Evaluation of sediment management for two large reservoirs in Lombok Island

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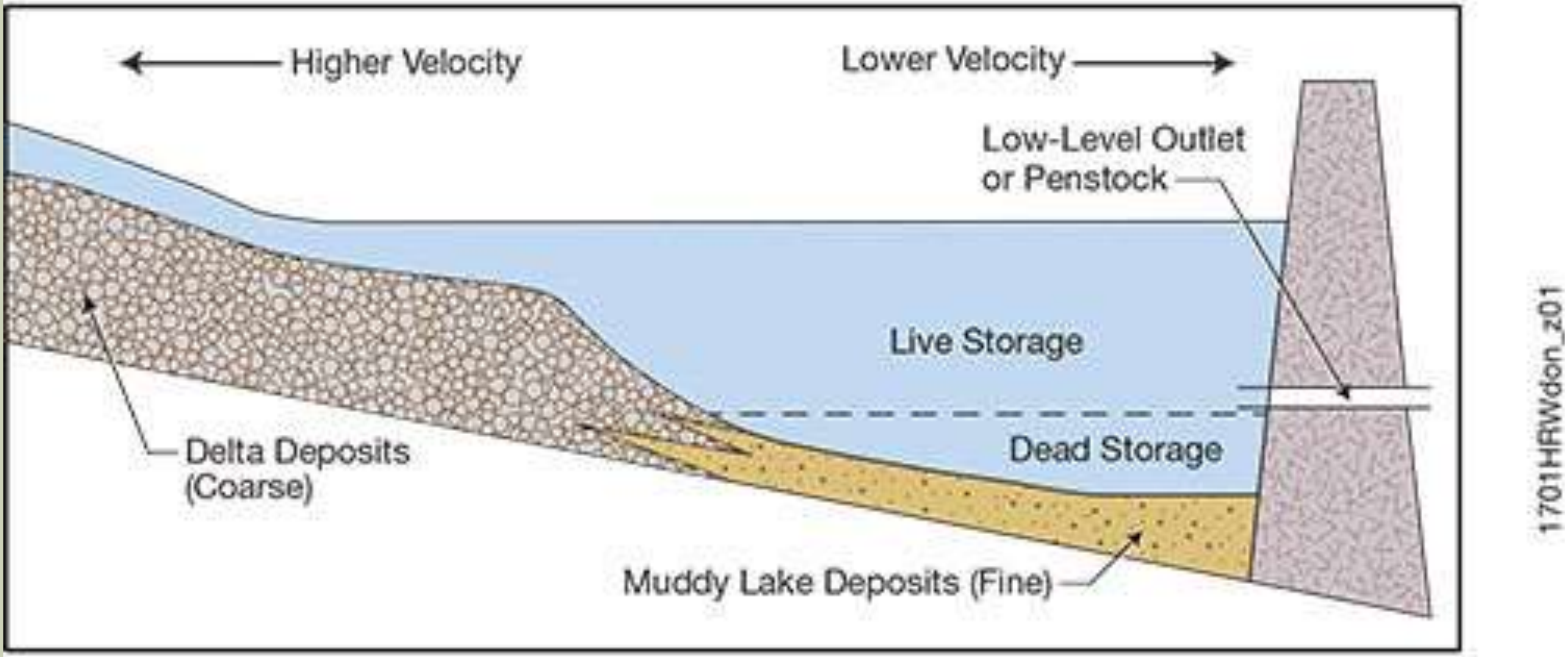
RESERVOIR SEDIMENTATION

Figure 1 — Typical Reservoir Sediment Profile*



Typically, sedimentation in the reservoir behind a dam takes the form of progressively finer materials being deposited as the flows approach the dam.

*Adapted from Morris, G.L. and J. Fan, *Reservoir Sedimentation Manual*, McGraw-Hill, New York, 1998.

