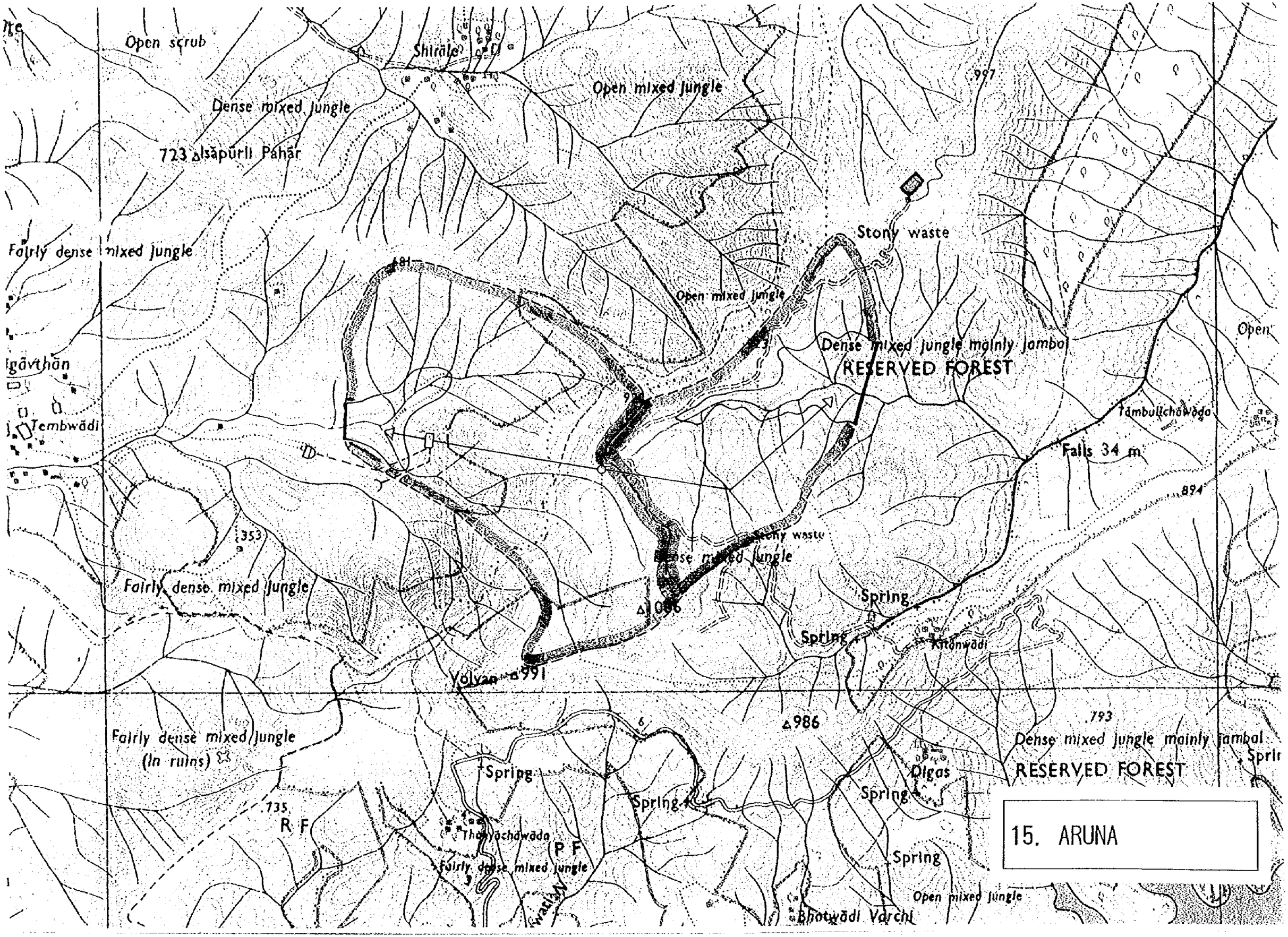
15: General Description of the ARUNA Project Site

