23: General Description of the Shewi Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 54 ha of forest including 12 ha of reserved forest s well as 5 ha of agricultural land
	(2) Lower reservoir		The submerged area involves 22 ha of non-reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	The basin is located in the upstream parts of the Shewi Nadi river. The 47 square km large basin has a relatively gentle relief in its most upstream part. In its middle reaches, however, there are precipitous cliffs and further downstream towards the reservoir, however, the relief assumes a gentle gradient.
		(2) Submerged dwellings	It appears that there is no dwelling in the reservoir. In the upper reaches of the basin, however, there are some villages.
		(3) River bed condition	In the most upstream part, the river bed shows signs of progressive erosion. The river dips at a gentle gradient. In the middle reaches, the river forms a stream running from the overhanging cliff in the middle reaches to the left bank some 2km upstream of the dam site. Up to this point, erosion is assumed to be strong in evidence. Further downstream it appears that rock debris washed down from the upper reaches has settled with the formation of deposits.
		(4) Circum-reservoir terrain	The terrain surrounding the reservoir shows a large number of small streams developing from the main river. In the lower reaches rock debris has been washed down from the upstream regions with evidence to suggest that the deposits of weathered rock waste are present on both banks. It is reasonable to fear that these deposits may slide on both banks as a result of the variations in the reservoir water level.
	(2) Lower reservoir	(1) River basin	This basin is located in the most upstream part of the tributary emptying into the Tilari Nadi river on the right bank. The watershed peak consists of a plateau formation. The terrain abruptly changes to steep cliffs and from around 2km or so upstream of the dam site, the river starts to dip at a gentle gradient. On the left bank, in particular, the relief is marked by a steep gradient of dip.
		(2) Submerged dwellings	There is no dwelling in the reservoir, but there are villages near the watershed peaks consisting of plateau formations on either bank of the river.
		(3) River bed condition	Past the steep cliffs skirting the most upstream parts, the relief is intensively gouged out and the river gradient assumes a gentle dip from about 2km or so upstream of the dam site. The river bed has rock debris deposits gouged out and washed down from the upper reaches.
		(4) Circum-reservoir terrain	On the left bank near the reservoir, the terrain shows a steep incline. On the right bank, the river forms a stream and assumes a gentle gradient. It is believed that rock debris has settled here.
	(3) Changes in river basin		This project does not qualify for river flow diversion schemes.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	The river bed near the dam site is believed to have deposits of rock debris washed down from the upper reaches. On both banks, the terrain is gently inclined, with evidence indicating that weathered rock debris or gouged-out rock waste is believed to have settled.
		(2) Dam	In view of the topography of the area around the dam site, it may be possible to increase the water storage capacity by raising the dam height a little further.
	(2) Lower reservoir dam	(1) Dam site status	It is difficult to imagine that the rock debris deposits on the river bed is of any significant depth. On the right bank, there is a small mountain ridge, and weathering is believed to have progressed near the ground surface.
		(2) Dam	The dam site is located in the upper reaches. The river has a relatively steep gradient so that the water storage capacity is small. On the right bank there is a small mountain ridge, and weathering has progressed near the ground surface.
	(3) Waterway route	(1) Geographical profile	The route of the waterway system is straight from the intake to the outlet. The longitudinal relief shows a gentle dip toward the upper and lower reservoirs, with the watershed peak in-between the two reservoirs.
		(2) Layout	The waterway system is short with a length of only approximately 3km. The headrace tunnel has to be built at a gradient of about 1:200 to accommodate the existing topographical constraints. As a result, the powerhouse can be positioned near the outlet.
	(4) Intake and outlet		For the intake and outlet, it is possible to use the ordinary horizontal type structures.
	(5) Surge tank		The headrace has a length of approximately 1.6km and it is necessary to provide a surge tank on the headrace to control water pressure. On the tailrace, however, it is not necessary to layout a surge tank.
	(6) Powerhouse		The powerhouse is to be situated at a location approximately 1km from the outlet.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to dam on the upper reservoir, it is not clear whether or what road infrastructure is available. (There is no 1:50,000 scale topographical map.) For access to the dam on the lower reservoir, it will be necessary to construct a new approximately 3km long stretch of road from the existing road near Morle.
	(2) Access tunnel to powerhouse		The access tunnel is planned to connect to the powerhouse from the right bank. Its length would be approximately 1.5km.
	(3) Cable tunnel		A switchyard is to be constructed with the dam road at the lower reservoir extended. From there, an inclined type tunnel of approximately 1km length needs to be provide to connect to the underground transformer room.
5. Power transmission lines			To construct the 220kV one circuit, one conductor, 110km from Shemi PPS to Kolhapur II S/S along the 220kV double circuits transmission line between Ponda S/S and Kolhapur II S/S.
6. General evaluation			In view of the small water storage capacity and the low water head compared to the other projects and then the exceedingly small maximum output, this basin cannot be remotely described as being economically favorable. This poor prospect is not improved by the fact that this project does not require river flow diversion schemes. The submerged forest area in the reservoirs would amount to a significant 70ha.

