Three Gorges Dam

Excerpted from:

Freer, R., 2001, "The Three Gorges project on the Yangtze river in China", *Civil Engineering, Proc. Of Institution of Civil Engg*., Vol. 144, Issue 1, pp. 20-28, UK.

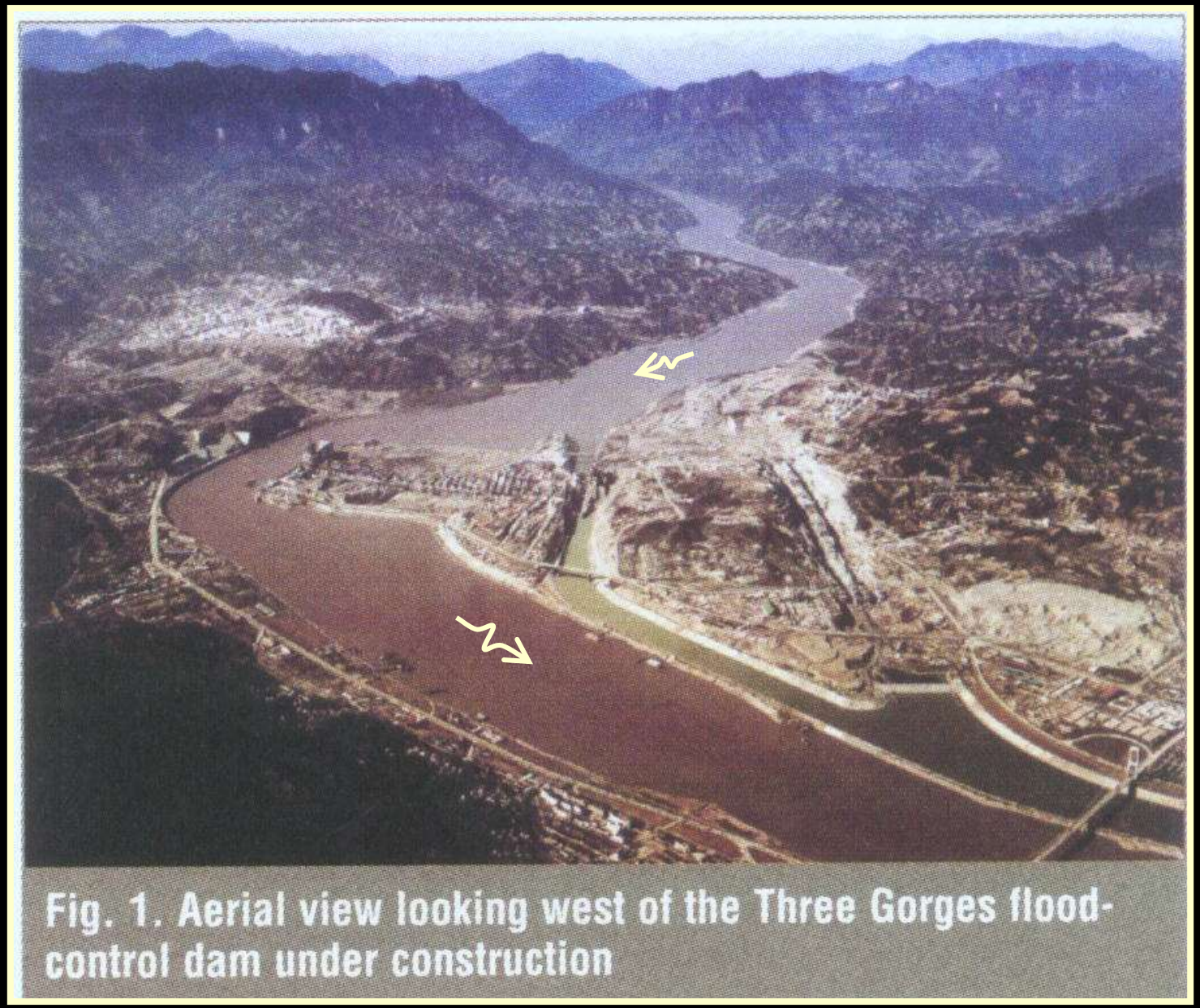

Fig. 1. Aerial view looking west of the Three Gorges flood-control dam under construction

Fig. 3. Artist's impression of the completed dam showing the ship lift and ship lock on the righthand side of the picture

Three Gorges Dam

- Main purpose
  - to alleviate flooding in the industrial and agricultural areas downstream of the dam.

Flooding of the Yangtze (1)

- Major floods causing damage and loss of life
  - 1870, 1931, 1935, 1954, 1981, 1991, and 1998.
- Flooding
  - appears to have become more frequent in recent years.

Flooding of the Yangtze (2)

- The 1998 flood
  - the cost of providing emergency protection for the city of Wuhan, other downstream cities and areas of cultivated land together with the cost of clearing up flood damage was comparable with the capital cost of the proposed dam.

Three Gorges Dam

- Other purposes
  - to supplement urban water supplies in northern China, including the city of Beijing,
  - to generate electricity, and
  - to improve navigation on the river from Shanghai on the coast to the inland city of Chongqing, a distance of about 3500 km,
  - to facilitate fish farming and aquaculture,
  - to provide better supply of irrigation water to the farming areas downstream,
  - to have better control of the salinity of the water in the estuary region near Shanghai.