LOSS OF STORAGE DUE TO SEDIMENTATION

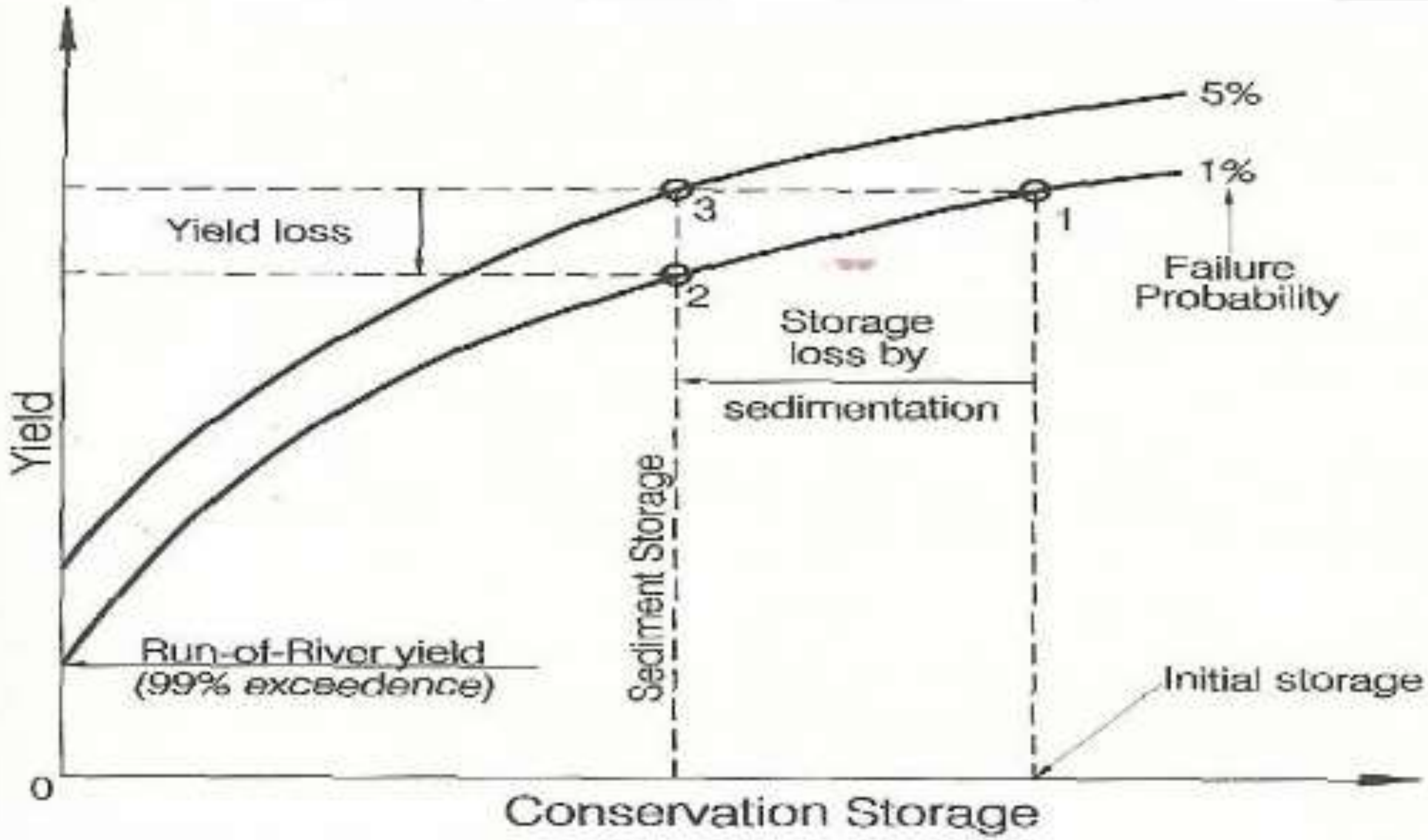
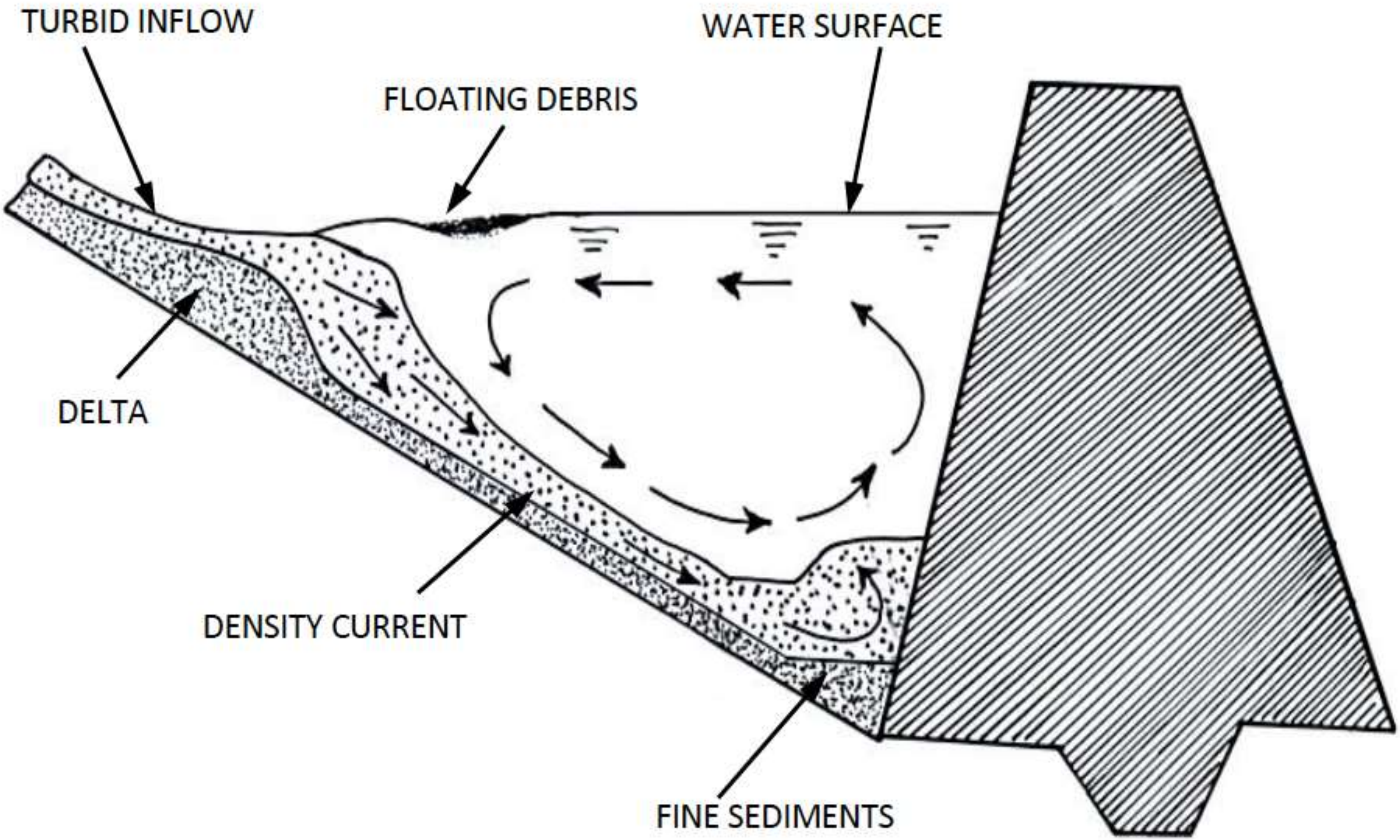
