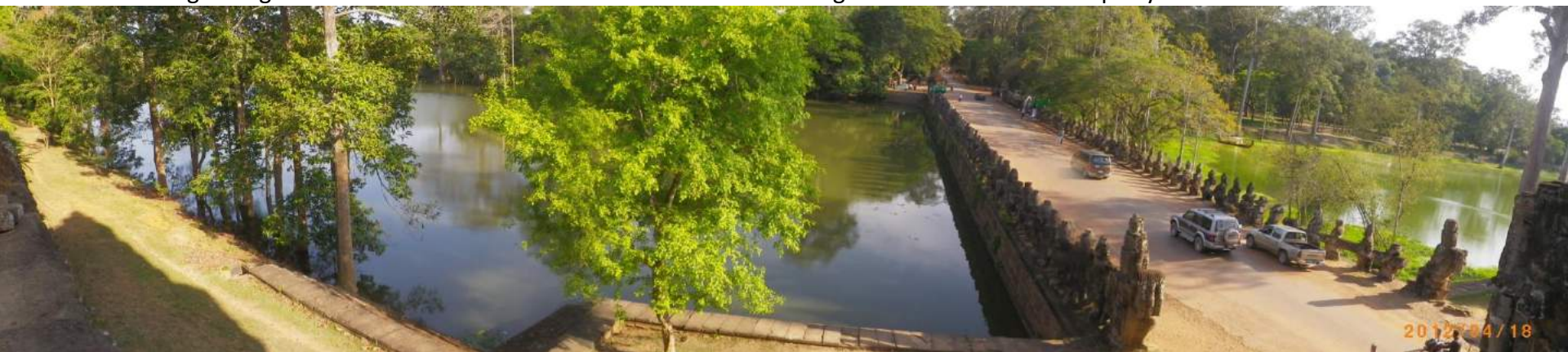
- Angkor Wat moat
- Angkor Thom moat
- Banteay Srei moat
- Preah Khan moat

The Baray (reservoir):

- Srah Srang (royal basin)
- West Baray (11th century)
- North Baray (Jayatataka – 12th century)

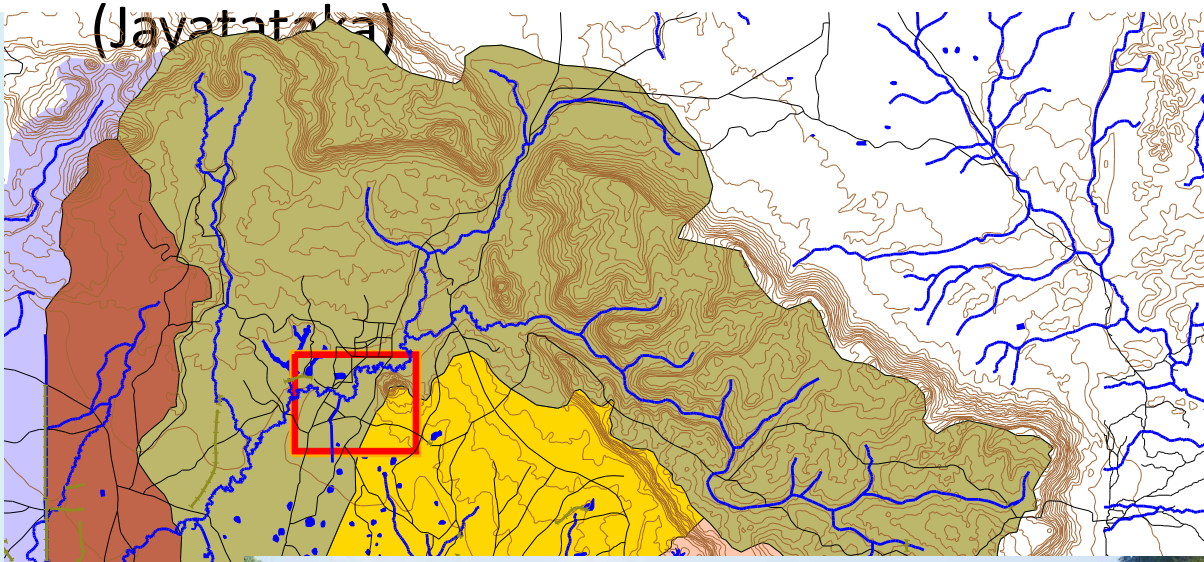
The North Baray project has four main objectives:

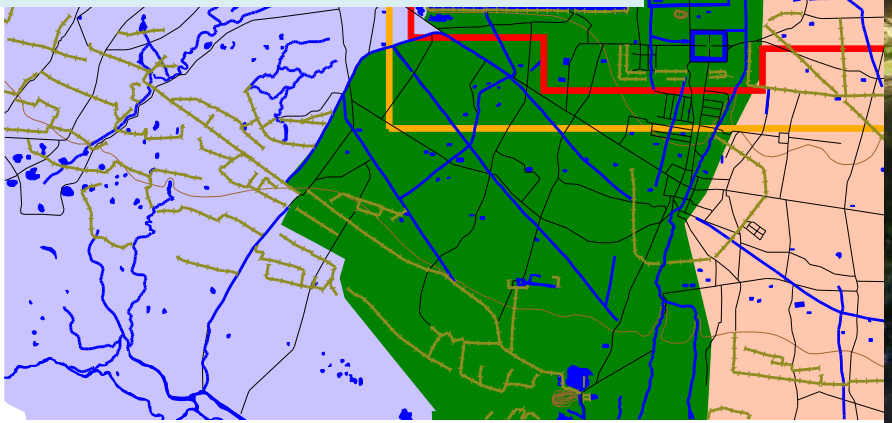
- ❖ Research on Ancient Hydraulic System that built in 12th century and dry up in 16th century to understand the whole system and refill water to Jayatataka (with dimension 3600 m X 930 m and its original capacity of 5 /10 Mm^3).
- ❖ Restore historical cultural landscape and develop a new support for circuit of visit to attract more tourism to Angkor Park.
- ❖ Bring more water for local people living in the Angkor Park and give them a model of sharing water between local community and temples in the region, and
- ❖ Recharge the groundwater to balance an uncontrolled extraction of groundwater in Siem Reap city.

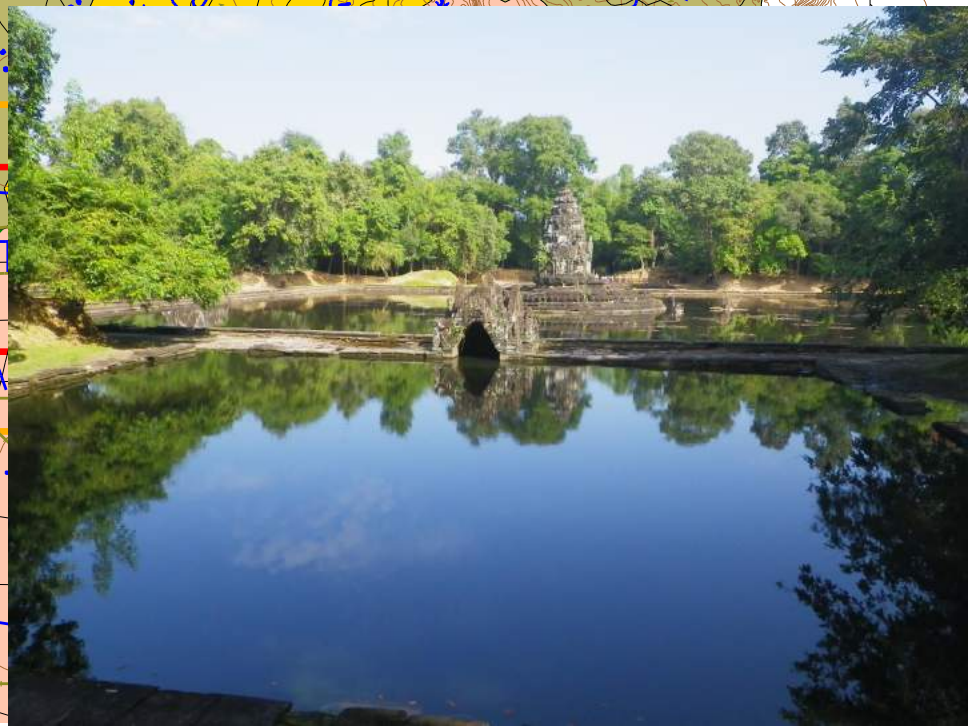


Rehabilitation of Jayatataka (North Baray)

- North Baray
  - Dimension : 3600m X 930m
  - Storage : 5/10 Mm^3
- Watershed
  - Surface: 105.27 Km^2
  - Runoff : 36.84 Mm^3
  - Base flow : 0
- Storage
  - 2008 : 700 000 m^3
  - 2009 : 3 000 000 m^3
  - 2010 : 3 786 000 m^3
  - 2011-2015 : 5 000 000 m^3
  - Recharge ground water
    - Preah Khan moat
    - down stream of Baray
  - Flood control
    - Villages
    - Angkor Thom