Dense scrub

Falls 40 m

Bhaota Temple 768

650

Khadpole

RESERVED FOREST

414

500

Kalāgumbvādi

Dense mixed jungle with bamboo

Sāvarvādi

725

891

Isāpur

863

Motorable in dry season

Causeway

Pendrāvādi

796

Tervan

Dense mixed jungle

Shemi Nadi

RESERVED FOREST

Bhekurli

724

Nāmkhol

336

602

Pārgarh

Spring

Sāvat Sara 651

Dense mixed jungle

Kali Kapi 710

349

621

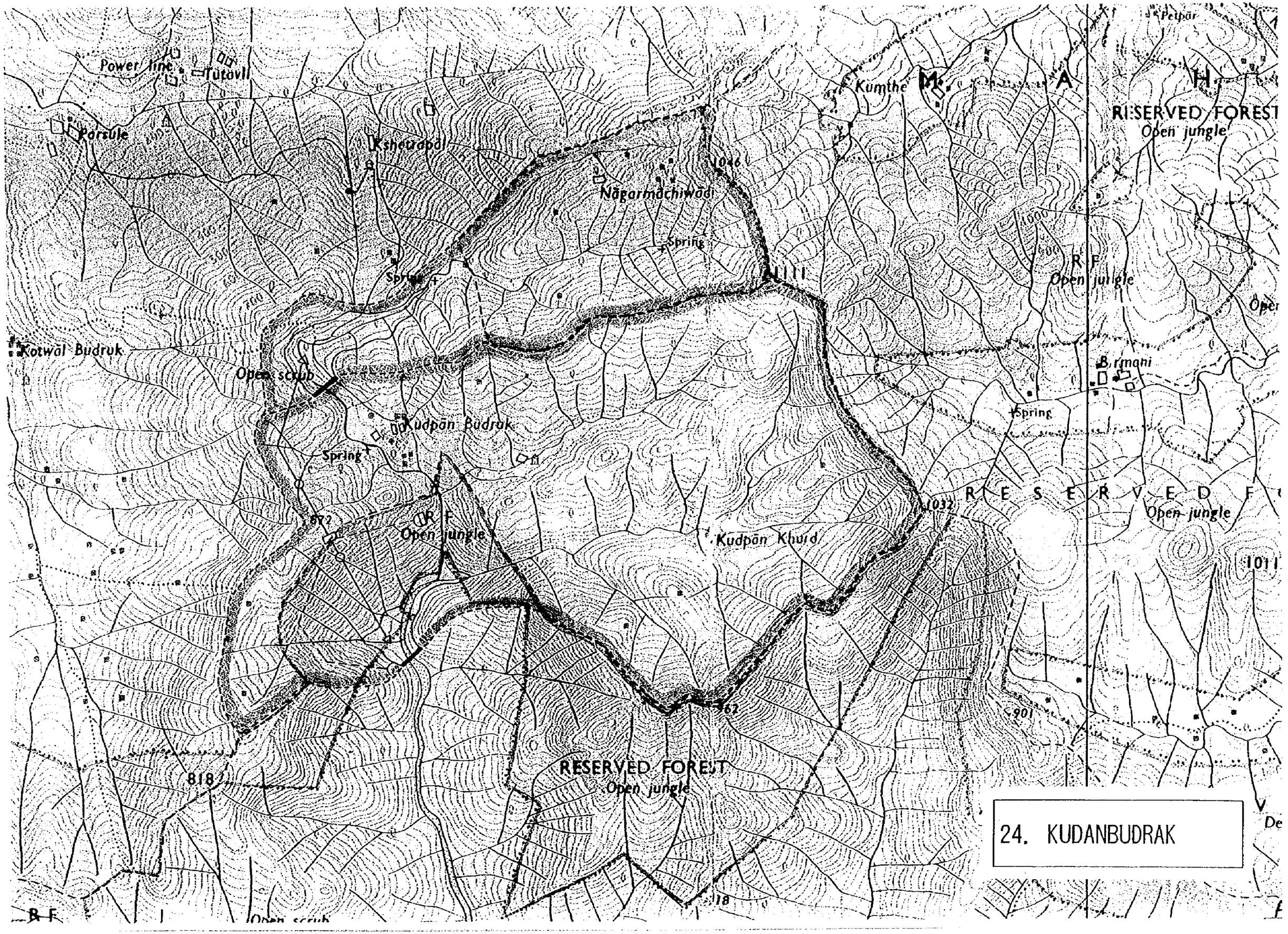
Dense mixed jungle with bamboo

RESERVED FOREST

23. SHEMI

24: General Description of the Kudpan Budra Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 33 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 24 ha of forest including 15 ha of reserved forest as well as 12 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin	This basin is situated in the most upstream parts of the tributary emptying into the Jagbudi river. The basin is long and narrow stretching in the east-west direction, and the terrain is steep. From about the middle reaches the river assumes a somewhat gentler gradient, flanked by steep slopes on both sides.
		(2) Submerged dwellings	There appear to be no dwelling submerged in the reservoir, but there are villages downstream of the dam site.
		(3) River bed condition	In the upper reaches, the river has a steep gradient. There is evidence of the terrain having been washed or gouged out. The river near the reservoir has a somewhat gentle gradient. There is a spring upstream of the terminal end of the reservoir.
		(4) Circum-reservoir terrain	The terrain surrounding the reservoir dips at a steep gradient.
	(2) Lower reservoir	(1) River basin	Located some 3km downstream of the dam site on the upper reservoir, the basin has a generally steeply inclined topography. Towards the reservoir, the river assumes a gentle gradient.
		(2) Submerged dwellings	There is no dwelling submerged in the reservoir, but there are significant villages downstream of the dam site on the upper reservoir. There are also isolated dwellings dotted here and there throughout the basin.
		(3) River bed condition	At a position approximately 2km upstream of the dam site, the river forms two streams. Upstream of this point, the river has a steep gradient with significant evidence of erosion. Downstream of the confluence of the streams the river assumes a gentle gradient.
		(4) Circum-reservoir terrain	The terrain around the reservoir presents a steeply inclined topography.
	(3) Changes in river basin		The lower reservoir is to be sited according to the plan at a position approximately 3km from the upper reservoir. The project does not consist of the diversion of the riverflow.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	In the upper reaches, the river has a steep gradient. The dam site is to be sited at the point in which this steep gradient suddenly changes to a gentle one. The river bed has few deposits. On both banks of the dam site, the relief is steep but the foundation rock bed is shallow.
		(2) Dam	On the left bank of the dam site, there is a somewhat narrow mountain ridge. It would be difficult to raise the dam height beyond this. If the dam site were shifted slightly downstream, it might be possible to raise the dam height.
	(2) Lower reservoir dam	(1) Dam site status	The river bed from about 2km upstream of the dam site is assumed to consist of rock debris. On the river bed, there are deposits of rock debris. On both banks, the terrain is steep.
		(2) Dam	On the river bed, it is believed that the deposits of rock debris have formed. On both banks, the terrain is steep and exposed rock is likely to be present. However, this would not present a problem area for the abutment structures. Nonetheless, it is difficult to raise the dam height any further and the water storage efficiency is not satisfactory so that the project is not economically feasible.
	(3) Waterway route	(1) Geographical profile	The route of the waterway system has been selected by taking into account the topographical features of the location. There are no particular factors in the topography likely to become a problem.
		(2) Layout	The waterway system has an extended length of approximately 2.3km and given the positions for the intake and outlet, the layout can be described as optimum.
	(4) Intake and outlet		For the intake and outlet, it is possible to use the ordinary horizontal type structures.
	(5) Surge tank		The headrace tunnel has a length of approximately 1km. The plan envisages the construction of a surge tank on the headrace to control water pressure. On the tailrace, however, there will be no need to layout a surge tank.
	(6) Powerhouse		The powerhouse is situated deep underground some 0.8km from the outlet.
4. Access road and tunnel	(1) Upper and lower reservoirs		The existing road of approximately 5km length leads from Parsule to the dam site on the lower reservoir, and to gain access to the upper reservoir, it will be necessary to provide a new road of approximately 7km length from this existing road.
	(2) Access tunnel to powerhouse		The access tunnel of approximately 2km length from the right bank of the dam site on the lower reservoir to connect to the powerhouse.
	(3) Cable tunnel		The layout provides for an inclined tunnel of approximately 1km length from the switchyard to connect to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 70km from Kudanbudrak PPS to planning of New Koyna S/S along the 220kV double circuits transmission line between Kandalgaon S/S and Koyna III S/S.
6. General evaluation			Although the submerged forest area is small and no river flow diversion is needed in the project, the fact is that this project does not offer a very favorable economic prospect. This is the result of the poor water storage efficiency in this site, with or without raising the dam height, and the limited water storage capacity. Although, furthermore, the location has the advantage of using the same river, this is outweighed by the disadvantage that the water head is of the order of 300m.



