Role of cascading reservoirs in effective flood risk management

-the case of Integrated Management of Narmada River Basin

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SAARC

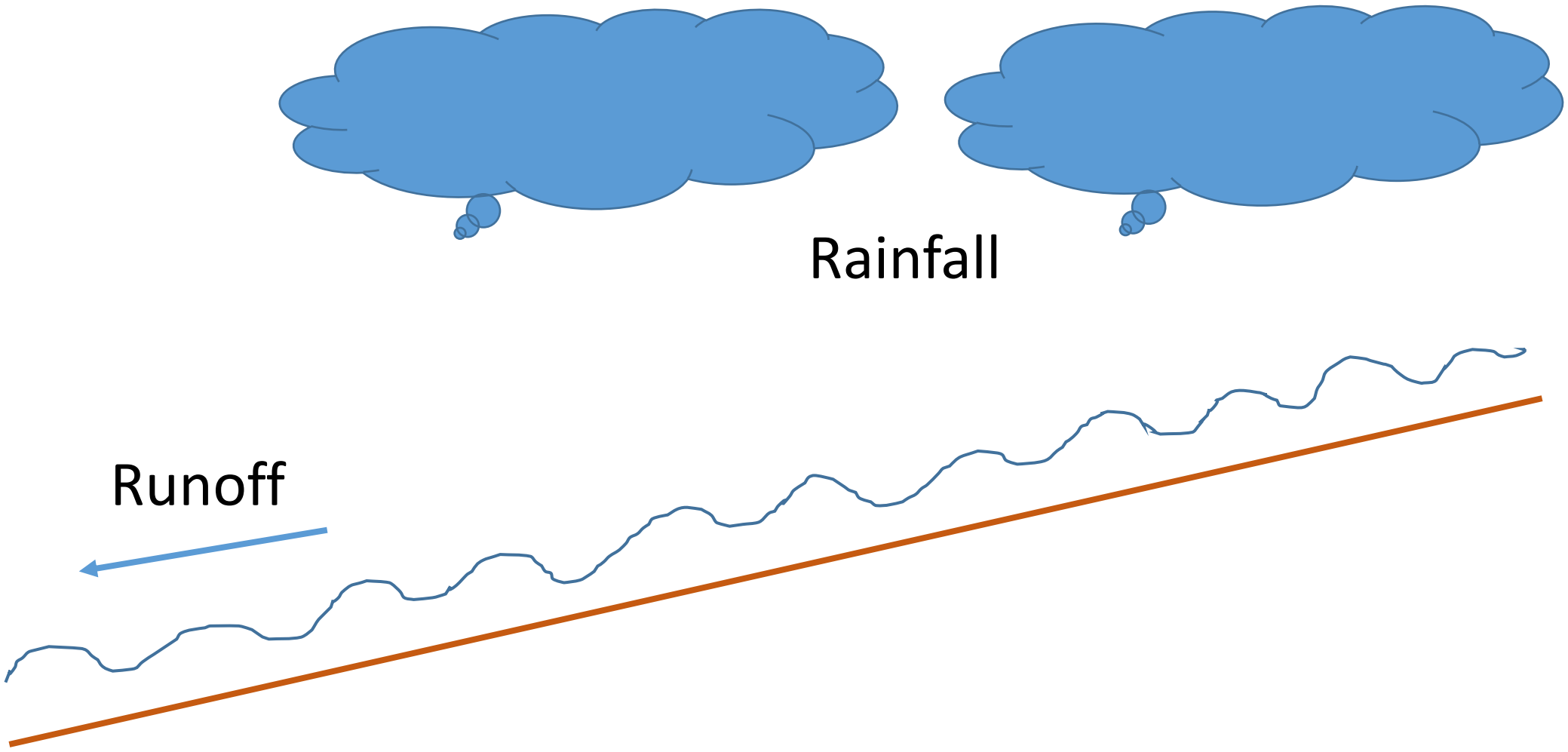
Disaster Management Centre (IU)

Virtual Workshop on 'Integrated Flood Risk Management'