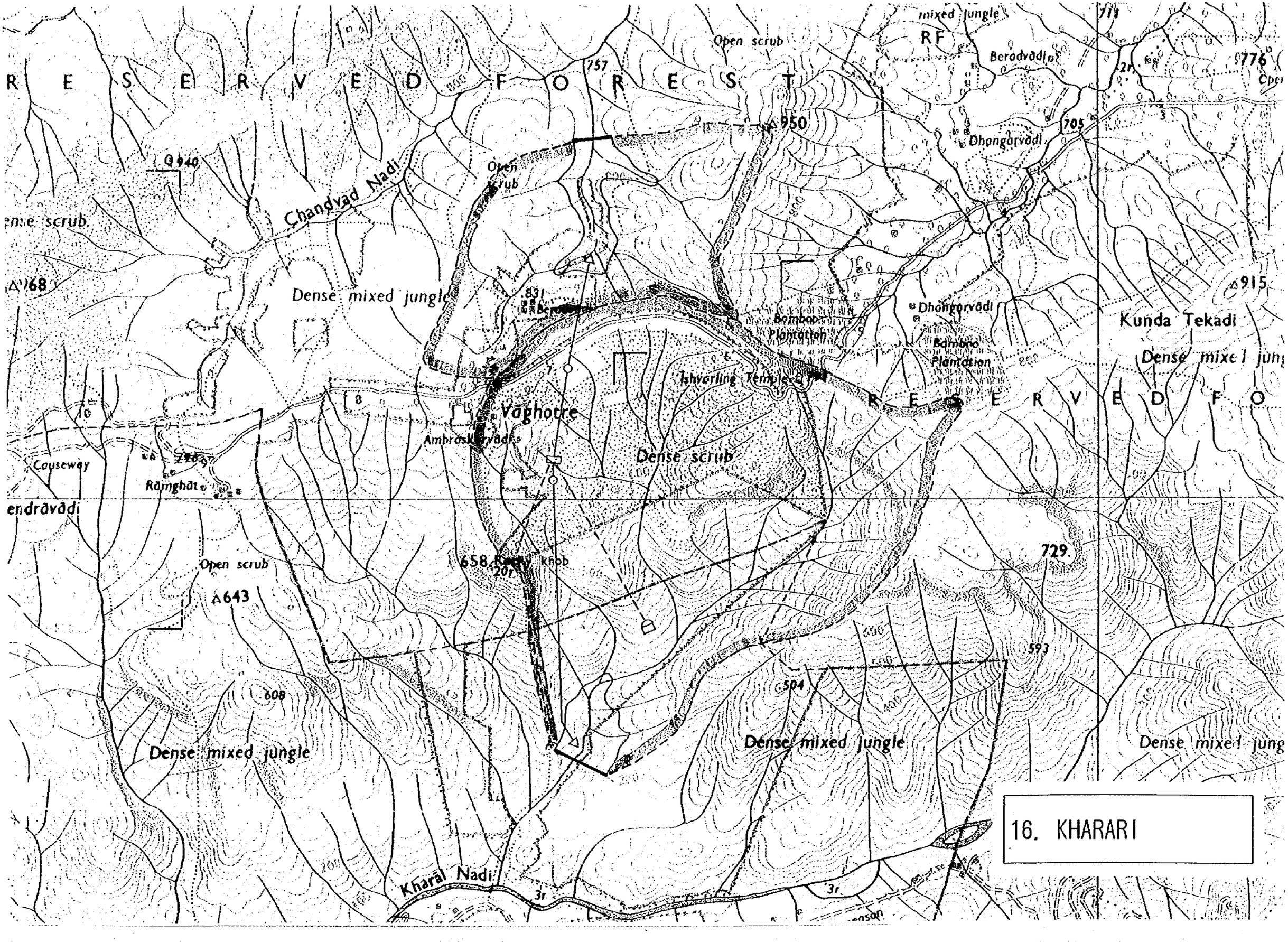
1. Environment conditions	(1) Upper reservoir		The submered area involves 27 ha of reserved forest
	(2) Lower reservoir		The submerged area involves 23 ha of reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	This basin consists of gentle slopes, with the watershed peak at an elevation of about 900m. Near the reservoir, the land surface slopes at a fairly gentle gradient.
		(2) Submerged dwellings	The basin is one of the tributaries, and in the lower reaches there is a waterfall, with no dwelling in the basin.
		(3) River bed condition	The topography is marked by a gentle gradient. Both the main and subsidiary flows present evidence suggesting that the beds have been gouged out. Downstream of the dam site, the banks and the rivers are somewhat narrow so that it is assumed that there are deposits of rock debris or sand.
		(4) Circum-reservoir terrain	The terrain surrounding the reservoir dips at a gentle gradient so that the areas around the reservoir are likely to have progressively developed deposits of rock debris or sand. There is ground for fear that the land surface layer may slide as a result of variations in the water level of the reservoir
	(2) Lower reservoir	(1) River basin	In the most upstream part, the basin forms a gently inclined plateau. Further downstream, the terrain then changes to slopes inclined at a steep gradient toward the scheduled site for the lower reservoir. In the vicinity of the reservoir, the relief is inclined at a somewhat gentle gradient and the rivers also dip at a gentle gradient.
		(2) Submerged dwellings	There are large village communities near a point some 3km downstream of the dam site. Near the reservoir, the banks on either side come close so that it may be concluded that there is no dwelling there.
		(3) River bed condition	Upstream of the dam site there are mainly two rapidly flowing streams forking off from the river. The two streams have gouged out the terrain more extensively than any of the other small streams. On the gentle slopes flanking the reservoir from these streams, it is believed that rock debris or similar has washed down and settled.
		(4) Circum-reservoir terrain	The terrain around the reservoir presents a gently inclined topography. It is inferred that the surface soil forms a thin layer.
	(3) Changes in river basin		The rivers feed the upper and lower reservoirs flow in opposite directions in the east-west site, divided by the watershed peak formed by a plateau of 900m elevation.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	Both banks of the dam site are situated in a gently inclined location. It is estimated that the rock debris deposit and weathered soil layers are deep. The river bed has accumulated sand or rock debris deposits washed down from the upper reaches. There is also probability that the dam foundation rock bed has also been subject to progressive weathering.
		(2) Dam	As has already been stated in connection with the river bed condition, it will be necessary to select the type of dam and decide on the foundation work procedures on the basis of the results obtained from detailed geological survey. For topological reasons, it would be difficult to raise the dam height any further.