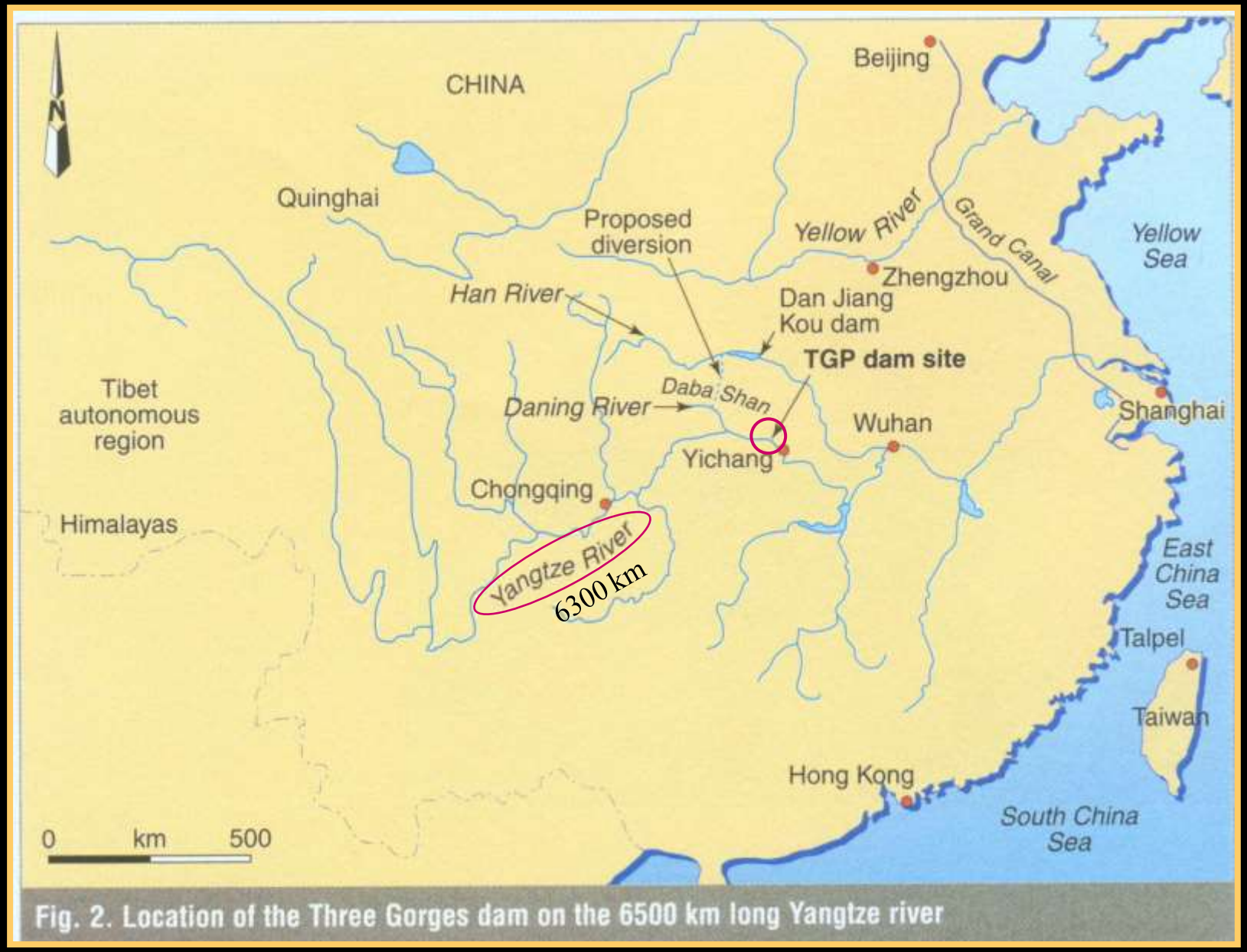

Fig. 2. Location of the Three Gorges dam on the 6500 km long Yangtze river

Technical Data

- The main dam
  - a concrete gravity dam 183 m high and 2.3 km long founded on granite
  - dam crest El. 185 m
  - normal WL El. 175 m
  - tailwater level E. 62 – 83 m
- The reservoir
  - impounding area 1,100 km^2
    that extends back to the city of Chongqing some 600 km upstream.
- The construction
  - started in 1993
  - completion is scheduled for 2009
  - cost approaching £15 billion.