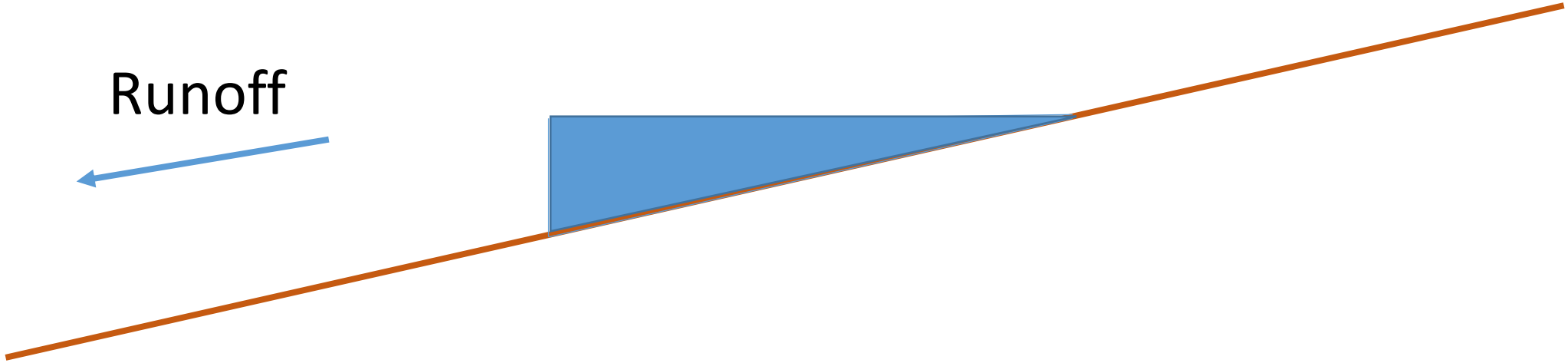
December 9, 2023

Flood Management is All about its TEMPORAL DISTRIBUTION

Integrating Structural and Non-Structural Strategies for Flood Risk Mitigation

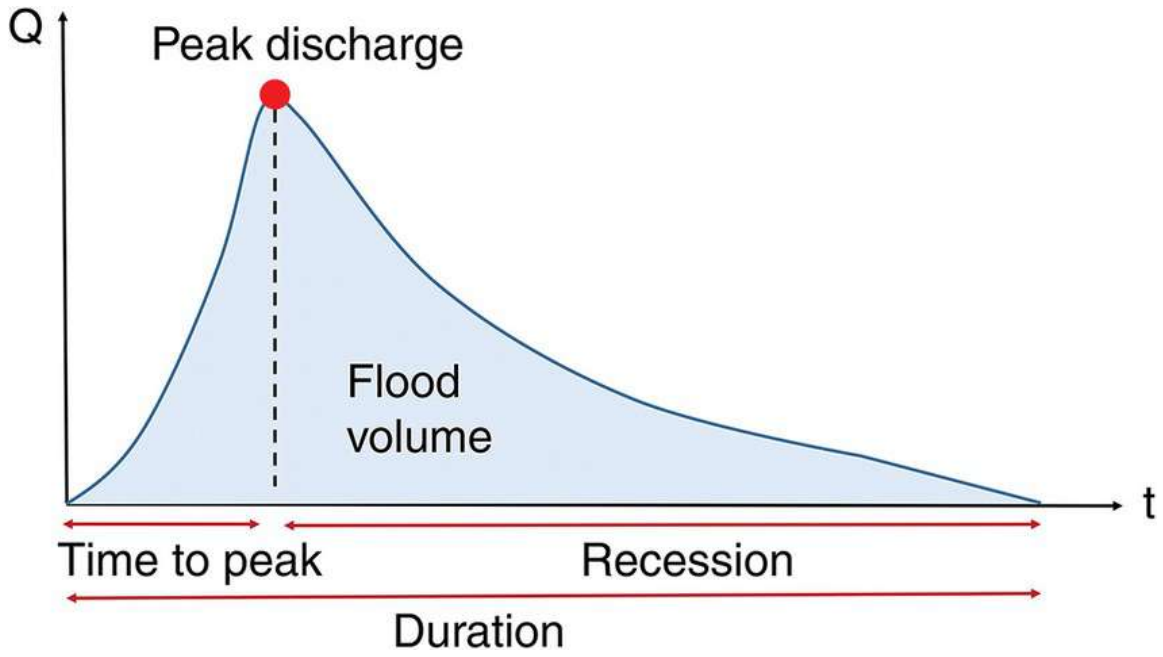

Rainfall
Runoff
Flood Plain

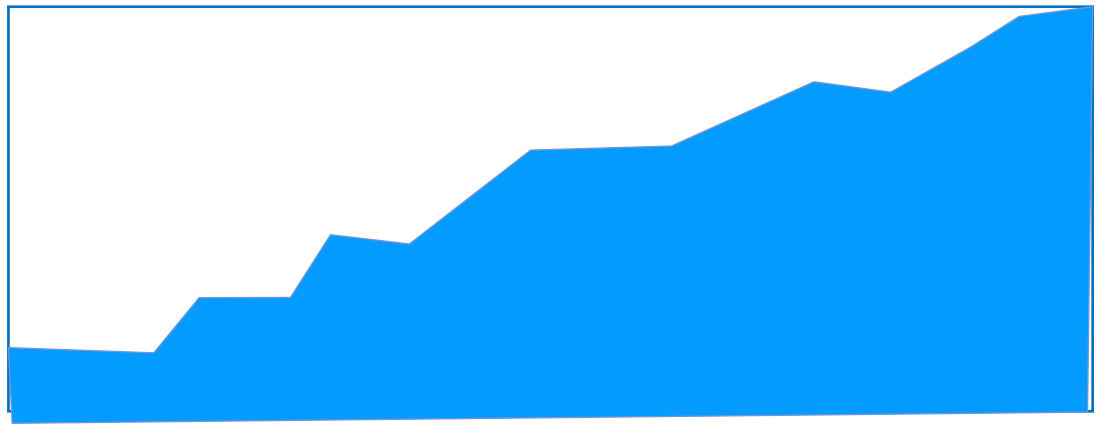
Rainfall



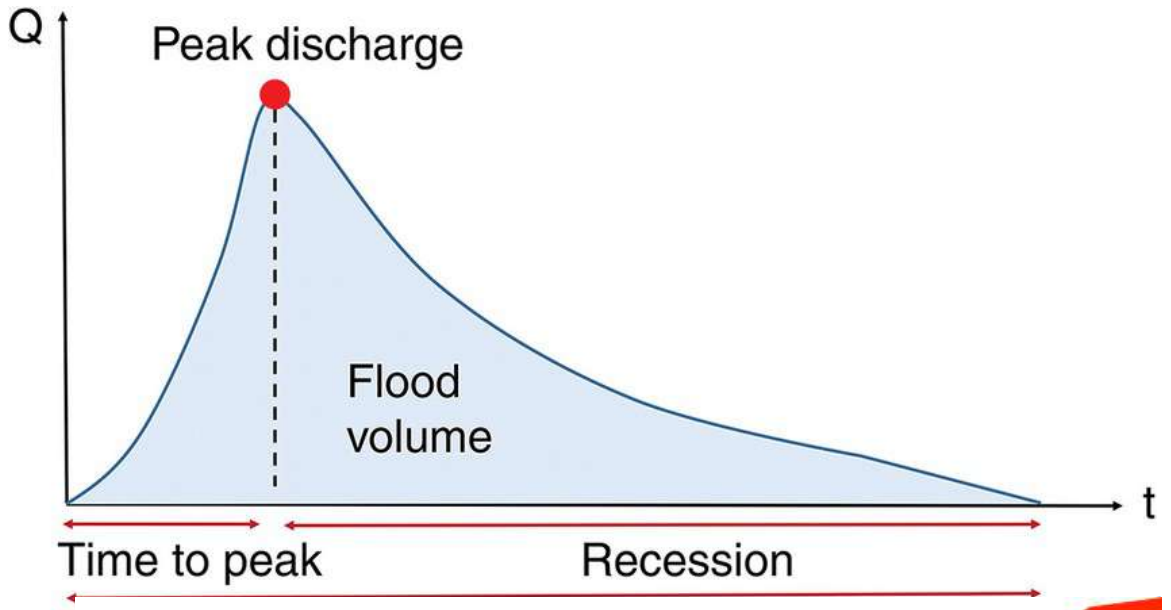
Runoff

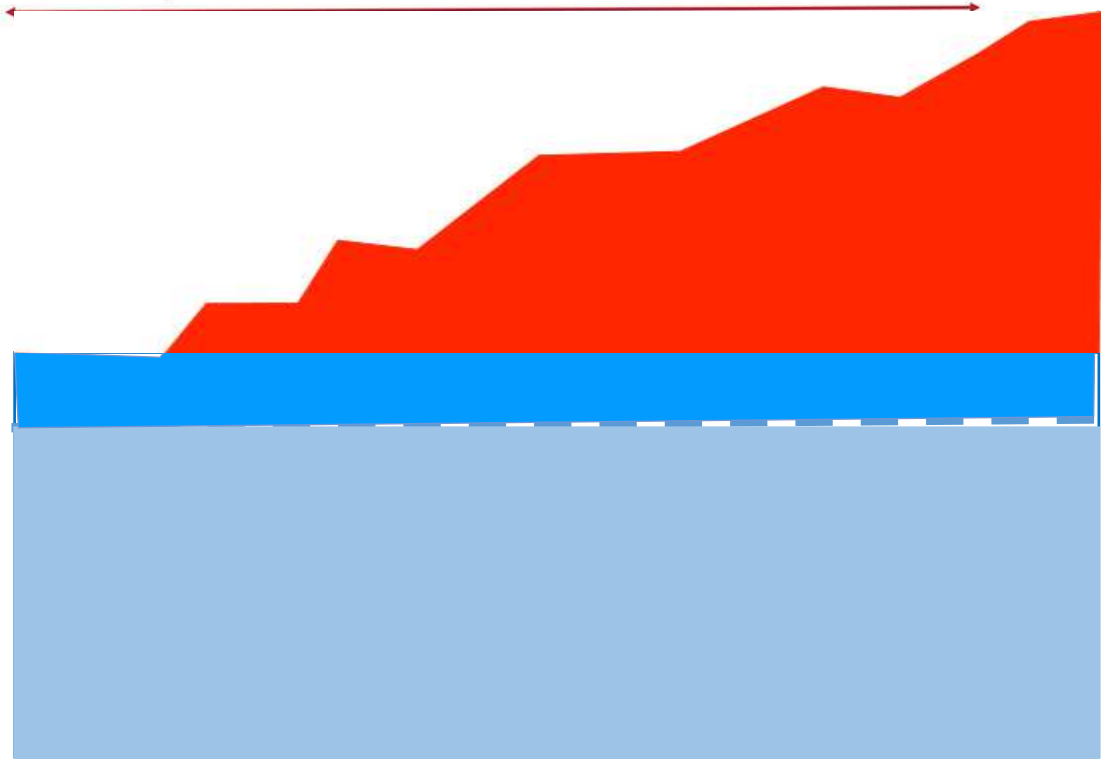
Reservoir created by constructing a Dam



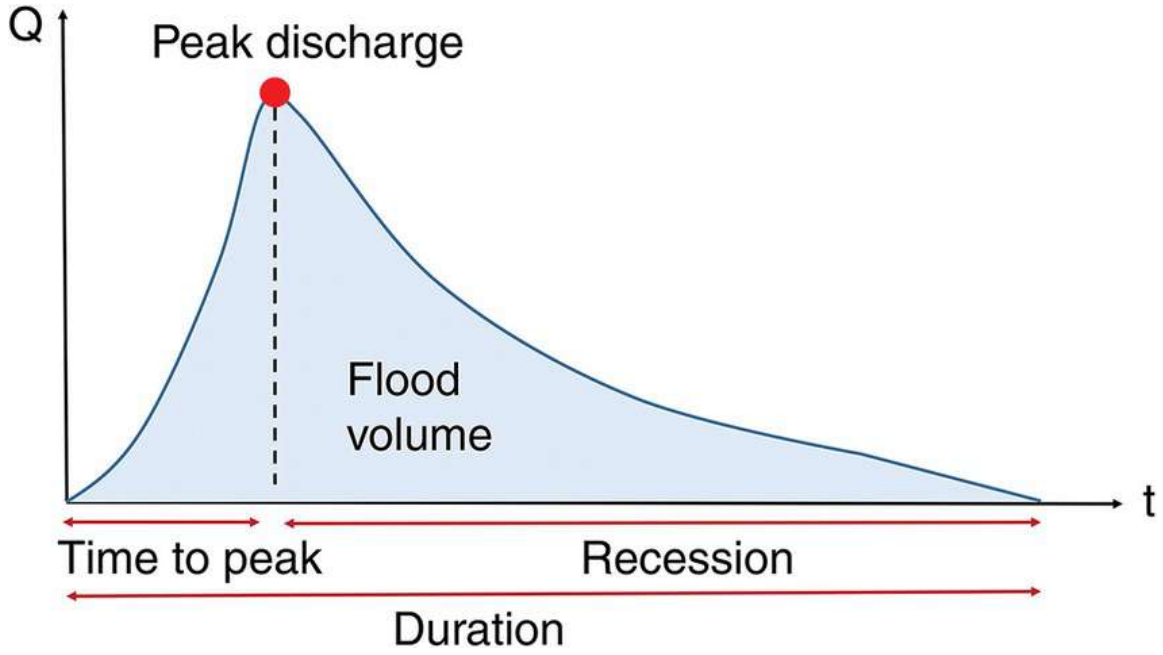


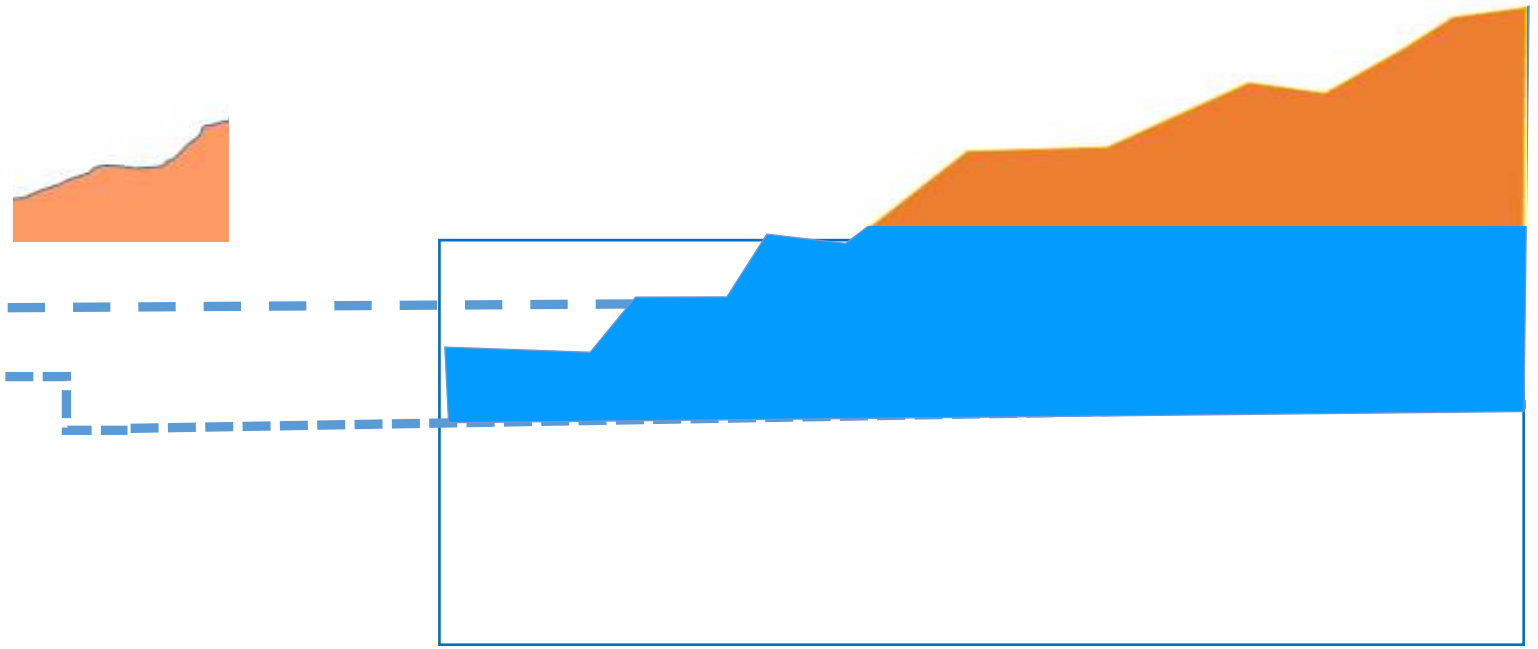
Flood Routing when the Dam is completely EMPTY