	(2) Lower reservoir dam	(1) Dam site status	Rock debris and sand washed down from the upper reaches is likely to have deposited on the river bed. The surface soil on both banks forms a thin layer. Yet, in terms of raising the dam height, it appears that the geological conditions present problems, as seen that the left bank consists of gently inclined slopes.
		(2) Dam	With the present dam height, it is though that there are no problems that might hamper the construction of the dam. Yet, even when the dam height is raised, storage efficiency will remain poor and the project will not be economic because of the steep mountain near the reservoir.
	(3) Waterway route	(1) Geographical profile	The longitudinal relief near the waterway route presents a flat topography up to the watershed peak. Further downstream the relief slopes more gently after the precipitous cliffs have been crossed and steadily falls toward the lower reservoir.
		(2) Layout	The waterway has a total length of approximately 4km. The terrain presents a very favorable topography for the layout of the waterway system. The headrace has a length of 2.5km, and the merit of the arrangement is that the powerhouse is close to the outlet.
	(4) Intake and outlet		The ordinary horizontal type structures may be used for both the intake and outlet.
	(5) Surge tank		As stated above, the headrace is long so that it required the construction of a surge tank to control water pressure. On the tailrace, however, it will not be necessary to construct a surge tank.
	(6) Powerhouse		The powerhouse is situated in the vicinity of the outlet. All ancillary structures related to the powerhouse are amenable to an economically advantageous layout.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the upper reservoir, there are existing roads in the vicinity so that there is practically no need to provide any new access roads. To gain access to the lower reservoir, the situation is quite similar in that an existing road already leads to the villages 3.5km downstream. It is also easy to construct new roads.
	(2) Access tunnel to powerhouse		The switchyard is situated at the left downstream of the dam site of the lower reservoir. According to the plan, this forms the starting point for the construction of the access tunnel to the powerhouse.
	(3) Cable tunnel		The cable tunnel is layouted running parallel to the access tunnel to the powerhouse and connecting to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 60km from Aruna PPS to Kolhapur II S/S along the 110kV one circuit transmission line between Kankavli S/S and Kolhapur II S/S.
6. General evaluation			While the head is comparatively high, the fact is that because of the limited water storage capacity of both the upper and lower reservoirs, the effective water volume is small so that economic performance is somewhat poor. The submerged forest area in the upper reservoir is close to 60ha and the project site requires the river flow diversion.