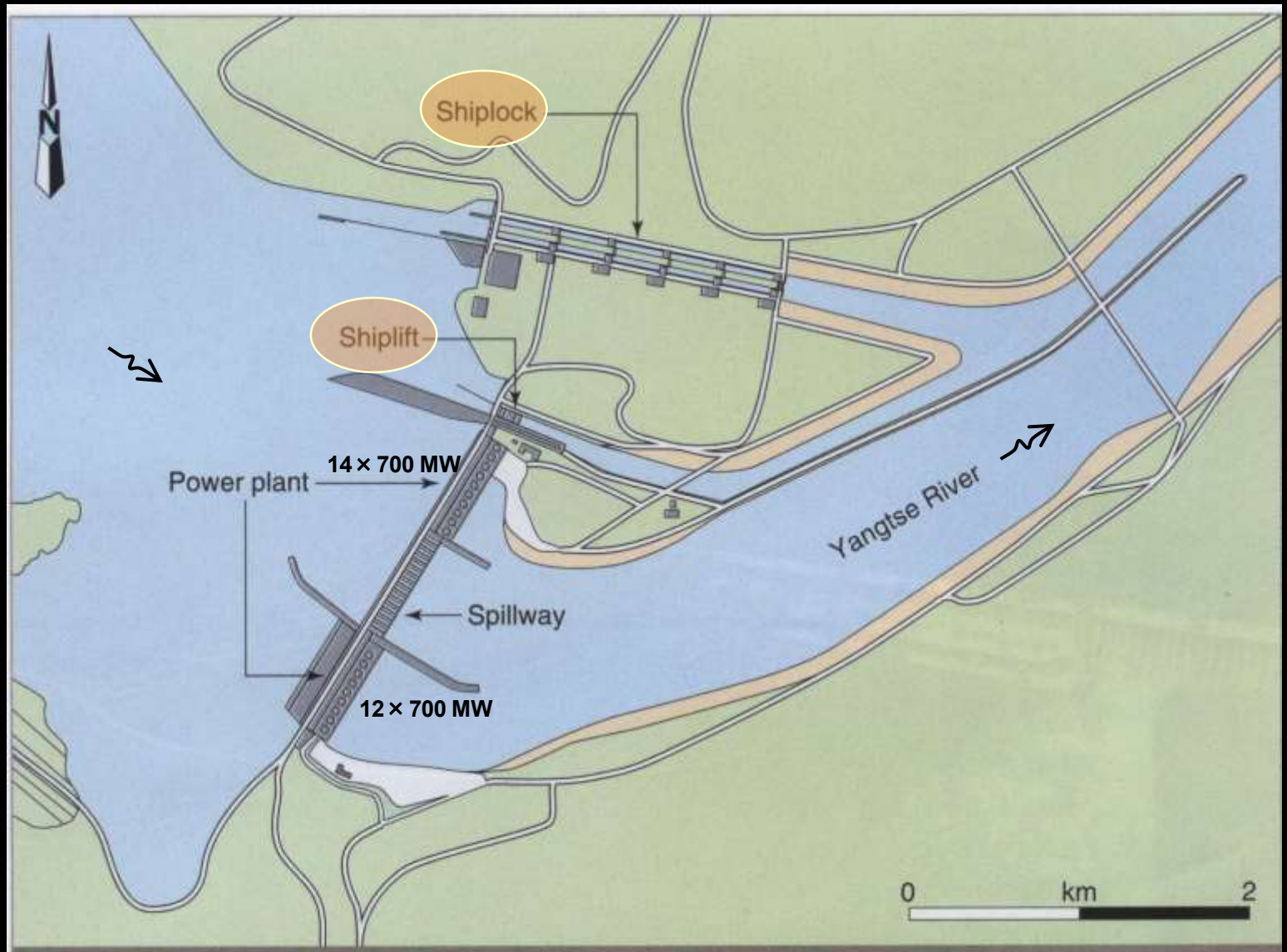

Fig. 4. Plan view of the Three Gorges dam site

shiplift → kapal kecil

shiplock → kapal besar

Fig. 5. Model of the completed project, looking west

The Gezhouba Dam

- The layout of the Three Gorges Dam is similar to that of the smaller Gezhouba dam built across Yangtze around 20 years ago at Yi Chang, 38 km downstream of the Three Gorges site.
  - a gravity dam 2,600 m long and 70 m high,
  - has 2 power stations containing 21 Kaplan turbines with a total capacity of 2.7 GW.

Fig. 6. The Three Gorges layout is based on the Gezhouba dam, built 20 years ago, and 38 km downstream

Resettlement

- Relocation of 1.1 million people of whom ⅓ are farmers
  - finding new land for them to farm is more difficult tha allocating land for urban housing and industry,
  - the agricultural land to be flooded is 24,500 ha.