Flood Routing when the Dam is FULL or ALMOST FULL

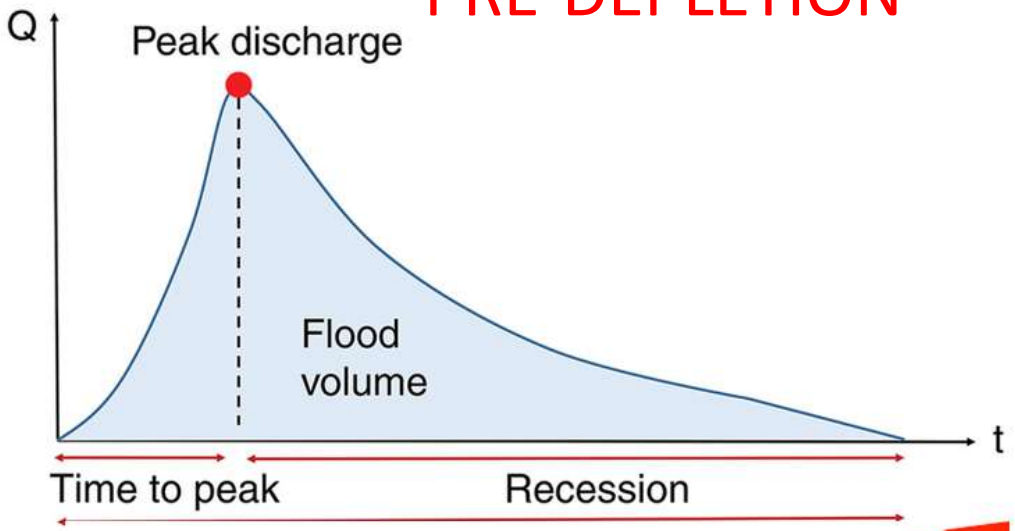


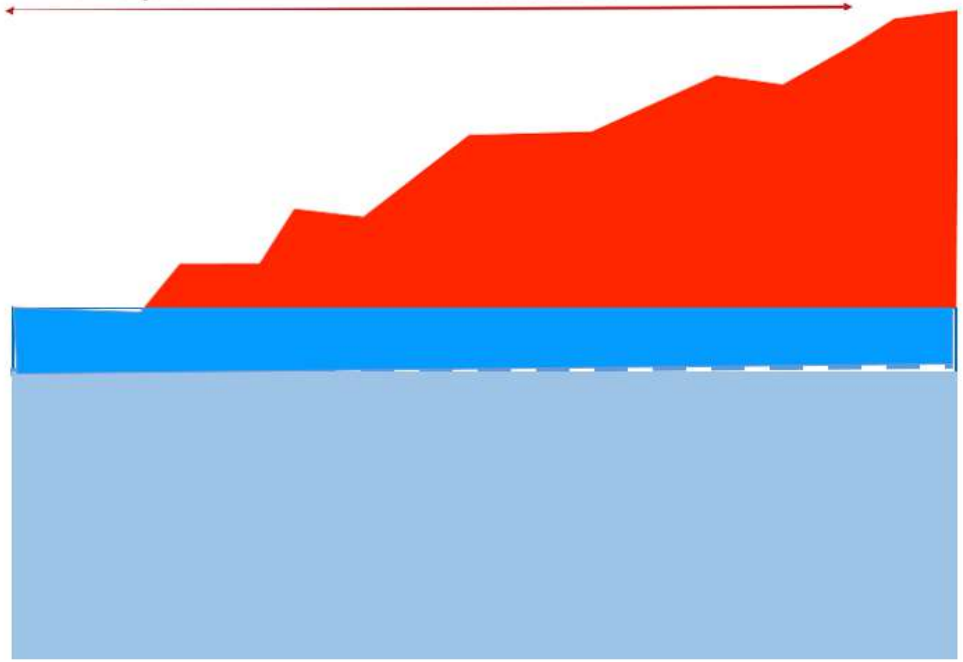


Flood Routing when the Dam is FULL or ALMOST FULL

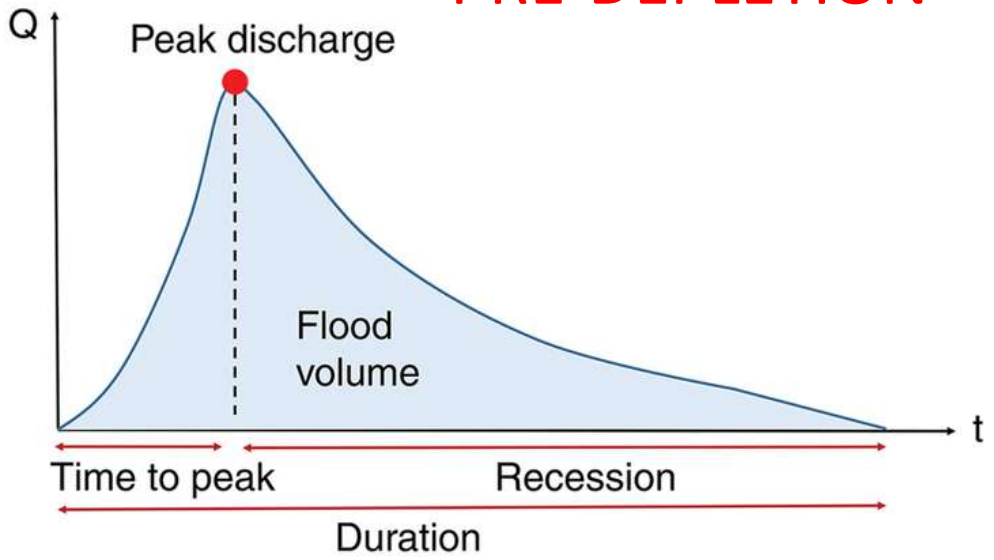
With Pre-Depletion of Reservoir

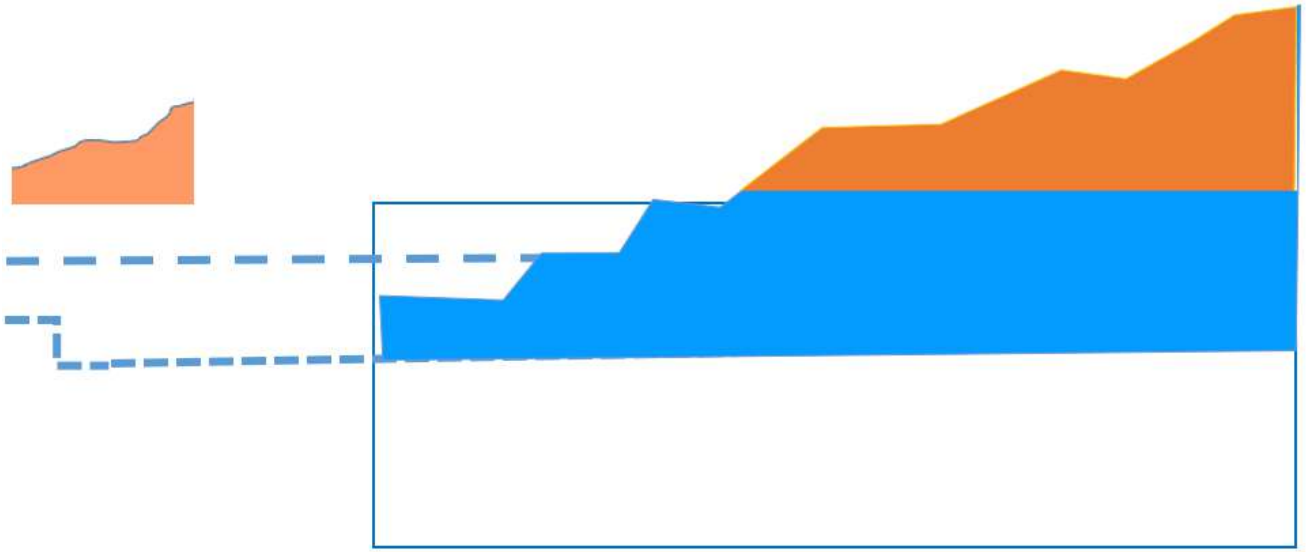
Without
PRE-DEPLETION



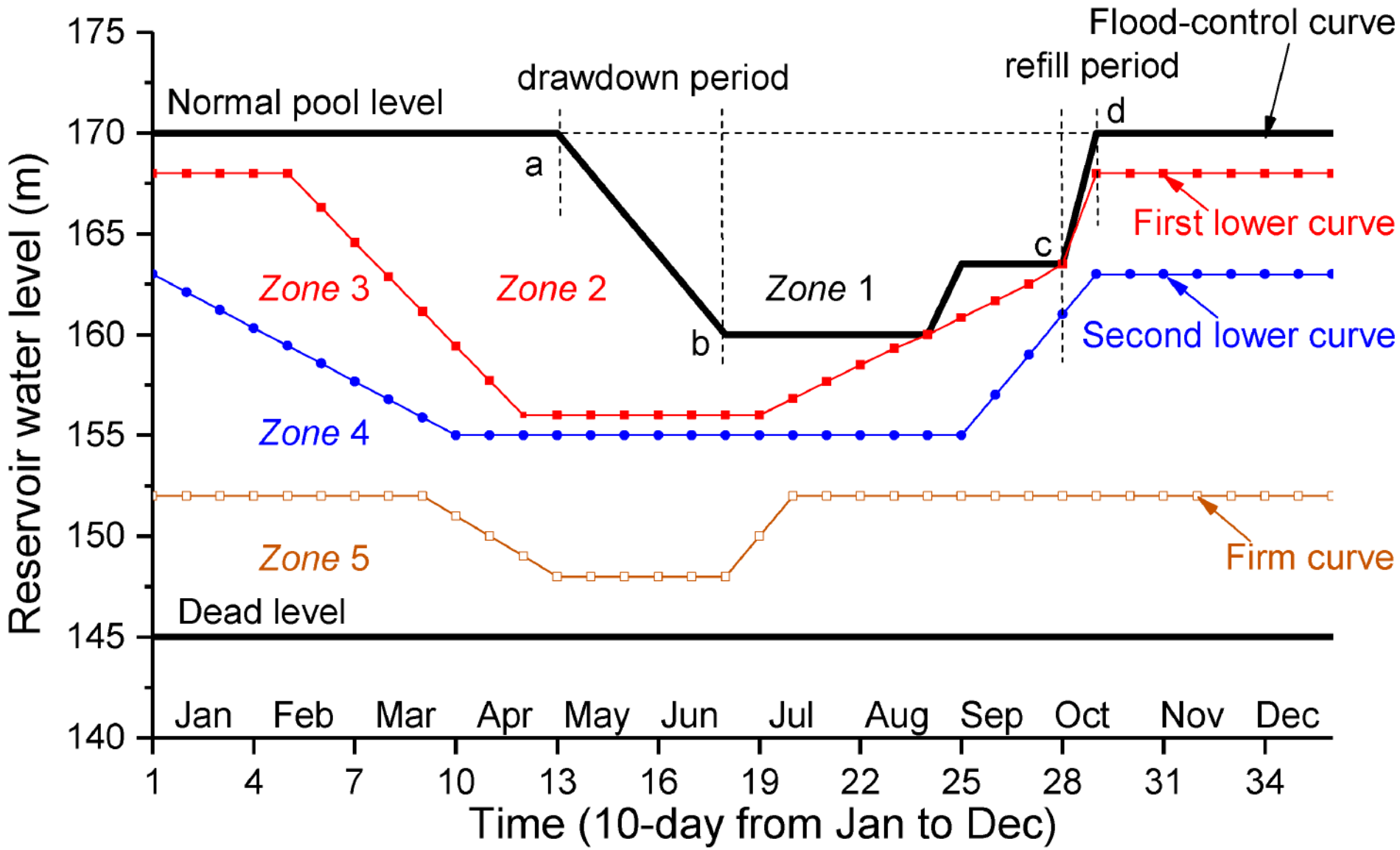


With
PRE-DEPLETION



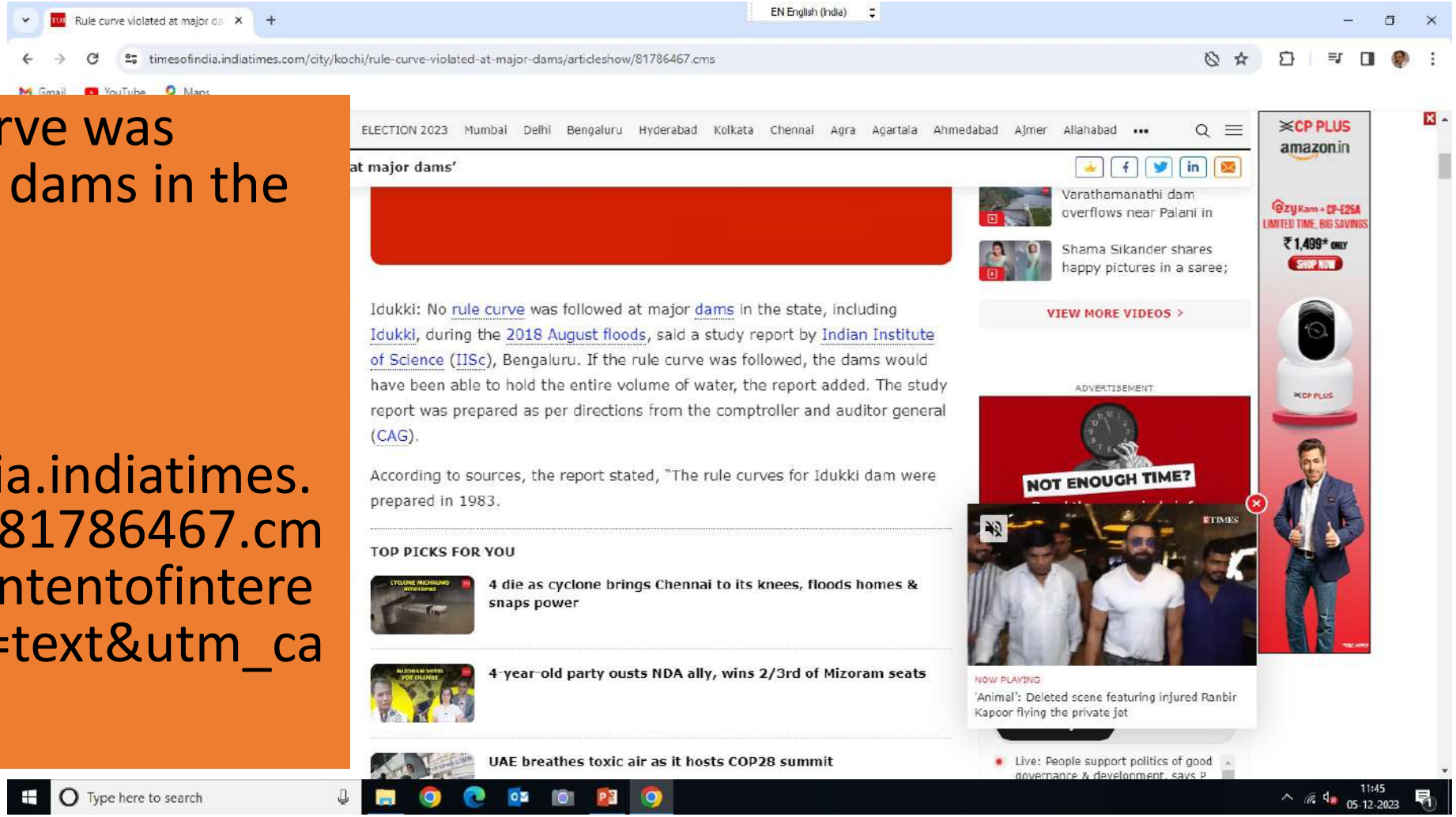


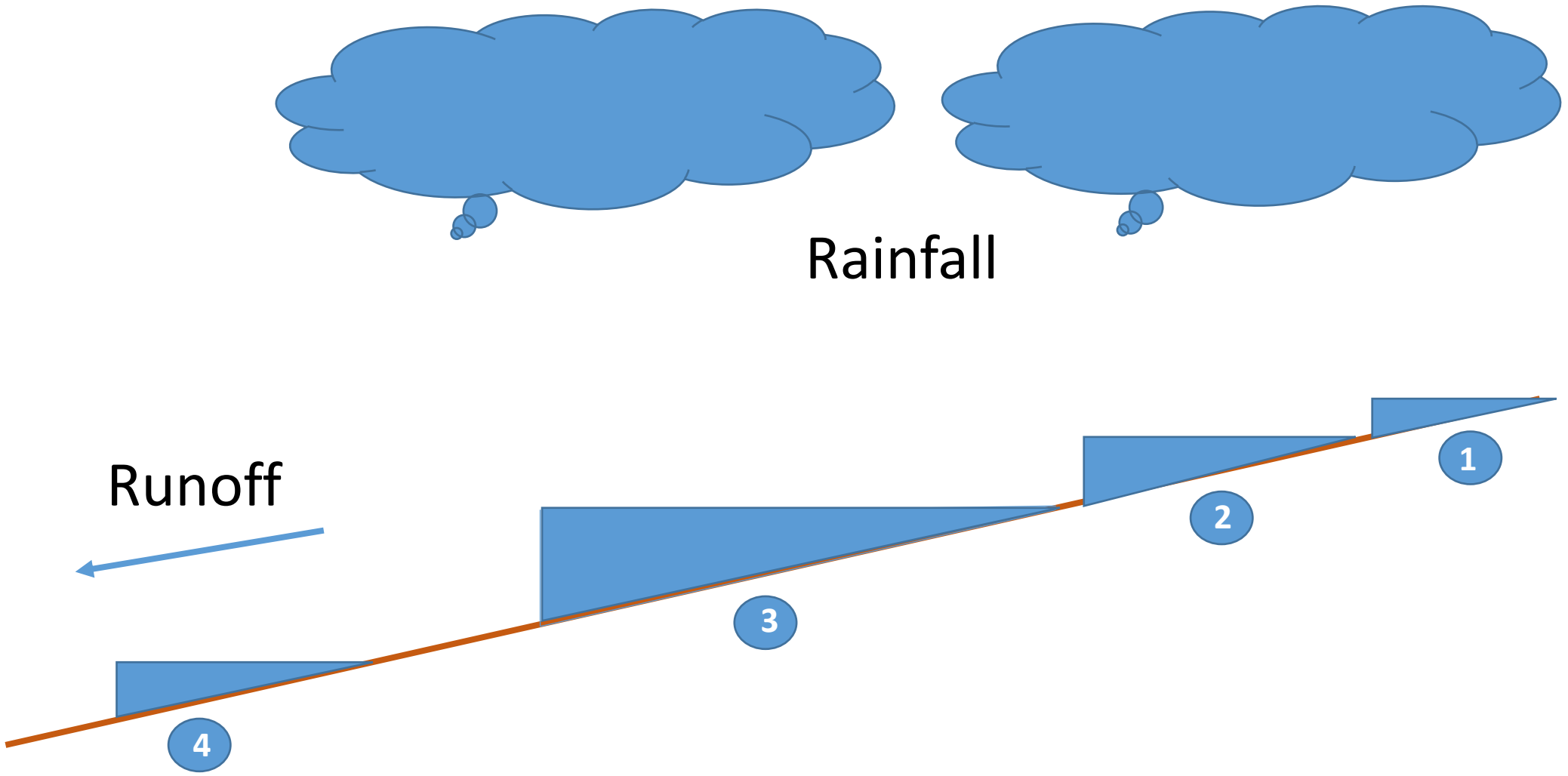
Defining Rule Curve for Reservoir Operation



