6. Introduction of Projects

Projects implemented in the Brantas River Basin Development Project are presented as follows according to sectors, including multi-purpose dams, river improvement, irrigation, debris control, etc.

(1) Dam projects

(a) Multi-purpose dams

Since the Karangkates Dam Project was started in 1962, there are nine hydroelectric power stations constructed to date (eight of which are dam-type). Their total output is 240,150 kW, as listed in Table 2-43, including the Wonorejo Power Station under construction as of 1993.

Table 2-43 Summary of multi-purpose dams (1995)

No.	Dam	River	Use	Active storage capacity ($\times 10^6$ m^3)	Maximum generated output (kW)	Dam height (m)	Type	Year of completion
1	Karangkates	Brantas main stream	Flood control, water use, power generation	253.0	105,000	100	FD	1973
2	Lahor	Lahor	ditto	29.4	—	74	FD	1975
3	Selorejo	Konto	ditto	54.6	4,500	49	FD	1972
4	Wlingi	Brantas main stream	ditto	5.2	54,000	47	FD	1978
5	Lodoyo	Brantas main stream	Re-regulating reservoir, power generation	5.0	4,500	12	MCD	1983
6	Sengguruh	Lesti	Water use, power generation	2.5	29,000	31	FD	1988
7	Bening	Widas	ditto	24.8	650	35	FD	1984
8	Wonorejo	Ngrowo	ditto	106.0	6,500	100	FD	Under construction
9	Tulungagung	Nejama diversion channel	Power generation	—	36,000	—	—	1991

Source: Brantas River Basin Development Executing Office

Remarks: 1) Dam type: FD: fill dam, MCD: movable concrete weir
2) The Tulungagung Dam is equipped with a run-of-river type power station using the No. 2 Nejama diversion tunnel.

As shown in the table, three dams are constructed across the Brantas main stream and five across the Brantas branches including the Wonorejo Dam now under construction.

Their total active storage capacity is 480,500,000 m^3 contributing to an increase in droughty water discharge of 44.9 m^3/sec.

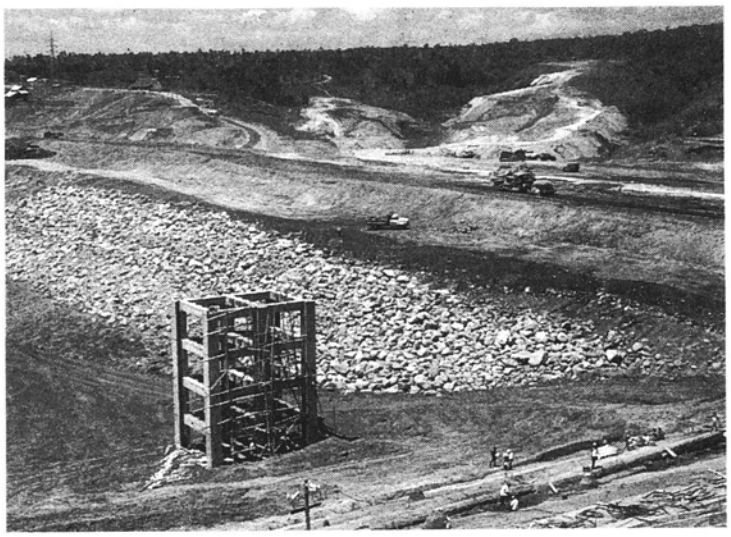
The Karangkates Dam offers an active storage capacity of 253,000,000 m^3, or 282,000,000 m^3 when adding the portion created by the modified Lahor River Basin, with a maximum output of 105,000 kW. This is the largest-scale dam in the Basin and by itself provides 74.4% of the Basin's total active storage capacity and 43.7% of the Basin's total hydropower output of 240.15 x 10^3 kW. Construction of the Lahor Dam was started in 1973 to increase the flow rate into the Karangkates Dam reservoir by changing the course of the Lahor River. It was completed in 1977.

Canoe race on Karangkates Dam Reservoir

Coupled with the Karangkates, the Selorejo is well known being the second largest dam built across Brantas tributaries. It produces the substantial effects of providing supplementary droughty water discharge for the power stations of Siman and Mendalan, which were constructed in the colonial days, located downstream of the Selorejo Dam. The Karangkates and Selorejo both have golf courses and their surrounding areas are developed for public use. On holidays they are thronged with golfers and tourists.