the biggest cost

Fig. 8. New housing is being built above the proposed reservoir level

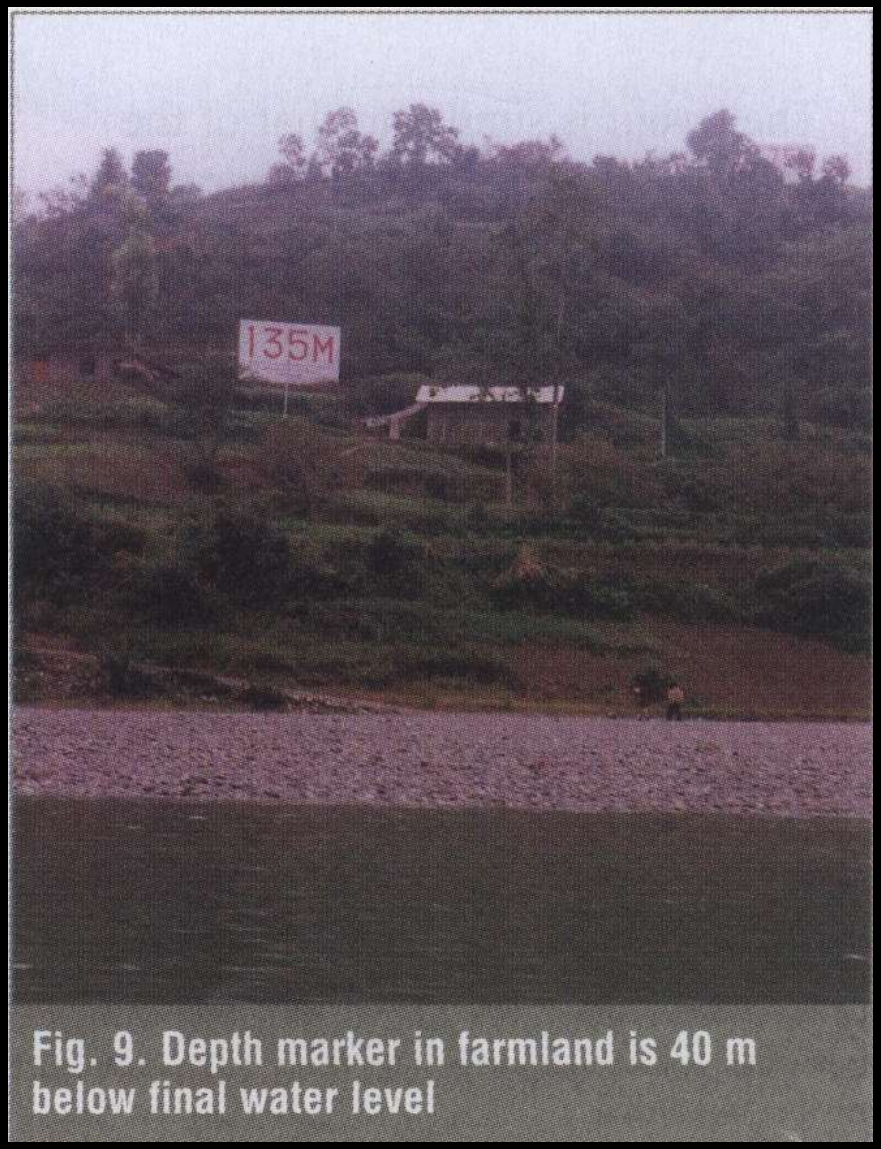

Fig. 9. Depth marker in farmland is 40 m below final water level

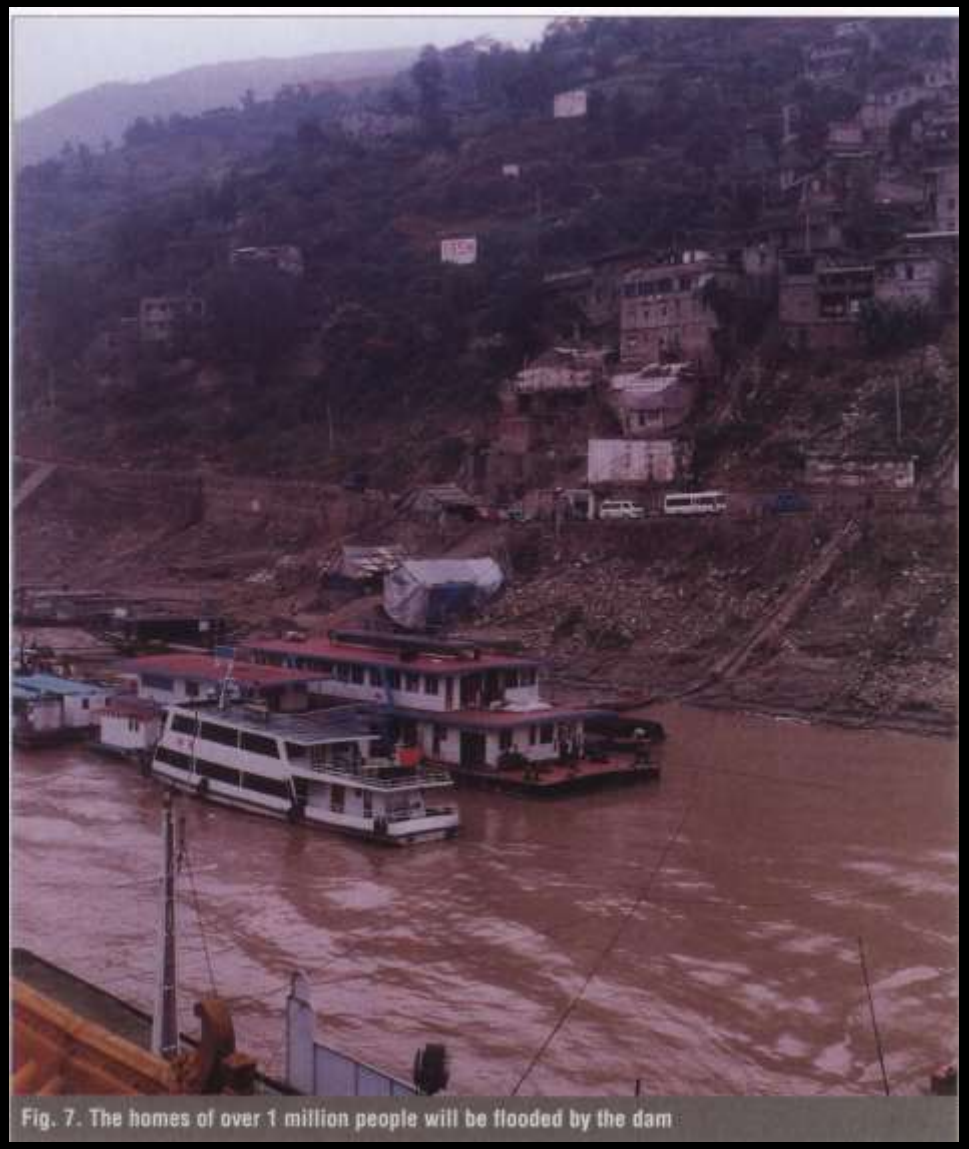

Fig. 7. The homes of over 1 million people will be flooded by the dam

Farm Land

- Alternative farm land has been identified, but
  - the new land is more suitable for cash crops such as tea and citrus fruit rather than the basic foods of wheat, rice, and vegetables that the farmers grew at the lower level,
  - thus it will have to import grain into the region from other parts of the country.

Control of River Flow

- Catchment area
  - total — 1.8 million km^2
  - at the dam site — 1 million km^2
- Mean annual run-off
  - total — 960 billion m^3
  - at the dam site — 451 billion m^3
- Regulated flow
  - minimum — 5,000 m^3/s (winter)
  - maximum — 30,000 m^3/s (summer)

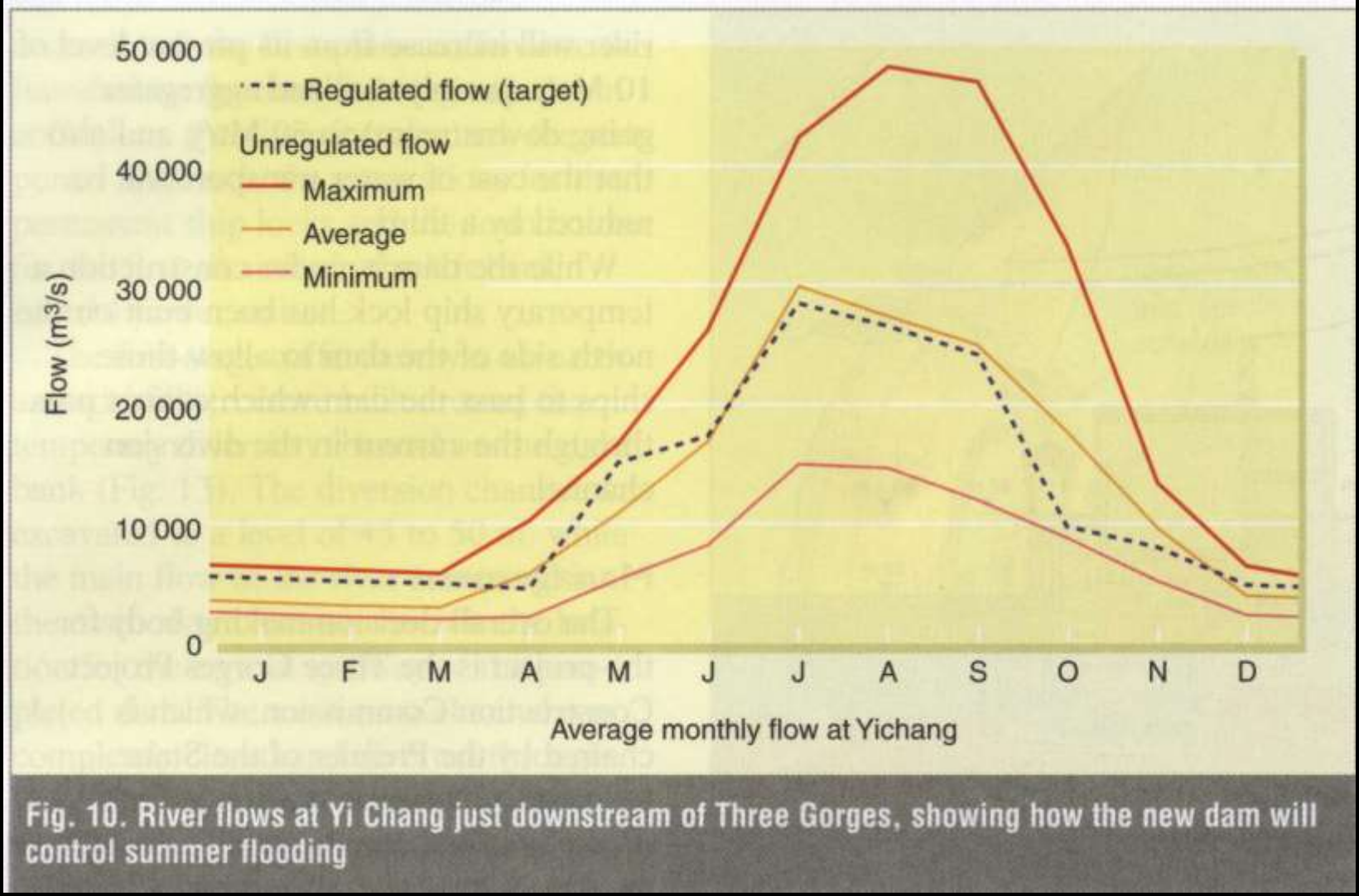

Fig. 10. River flows at Yi Chang just downstream of Three Gorges, showing how the new dam will control summer flooding