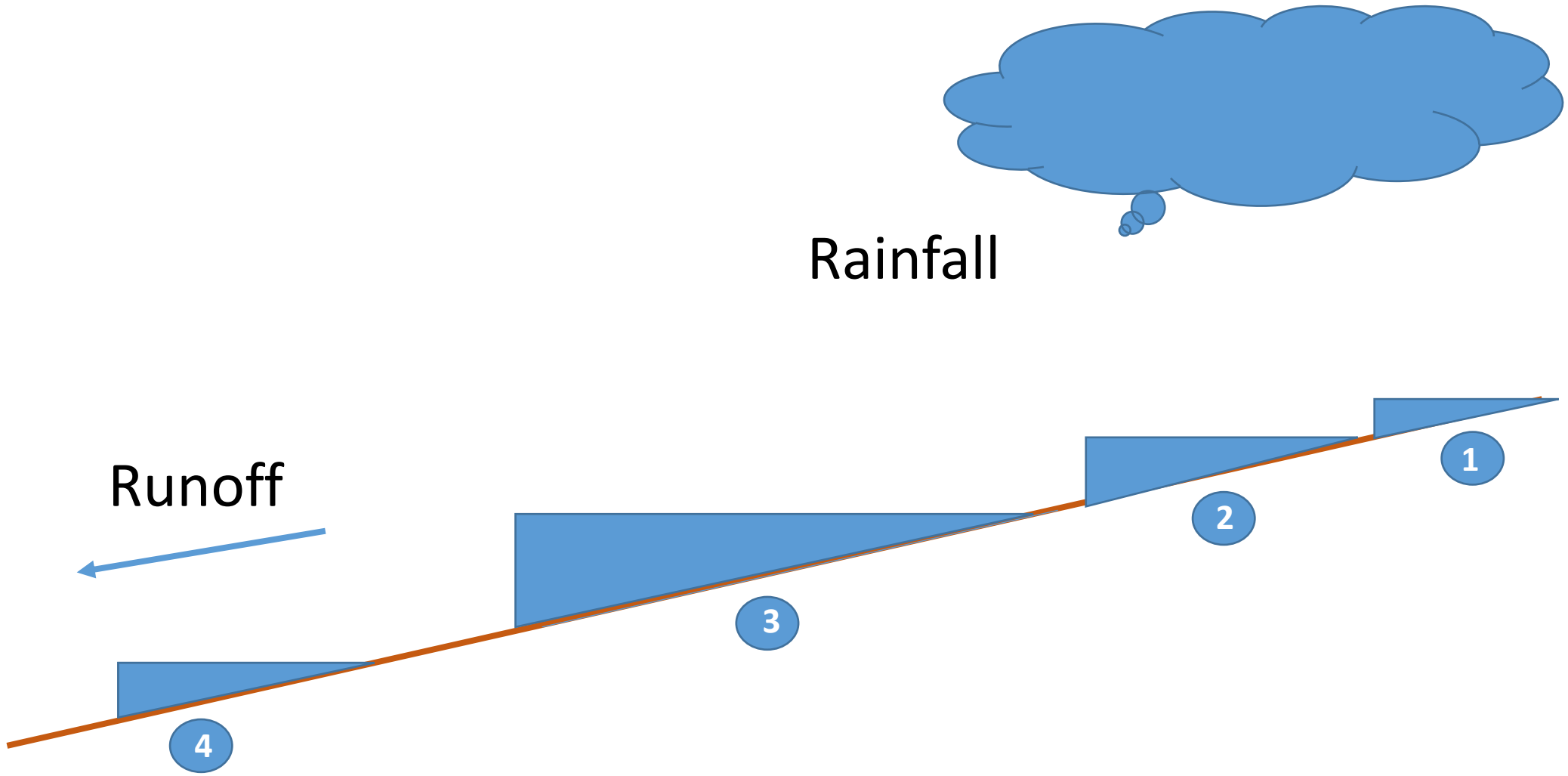
IISc Bangaluru Study for August 2018 Flood

- Idukki: No rule curve was followed at major dams in the stat ..
- Read more at:
- http://timesofindia.indiatimes.com/articleshow/81786467.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