24. KUDANBUDRAK

25: General Description of the Kandoshi Project Site

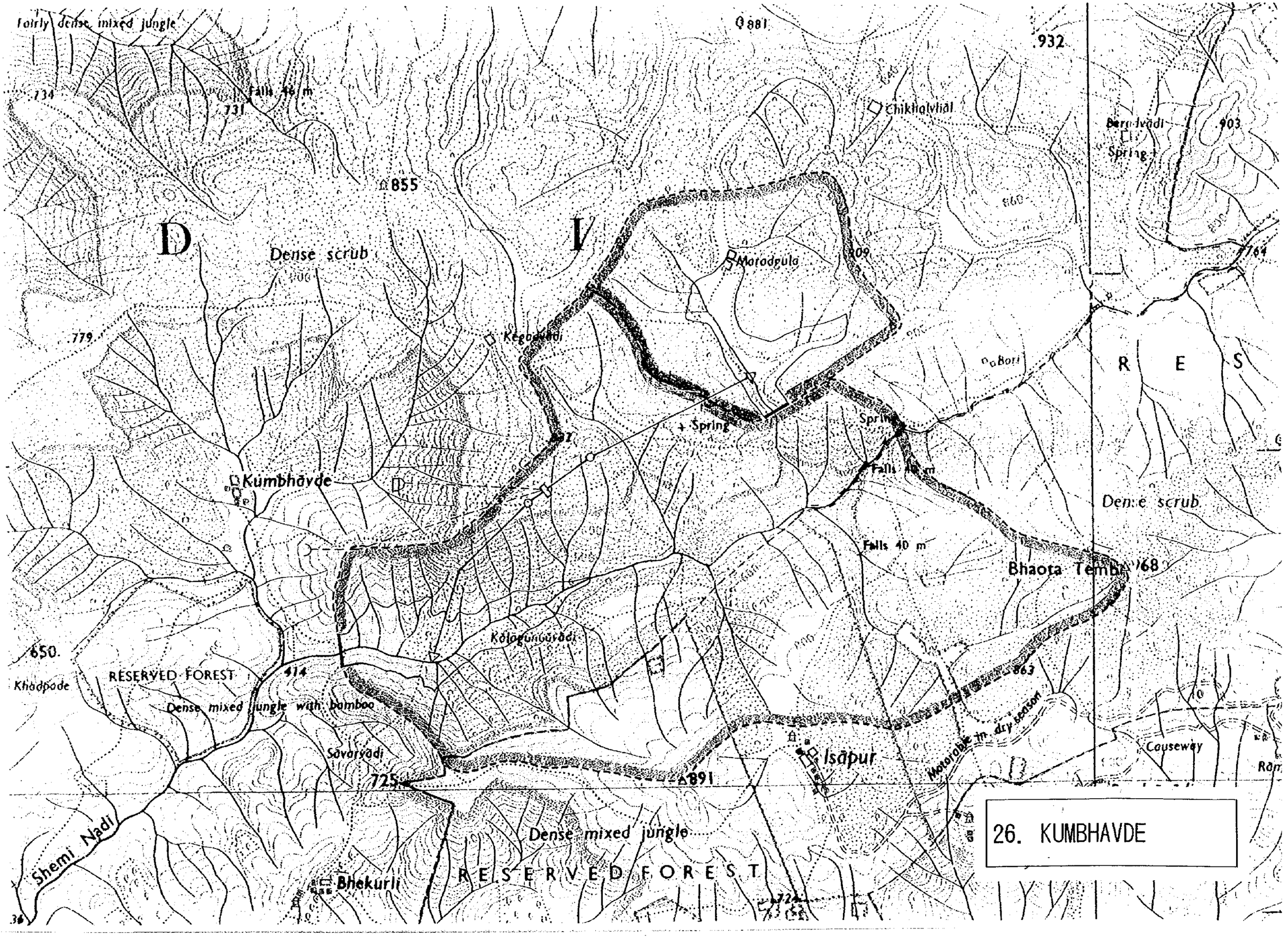
1. Environment conditions	(1) Upper reservoir		The submerged area involves 30 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 47 ha of non-reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	This basin is situated in the most upstream part of the river Jagbudi. The watershed of the basin is generally formed by a plateau. The terrain is steep as far as the backwater of the reservoir.
		(2) Submerged dwellings	There is no dwelling submerged in the reservoir, but there are some villages and temples in the basin.
		(3) River bed condition	Generally, the terrain is steep as far as the backwater of the reservoir. Further downstream of the middle reaches of the river, including the streams, there is evidence of erosion having taken place. The terrain is also steep towards the dam site and it is believed that there are few deposits on the river bed.
		(4) Circum-reservoir terrain	The mountains around the reservoir have a gentle gradient of dip. The ground surface may have been weathered or may carry rock debris. With the changes in the reservoir water level, these deposits of rock debris may collapse or slide.
	(2) Lower reservoir	(1) River basin	The dam site is located on the same river some 4km downstream of the dam on the upper reservoir. The watershed is formed by a mountain ridge in a very steep terrain with some isolated overhanging cliffs. Towards the backwater end of the reservoir the slopes assume a gentle gradient.
		(2) Submerged dwellings	On the right bank there are some villages approximately 1km from dam site. On the left bank there are some isolated dwellings. On the evidence of the 1:50,000 topographical map it is not clear whether submerging takes place or not.
		(3) River bed condition	The upper reaches of the river from the end of the reservoir branch off into innumerable mountain streams. The river, including these mountain streams, show signs of erosion. In the lower reaches from the reservoir the river exhibits a gentle gradient. The river bed of the downstream is likely to have deposits.
		(4) Circum-reservoir terrain	In the vicinity of the reservoir on both banks, the terrain has a relatively gentle gradient, inviting human habitation with the presence of dwellings. The deposits may collapse or slide with the changes in the reservoir water level.
	(3) Changes in river basin		The project is on the same river, with an approximately 4km distance between the upper and lower dam sites.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	Near the dam site, the river dips at a gentle gradient, and the river bed is believed to have few deposits. On both banks, the terrain is relatively gentle, and the surface layer may be deep.
		(2) Dam	The surface layers on both sides and the river bed are relatively thin, and the dam foundation rock bed would make a favorable dam site if the deposits is shallow. However, the location has not satisfactory water storage efficiency, nor would this efficiency be much improved if the dam height is raised.