The Reservoir

- Storage capacity at El. +175 m
  - 39.3 billion m^3 of which
    22.2 billion m^3 is available for flood control
  - 4.3% of the yearly run-off at the dam site → the reservoir provides only seasonal regulation and low run-off regulation

Control of Flood Discharge

- Design flood of the dam spillway
  - pmf 102,500 m^3/s
  - FWL El. 180.4 m
- Design flood of the diversion channel and the cofferdam
  - 20-year flood 72,300 m^3/s
- The 100-year flood is 83,700 m^3/s

Reservoir Sedimentation (1)

- Silt
  - Average silt load = 1.2 kg/m^3
  - More than half the annual silt load in the river is carried down in the three flood months July to September
  - The silt load will be discharged through the outlet gates in the dam

Reservoir Sedimentation *(2)*

- Bottom outlet
  - Spillway section
    - 23 bottom outlet gates 7 × 9 m at El. +90 m
    - 22 surface sluice gates 8 wide at El. 158 m
  - During construction
    - 22 bottom outlet gates in the bottom of the dam

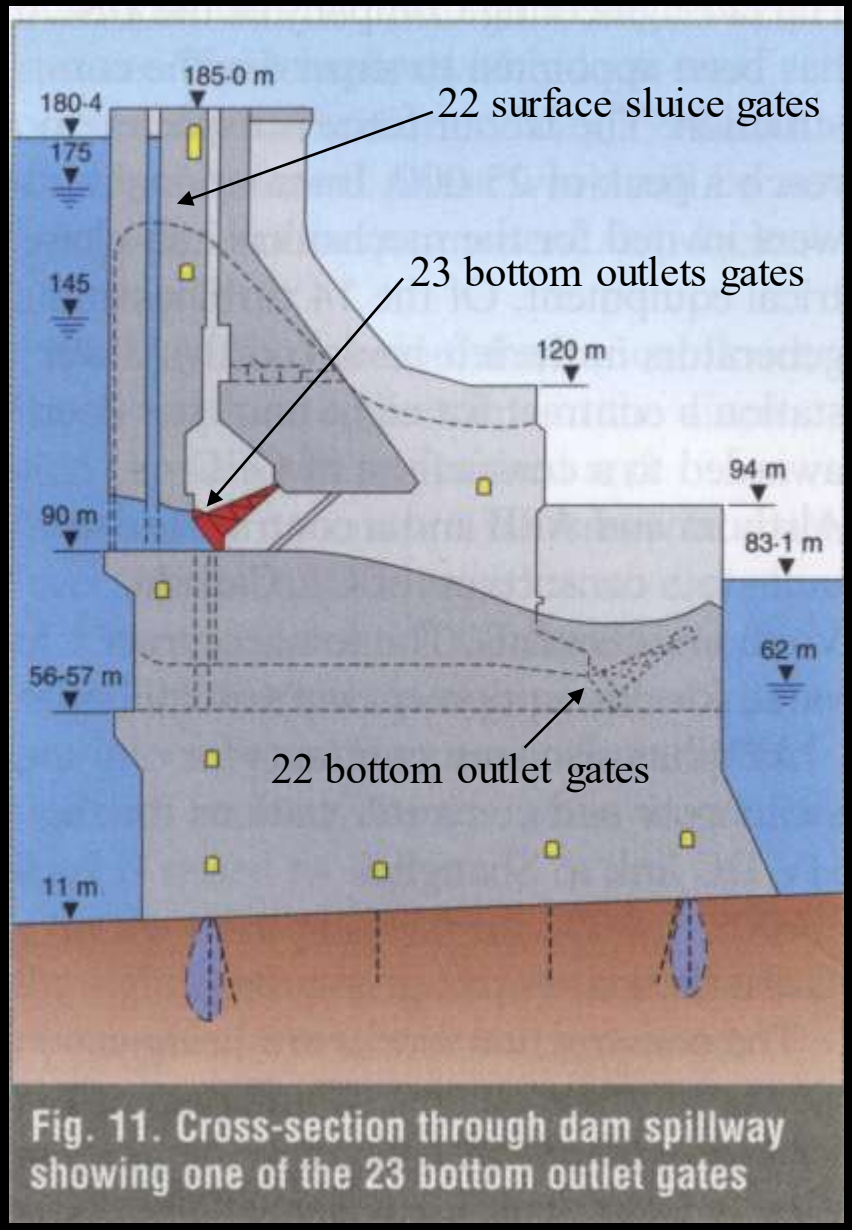

Fig. 11. Cross-section through dam spillway showing one of the 23 bottom outlet gates

Power Generation

- Two power stations (installed cap. 18.2 GW)
  - left bank (north) 14 × 700 MW Francis turbines
  - right bank (south) 12 × 700 MW Francis turbines
- Possibility of additional 6 × 700 MW turbines (4.2 GW installed cap.)