Open scrub
Shirale
Open mixed jungle
997
Dense mixed jungle
723 Alsāpūrli Pāhār
Fairly dense mixed jungle
Stony waste
481
Open mixed jungle
Dense mixed jungle mainly Jambol
RESERVED FOREST
Open
Tembwādi
Tambulichāwāda
Falls 34 m
894
353
Fairly dense mixed jungle
Stony waste
Dense mixed jungle
Spring
Spring
Khānwādi
Yelvan 991
986
793
Dense mixed jungle mainly Jambul
Fairly dense mixed jungle
(In ruins)
Spring
Digas
RESERVED FOREST
Spring
Spring
735
R F
Thakyachāwāda
P F
Fairly dense mixed jungle
Spring
Open mixed jungle
Bhatwādi Varchi

15. ARUNA

16: General Description of the KHARARI Project Site

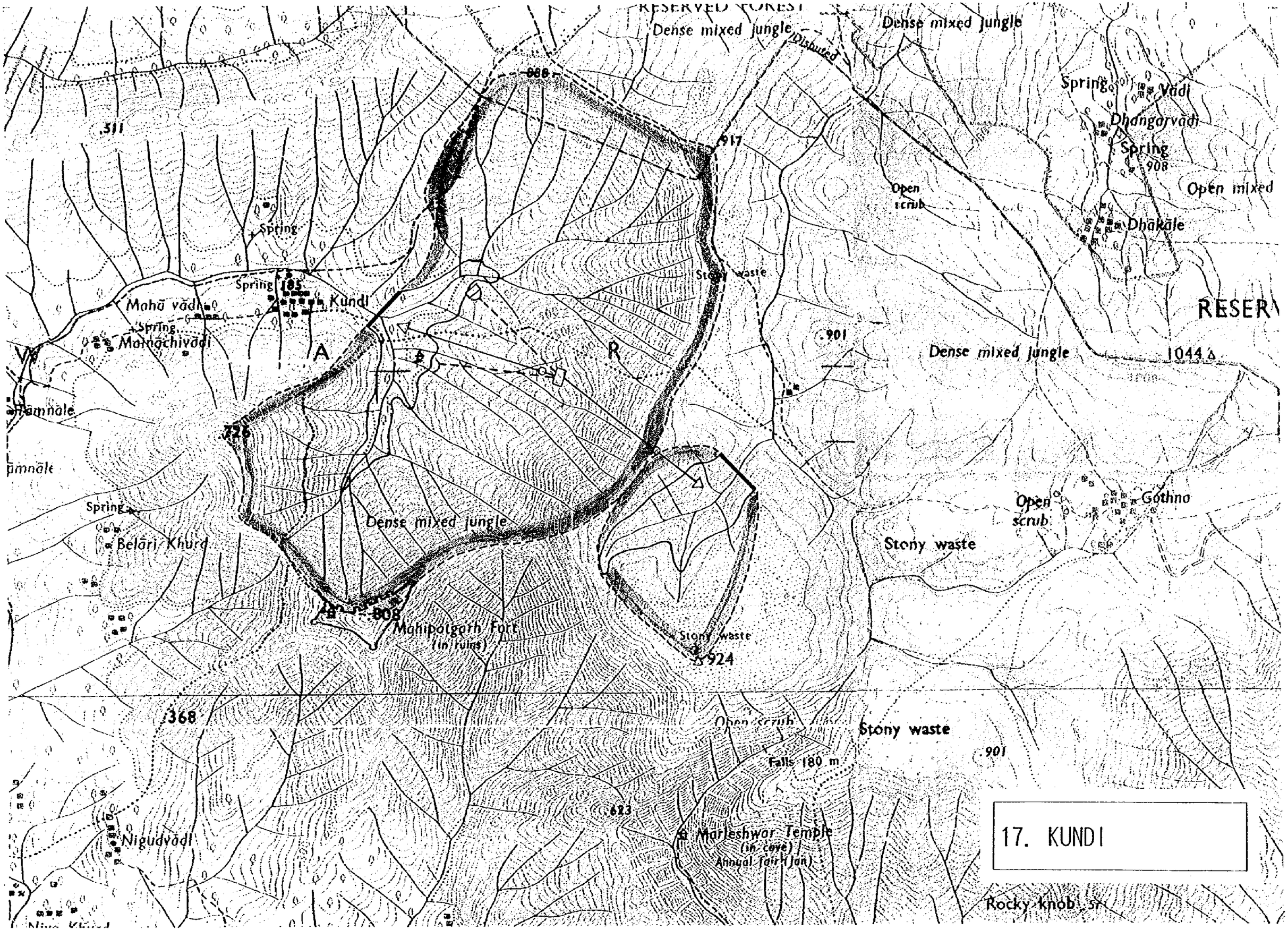
1. Environment conditions	(1) Upper reservoir		The submerged area involves 52 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 25 ha of reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	At the most upstream part of the stream emptying into the Chandvad Nadi river on the right river bank, the topography presents a watershed peak in the form of a plateau at an elevation of around 800m. The river basin as a whole is dipped at a gentle gradient. In the vicinity of the reservoir, the terrain is flat. In the upper reaches of the basin, there are some villages or hamlets.
		(2) Submerged dwellings	The map suggest that there is no submerged dwelling. As the map is quite old, however, there may now be some villages.
		(3) River bed condition	In the upstream part, the river dips at a steep gradient. In the vicinity of the reservoir, the terrain has a flat topography with the river dipping at a gentle gradient. It is estimated that sand or rock debris has deposited.
		(4) Circum-reservoir terrain	In the vicinity of the reservoir there are some hilly elevations taking the shape of tableland type plateaus. The slopes have a gentle gradient of dip. It is thus clear that with the changes in the reservoir water level, there is a possible risk of the slope surface sliding.
	(2) Lower reservoir	(1) River basin	The basin is located on the stream flowing into the Kharal Nadi on the right bank. The upstream part of the basin is marked by mountainous terrain with cliffs dipping at a steep gradient. Towards the reservoir, the terrain assumes a somewhat gentler gradient of dip. There are some villages or hamlets in the upper reaches.
		(2) Submerged dwellings	The surrounds of the reservoir form the terminal rim of a steeply inclined topography, with no dwelling in evidence.
		(3) River bed condition	The upper reaches are marked by a steep river gradient which become less steep as the flow approaches the lower reaches. The river shows signs of erosion from about the middle reaches. From the vicinity of the reservoir to the lower reaches there is evidence to suggest the presence of deposits of washed-down rock debris.
		(4) Circum-reservoir terrain	The reservoir is situated in a topographical relief abruptly changing from a steep inclination to a gentle dip. The terrain around the reservoir has a generally gentle gradient, and on the left bank in particular, the terrain forms a plateau. The surface of the land is assumed to be covered by a top soil layer, with the risk of subsidence due to movements in the reservoir water level.
	(3) Changes in river basin		The watershed peak in the form of a plateau at an elevation of approximately 800m divides the basin into a northern and southern flow pattern.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	The dam site is situated in a gently dipped location forming a tableland plateau. It is believed that the river bed and both banks are covered with rock debris deposits and that the foundation rock bed has progressively weathered.