	(2) Lower reservoir dam	(1) Dam site status	Near the dam site, the river dips at a gentle gradient. On both banks, the terrain has a gentle gradient. The river bed is likely to be covered with deposits and on the banks on either side of the river the surface layer will be deep.
		(2) Dam	As both river banks slope at a gentle gradient, the dam has a relatively great length. In the upper reaches there are some villages. It is felt difficult to raise the dam height any further.
	(3) Waterway route	(1) Geographical profile	The layout for the waterway system has been selected by taking into account the natural relief of the topography. As the plan makes use of the fact that the both dam sites are on the same river, the waterway has a total extended length of a good 4km. In view of the topographical constraints, the powerhouse has to be sited midway on the waterway system.
		(2) Layout	For topographical reasons, the waterway system has a great length, and both the headrace and the tailrace are about 2km long. As, on the plan, the powerhouse is located midway on the waterway system, the structures belonging to the powerhouse will take an uneconomic layout.
	(4) Intake and outlet		For the intake and outlet, it is possible to use the ordinary horizontal type structures.
	(5) Surge tank		In view of the great length of both the headrace and the tailrace, it is necessary to provide surge tanks on both.
	(6) Powerhouse		The powerhouse needs to be sited approximately 1.6km from the outlet. For topographical reasons, the overburden is about 350m at the powerhouse, its depth is not so deep.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the upper reservoir, a new approximately 7km long road will need to be constructed from Govtunwadi. For access to the lower reservoir, there is already an existing road passing nearby so that a new road should be layouted forking off from this existing road.
	(2) Access tunnel to powerhouse		An access tunnel of approximately 2km length will need to be provided from the dam site on the lower reservoir.
	(3) Cable tunnel		The approximately 2km long road from Dhawade is extended to the switchyard and the construction of an approximately 1.5km long inclined type tunnel from this location is planned to connect to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 55km from Kaudoshi PPS to planning of New Koyna S/S along the 220kV double circuits transmission line between Kandalgaon S/S and Koyna III S/S.
6. General evaluation			This project is on the same river and the submerged area is a little. As the reservoir capacity is limited and the waterway is long, the project site offer poor economic efficiency.

Bhangewadi
Birmani
Rocky knobs
Kalaphani Khurd
671
R F
Dabhemohan
Dabhedabhekar
RESERVED FOREST
Dense jungle
1056
Suvarwadi
Kenjale
Kondoshi
1201
Kumbyachiwadi
Open scrub
478
736
Jadani
Spring
Jagbudi R
Dhowade
683
Open scrub
R F
Q278
Dhangarwadi
Sutarwadi
689
Kandat
Dense jungle
Fairly dense jungle
Kandat R