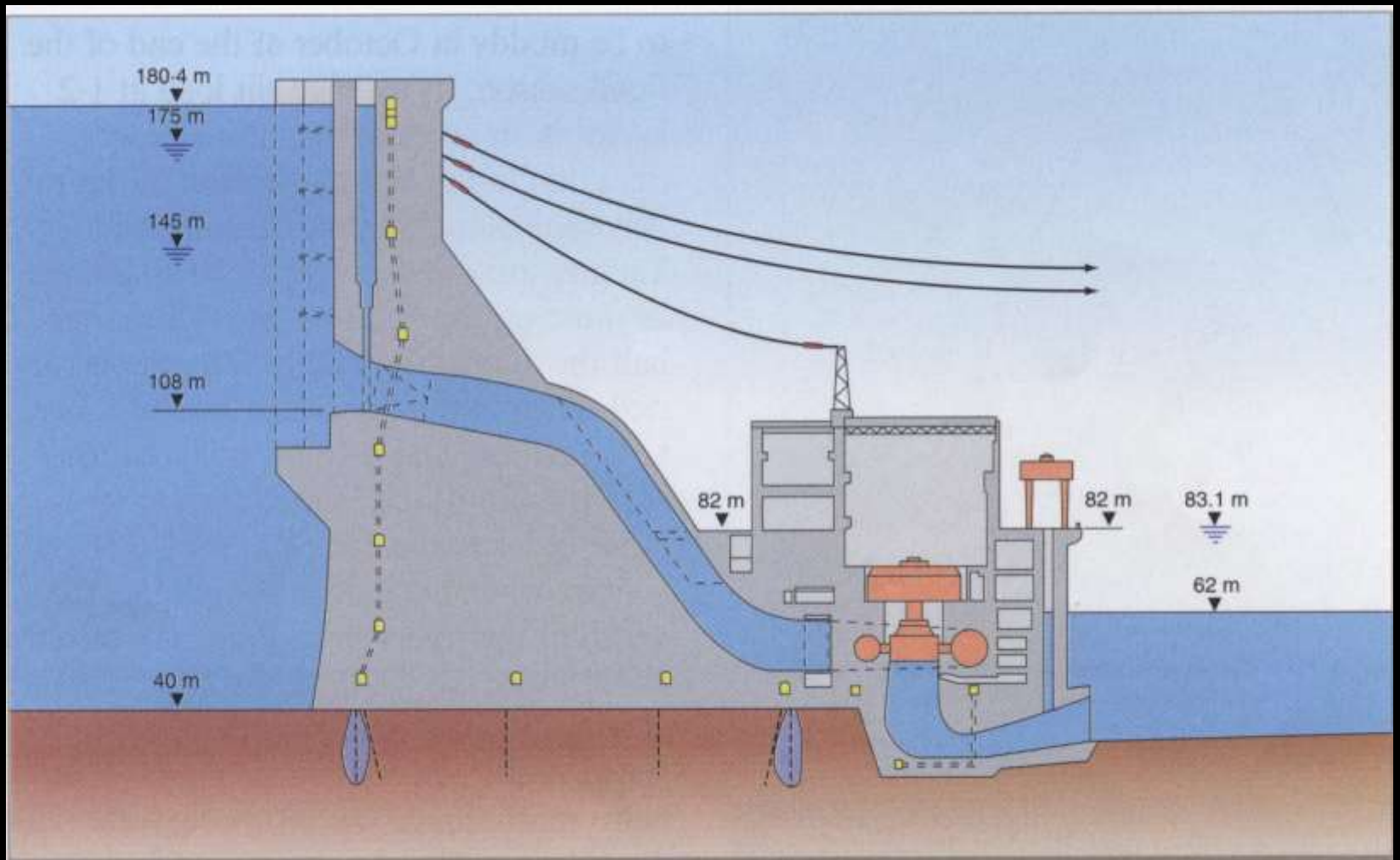

Fig. 12. Cross-section through power station showing one of 26, 700 MW Francis turbines

Navigation

- Ship locks
  - number of ship locks = 5
  - 280 m long, 34 m wide, 5 m deep (minimum)
  - capable of passing 10,000 T barge over the dam in 3 hrs.
- Ship lift
  - number of ship lifts = 1
  - dimension = 120 × 18 × 3.5 m
  - capable of passing 3,000 T passanger ships and small cargo ships over the dam in 30 minutes