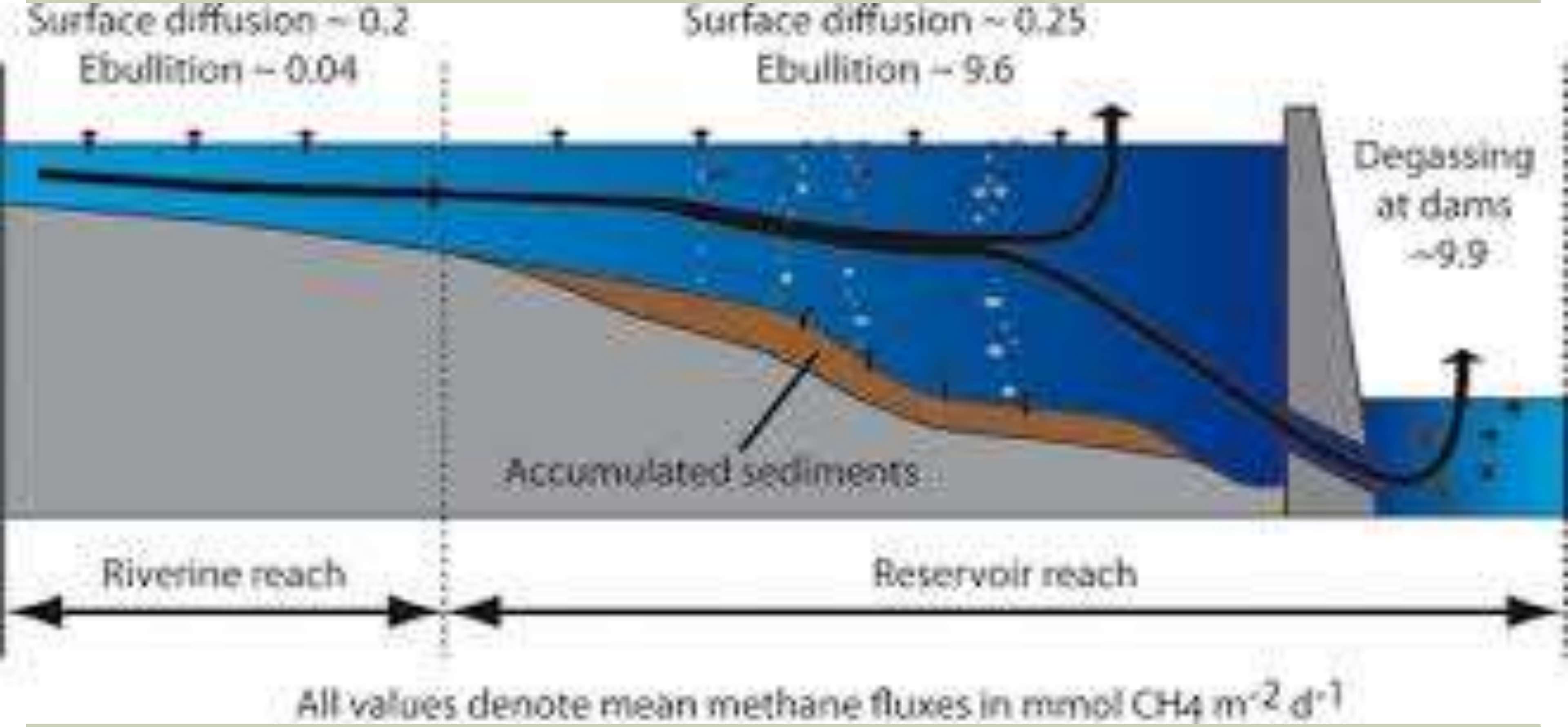