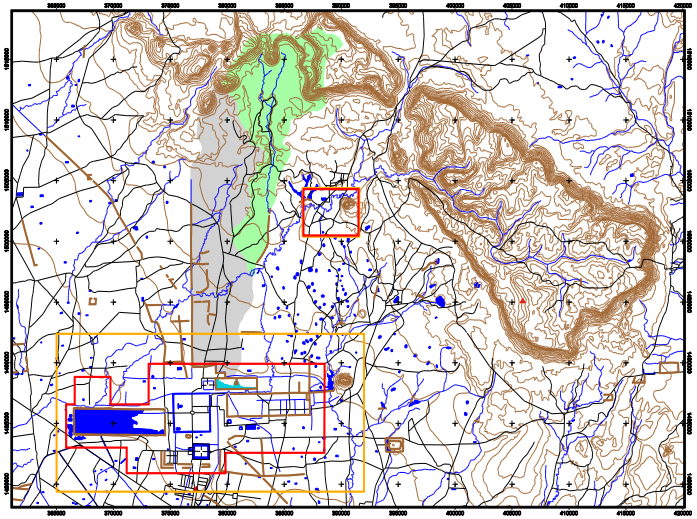
Rehabilitation of Jayatataka (North Baray)

21 May 2007

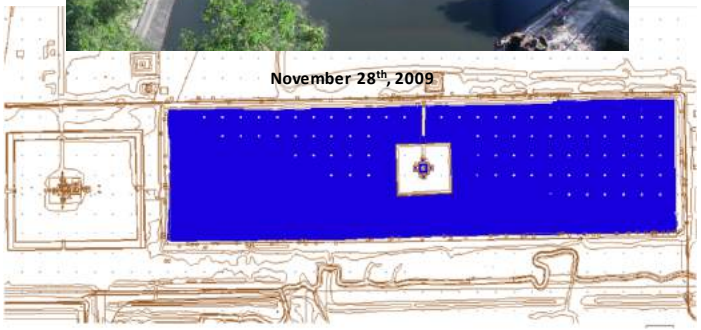
October 17th, 2009

November 20th, 2009

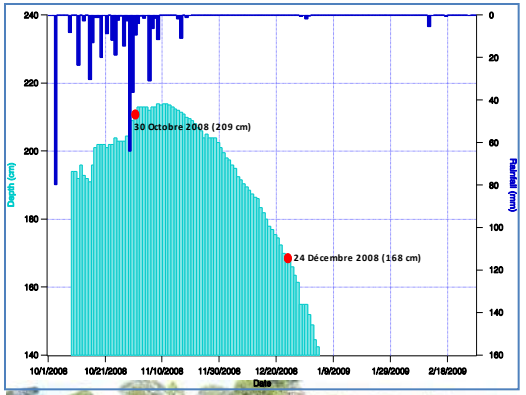
November 20th, 2009



November 28th, 2009