The Wlingi Dam was completed after overcoming the difficulty of sealing its limestone foundation. In addition to water utilization and power generation, it also serves as a reservoir for sediment flowing from Mt. Kelud, hence taking a role of keeping flood run-down capacities from declining due to increasing sedimentation of the Brantas lower

streams riverbeds. The dam, now dredged, operates normally with active storage capacity secured after the 1990 eruption of Mt. Kelud which filled the dam's lake with sediment.



Selorejo Dam under construction

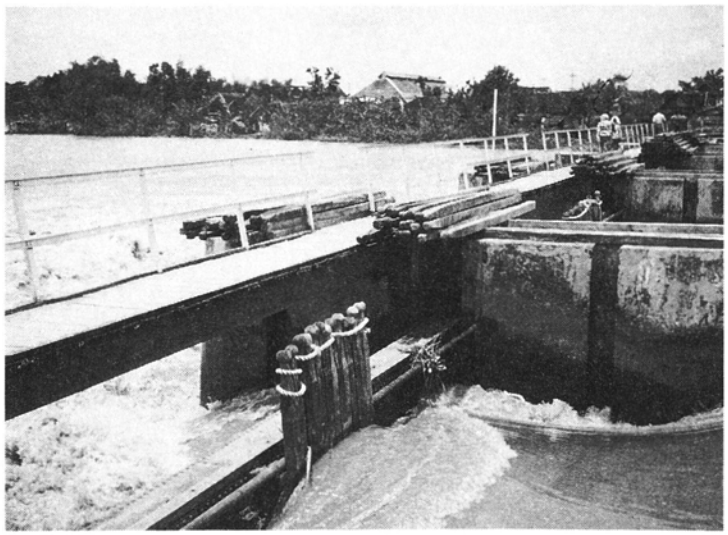
The Lodoyo Dam is designed to provide the function of re-regulating reservoir for the Wlingi Dam's peak power generation. Of the multi-purpose dams in the Basin, it is the only dam equipped with an all-width gate, which is of roller-type and 11.3 m tall. It is also a movable weir, which was very popular at the time of its construction. For power generation, it employs a tubular turbine with short head and large flow rate.

The Sengguruh Dam was single-handedly initiated by the Brantas Office. It was completed through the bilateral assistance of Austria and IBRD funds. Located in the uppermost streams of the Brantas, noticeable sedimentation occurs in the dam's lake, thereby creating the need for early execution of debris control work for the Lesti River situated upstream of the Sengguruh Dam.

The Bening Dam has a comparatively low height of 35 m yet offers a large active storage capacity of 20,000,000 m^3, playing a big part in supplying irrigation water for the Widas River Basin. It incorporates a cross flow turbine for power generation, the first ever in Indonesia. Although the turbine produces only a small-scale output of 650 kW, from the viewpoint of effective water use this generation method should be used for more dams in the future.

The Wonorejo Dam is to be a large dam of Karangkates class with a height of 100 m when complete. For the sharp mountain ridge section on the left bank, underground

concrete walls are employed for water sealing, which is a large-scale construction method world-wide. The dam will contribute a supplementary supply of domestic and industrial water to Surabaya City and irrigation for Wonorejo district as well as the generation of 6,500 kW. The early completion of this project is hoped for.



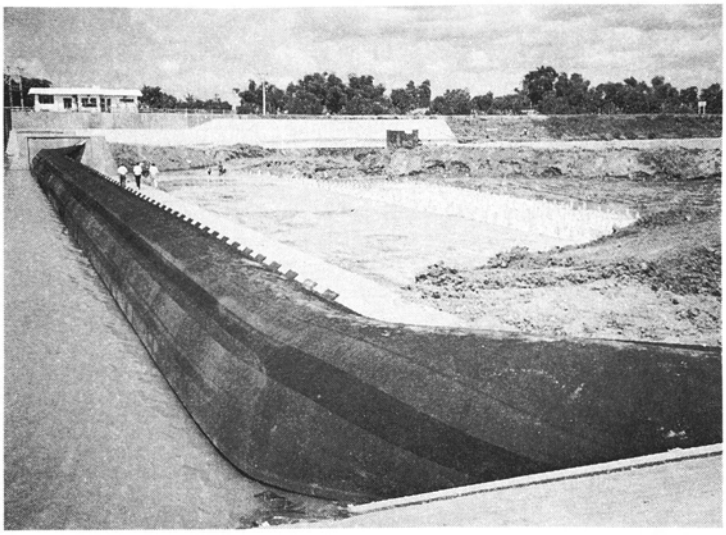
Needle gate of Gunungsari Dam

(b) Intake dam

There are many irrigation and city water intake facilities existing across the Brantas main streams and branches. Large-scale efforts were expended to rehabilitate them and also to establish new facilities. The first result to be realized from these efforts on the main stream was the New Lengkong Dam in Mojokerto City in 1971. Initially the large Lengkong Dam was built by the Dutch in 1857 to be used for diverting water into Surabaya City for domestic and industrial use and into Sidoarjo Delta for irrigation. Because of deterioration and loss of function, the original structure was replaced with a new dam equipped with an all-width gate in Oct. 1974. After a work period of three years, a grand inauguration ceremony was held in the presence of Mr. Sutami, Minister of Public Works.