		(2) Dam	The dam height is topographically limited to a maximum corresponding to an elevation of approximately 800m. It would be difficult to raise the dam beyond this in order to increase the reservoir at storage capacity. No further increase in output can therefore be reasonably expected at this site.
	(2) Lower reservoir dam	(1) Dam site status	There are no particular problems on the right bank of the river. Yet, the left bank of dam site consists of gentle slope so that it may be assumed that deposits have settled on the river bed and that progressive weathering has taken place on the foundation rock bed.
		(2) Dam	On the left bank of the dam site, the terrain is gently dipped. It is thus absolutely essential to conduct a geological survey on the dam foundations, including the river bed. The results of such a survey should form the basis for formulating the approach to be adopted for finishing the dam foundations.
	(3) Waterway route	(1) Geographical profile	The waterways system has a flat extension of 4km and thus present a topographical shape with the characteristics of an area qualifying for a water flow diversion. From the upper reservoir to the watershed peak, the terrain maintains a gentle dip, with the lower reaches showing a similarly gentle incline.
		(2) Layout	From the upper reservoir to the watershed peak, the terrain has a gentle topography so that the layout for the headrace needs some considerations. In view of the gentle longitudinal profile, the tailrace takes a long course and the powerhouse will have to be positioned on the upstream end of the waterway system.
	(4) Intake and outlet		For both the intake and outlet, the ordinary horizontal type structures are planned.
	(5) Surge tank		If the headrace tunnel and the penstock line are included, the total length will be approximately 1.9km so that a surge tank will be needed to control the water pressure. Similarly, the need for a surge tank also arises on the tailrace side as the tailrace tunnel has a considerable length of 2.4km.
	(6) Powerhouse		The powerhouse will have to be sited underground at a point 2.4km from the outlet. This will make the layout economically unfavorable.
4. Access road and tunnel	(1) Upper and lower reservoirs		The existing road goes as far as Umgaon in the direction toward the upper reservoir, and a new road of approximately 4km length should therefore be constructed from this point to gain access to the upper reservoir. To reach the lower reservoir, an approximately 1.5km road needs to be newly constructed.
	(2) Access tunnel to powerhouse		It will be necessary to construct an approximately 1.5km long access tunnel from the lower reservoir.
	(3) Cable tunnel		A new approximately 2km long road is to be extended to gain access to the right bank of the lower reservoir. It will also be necessary to construct a switchyard and an approximately 1.5km long inclined tunnel to connect to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 105km from Kharari 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 reservoir has a topographically limited water storage capacity and the waterway system is long. The basin also makes it necessary to locate the powerhouse on the upstream end of the waterway system. For these reasons, the economic effectiveness of the layout is somewhat adversely affected. In the upper reservoir there is a considerable area of submerged forest reaching 50ha. The basin qualifies for the river flow diversion.