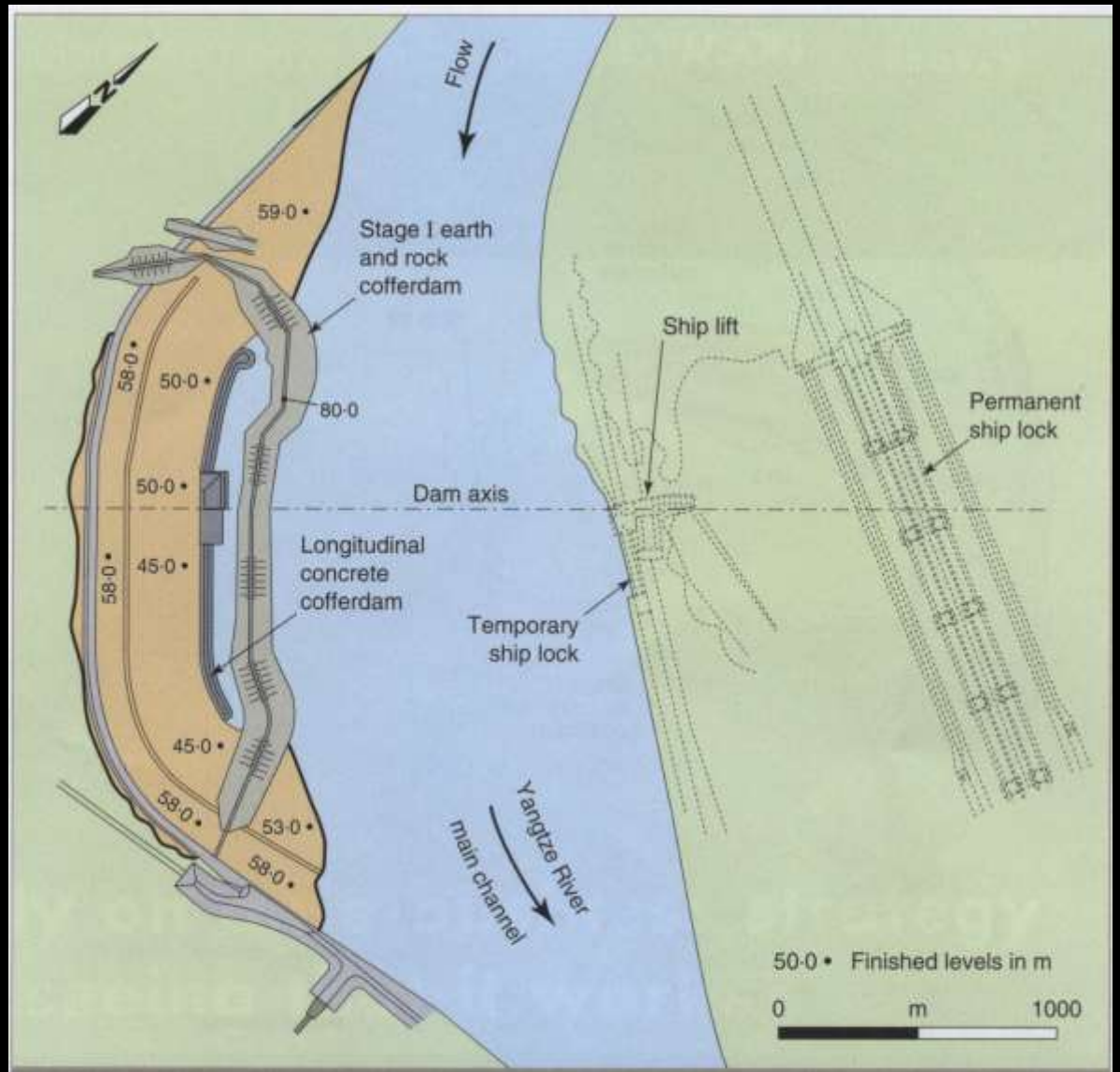

Fig. 13. Plan of first-stage cofferdam, which allowed construction of the river diversion channel

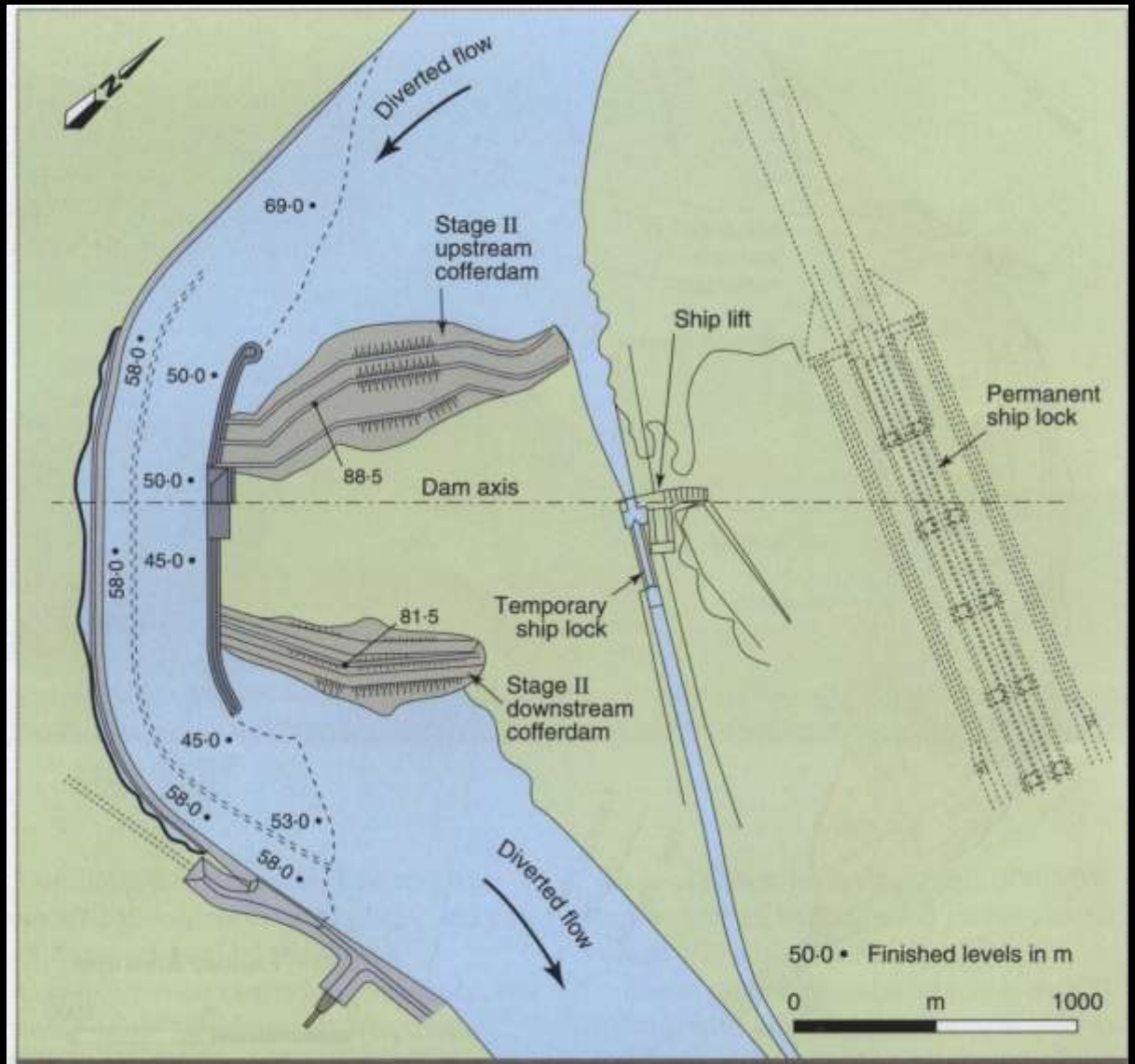

Fig. 14. Plan of second-stage cofferdams, which enabled construction of the north side of the dam to start