25. KAUDOSHI

26: General Description of the Kumbhavde Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 98 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 86 ha of non-reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	The basin is located in the most upstream part of the Shewi Nadi river. Towards the river, the relief forms a highland plateau dipped at a gentle gradient. On the slopes, it is believed that weather rock debris has deposited.
		(2) Submerged dwellings	In the submerged reservoir basin, there are some huts. As the topographical map available is rather old, it is likely that the number of these huts has grown.
		(3) River bed condition	The dam location forms a narrow valley. The basin is subject to progressive weathering and as it is a highland plateau there are deposits on the river bed.
		(4) Circum-reservoir terrain	The terrain surrounding the reservoir shows a gentle gradient throughout the basin. It is supposed the surface layer is deep and the foundation rock has progressively weathered. With the variations in the reservoir water level, the surface layer around the reservoir may possibly slide.
	(2) Lower reservoir	(1) River basin	The dam on the lower reservoir is located on the Shewi Nadi river approximately 3km downstream of the upper reservoir dam site. In the upper reaches of the basin, the terrain has a relatively gentle gradient, with a chain of steep cliffs on the way. From this point, the river slopes at a steep gradient, descending into the reservoir.
		(2) Submerged dwellings	There is no dwellings submerged in the reservoir area along the river because the topography is steep. The plain near the watershed on the left bank side has attracted human habitation with the village of Isapur.
		(3) River bed condition	The main river stream forms innumerable streams and mountain ones. These have a rapid flow which has gouged out the rock and washed down the rock debris. Near the reservoir, the river slopes at a gentle gradient and the deposits of rock debris are believed to be deep.
		(4) Circum-reservoir terrain	On both banks of the reservoir, the terrain shows a relatively gentle incline, with evidence to suggest the deposits of rock debris which may collapse or slide with the changes in the reservoir water level.
	(3) Changes in river basin		This project does not qualify for river flow diversion schemes, as it is situated on the same river with a distance of approximately 3km between the upper and lower reservoir dam sites.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	At the dam site, both banks come down at a very steep dip. On the downstream side, the river has a rapid flow. Yet, the banks on both sides have a gentle gradient and it is supposed that the surface layer is somewhat deep, with the dam foundation rock having progressively weathered. It is not likely that there are deep deposits on the river bed.
		(2) Dam	The banks of the dam site on both sides have a gentle gradient. Provided that the geological conditions on both sides are favorable, the location presents no problems for the siting of the dam. For topographical reasons, it appears relatively easy to secure water storage capacity in this project.
	(2) Lower reservoir dam	(1) Dam site status	On both banks of the dam site, there are lean, rugged mountain ridges without vegetation. The dam site has a relatively gentle gradient and the river bed is wide and dips at a gentle gradient. It is therefore reasonable to assume that deep deposits of rock debris are present. In some cases, the dam foundation rock may have been subject to progressive weathering.
		(2) Dam	For the dam site, the key point will be the geological conditions. The topography of the reservoir is marked by a relatively gentle gradient so that it may be possible to secure water storage capacity by raising the dam height.
	(3) Waterway route	(1) Geographical profile	The route of the waterway system has been selected in view of the topographical lie of the land. The plateau near the upper reservoir forms a long extension of flatland, which eventually dips at a steep slope, and from this point the slopes with some undulation descend towards the lower reservoir.
		(2) Layout	The headrace tunnel has a shallow overburden and it will be necessary to provide a 1:500 gradient. At the terminal end of the headrace tunnel, a surge tank needs to be provided to control water pressure. The layout then has a penstock line and an approximately 1.2km long tailrace tunnel passing through the powerhouse and leading to the lower reservoir.
	(4) Intake and outlet		For the intake and outlet, it is possible to use the ordinary horizontal type structures.
	(5) Surge tank		The headrace has a length of 1.5km and it will be necessary to provide a surge tank on the headrace to control water pressure. On the tailrace tunnel, however, it will not be necessary to layout a surge tank.
	(6) Powerhouse		The powerhouse is to be situated somewhat close to the tailrace side of the waterway system, in view of the topographical conditions.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to dam site on the upper reservoir, it is necessary to provide a new, approximately 5km long road from Chukul. For access to the dam site on the lower reservoir, it will be necessary to construct a new approximately 5km long stretch of road from Isapur.
	(2) Access tunnel to powerhouse		The access tunnel of approximately 2.5km length from the right bank of the lower reservoir dam is planned to connect to the powerhouse.
	(3) Cable tunnel		A switchyard is to be layouted on the right bank of the lower reservoir dam site, with an approximately 2.5km long cable tunnel forming the connection to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 100km from Kumbhavde PPS to Kolhapur II S/S along the 220kV double circuits transmission line between Ponda S/S and Kolhapur II S/S.
6. General evaluation			It is possible to secure adequate water storage capacity, and the maximum available discharge is also high in the order of 300 cubic m/sec. However, the effective water head is small at only 325m. As a result, the project offers a somewhat poor economic efficiency. There is also a likelihood of there being some sanctuaries in the area and the location will have significant areas of submerged forest.


Fairly dense mixed jungle
Falls 46 m
734
731
855
D
Dense scrub
779
Kumbhavde
881
932
Chikhalvihal
Berdivadi
Spring
903
855
I
Morodgula
809
764
Kegaonvadi
Spring
Bori
R E S
Spring
Falls 40 m
Dense scrub
Bhaota Temb
768
650.
Khadpade
RESERVED FOREST
414
Dense mixed jungle with bamboo
Kologunbavadi
863
Motorable in dry season
Causeway
Savaryadi
725
891
Isapur
Shemi Nadi
Dense mixed jungle
Bhekurli
RESERVED FOREST
724
26. KUMBHAVDE