As part of the Surabaya River Improvement Work, the old structure of the Gunungsari Dam, an agricultural intake weir for Surabaya lower reaches, was removed and an all-width gate was built in its place, as was done at the New Lengkong Dam. The former gates of the Lengkong and Gunungsari Dams were needle gates to regulate flow rate by manually assembling or drawing out many pieces of 10-cm square timber with sharpened edges. Such gates are rarely seen these days.

As part of the improvement efforts for intake facilities on the Brantas main streams, the Mrican was built as an intake dam covering Waruturi and Mrican irrigation areas. Towards the same purpose, Jatimlerek and Menturus rubber dams were constructed in the middle reaches of the main stream. The use of rubber dams is likely to increase in the future due to the low construction costs involved (see Table 2-44).



Menturus Rubber Dam

Table 2-44 Intake barrages

Project	Location	Type	Scale	Year of completion
1) Lengkong Dam	Brantas main stream, Mojokeruto City	Sluice gate weir	H = 11.3 m L = 151.9 m	1974
2) Gunungsari Dam	Surabaya River, Gunungsari City	Sluice gate weir	H = 6.0 m L = 77.2 m	1981
3) Mrican Dam	Brantas main stream, Kediri City	Sluice gate weir	H = 4.8 m L = 141.0	1992
4) Jatimlerek Dam	Brantas main stream, the Jatimlerek Dam point	Rubber dam	H = 2.4 m L = 137.3 m	1993
5) Menturus Dam	Brantas main stream, Menturus point	Rubber dam	H = 2.7 m L = 136.0	1993

(2) Irrigation projects

The South Tulungagung Diversion Project (Nejama Diversion Tunnel), the first agricultural development project in the Brantas Basin, was launched in 1959 aimed at the reclamation of a 3,000 ha swamp along the Ngrowo River. Its results were a great success as described earlier. Later the reclamation of a remaining section of a rainy season swamp was planned in 1981 and the Tulungagung Diversion Tunnel (Nejama Tunnel No. 2) was constructed. The water thus diverted is now used at the Tulungagung Power Station.

As a first step to effectively utilize the irrigation water newly created by the construction of Karangkates and Selorejo Dams, rehabilitation of deteriorated irrigation facilities (water channels, diversion weirs, water intakes, etc.) was carried out. This project covered 29,000 ha of the largest irrigation area in the Basin, the Brantas Delta and was completed in 1973 (see Table 2-45).

Table 2-45 Summary of irrigation projects

Project	River for water intake	Irrigation area (ha)	Year of completion
1) South Tulungagung Diversion Tunnel	Ngrowo	28,000	1961
2) Brantas Delta Irrigation Facilities Rehabilitation	Brantas main stream	29,250	1973
3) Widas Irrigation	Widas	8,600	1984
4) Lodoyo Tulungagung Irrigation	Brantas main stream, Wlingi Dam	14,200	1984
5) Tulungagung Diversion Tunnel	Ngrowo	1,600	1985
6) East Java Groundwater Irrigation	Within basin, wells	6,250	1986
7) Waru - Turi Irrigation	Brantas main stream, Mrican Dam	22,080	1992
8) Wonorejo Irrigation	Ngrowo	7,500	Under construction

Remarks: Irrigation areas are 1990 data

Lodoyo-Tulungagung is the largest of the newly developed irrigation areas in the Basin with water taken from the Wlingi Dam reservoir. New construction and enhancement of irrigation facilities were performed for the newly developed Lodoyo irrigation area consisting of approximately 3,000 ha and the existing Lodoyo-Tulungagung area.

Facilities for irrigation areas of Warujayeng-Kertosono and Turi-Tunggorono were also improved and expanded upon the completion of the Mrican Dam across the Brantas main stream.

As for Brantas branches, water conveyance facilities in the basin irrigation areas were sophisticated to utilize irrigation water created by the construction of the Bening Dam in the Widas upper reaches. Currently under way are the development and improvement of irrigation facilities for the area covered by Wonorejo Dam (under construction).