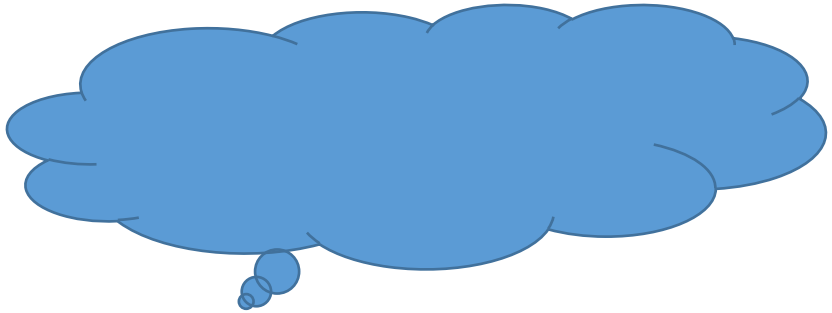




Cascading Reservoirs with Heavy Rainfall in entire Basin



Scenario I : Heavy Rainfall only in the Upstream Catchment



Rainfall

Runoff

Flood

1

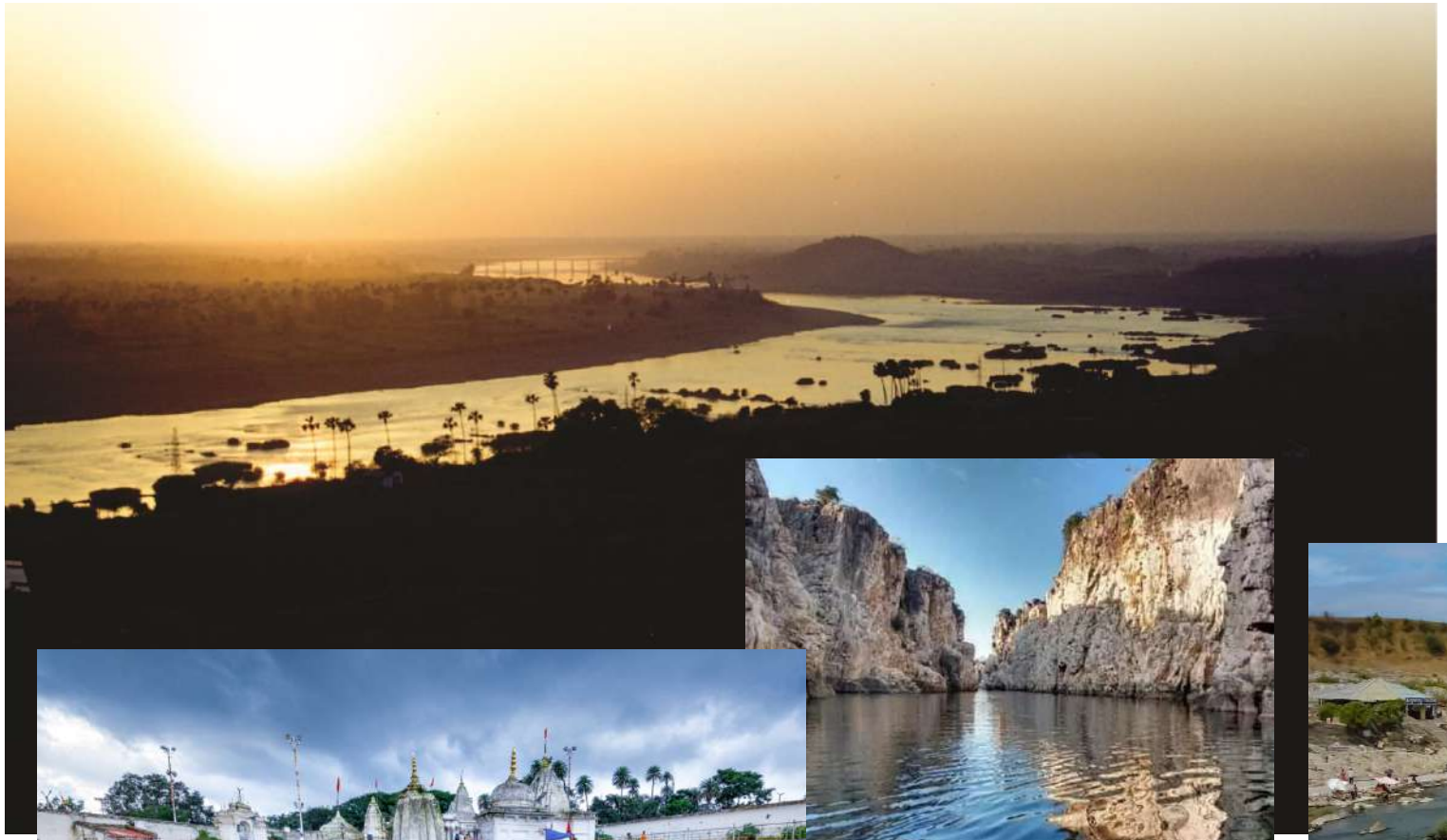
2

3

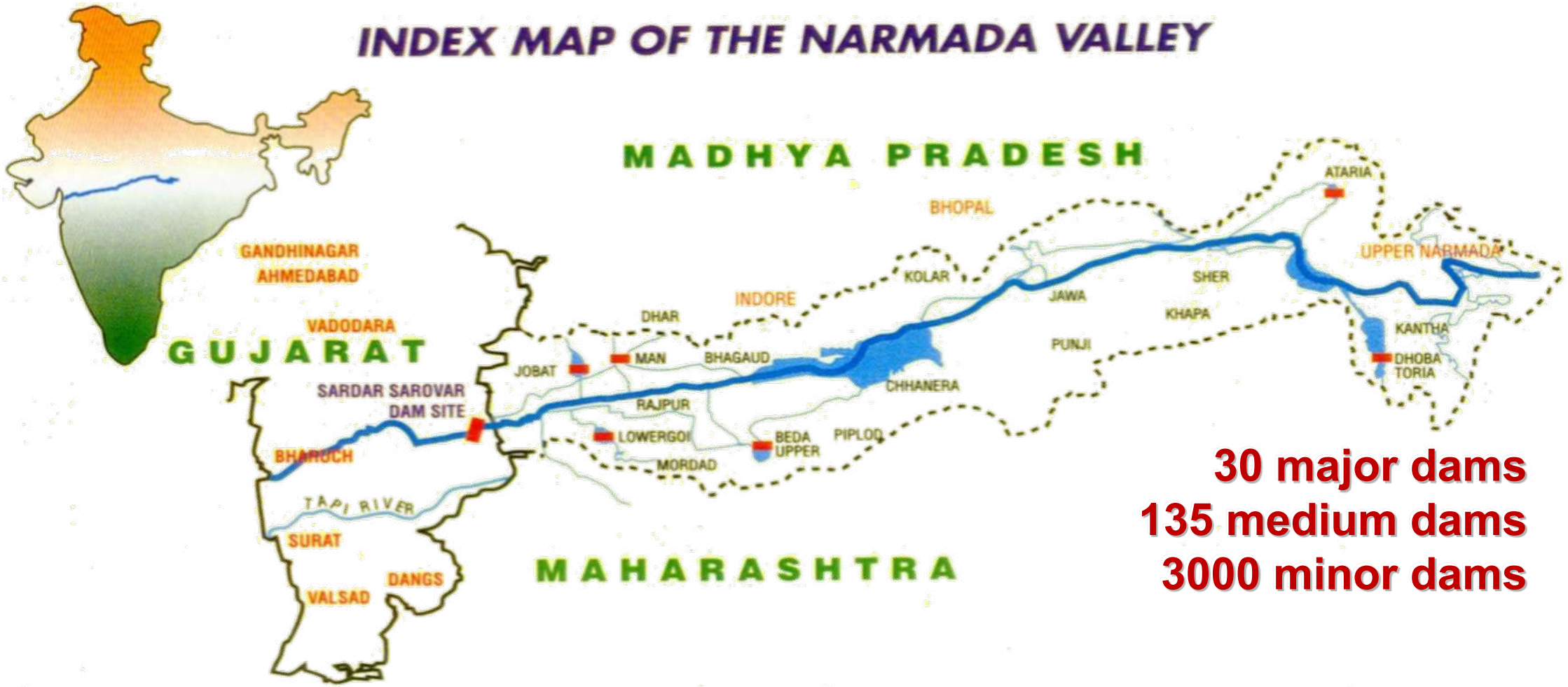
4

Scenario II : Heavy Rainfall only in the Downstream Catchment

Integrated Flood Management in Narmada Basin



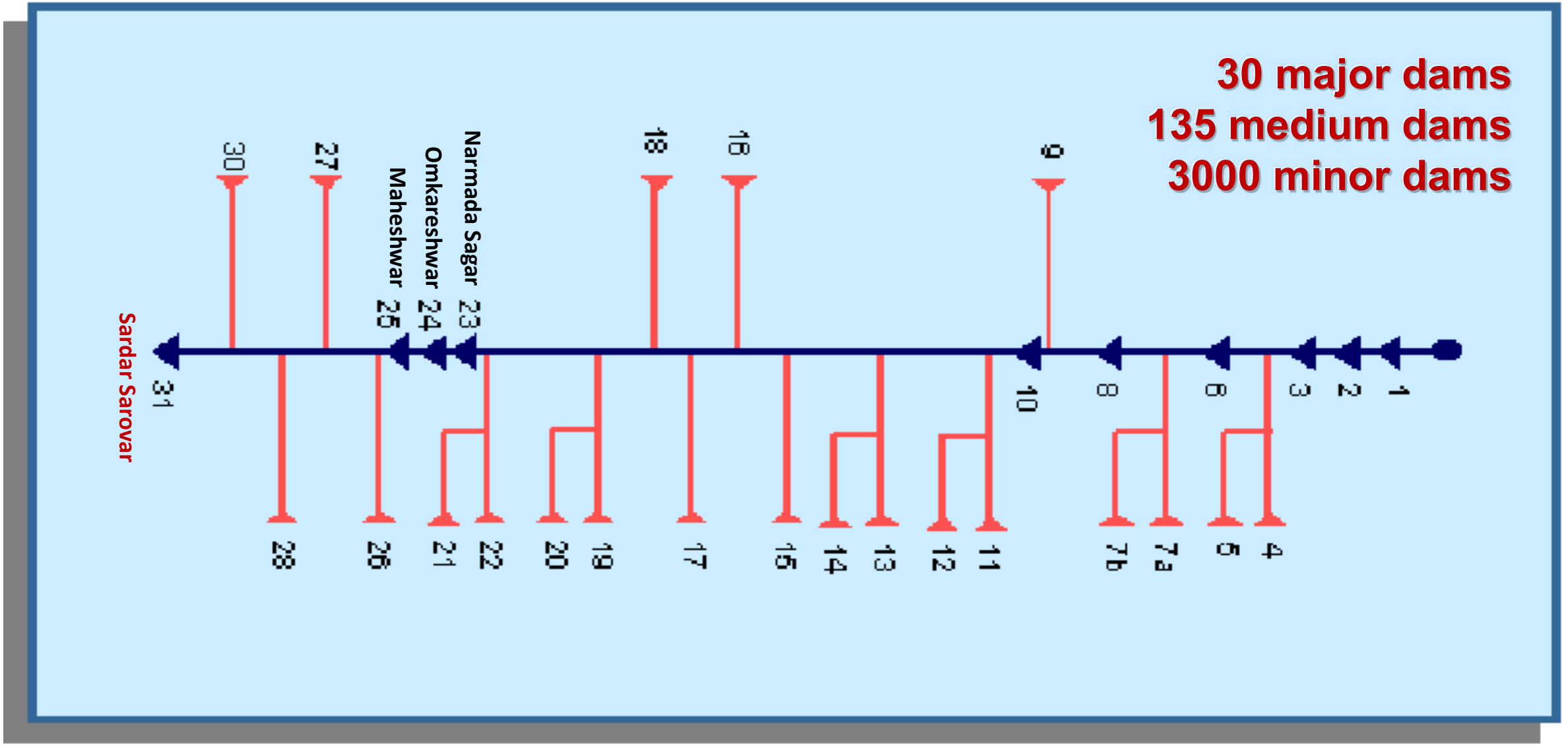
Integrated Planning & Development of Narmada Basin



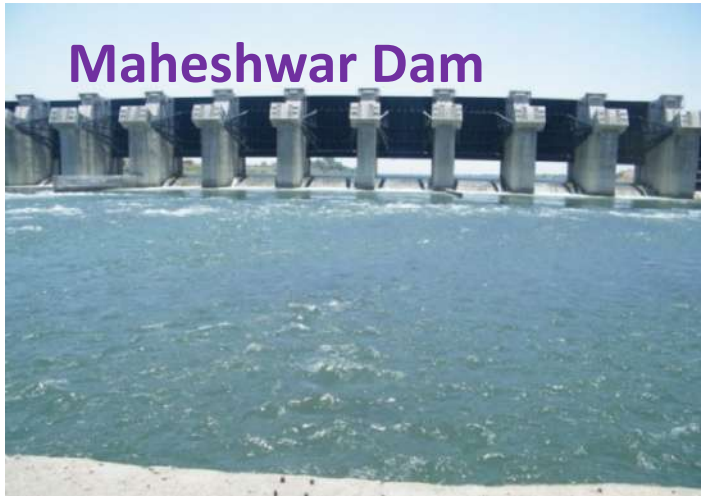
30 major dams
135 medium dams
3000 minor dams

Total length 1,312 km (1077 km in M.P., 161 km in Gujarat).
41 tributaries (22 on Left Bank and 19 on the Right Bank).

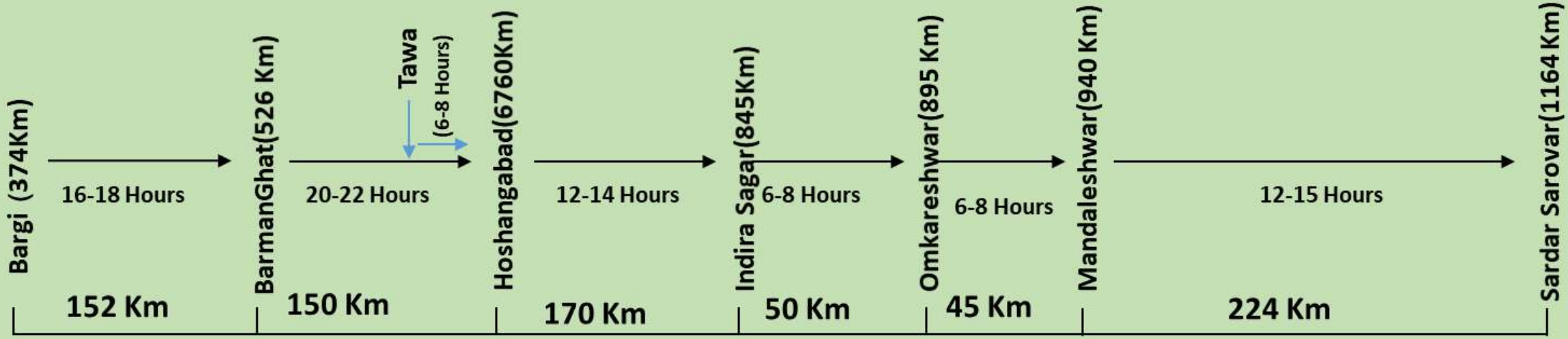
Integrated Water Management of Narmada River



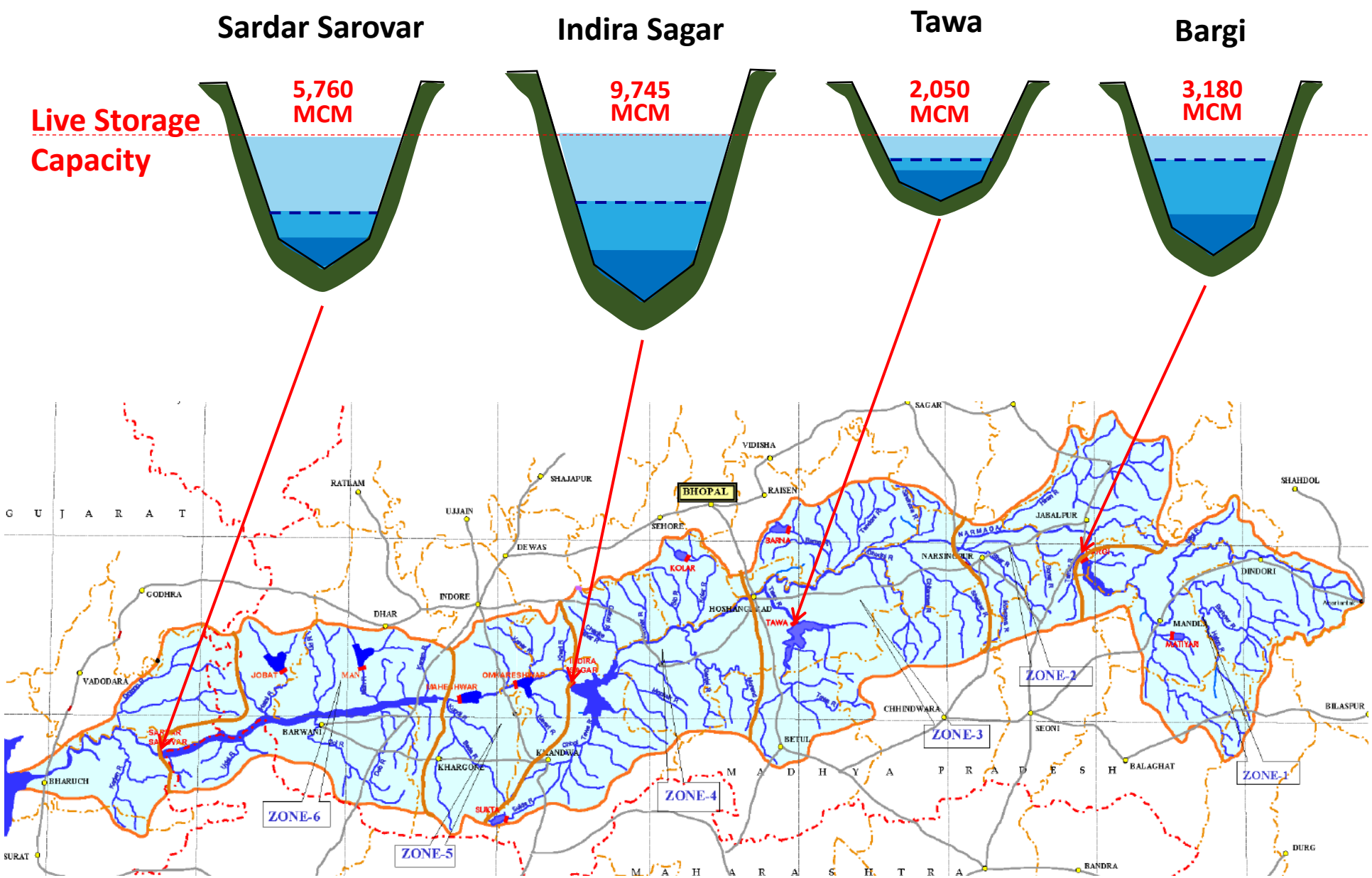
Integrated Water Management of Narmada River



Time for water flow in different reaches



Water stored at any Dam in the Basin is sharable



Bargi Dam on River Narmada

Spillway Discharge 1.6 million cusec

Tawa Dam on River Tawa (A Tributary of Narmada)