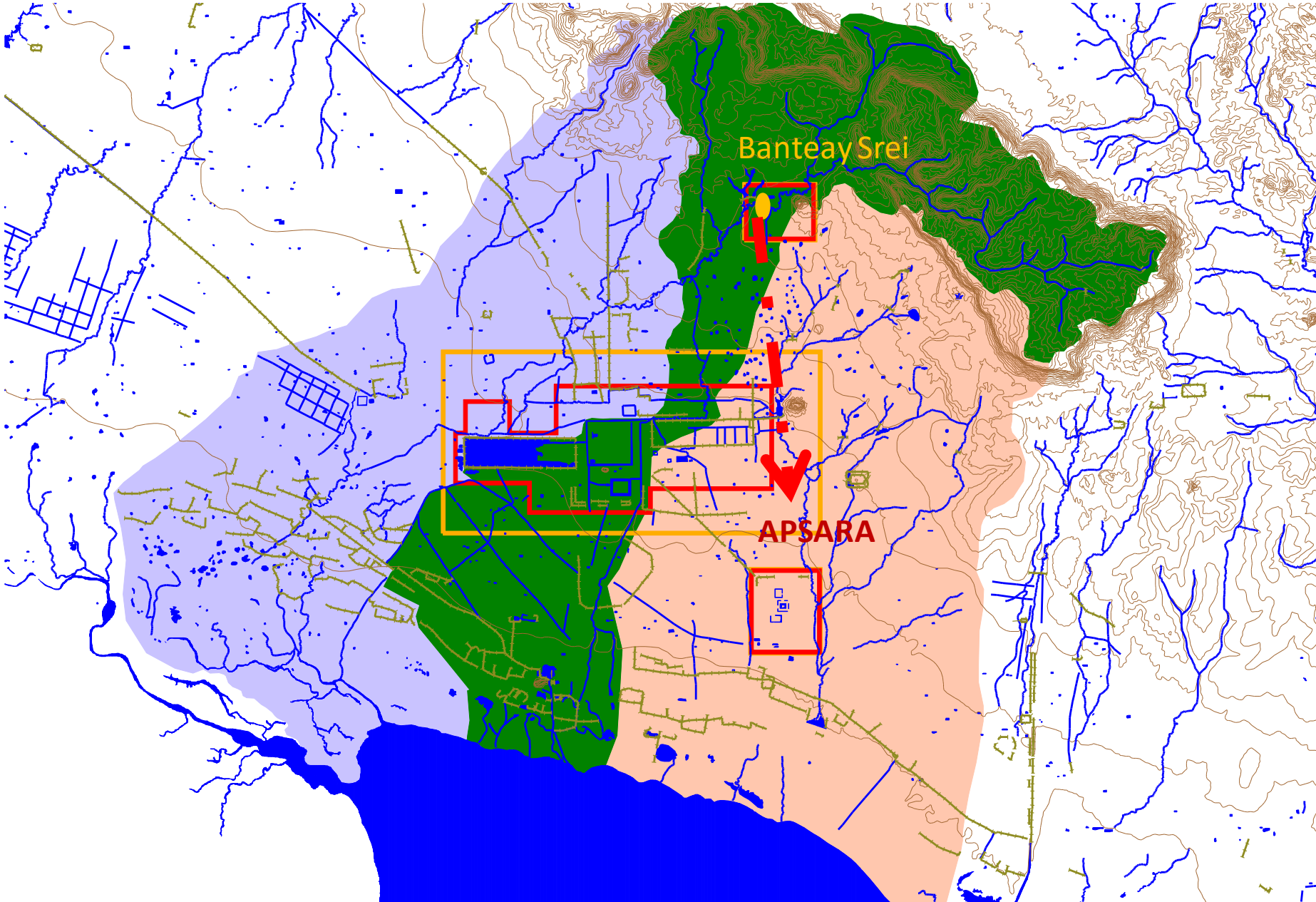
December 14th, 2008



January 6th, 2009

November 9th, 2009

Flood events



Flood in 2009

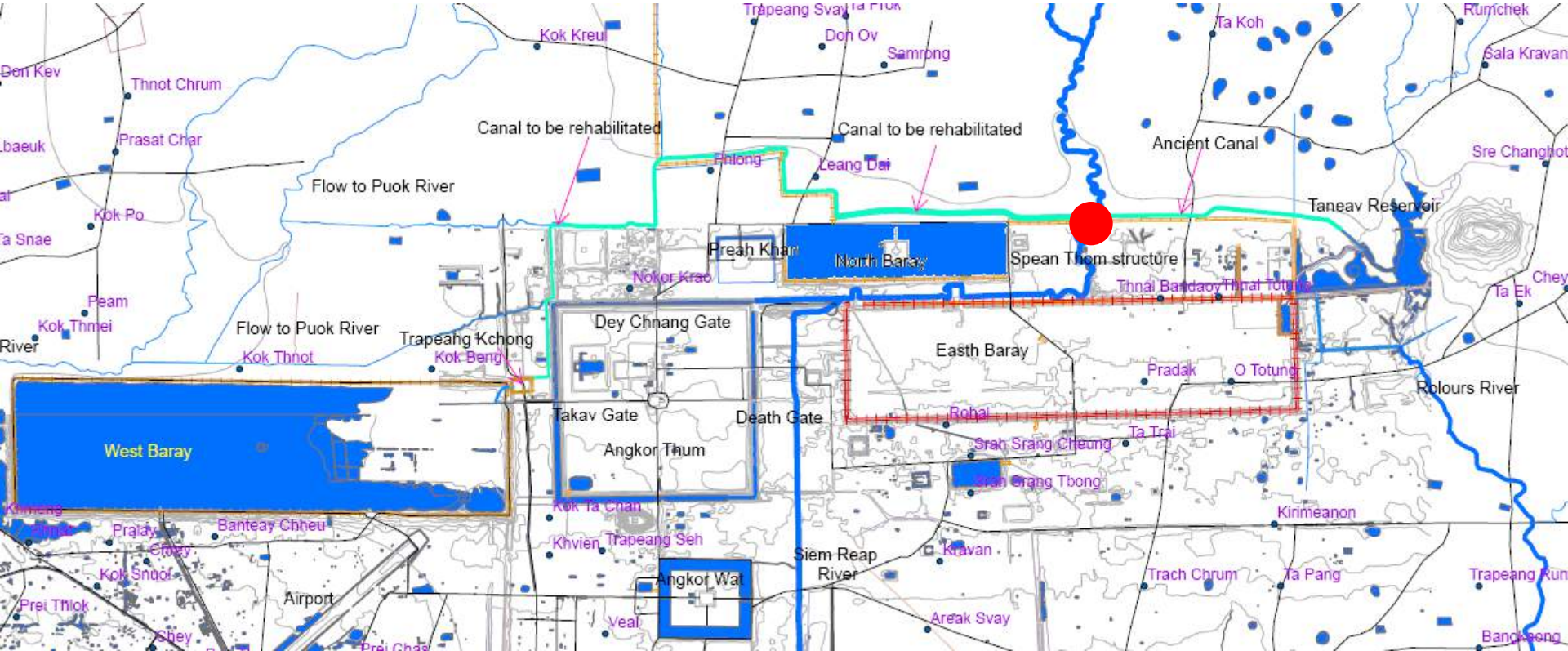
Flood in 2010

Flood in 2011



Without restoration of ancient hydraulic system:

- 2009,
- 2010,
- 2011. ➔ 20 M$ for infrastructure

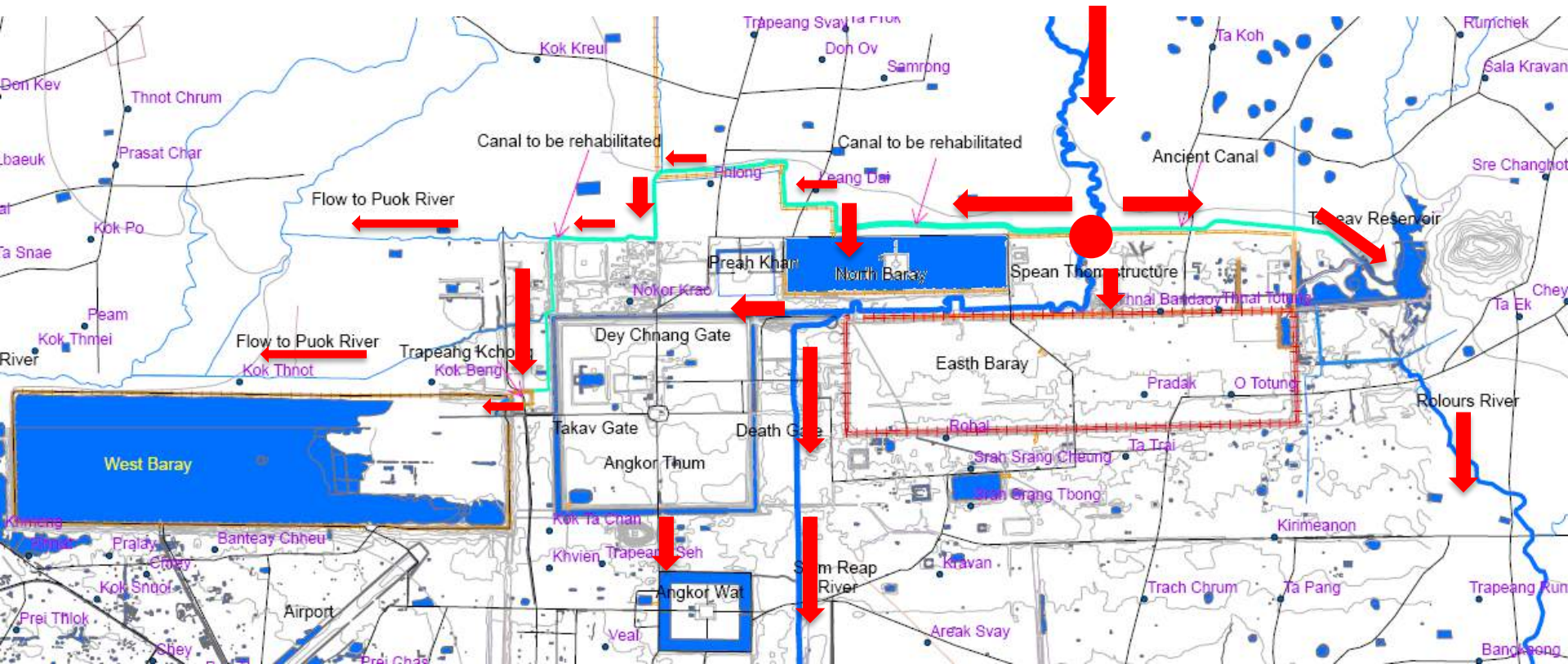


Without restoration of ancient hydraulic system:

- 2009,
- 2010,
- 2011.

Flood in 2012:

- September 3-6th ,
- September 15-18th ,
- September 21-24th and
- September 29th to October 2nd



West Baray

Mebon before flood

Mebon after flood with more than 56 Millions Cubic meters

With ancient hydraulic system, we can protect the temples, airport and city center of Siem Reap from flood since 2012:

Flood in 2012:

September 3-6th ,

September 15-18th ,

September 21-24th and

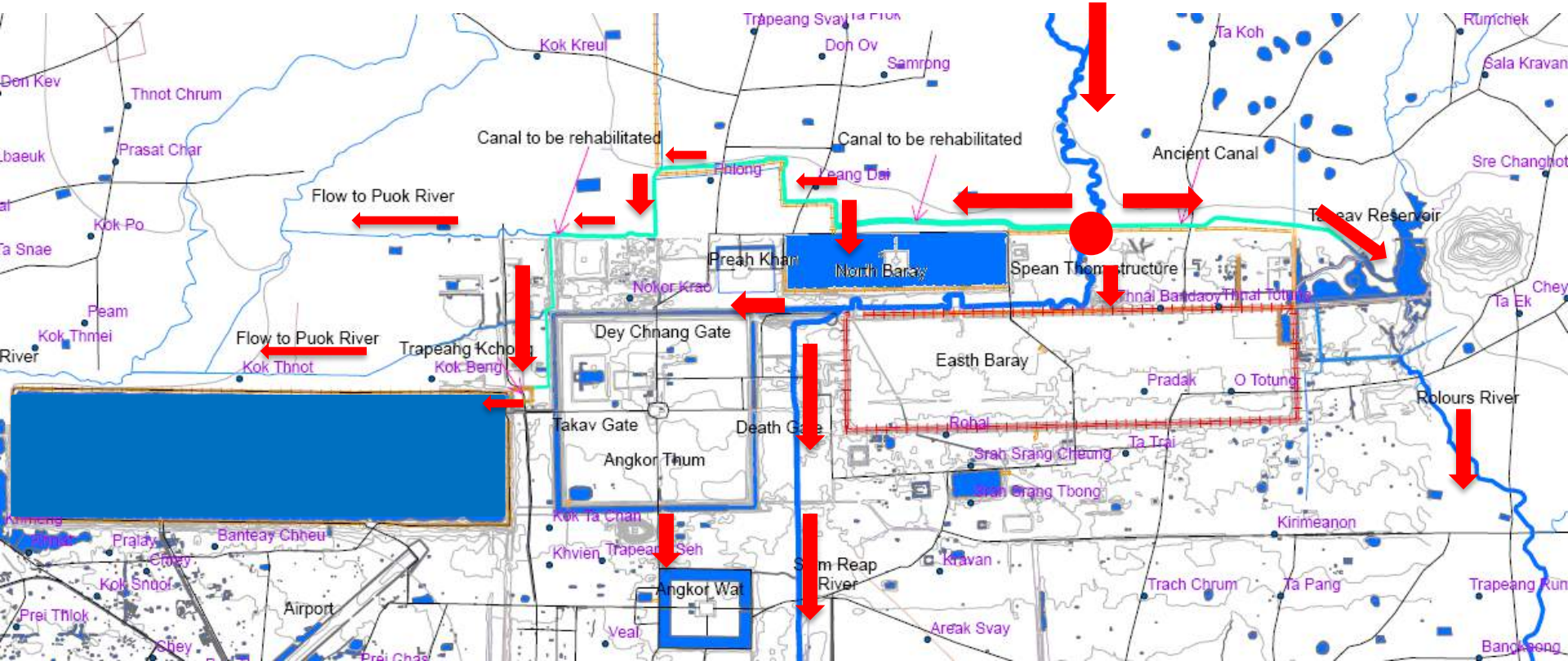
September 29th - October 2nd

Flood in 2013:

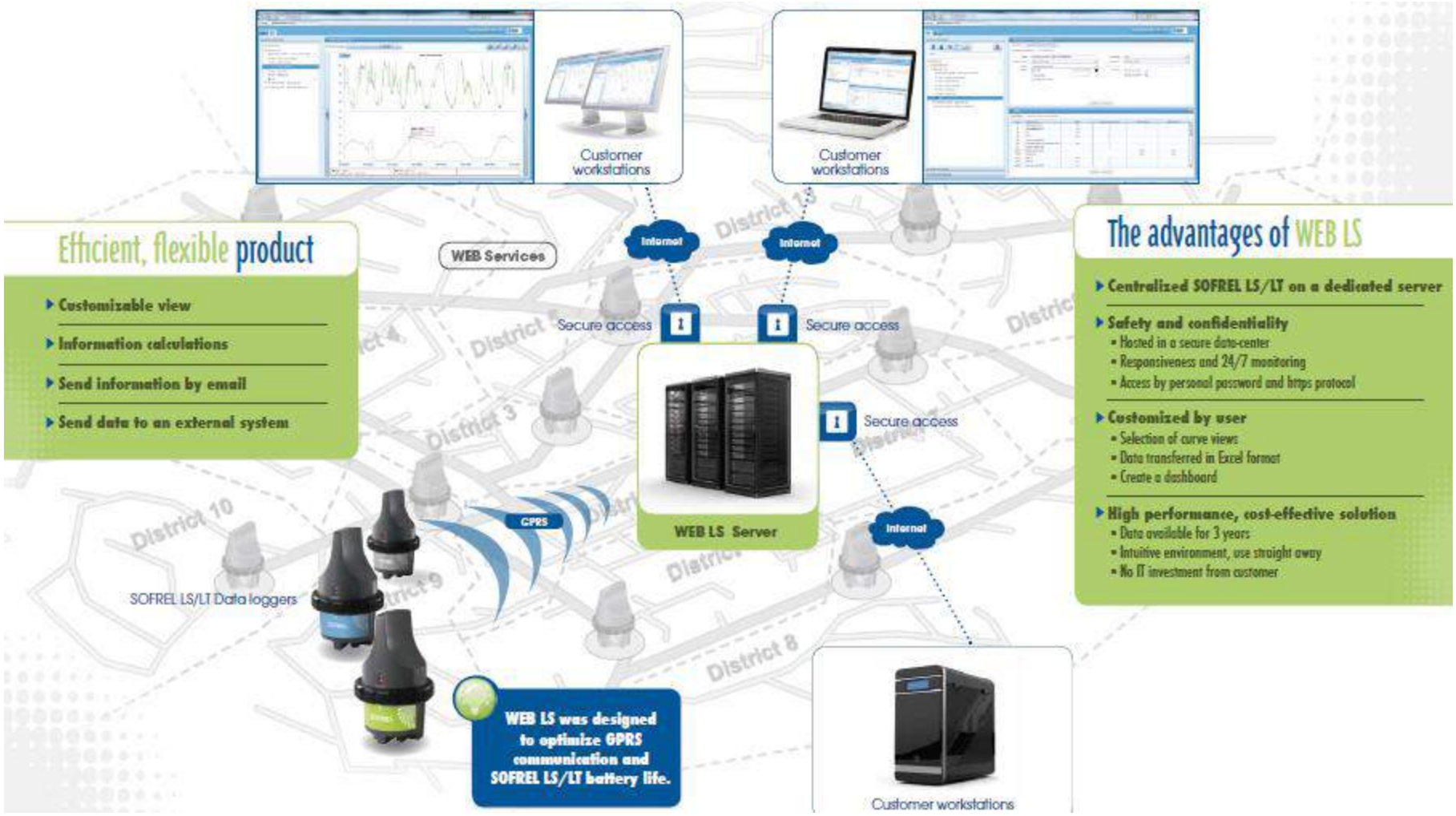
August 1-2nd ,

September 20-28th ,

October 2-7th



Future vision



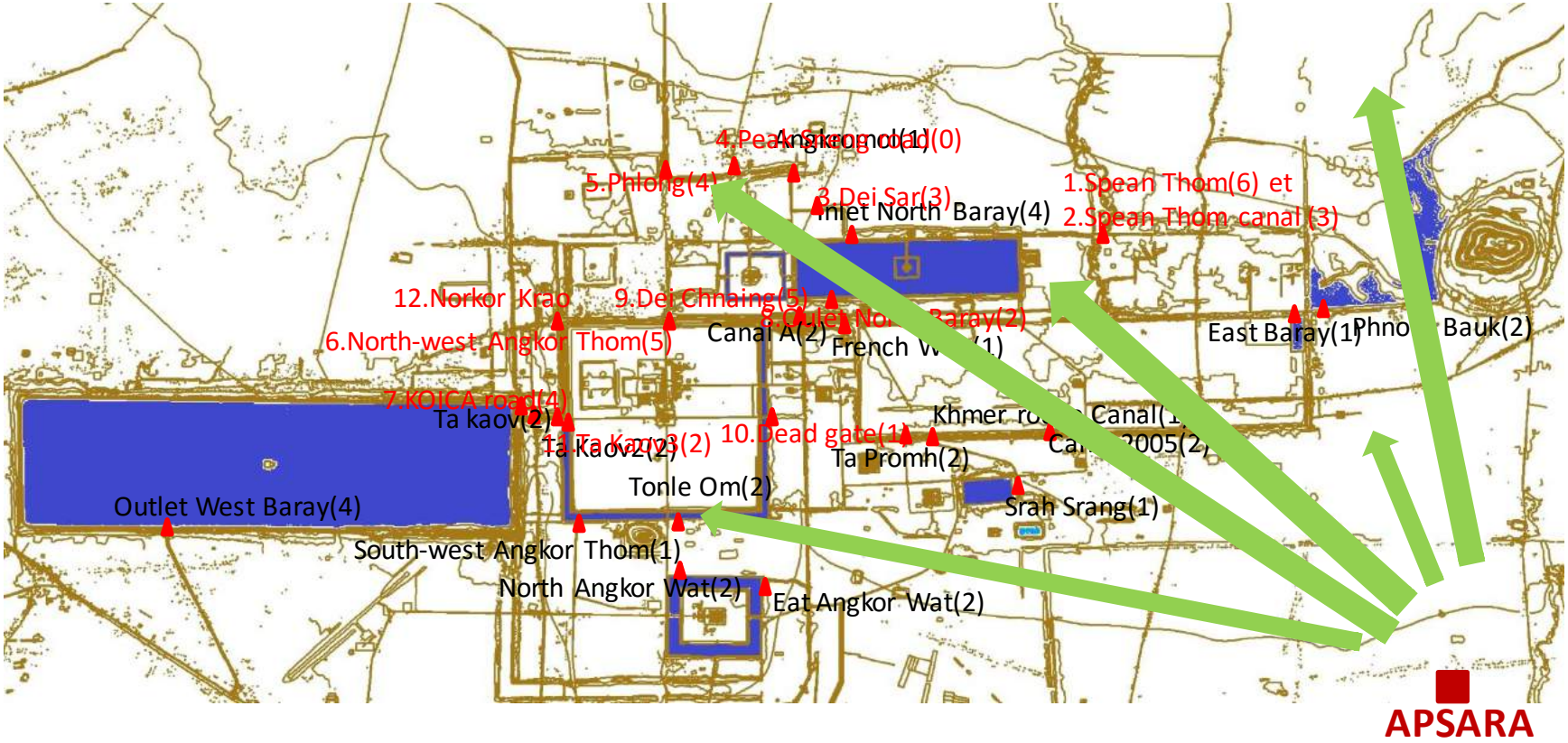
PAAGERA project (Cambodia-France)

