

Gibe III Reservoir Outflows

An outline of possible water releases as the reservoir fills.

Discharge levels from the Gibe III Reservoir are not solely dependent on operator decision. The design of the dam also physically limits the amount of water that can be released.

When the reservoir first begins filling, only one outlet (Fig. 1, A) is available – the temporary minimum flows outlet. When water levels reach 750 m.a.s.l., operators can open two middle outlets (B) which give operators some flexibility to release flows without running water through turbines. When the water level is at 800 m.a.s.l. (C), the minimum exceptional operating level, operators can then release water downstream while producing power. Once all ten turbines come online, a max discharge of ~ 2200 m³/s is possible. (D) The maximum discharge then increases as water levels rise.

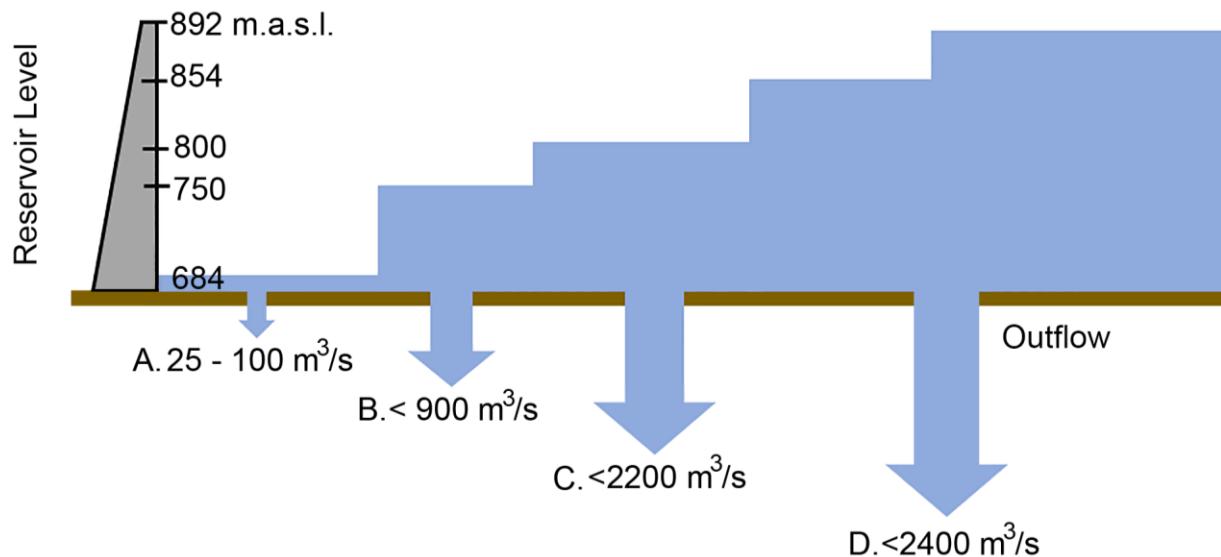


Fig. 1 : Maximum discharge possible from the Gibe III at different reservoir water levels.

EEPCo consultants estimated that mean monthly discharge from July through September at the Gibe III site is ~ 1200 m³/s [5]. In comparison, the 25 – 100 m³/s minimum flow release is less than 10% of this value. Furthermore, the peak flow value of the dam without use of the spillway is ~ 2400 m³/s. EEPCo consultants estimated that floods with a 10-yr return period would peak at ~ 3300 m³/s (bordered by three months of flows >2000 m³/s) at the Gibe III site and a flood with a 30-yr return period would peak at 4200 m³/s [5]. In 2006, the peak flow recorded at the Gibe III dam construction site was ~ 3500 – 4000 m³/s [5].

DAM COMMISSIONING SEQUENCE: DISCHARGE OPTIONS AND POWER PRODUCTION

Reservoir Height

	A. 684 – 750 m.a.s.l	B. 750 – 800 m.a.s.l.	C. 800 – 854 m.a.s.l.	D. 854 – 873 m.a.s.l.	E. 873 - 892 m.a.s.l.
Discharge structures available	Temporary conduit in the diversion tunnel plug provides minimum flow releases	Invert elevation of two middle outlets (MOs) reached at 750 m.a.s.l.	Minimum exceptional operating level reached. Turbine commissioning can begin. Intake elevation of permanent minimum flow outlet reached.	Normal operating level.	Spillway sill is reached.
Duration of period during dam commissioning	~3 months	~4 months	854 m.a.s.l. could be reached as early as 7 months after impoundment, with commissioning of all turbines taking 1-2 yrs. Turbines will take 45 days each to commission.	The final turbines are expected to come online during the 3 rd year.	Dependent on water year type.
Possible Discharge	$Q = 25 \text{ m}^3/\text{s}$, rising quickly to $100 \text{ m}^3/\text{s}$	At 780 m.a.s.l., each middle outlet is calculated to discharge $315 \text{ m}^3/\text{s}$. Combined with the temporary outlet, up to $900 \text{ m}^3/\text{s}$ can be released.	At 800 m.a.s.l., one turbine can discharge $75 \text{ m}^3/\text{s}$. The permanent minimum flow outlet discharges $25 \text{ m}^3/\text{s}$. The middle outlets can discharge a maximum of $\sim 600 \text{ m}^3/\text{s}$ each. If all 10 turbines came online, flows up to $\sim 2200 \text{ m}^3/\text{s}$ are possible.	Flow rate for each turbine $\sim 102 \text{ m}^3/\text{s}$. MOs can release $\sim 675 \text{ m}^3/\text{s}$. With all 10 turbines operational, flows up to $\sim 2400 \text{ m}^3/\text{s}$ possible.	The spillway is rated for a design flood of $10600 \text{ m}^3/\text{s}$ and a safety check flood of $18660 \text{ m}^3/\text{s}$.
Power production	0	0	At 800 m.a.s.l., 80 MW is generated from each turbine.	$\sim 187 \text{ MW}$ per turbine. 1870 MW maximum.	1870 MW maximum.
Operational Choices	Almost none. Operators could decide to change the design of the temporary conduit such that greater flows are released.	Whether to release a controlled flood (such as the planned 10-day flood) or increase flow levels using the middle outlets.	Commissioning turbines early, # of turbines running, middle outlets, minimum flow released	# of turbines running, middle outlet operation, minimum flow released.	# of turbines running, middle outlets, minimum flow rate. Spillways aren't designed for regular use and are for exceptional flooding events.

Table 1 : Estimates mainly from SOGREAH, 2010 [3]. All values indicated are for an average water year, but estimates of time durations depend, of course, on the distribution and volume of runoff that occurs during dam commissioning.

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