Spillway
Discharge
7,20,000cusec

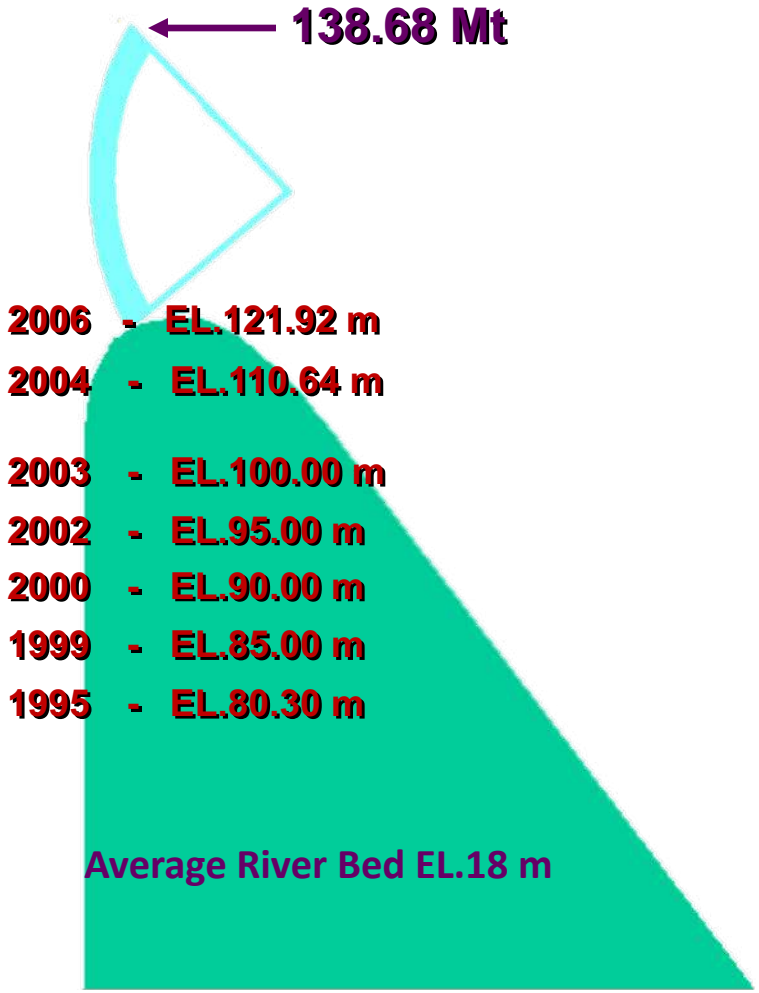
Indira Sagar Dam on River Narmada

Spillway Discharge 2.95 million cusec

Bird's eye view of Completed Dam

Sardar Sarovar Dam

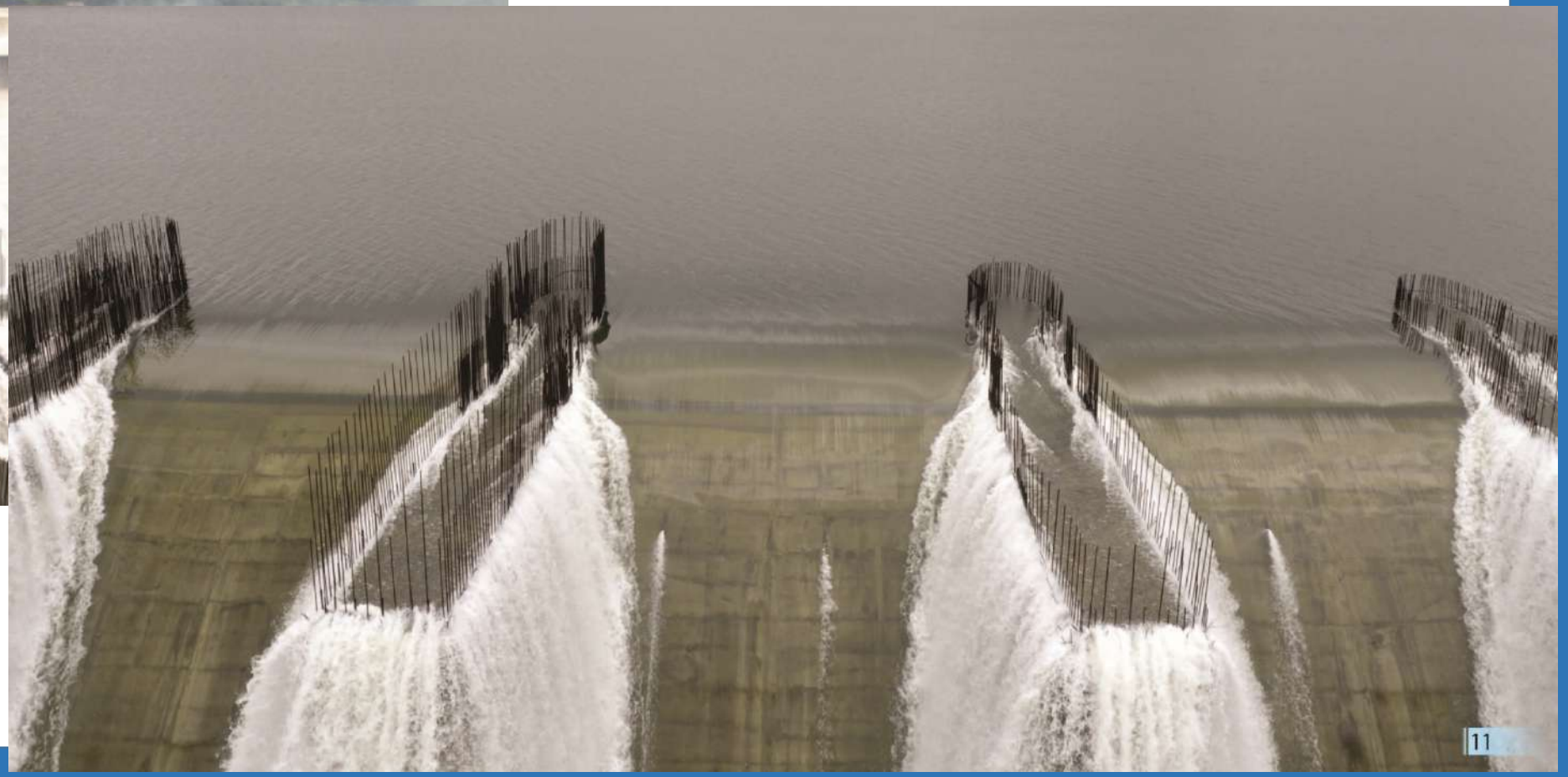
Conceived by Shri Sardar Patel	1946
Foundation stone laid by late Hon'ble P. M .Shri Jawaharlal Nehru	April 1961
Referred to Narmada Water Disputes Tribunal	Oct. 1969
Tribunal Award	Dec. 1979
Construction Started	1985
Hon. Supreme Court Stay on further raising beyond 80.3 m	May 1995
Hon. Supreme Court Judgement	2000
Work Resumed	2000
Achieved Dam height of 100 Meters	July 2003



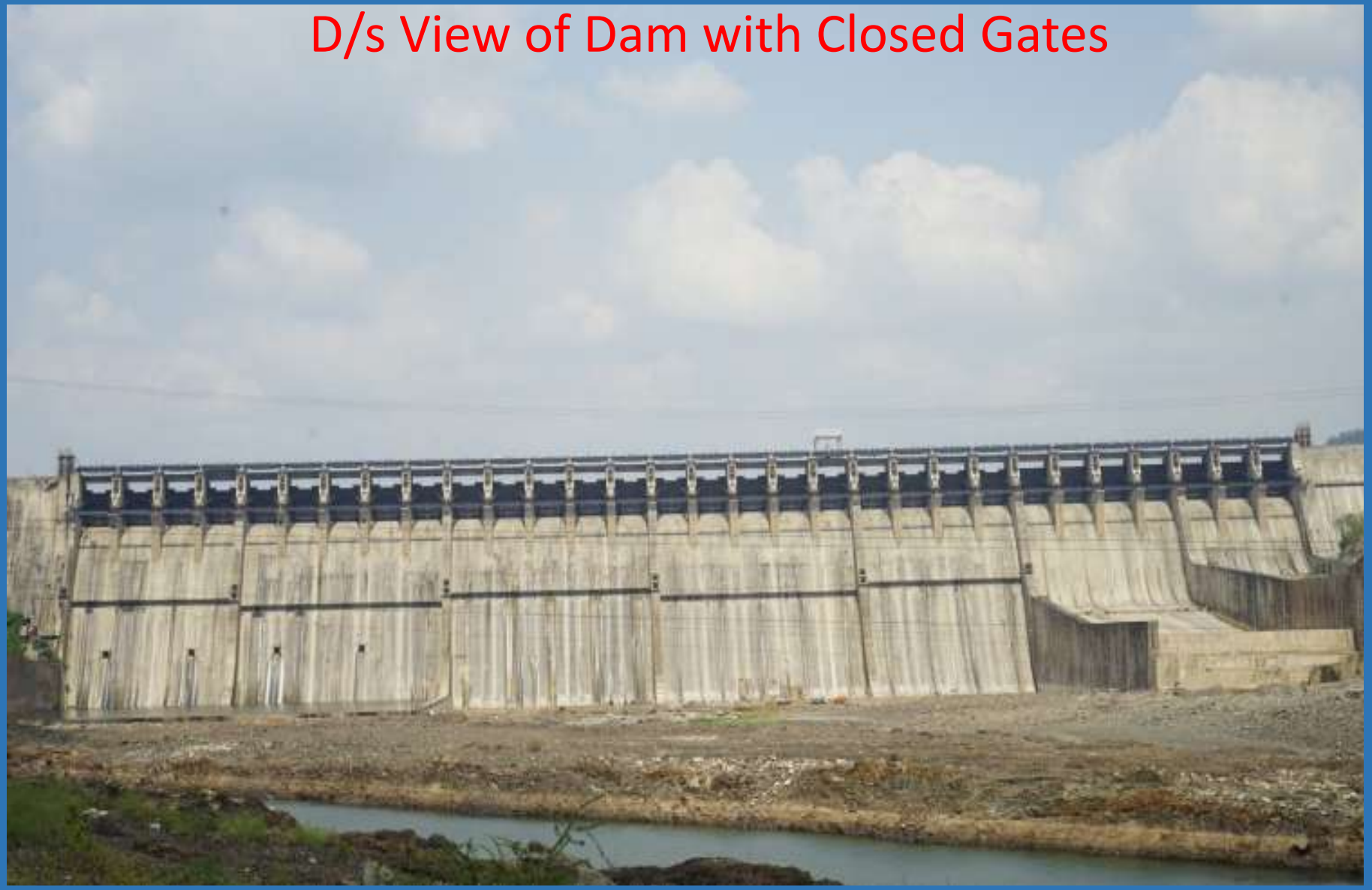
Dam reached 121.92 m in the year 2006, 97% concrete completed

Uncontrolled overflow over Dam body

Uncontrolled overflow over Dam body



D/s View of Dam with Closed Gates



Completion of Bridge on Main Dam

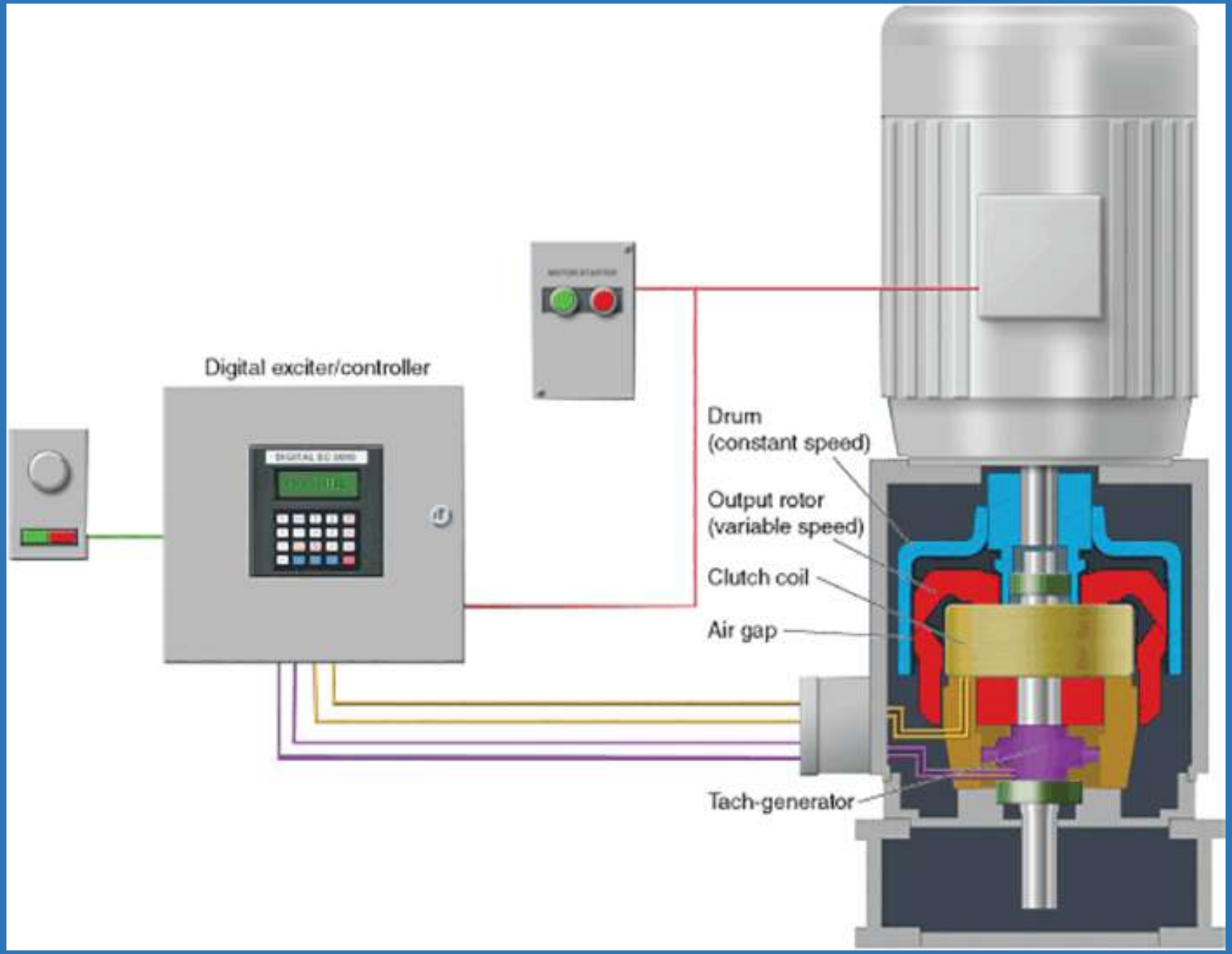
Completed Piers of Narmada Dam (Upstream View)

Gates in Open condition (Upstream View)

All 30 Gates in Open condition (Upstream View)