27. General Description of the Mundirichi Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 21 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 85 ha of non-reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	The reservoir is to be constructed by the excavated and embanked pondage at the plateau of 800m elevations in the upper reaches of the Mundirichi Nadi river. Nearby, there is a hilly plateau, with the Parvad village in the vicinity.
		(2) Submerged dwellings	As the excavated and embanked pondage is proposed, there is no submerged dwelling.
		(3) River bed condition	Non
		(4) Circum-reservoir terrain	The pondage is surrounded by a hilly plateau area. The surface layer is believed to have progressively weathered.
	(2) Lower reservoir	(1) River basin	The basis in situated in the upper reaches of the river Mundirivhi, a tributary of the Navada Nadi which empties into the Nadei river on the right bank. The upper reaches account for about two thirds of the basin and form a hilly plateau relief. Past the plateau, the terrain abruptly assumes a steep gradient. Only the parts skirting the lower reservoir have a more gentle gradient.
		(2) Submerged dwellings	There is no submerged dwelling.
		(3) River bed condition	At an elevation above 700m in the upper reaches, the river flows at a gentle pace through the reservoir. Further downstream, however, there are ravines. From a position approximately 4km upstream of the dam site, the river flows at a gentle gradient. The river bed is supposed to have deposits of rock debris.
		(4) Circum-reservoir terrain	The terrain around the reservoir presents a relatively gently inclined topography. It is estimated that the rock debris deposits are somewhat thick so that there is a risk of their collapsing or sliding with the variations in the reservoir water level.
	(3) Changes in river basin		The project is within the same basin. The state boundary passes along the upper reservoir.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	The topography features form a plateau, with evidence to suggest that progressive weathering has taken place in the surface layer.
		(2) Dam	The pondage has an effective water storage capacity of $5 \times 10^6 m^3$. The dam height of this artificial pondage is 26m and the dam length 1,900m.
	(2) Lower reservoir dam	(1) Dam site status	Near the dam site, the river has a gentle gradient. On both banks, the terrain dips at a gentle slope. There is reason to fear that there may be deep deposits of rock debris. From the evidence of the geological features, it seems that it will be inevitable to investigate the foundation rock.
		(2) Dam	The river bed at the dam site is wide and the dam also has a long crest. Even if the dam height is raised to an elevation above 200m, the water storage capacity will remain poor and the project cannot therefore be described as economically advantageous.
	(3) Waterway route	(1) Geographical profile	The layout for the waterway system has been selected by taking into consideration the topographical conditions. The downstream topography from the plateau in the upper reaches dips at a steep gradient. It will be necessary to layout the powerhouse at a point approximately 2km of the outlet. It is therefore not a desirable layout.
		(2) Layout	Though the minimum distance is the stretch from the intake to the outlet, the headrace tunnel is short but the tailrace is long at 2km, and it will be necessary to provide a surge tank on the tailrace.
	(4) Intake and outlet		As the reservoir is the excavated artificial pondage, the intake needs to be of the morning glory type structure. For the outlet, however, it is possible to use a normal type of structure.
	(5) Surge tank		The tailrace is long at 2km and therefore needs a surge tank.
	(6) Powerhouse		On the layout, the powerhouse is situated at the closs to the intake and positioned deep underground.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the dam site on the upper reservoir it will be necessary to construct a new road of approximately 3.5km length, forking off from the existing road. To gain access to the lower reservoir, however, it will be provided a short new, approximately 1km long road connecting to the existing road.
	(2) Access tunnel to powerhouse		Constructing a lakeside road of approximately 1km length, a new road leads to the left bank of the lower reservoir dam site. Also due to be constructed is an approximately 1.5km long access tunnel connecting to the powerhouse.
	(3) Cable tunnel		Layouting the switchyard in the upper reaches of the lower reservoir, 1.5km long inclined type tunnel is to to connect to the under transformer room from the switchyard.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 120km from Mundirichi PPS to Kolhapur II S/S along the 220kV double circuits transmission line between Ponda S/S and Kolhapur II S/S.
6. General evaluation			The upper pondage is artificially created by excavated and embanked method within the same basin. The project is sited on the plateau which forms the state boundary. The construction costs for the upper pondage would be relatively low and the waterway system has a short extension. For these reasons, the project offers a somewhat favorable economic efficiency. The shortcoming is that the project has a large area of submerged forest reaching 85ha in the lower reservoir.

Stony Waste
Ford
Dense jungle
784
Falls 13 m
Dense mixed jungle
Open jungle
882
△Kukmi Temb
Tura Temb △837
Mandão Dhar △
794
32
33
Ford
765
Surla
Open jungle
Dense mixed jungle
Open jungle
Pawad
800
Open jungle
805
815
Dense jungle
780
797
672
709
Open scrub
217
Dense jungle
Spring
241
Dense scrub
628
197
Spring
2r
3r
Spring
re Khurd
Dense jungle
202
578
Desert N.
309
135
475
370
Golāli
River
△123
122
395
134
49r
27r
2h
53