mixed jungle
RF
Open scrub
757
Berdvadi
776
950
705
Dhangarvadi
Chandvad Nadi
Open scrub
940
Dense mixed jungle
831
Bamboo Plantation
Dhangarvadi
Kunda Tekadi
Ishvarling Temple
Vaghotre
Ambrasli Vadi
Dense scrub
Causeway
Ramghat
Open scrub
643
658
Rocky knob
729
608
504
593
Dense mixed jungle
Dense mixed jungle
Kharal Nadi
3r
3r

16. KHARARI

17: General Description of the KUNDI Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 65 ha of non-reserved forest
	(2) Lower reservoir		The submerged area involves 40 ha of non-reserved forest and 37 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin	The basin is situated in a plateau topography at the most upstream part of the Varna Nadi river. It is a small basin with a catchment area of only 1.7 km^2. There are stony waste in the vicinity and the land is deserted. Toward the river, the terrain is gently inclined.
		(2) Submerged dwellings	Located at the most upstream part of the Varna Nadi river, the surrounds of the reservoir are deserted land with no evidence of any dwelling.
		(3) River bed condition	Sandy waste forming a plateau of approximately 900m elevation constitutes the water source area. On the left bank of the reservoir, the terrain consists of stony waste dipped at a gentle gradient towards the reservoir. It is therefore likely to anticipate no sliding problems in this part due to the variations in the reservoir water level.
		(4) Circum-reservoir terrain	The left bank of the reservoir area has deposits of weathered rock. In view of the stony waste terrain on the left bank and because of the gentle gradient of the relief toward the reservoir there is substantial ground to anticipate no sliding problems as a result of variation in the reservoir water level.
	(2) Lower reservoir	(1) River basin	The basin is situated at the most upstream part of the stream emptying into the Bav Nadi river on the right bank. From the watershed peak at an elevation in the order of 800m towards the river, the terrain dips at a steep gradient. Immediately upstream of the dam site there are two streams forking off from the river, and the terrain assumes a gentle inclination in the direction towards these streams.
		(2) Submerged dwellings	There is a temple in the reservoir and the village of Kundi is located downstream of the dam site.
		(3) River bed condition	The basin as a whole is a mountainous zone with cliffs dipping at a steep gradient. Immediately upstream of the dam site there are two streams forking off from the river, and the main stream, including these two streams, dip at a gentle gradient. There is ample reason to suppose that rock debris has formed the deposits.
		(4) Circum-reservoir terrain	On the left bank by the reservoir the terrain dips at a sharp gradient. On the right bank, however, it dips at a gentle gradient. It is believed that there are deposits of rock waste on this bank and in the river bed. There is a possibility that these rock debris deposits may collapse with the variations in the reservoir water level.
	(3) Changes in river basin		The basin qualifies as the river flow diversion. It also offers sufficient potential for a scheme to construct the upper reservoir as an excavated and embanked pondage.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	The terrain has a gentle relief and reports stony waste in the basin. The rock debris are believed to be little. The dam foundation rock forms a plateau table so that it is most likely to have progressively weathered.