U/s View of Dam with Closed Gates

U/s View of Electric Motors & Rope Drums

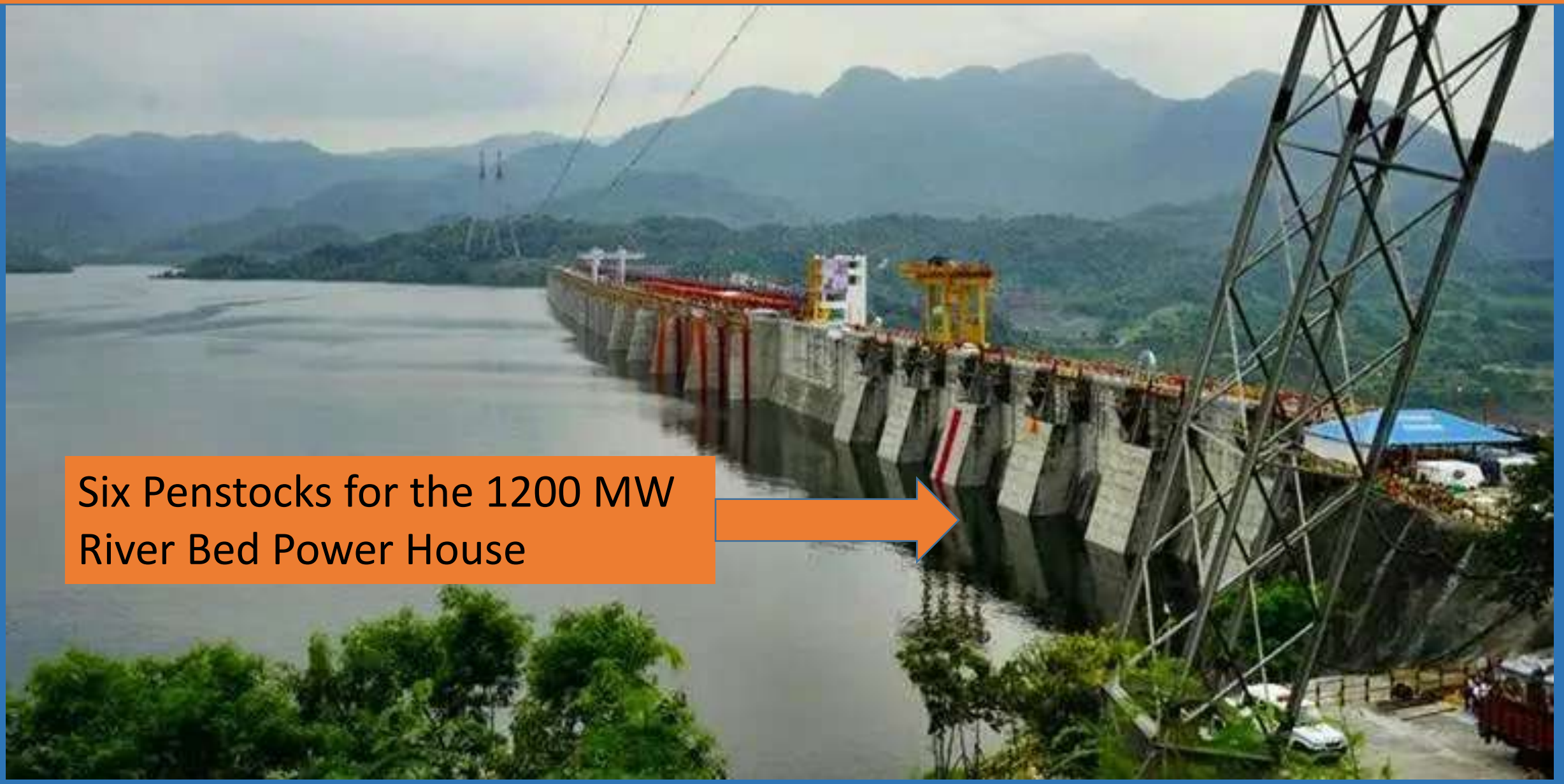


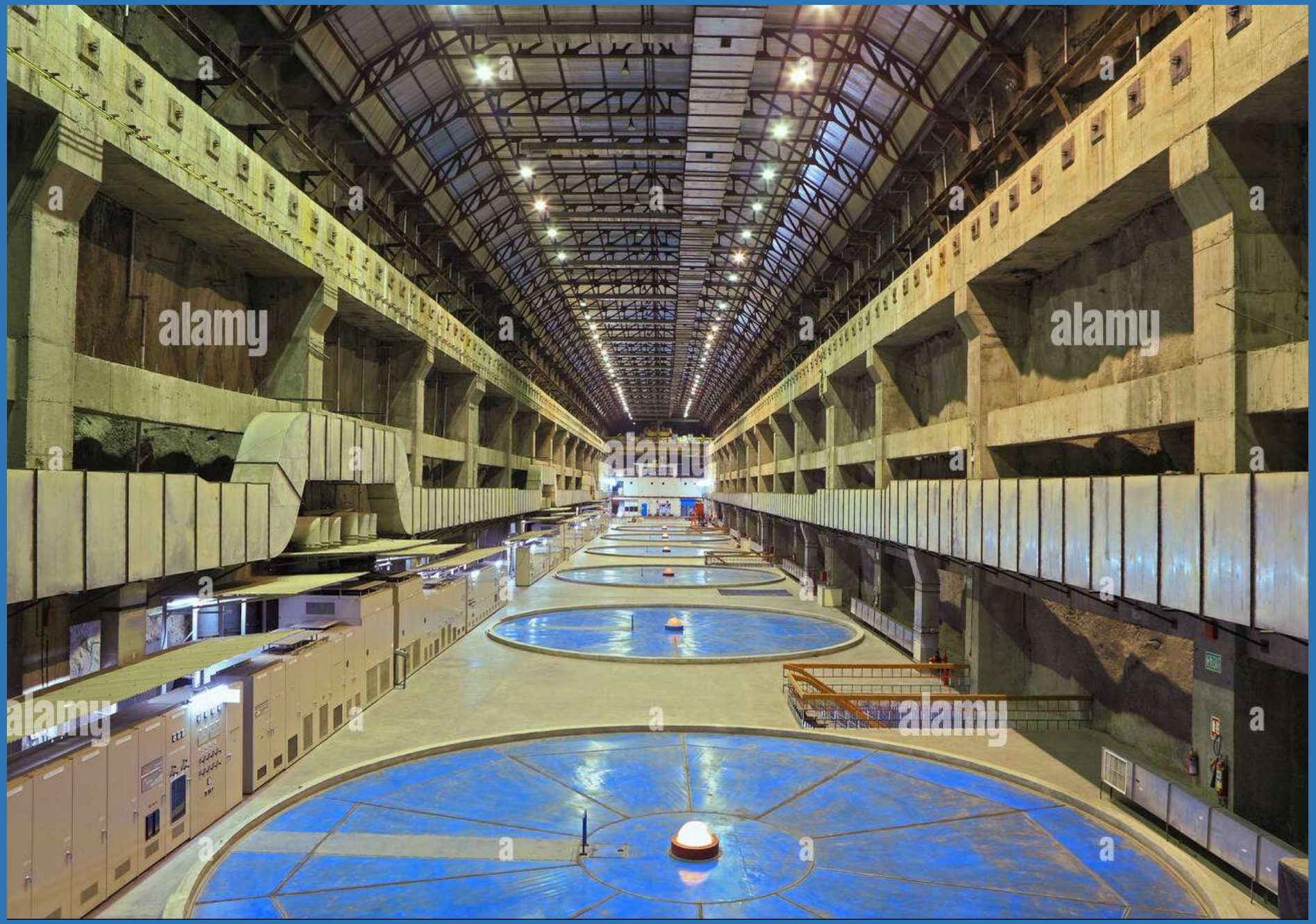
Variable Speed Motor and Eddy Current Drive with Digital Controller

State of the Art SCADA Control Room With Mimic Display

Outlet Option I : Spillway Gates : Maximum Discharge 3 million cusec

Outlet Option II : RBPH : Maxium Discharge 42,000 cusec



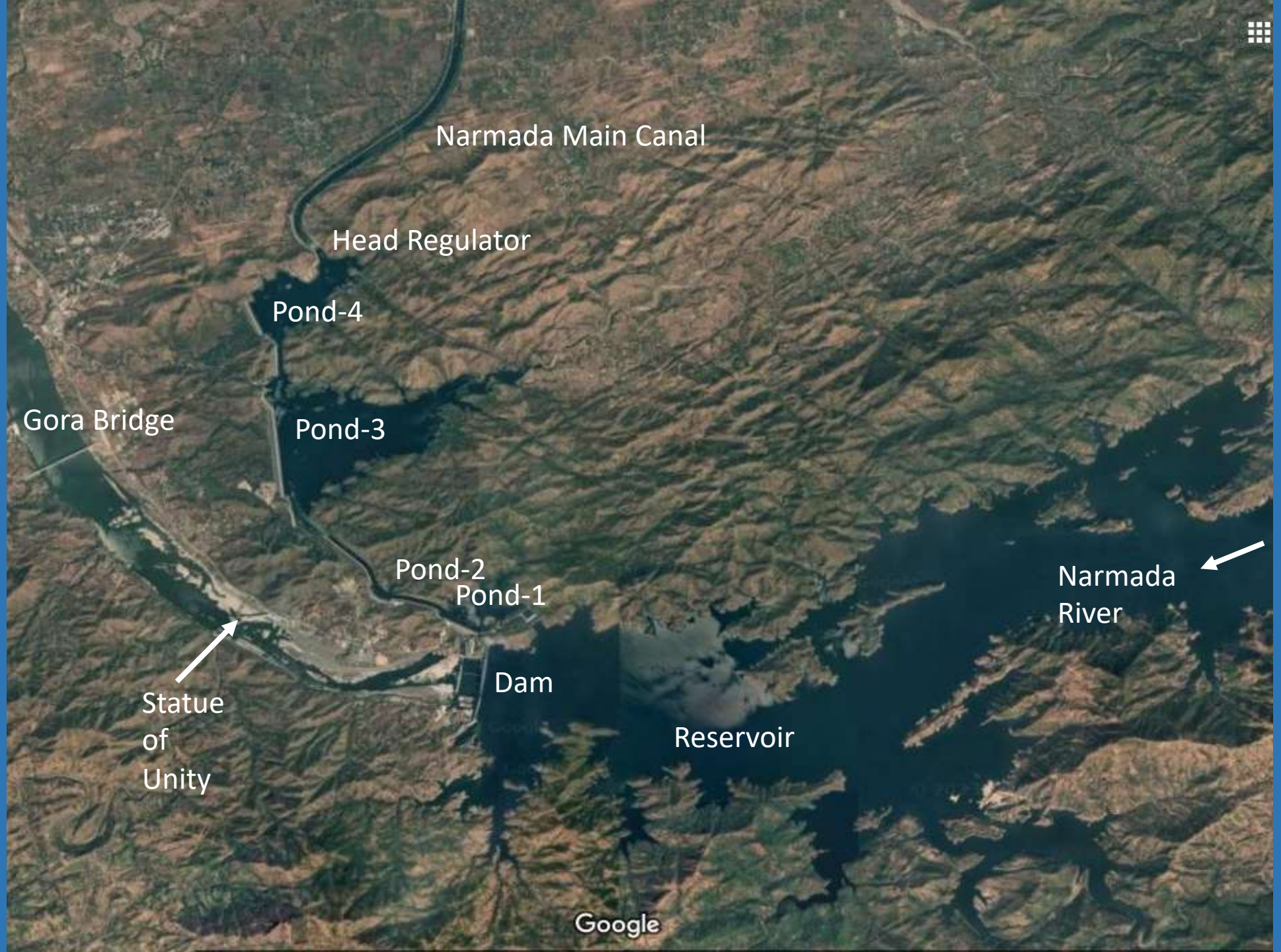


Machine Hall of RBPH : Maximum Discharge @ 42,000 cusec

Outlet Option III : CHPH : Maxium Discharge 25,000 cusec

CANAL HEAD POWER HOUSE (250MW)

Geo - Physical View of The Sardar Sarovar (Narmada) Dam.


Narmada Main Canal
Head Regulator
Pond-4
Gora Bridge
Pond-3
Pond-2
Pond-1
Narmada
River
Dam
Statue
of
Unity
Reservoir
Google

Head Regulator of Narmada Main Canal (NMC) U/S

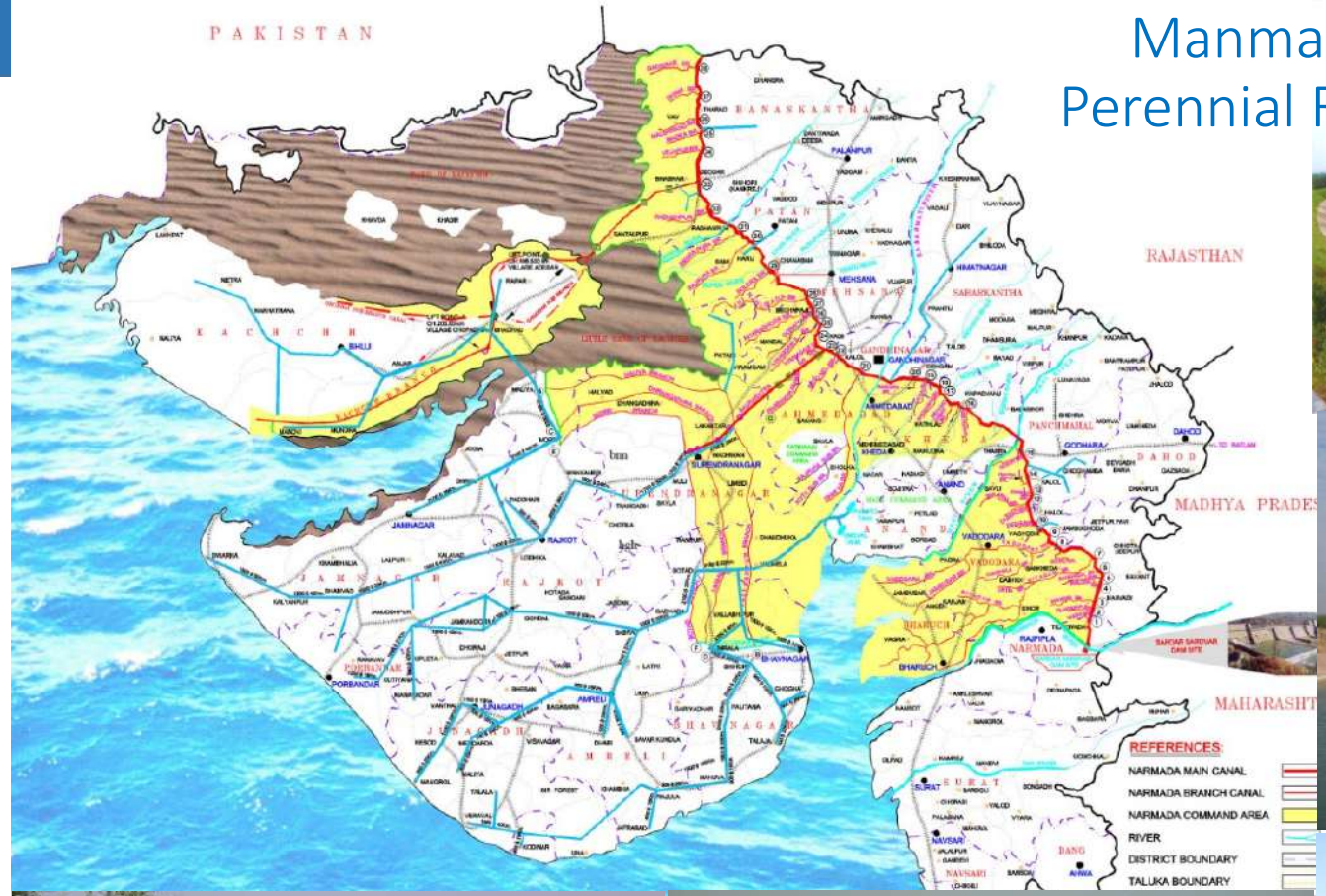
Head Regulator of Narmada Main Canal (NMC) D/S