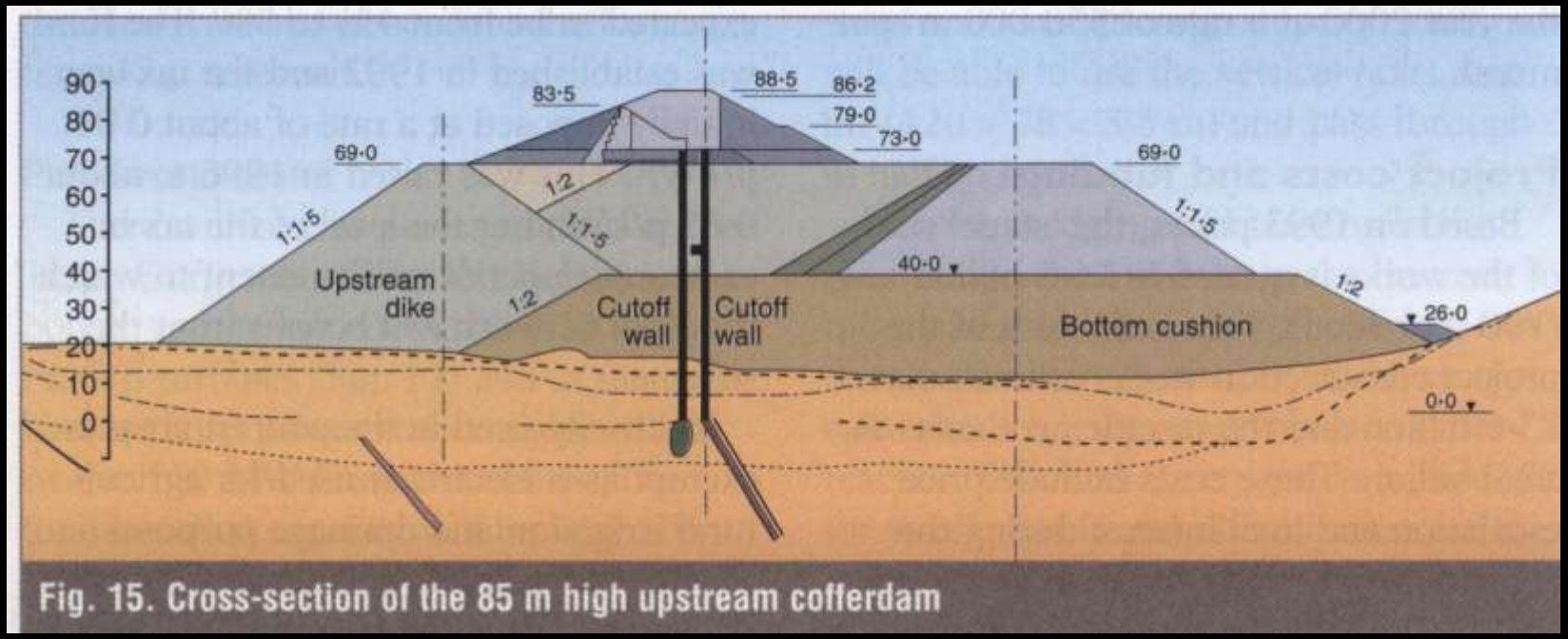

Fig. 15. Cross-section of the 85 m high upstream cofferdam

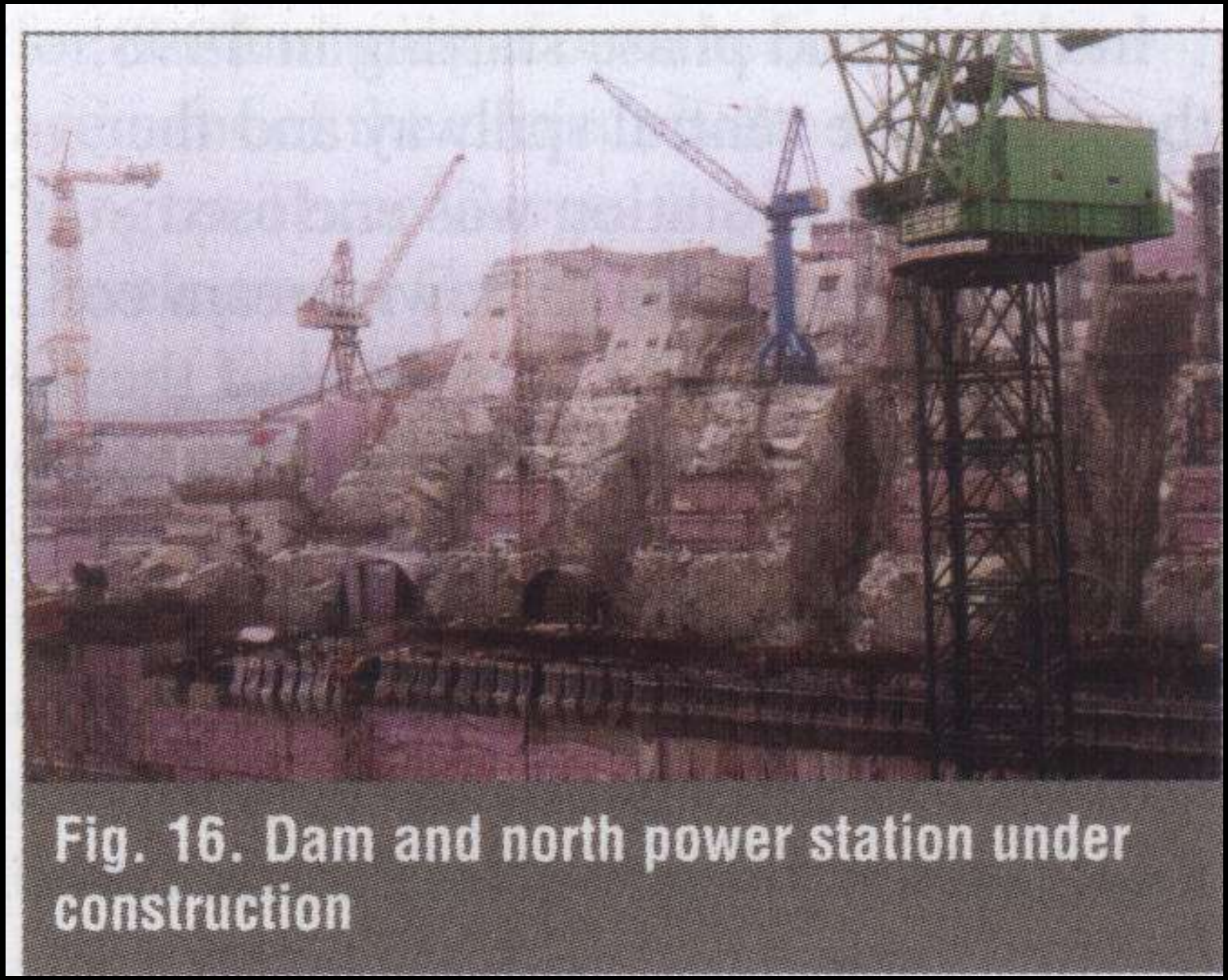

Fig. 16. Dam and north power station under construction

The Three Gorges Project

- See also
  - http://www.en.wikipedia.org/wiki/Three_Gorges_Dam
  - http://www.threegorgesprobe.org/
  - http://www.tourroundchina.com/news/img/three_gorges

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The Film