		(2) Dam	With the present layout, a saddle dam will be required on the upstream end of the reservoir. It would be difficult, however, to raise the dam height beyond this. On topographical and geological grounds, the basin therefore qualifies for a scheme envisaging the creation of a pondage based on the excavated and embanked method.
	(2) Lower reservoir dam	(1) Dam site status	The basin represents a topography dipped at a steep gradient, with a river bed sloping at a gentle gradient. The river bed itself is supposed to have deposits of somewhat depth. The terrain adjoining the right bank of the dam site slopes at a gentle gradient, with deposits.
		(2) Dam	There are supposed to have deposits on the river bed and also on the right bank it is reasonable to assume that the dam foundation rock has no progressively weathered.
	(3) Waterway route	(1) Geographical profile	The longitudinal profile of the waterway system has an ideal pattern for a river flow diversion scheme.
		(2) Layout	The waterway system has a short overall length, thus permitting an economically favorable layout.
	(4) Intake and outlet		The headrace has a shallow overburden and the intake takes the form of inclined type. The outlet can be constructed using ordinary horizontal type structures.
	(5) Surge tank		As the waterway system has a short overall length, there will be no need to provide the surge tank to control water pressure either on the headrace or the tailrace.
	(6) Powerhouse		Given the topographical features of the terrain and the nature of the waterway layout, the powerhouse is planned to be positioned roughly midway on the waterway system.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the upper reservoir, a new approximately 3km long road is to be constructed forking off from the existing road leading to Gathna. For access to the lower reservoir, it is proposed that an approximately 10km long road should be newly constructed or repaired from Kadowvadi downstream of the dam site.
	(2) Access tunnel to powerhouse		On the right bank of the lower reservoir, a new access road of approximately 3km length should be constructed along the reservoir. To gain access to the powerhouse, it is proposed that an access tunnel be constructed connecting to the powerhouse at a length of approximately 1km.
	(3) Cable tunnel		The switchyard is layouted on the left bank of the lower reservoir and an approximately 1km long inclined tunnel to gain access to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 55km from Kundi PPS to planning of New Koyna S/S.
6. General evaluation			The site offers favorable economic prospects in view of the large storage capacity of the reservoir and the short overall length of the waterway system. The findings of the site survey have also shown that the upper reservoir qualifies as a pondage by excavated and embanked method. The upper reservoir has a total of 65ha of submerged forest area and the project includes the river flow diversion.


RESERVED FOREST
Dense mixed jungle
Disbursed
Dense mixed jungle
Spring
Vadi
Dhangarvadi
Spring
908
Open mixed
Open scrub
Dhakale
917
Stony waste
RESER
901
Dense mixed jungle
1044
Spring
511
Spring
Spring
185
Kundi
Maha vadi
Spring
Malnachivadi
A
R
V
amnale
726
Dense mixed jungle
Spring
Belari Khurd
B
808
Mahipatgarh Fort
(in ruins)
Stony waste
924
Open scrub
Gothna
Stony waste
368
Open scrub
Stony waste
901
Falls 180 m
623
Nigudvadi
Marleshwar Temple
(in cave)
Annual fair (Jan)
Rocky knob
17. KUNDI