Lodoyo Irrigation Trunk Canal

(3) River improvement projects

The Porong River improvement project, the Brantas flood diversion channel, began in 1971, which was around the same time that dam projects in the Brantas upper reaches were completed (see Table 2-46). It was performed on a scale large enough to meet the planned high flow rate of 1,500 m^3/sec. Improvements included raising of existing banks, dredging of riverbeds, provision of cut-offs at the river mouth, and revetment work. As for construction equipment, many pieces of equipment typically used in dam projects were used on this river project. A dredger for mouth dredging and an amphibious dredger for riverbed dredging were purchased with the project expenses, this equipment drew attention due to its rareness in those days. Later the Porong River was subjected to other rehabilitation work from 1989 to 1992 during Phase II of the river improvement project.

Following Phase I of the Porong River Improvement Project, improvement work on the Brantas middle reaches was carried out in two phases. Phase II lasted from 1978 to 1993. Due to the great length of the work section, the work volume was also large as shown by the total earth volume of 7,000,000 m^3 required for raising the riverbed, which

was equivalent to that for 100-m class fill dams. This project was directly worked by task force that presented difficulties in securing a number of varied pieces of construction equipment, quality control, and a secured work budget. It was also a long-running project which is characteristic of any river improvement work and so imposed continuous strain on the staff involved. It was quite a project.

Table 2-46 Overview of river improvement projects

Project	River	Planned flow rate (m^3/s)	Embankment ($\times 10^3\ m^3$)	Dredged bed ($\times 10^3\ m^3$)	Work period (year)
Porong River Phase I	Entire river, mouth	1,500	580	1,200	1971-77
Phase II	Entire river	1,500	53	500	1978-93
Middle Reach River Phases I, II	Brantas main stream	900-1,200	7,000	7,000	1975-93
Widas River	Branch		129	181	1979-81
Surabaya River Phase I	Branch	190-260	10	410	1974-81
Phase II	Branch	(Municipal sewerage)	—	—	1990 - (under way)

Remarks: The Surabaya River Project Phase I was mainly intended for the rehabilitation of existing structures; Phase II, involved sewerage work for Surabaya City.

The development of tributaries was initiated with the improvement work on the Surabaya River. This project began with the planning and study phases in 1971 and finished in 1974. During this project the difficulty of acquiring sites for river channel expansion and improvement was experienced, especially in the central part of Surabaya City, this is common with any urban river improvement work. After this project was completed, cleaning of Surabaya River was performed through the cooperation of the Public Water Management Corporation and residents in an effort to achieve a cleaner urban river. A canoe race was held to celebrate the achievement. An Indonesian nationwide newspaper carried this event under the heading of "Now Clean Surabaya River".

The advancement of the Brantas Basin development has caused changes in the flow out mechanism as well as an increase in flood waters. To deal with these, a plan was formulated to effectively use existing retarding basins in the middle Ngrowo and at the Widas mouth for absorbing the increased flow. In accordance with this plan, the Tulungagung Diversion Tunnel was constructed and the Widas River Improvement Work was implemented at the time of the Bening Dam construction.

(4) Debris control projects

The construction of debris control facilities is still under way as part of Basin management efforts. Such facilities can be divided into two categories: one for storage of ejecta from Mt. Kelud and checking of outflow, and the other for checking of earth produced from Basin erosion.

There is a lake in the crater atop Mt. Kelud and with eruptions the lake water runs down the sides of the mountain mixed with ejecta in the form of hot mud flow (primary lahar). To prevent the primary lahar from doing extensive damage, repeated efforts to construct a diversion tunnel for decreasing water levels in the lake have been in vain; every time an eruption occurs, the diversion tunnel is destroyed and requires repairs. Restoration is under way at present on the 874-m tunnel which was destroyed by the latest eruption in 1990.

The Mt. Kelud Debris Control Project has been ongoing since 1969. Debris control facilities have been provided up to present as shown in Table 2-47 to cover the 2,003 km^2 area affected by Mt. Kelud eruptions; including the rivers of Lekso, Putih, Badak, Ngobo, and Konto.

Table 2-47 Implemented debris control facilities (1985)

Structure	Quantity	Regulation volume (x 10^6 m^3)
Debris control dam	4	1.75
Checkdam	25	1.69
Ground sill	29	0.95
Drop structure	—	
Settling basin	9	21.21
Total	67	25.60

From the viewpoint of conservation of the entire Basin and as a preventive measure to keep sediment from flowing into the Sengguruh Dam as well, there is a project planned to provide debris control dams with a total capacity of 1,000,000 m^3, and afforestation efforts in the Lesti reaches upstream of the Brantas as well.