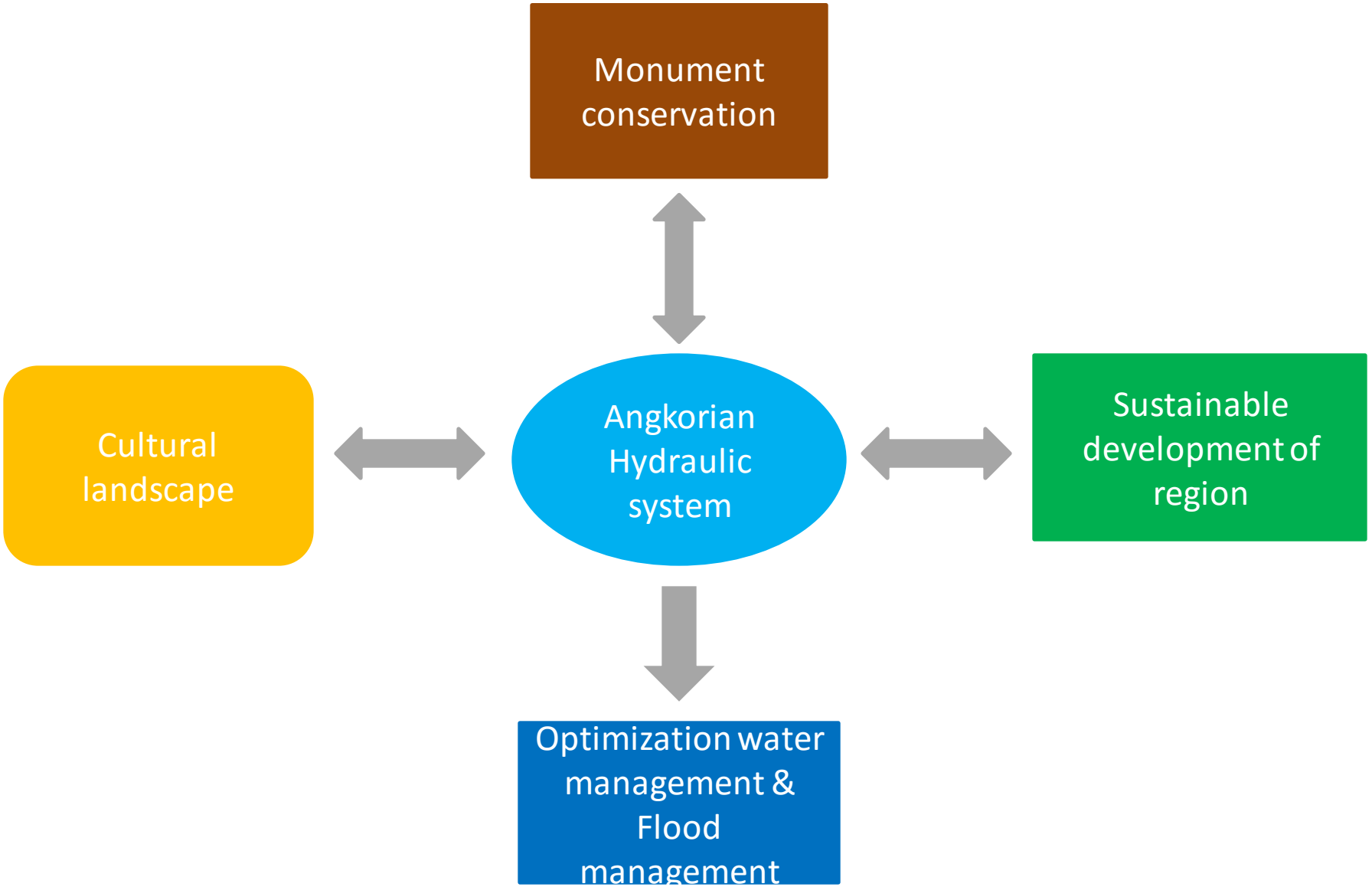
Telemetry : Decission tool

- Water level
- Weather
- METEO-SAT/Radar

APSARA

Remote Management




Monument conservation
Cultural landscape
Angkorian Hydraulic system
Sustainable development of region
Optimization water management & Flood management


Thank for your kind attention