- LAYOUT DRAWING OF HEAD REGULATOR
- LAYOUT DRAWING OF PIPE TYPE HEAD REGULATOR

Maximum Discharge @ 40,000 cusec

Conveying 11.7 billion cubic meter of water annually

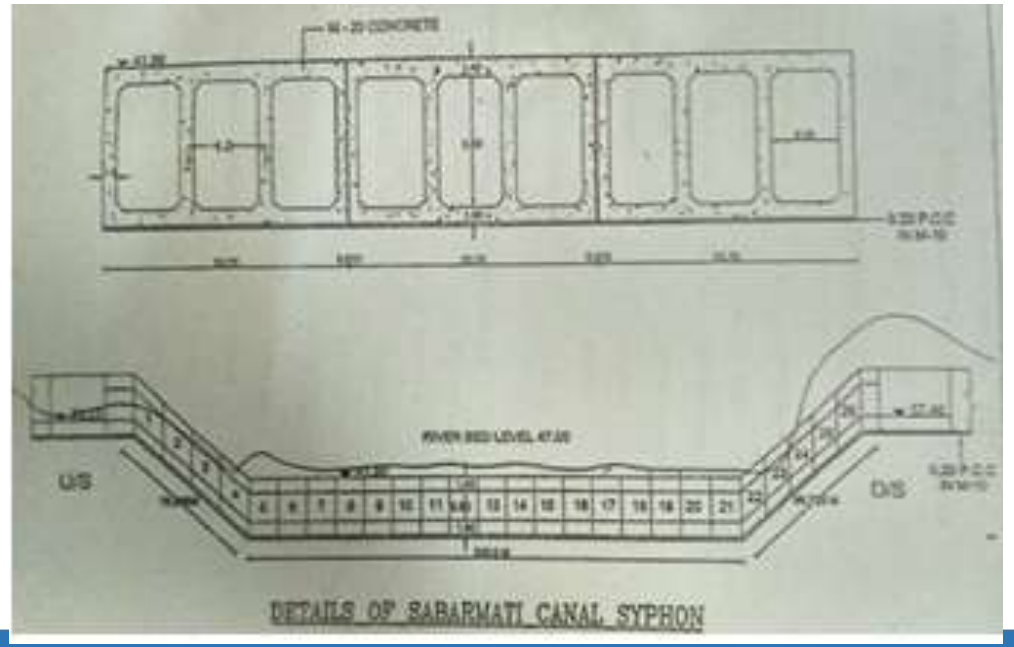
Manmade Perennial Rivers



603 m Long Mahi Aqueduct on Main Canal

3,87,000 cubic meter concrete, 22,904 tonne steel

Sabarmati
Canal Syphon



DETAILS OF SABARMATI CANAL SYPHON

Asia's Largest Pumping Station on Saurashtra Branch

10 Concrete Volute Pumps (7,000 cubic feet per second each)
6 Vertical Turbine Pumps (175 cubic feet per second each)

Inter-Basin Transfer of Narmada Water



Narmada water released in enroute rivers,

Heran, Orsang, Karad, Dhadhar, Mahi,

Saidak, Mohar,Shedhi, Watrak, Meshwo,

Khari, Sabarmati, Rupen, Pushpawati,

Khari-II, Banas and Saraswati.

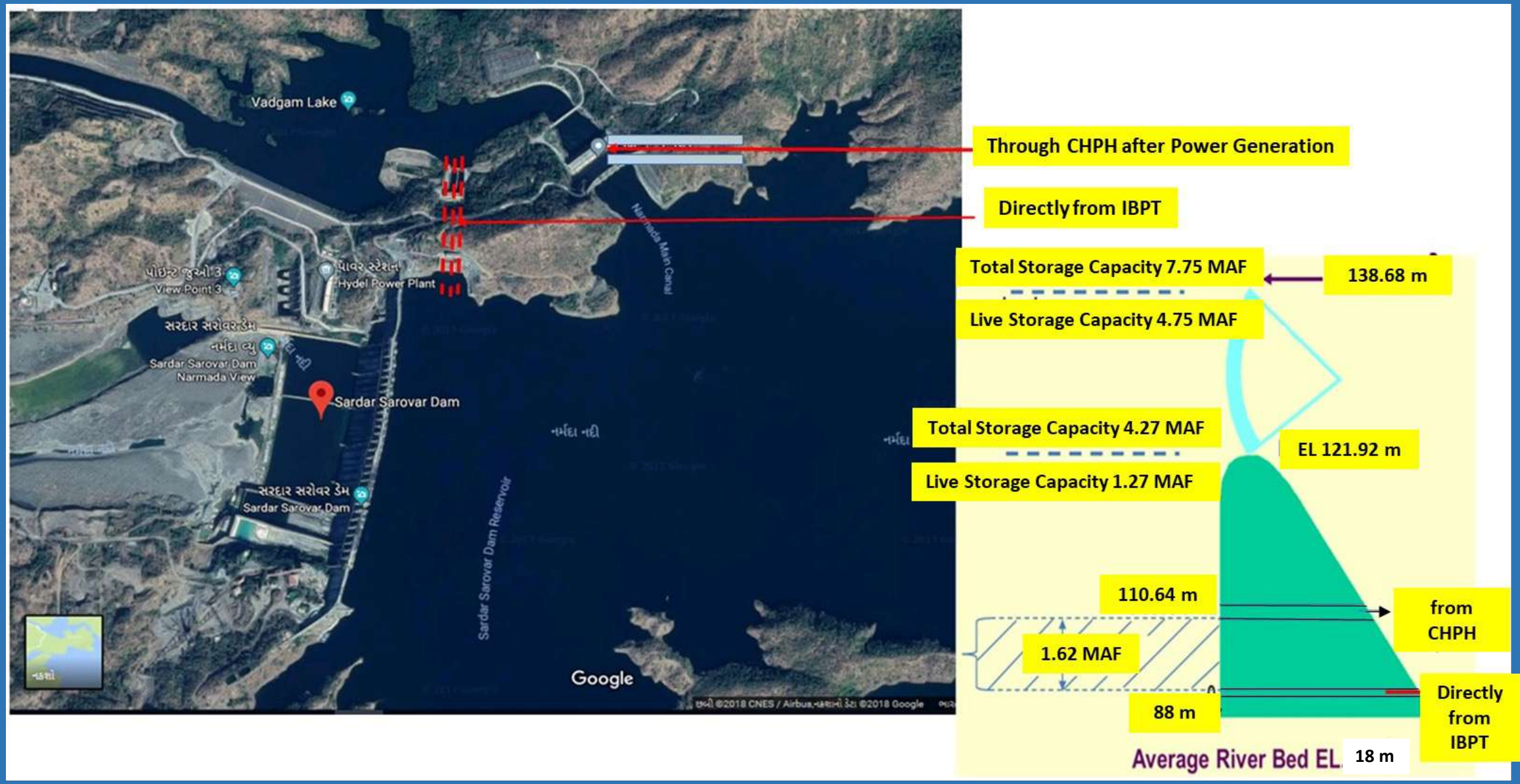
Benefits

Frenchwells and Tubewells rejuvenated

Recharging of natural aquifers

Water quality of these rivers got enriched in terms of pH, Dissolved Oxygen, Bio-chemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) etc.

Outlet Option IV : IBPT : Maxium Discharge 15,000 cusec

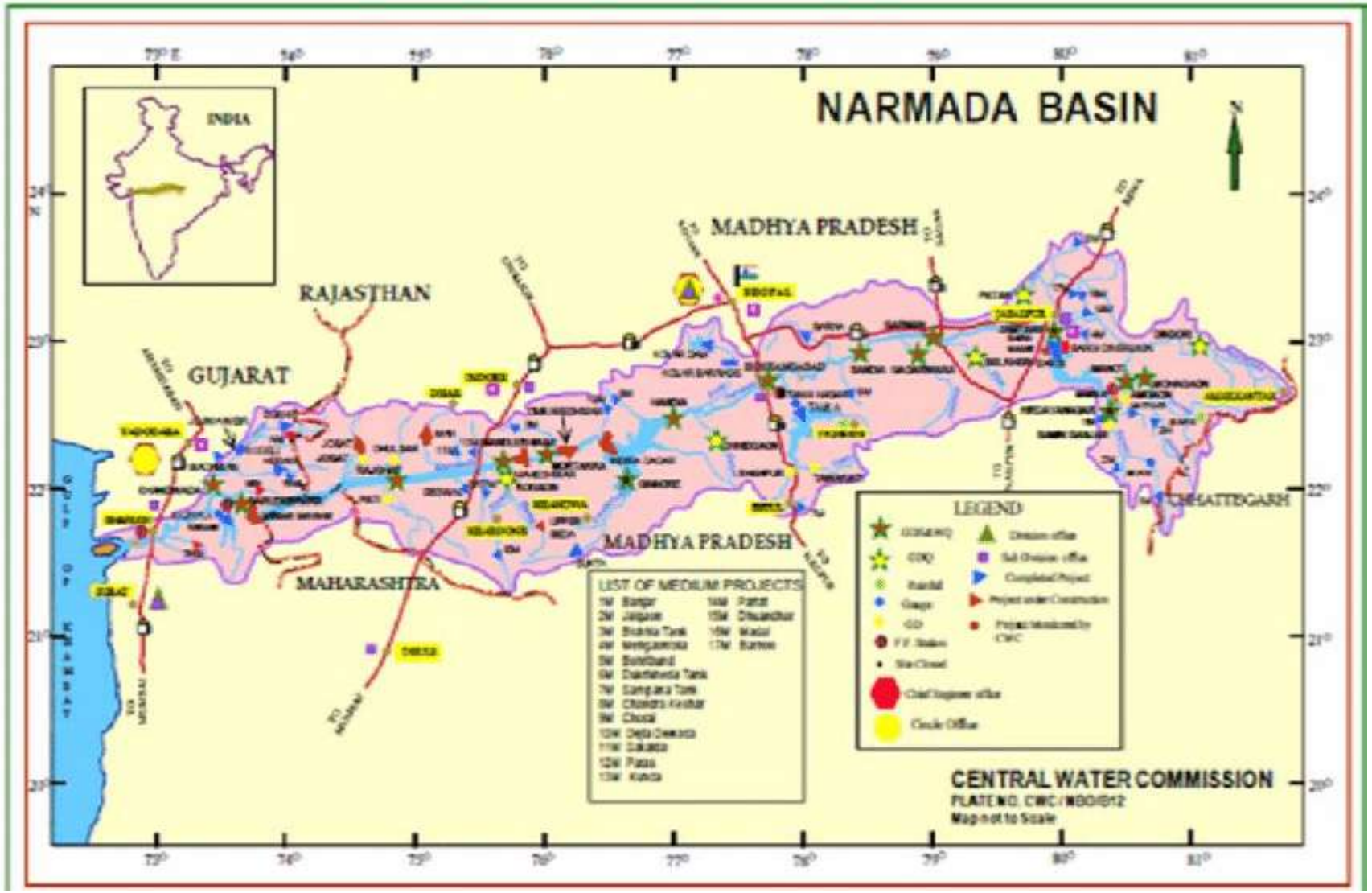


Outlet Option V : Godbole Gates : Discharge 600 cusec

E-Flow :
Downstream release of 600 cusecs (Godbole Gates)

E-Flow : Release of 600 cusecs (Godbole Gates)

Implementation of RTDAS



44 Rain Gauge Stations in Upstream of Sardar Sarovar Dam

State of the Art SCADA Control Room With Mimic Display

Role of Cascading Reservoirs in Flood Risk Management

- Integrated Basin approach – better for Flood Risk Mitigation, more so for Climate Change induced Flood Risks
- Vagaries of nature and Limitations of Rain/Flood Forecasting Methods can lead to serious situations : Higher storage capacities can help reduce Flood Risks
- On one hand, it's a question of averting potential risk and damage for millions of people & animals
- On the other hand, we can't afford to waste precious water just to mitigate risk of flood and create water stressed conditions for the rest of the year
- A compatible merger of Structural & Non-structural strategies needs to be adopted with WISDOM & Cooperation at the Basin Level
- State of the art Technological Solutions can certainly help

THANKS for THINKING

For Questions:
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SAARC
Disaster Management Centre (IU)