27. MUNDIRICHI

28: General Description of the VIRDI Project Site

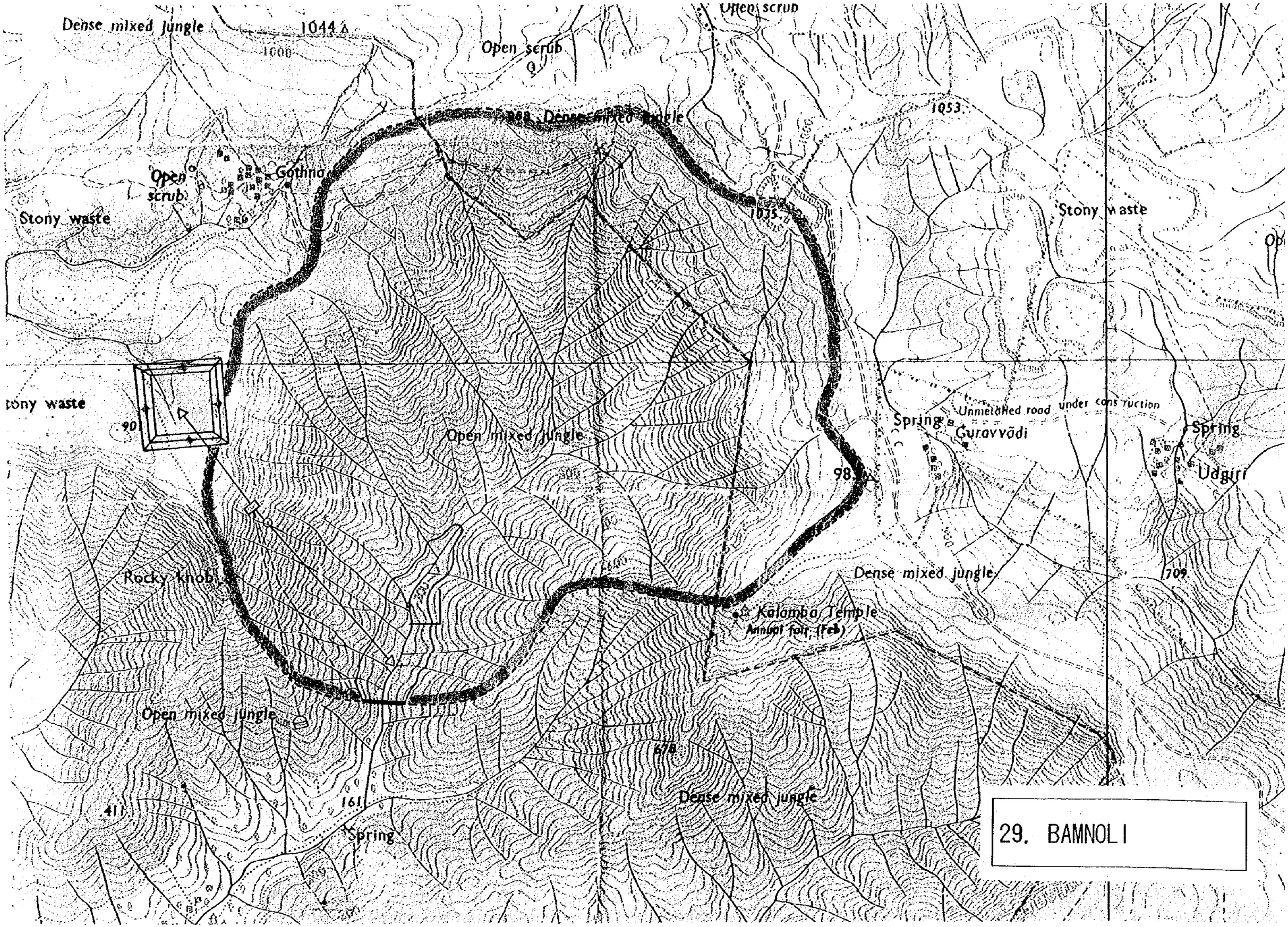
1. Environment conditions	(1) Upper reservoir		The submerged area involves 21 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 48 ha of non-reserved forest and 7 ha of agricultural land
	(1) Upper reservoir	(1) River basin	The excavated and embanked artificial pondage is to be provided on a plateau of 800m elevation in the most upstream part of the river Kattika, a tributary emptying into the river Valvot on the right bank. The vicinity of the pondage is marked by a hilly plateau and further downstream there is the village of Soda.
		(2) Submerged dwellings	As it is an artificially created pondage, the site is selected with no submerged dwelling.
		(3) River bed condition	Non
		(4) Circum-reservoir terrain	On the hilly plateau near the watershed peak, there are exposed stony rock and rock debris.
	(2) Lower reservoir	(1) River basin	In the most upstream part of the river Kattika, the rivers forms numerous mountain streams bordered in by the ridgeline-shaped watershed. The basin represents a mountainous area of very steep cliffs and slopes. Towards the reservoir, the relief becomes gentler, and downstream of the dam site there is the village of Virdi on the left bank.
		(2) Submerged dwellings	On topographical grounds, there is no submerged dwelling in the reservoir.
		(3) River bed condition	The river basin as a whole represents a mountainous area with very steep, sharp cliffs and slopes. The river has a steep gradient and the river bed shows signs of erosion. Towards the reservoir, however, the river assumes a gentler gradient and the river bed is believed to be covered with rock debris.
		(4) Circum-reservoir terrain	The terrain around the reservoir, including both banks, has a generally steep gradient, and along the river, including the mountain streams, the gradients suddenly eases and becomes more gentle. The river bed may have ddeposits of washed-down rock debris. It is feared that this may be washed down into the reservoir through the construction of the dam.
	(3) Changes in river basin		This river basin does not need any changes of the river flow. The lower reservoir is located past the boundary with the neighboring state.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	Non
		(2) Dam	The effective water storage capacity is 4×10^6 m^3, with the dam of the artificial pondage having a height of 23m and a length of 1,900m.
	(2) Lower reservoir dam	(1) Dam site status	The dam site has a gentle river gradient. The river bed is wide and there are believed to be the deposits on the river. On the right bank, the topography is steep, with exposed rock in evidence. On the left bank, there is a rugged mountain ridge without vegetation and it is believed that the foundation rock has progressively weathered.
		(2) Dam	The river is supposed to have the deposits. This and the geological conditions on the left bank are the key factor deciding the relative ease or difficulty of constructing the dam. The present dam height is the limit to which the dam height can be raised, this is, therefore, the limit for any attempt to increase power output
	(3) Waterway route	(1) Geographical profile	The waterway system has been selected by taking into consideration the natural relief. Along the waterway, the area has a steep topography. This therefore necessitates the positioning of the powerhouse near the intake at a point 2.6km from the outlet.
		(2) Layout	The distance from the intake to the outlet is somewhat long at approximately 3.5km. The powerhouse is located near the upper reaches. The headrace is absent in this layout, instead of the headrace, the layout has a long tailrace.
	(4) Intake and outlet		Since the upper poondage is artificially excavated and embanked type, the intakes need a morning glory type structure. The outlet may be constructed using an ordinary horizontal type of structure.
	(5) Surge tank		Since there is no headrace, there is also no need to provide surge a surge tank on the intake side. The tailrace is rather long, extending over 2.6km. This requires the construction of a surge tank.
	(6) Powerhouse		The powerhouse is located deep underground near the intake. By using a wise arrangement for the access tunnel to the powerhouse and the cable tunnel, it is attempted to reduce construction costs.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the upper pondage an access tunnel of approximately 4km length needs to be led from Usap. For access to the lower reservoir, however, a new stretch of road of approximately 8km length needs to be provided, forking off from the existing road that passes through Bayalvada.
	(2) Access tunnel to powerhouse		A 2km long road has to be led from the left bank of the lower reservoir dam site and so has an approximately 1.5km long tunnel to connect to the underground powerhouse.
	(3) Cable tunnel		2km long road has to be constructed from the left bank of the lower reservoir dam site and the switchyard is to be built here. A 1km long inclined type cable tunnel also needs to connect to the transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 125km from Virdi PPS to planning of Kolapur II S/S along the 220 kV double circuits transmission line between Ponda S/S and Kolhapur II S/S.
6. General evaluation			The merits are that the construction costs for the upper pondage is low and that the construction costs can be reduced by considering the layout of the structures belonging to the underground powerhouse. As a result, this project offers a somewhat favorable economic efficiency. Nor does the project require river flow diversion schemes and there are also few areas of submerged forest.