FIGURE 3.15 *General shape of a reservoir storage-yield curve, in which yield asymptotically approaches the mean watershed yield, less evaporative and seepage losses, as storage becomes very large. Two yield curves are shown for different levels of service. The impact of sediment accumulation in the conservation pool may be expressed as either a reduction in yield at a given level of reliability (point 1 to 2) or a reduction in reliability at a fixed yield (1 to 3).*

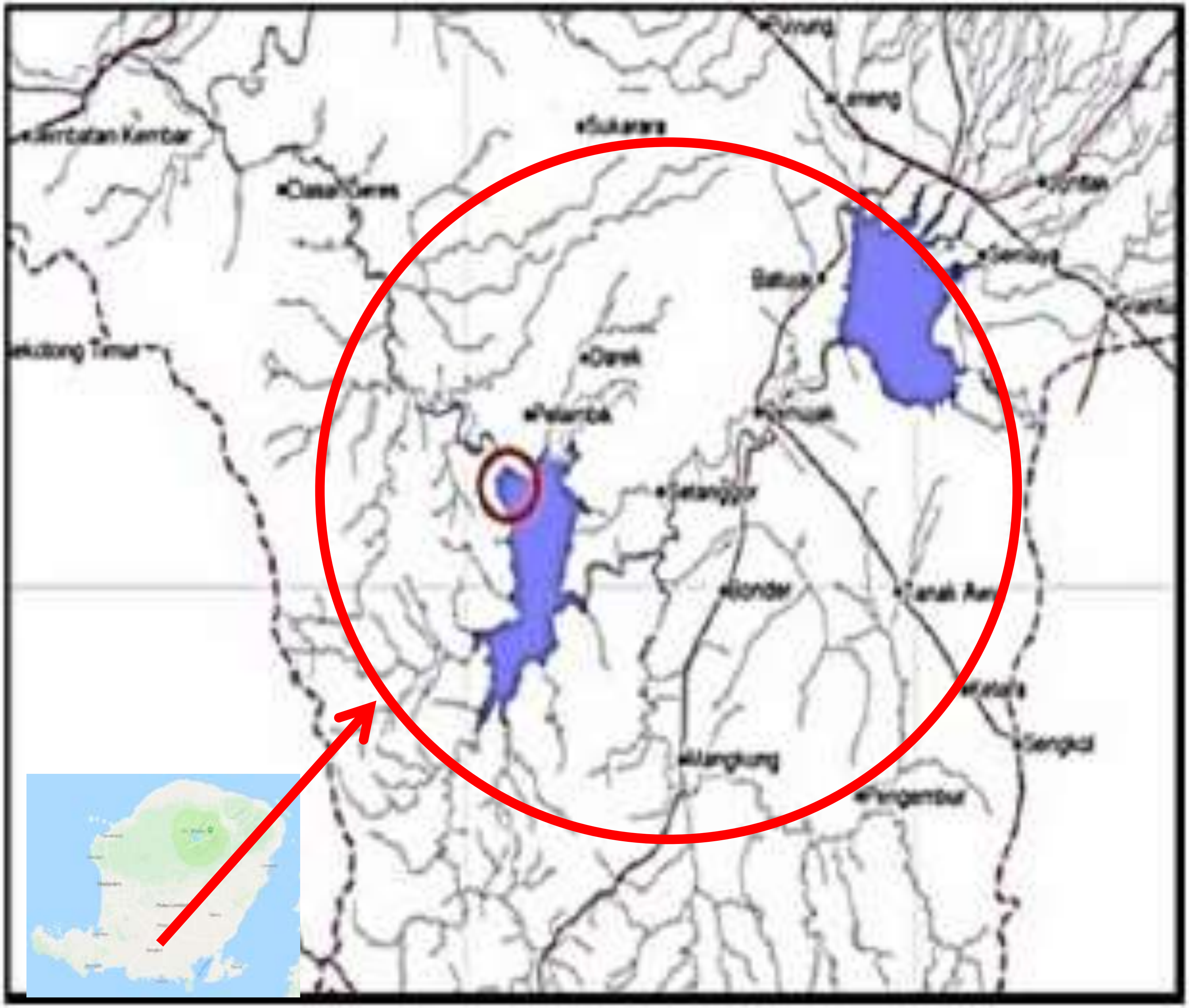

TURBID INFLOW
WATER SURFACE
FLOATING DEBRIS
DELTA
DENSITY CURRENT
FINE SEDIMENTS



All values denote mean methane fluxes in mmol CH_4 m^{-2} d^{-1}

PAST STUDIES

- Structural sedimentation management
- Non-structural sediment management
- Review of sediment management
- Little to none study employed mathematical RESCON in spite its advantages:
  - Clearer assumption
  - Objective calculatin
  - Ease in replication


Jembatan Kembar
Sukarara
Dasan Geres
Darek
Pelambik
Setanggor
Bonder
Mangkung
Pengembur
Sengkol

TECHNICAL CONSIDERATION

- Reservoir geometry
- Water characteristics
- Sediment characteristics
- Removal parameters
- Economic parameters
- Flushing benefit parameters
- Capital investment

ENVIRONMENTAL AND SOCIAL IMPACTS

Natural habitat

Human uses

Resettlement

Cultural assets

Indigenous people

Transboundary impacts

Sediment management alternatives

- Flushing
- Hydrosuction
- Dredging
- Trucking

RESERVOIR GEOMETRY AND WATER CHARACTERISTICS

Parameter	Units	Sources	Parameter	Units	Sources
S_o	(m^3)	[8]	EL_{min}	(m)	[9]
S_e	(m^3)	[8]	EL_f	(m)	Equal to EL_{min}
W_{bot}	(m)	[7]	L	(m)	[9]
SS_{res}		[7]	h	(m)	[9]
EL_{max}	(m)	[7]			

Parameters	Units	Sources
V_{in}	(m^3)	Based on inflow from 1982-2017 (Batujai) and 1994-2017 (Pengga)
C_v	(m^3)	As above
T	(°C)	[11]

SEDIMENT CHARACTERISTICS

Parameters	Units
ρ_d	(tonnes/m^3)
M_{in}	(metric tonnes)
Y	650 (10 m^3/s < Q_f < 3,000 m3/s), 180 (Q_f < 50 m^3/s)
Brune Curve No	3
Ans	1
Type	1

ECONOMIC PARAMETERS

Parameter	Units	Value	Parameter	Units	Value
E	0 or 1	0	V	($)	0
c	($/m^3)	1.75	omc		0.01
C_2	($)	0	PH	($/m^3)	0.02
r	decimal	0.07	PD	($/m^3)	0.02
Mr	decimal	0.07	CD	($/m^3)	3.00
P_1	($/m^3)	0.2	CT	($/m^3)	13.00

Parameters	Units/options	Sources and default values
HP	1	[8]
Q_f	(m^3/s)	10 – 3,000 m^3/s
T_f	(days)	1 day – 2 months
N	(years)	1 – 15 years
D	(feet)	1 -4 ft
NP	1, 2, or 3	1, 2 or 3
YA	Between 0 and 1	0 – 1
CLF	(%)	Greater than capacity lost already
CLH	(%)	Greater than capacity lost already
CLD	(%)	Greater than capacity lost already
CLT	(%)	Greater than capacity lost already
ASD	(%)	0 – 100
AST	(%)	0 – 100
MD	(m3)	1,000,000
MT	(m3)	500,000
Cw	(%)	30

FLUSHING BENEFIT AND INVESTMENT

s_1	decimal	The fraction of Run-of-River benefits available in the year flushing occurs (s_1 ranges from 0 to 1).	0.9
s_2	decimal	The fraction of storage benefits available in the year flushing occurs (s_2 ranges from 0 to1).	0.9

FI	$	Cost of capital investment required for implementing flushing measures. The cost entered will be incurred when fliushing is first practiced.	50
HI	$	Cost of capital investment to install Hydrosuction Sediment-Removal Systems (HSRS).	20
DU	Years	The expected life of HSRS.	25

RESULTS FOR BATUJAI

Possible Strategies	Technique	Aggregate Net Present Value
Do nothing	N/A	IDR 2,331,169.29
Nonsustainable (Decommissioning) with Partial Removal	HSRS	IDR 2,331,169.29
Nonsustainable (Run-of-River) with No Removal	N/A	IDR 2,226,923.75
Nonsustainable (Run-of-River) with Partial Removal	HSRS	IDR 2,226,923.75
Sustainable	Flushing	IDR 2,641,009.16
Sustainable	HSRS	Total Removal with HSRS is technically infeasible, See Partial Removal with HSRS
Sustainable	Dredging	-IDR 12,802,914.60
Sustainable	Trucking	-IDR 33,013,087.09

RESULTS FOR PENGGA

Possible Strategies	Technique	Aggregate Net Present Value
Do nothing	N/A	IDR 2,331,169.29
Nonsustainable (Decommissioning) with Partial Removal	HSRS	IDR 2,331,169.29
Nonsustainable (Run-of-River) with No Removal	N/A	IDR 2,226,923.75
Nonsustainable (Run-of-River) with Partial Removal	HSRS	IDR 2,226,923.75
Sustainable	Flushing	IDR 2,641,009.16
Sustainable	HSRS	Total Removal with HSRS is technically infeasible, See Partial Removal with HSRS
Sustainable	Dredging	-IDR 12,802,914.60
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