Pikule
Lādchetemb
Shālāvādi
Selbichvāda
Devulvādi
124
Dhāmal Dongar
Usap
PO
Bokarvāda
Open scrub
Talevādi
Falls 26
Sada
Stony waste
Stony waste
3. Talaika Dongar
y dense jungle
395
Open scrub
470 Lavki Dongar
Katuke N
Mūk Dongar
Savalvādi
Yaira Sakkal Falls 143 m
Falls 6
806△Lāsni
Dense mixed jungle
389 Rāika Dongar
Talekhol
Virdi
83
Panji Dongar
403
572
Dense
Watulvādi
282.
Goura Dongar
Fairly dense jungle
Kumbhārvādi
54
406
Dense scrub
Kelvade
Jinjuhe
Rāvan
Shiroli

28. VIRDI

29. General Description of the BAMNOLI Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 56 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 50 ha of non-reserved forest and 5 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin	The basin is located in the most upstream parts of the tributary emptying into the Bav Nadi, and the artificially excavated and embanked type pondage is to be layouted on a plateau of 900m elevation.
		(2) Submerged dwellings	As it is an artificially created pondage, there is no submerged dwelling in the area.
		(3) River bed condition	Non
		(4) Circum-reservoir terrain	The vicinity of the pondage is a plain, with exposed rock outcrops and a surface layer of rock debris likely to be present.
	(2) Lower reservoir	(1) River basin	The highland plain at an elevation in the order of 900m forms the watershed. From this plateau, the mountainous area continues at a sharp gradient of steep cliffs. The rivers forms numerous mountain streams. Only around the reservoir and on both banks is the terrain steep but the river itself dips at a gentle angle.
		(2) Submerged dwellings	Since it is a mountainous area of steep cliffs, there is no dwelling in the area.
		(3) River bed condition	The river assumes a somewhat gentle gradient approximately 3km upstream of the dam site. Further upstream, however, the river has a rapid flow and forms numerous mountain streams. It appears that weathering has not taken a progressive source in the river.
		(4) Circum-reservoir terrain	The terrain on both banks has a steep gradient.
	(3) Changes in river basin		Since the plan is to layouted the upper pondage by the artificial method, the river basin does not need any changes to its natural river flow.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	Non
		(2) Dam	The effective water storage capacity of this pondage is 8.7×10^6 m^3.
	(2) Lower reservoir dam	(1) Dam site status	Near the dam site, the river has a gentle gradient. The river bed is narrow and there are believed to be only small amounts of deposits. On the left and right banks, the topography is steep, with exposed rock in evidence on the surface.
		(2) Dam	On both banks of the dam site, the terrain has a steep slope, forming a narrow valley. With the dam height being 59m, the reservoir has a relatively large capacity, making it a favorable dam.
	(3) Waterway route	(1) Geographical profile	The waterway system has been selected using a straight layout. The topography has no undulation from the upper reservoir and continues down to the lower reservoir up to 2.5km.
		(2) Layout	On topographical grounds, there is no headrace, and a penstock line is directly used instead. As a result, the powerhouse is located near the intake. The tailrace has a length of 1.6km on the layout. With the total length being approximately 3km, it is an efficient waterway system.
	(4) Intake and outlet		Since the upper pondage is artificial type, the intake needs a morning glory type structure. The outlet is to be constructed using an ordinary horizontal type of structure.
	(5) Surge tank		There is also no need to provide a surge tank on the intake side. The waterway is rather long so that the plan calls for the construction of a surge tank on the tailrace.
	(6) Powerhouse		The powerhouse is located deep underground near the intake. It enters somewhat deep into the mountains at a distance of 1.6km from the outlet.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the upper reservoir, an access road of approximately 2km length needs to be led from the village of Gathna. For access to the lower reservoir, a stretch of road of approximately 7km length needs to be provided, forking off from the existing road at Maral in the downstream.
	(2) Access tunnel to powerhouse		A 2.3km long tunnel is to be constructed from the right bank of the lower reservoir dam site to connect to the powerhouse.
	(3) Cable tunnel		The switchyard is to be constructed on the right bank of the lower reservoir dam site. From this point, an approximately 2.3km long cable tunnel is to connect to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 61km from Bamnoli PPS to planning of New Koyna S/S.
6. General evaluation			The merits are that the construction costs for the artificial pondage are low and that the waterway has a short total extended length and also that the location offers a large water storage capacity and a large water head. As a result, this project offers a favorable economic efficiency. This site is also an alternative to the Marleshwar project proposal and also has the advantage of there being only minor submerged area in the upper pondage.


Dense mixed jungle
1044
1000
Open scrub
Open scrub
1053
Dense mixed jungle
Gothna
Open scrub
Stony waste
1035
Stony waste
Stony waste
Unmetalled road under construction
Spring
Guravvādi
Spring
Udgiri
Open mixed jungle
98
Rocky knob
Dense mixed jungle
709
Kalamba Temple
Annual fair (Feb)
Open mixed jungle
678
411
161
Spring
Dense mixed jungle
29. BAMNOLI