18: General Description of the JALWARA Project Site

1. Environment conditions	(1) Upper reservoir			The submerged area involves 34 ha of reserved forest
	(2) Lower reservoir			The submerged area involves 25 ha of non-reserved forest and 3 ha of agricultural land
2. River basin conditions	(1) Upper reservoir		(1) River basin	The basin is situated in the most upstream part of the Halatar Nadi river. It has an uncertain topography with a vaguely outlined boundary formed by a plateau table at an elevation of 800m.
			(2) Submerged dwellings	As the basin forms a plateau of 800m elevation there is no dwellings in the area.
			(3) River bed condition	The main and streams dips at a gentle gradient and both banks are flanked by a gently inclined terrain. It is believed that rock debris or sand deposits have settled here and on the river beds.
			(4) Circum-reservoir terrain	The reservoir is flanked by gently dipping terrain . There is the conceivable danger of sliding as a result of the variations in the reservoir water level.
	(2) Lower reservoir		(1) River basin	At the most upstream end of the Jalwara Nadi river, a mountain ridge stretches around the watershed peak, with the terrain forming sharp overhanging cliffs and running out at a sharp gradient into steep slopes whose angle of dip becomes somewhat more moderate only in the vicinity of the reservoir.
			(2) Submerged dwellings	There is no dwelling on the reservoir, but there are villages or hamlets spread in the area spanning the elevation levels from 200m to about 300m on the left bank of the dam site.
			(3) River bed condition	The river has two streams forking off somewhere 500m upstream of the dam site. These streams terminate in a multiplicity of mountain streams. At the most upstream end, there is little evidence of erosion. Yet, in the lower reaches, erosion is very much in evidence as the river flow into the reservoir.
			(4) Circum-reservoir terrain	The mountainous terrain around the reservoir presents a fairly gentle gradient, and rock debris has been washed down from the streams and innumerable mountain streams to form no deposits. With the changes in the reservoir water level these deposits are liable to collapse.
	(3) Changes in river basin			The Halatar Nadi river basin goes over into the Jalwara river basin. The project location is situated at the most upstream part where the basin is small. There are no particular factors likely to cause any problems.
3. Location and condition of structures	(1) Upper reservoir dam		(1) Dam site status	Both banks form a dam site dipped at a gentle gradient. There are supposed to have deposits on the banks and the river bed itself. The dam foundation rock is considered to show signs of progressive weathering.
			(2) Dam	It appears difficult to raise the dam height beyond the height envisaged under the present plans. This means that the reservoir will have a limited storage capacity, offering no prospect for increasing output.
	(2) Lower reservoir dam		(1) Dam site status	The dam site is situated at a location in which the steep river gradient suddenly eases. The terrain in the lower reaches is also gentle. The river bed is believed to be covered with rock debris deposits. Both banks have relatively gentle slopes, with evidence to suggest that the deposits of rock waste have formed.
			(2) Dam	The dam is relatively long and the position of the dam poses no great problem. On the left bank, however, there are small mountain ridges. The basin offers an economically unfavorable storage effect. Nor would this effect be improved by raising the dam height.
	(3) Waterway route		(1) Geographical profile	The waterway route has been selected by taking into account the topographical conditions. The headrace tunnel reaches a length of approximately 3km, and as it passes underneath a plateau of some 800m elevation it needs to ensure about 100m overburden.
			(2) Layout	The distance between the intake and outlet is very long at over approximately 5km. The system does have the advantage, however, that the powerhouse, can be provided near the outlet.
	(4) Intake and outlet			Ordinary horizontal structures are used for the intake and outlet.
	(5) Surge tank			The headrace has a considerable length of approximately 3km so that a surge tank will be required on the headrace to control the water pressure. It is concluded that there will be no need to provide a surge tank on the tailrace.
	(6) Powerhouse			The powerhouse is layouted at the deep underground approximately 1.5km from the outlet.
4. Access road and tunnel	(1) Upper and lower reservoirs			The existing road can be used to gain access to the upper reservoir. For access to the lower reservoir, however, it will be necessary to construct a new road of some 10km length from Usap.
	(2) Access tunnel to powerhouse			The plan is to excavate an approximately 1km long access tunnel from the left bank of the lower reservoir to connect to the powerhouse.
	(3) Cable tunnel			The layout is to construct the switchyard on the left bank of the lower reservoir and an inclined tunnel to connect to the underground transformer room.
5. Power transmission lines				To construct the 400kV one circuit, double conductors, 110km from Jalware 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 limited reservoir capacity and the significant length of the waterway due to the natural features of the relief, the project offers poor economic effectiveness. The upper reservoir has a considerable area of submerged forest reaching 70ha and the project area is subject to the river flow diversion.

Dense mixed jungle mainly Bamboo

R E S E R

Gurkhi N

Spring

Jalwara Nāl

601. Kamarla Dongar

Kārla Temb 788

Ford

Māni

Küsgerhvādi

Mangeli

Fanasvādi

Falls 26 m

Talevadi

Dense mixed jungle

852 Sukmi Temb

Varandekarvās

Stony waste

scrub

Sada

Stony waste

Stony waste

Open jungle

Dense mixed jungle

Savalvādi

Ford

Charlo

Spring

Falls 6 m

Vajra Sakkal Falls 143 m

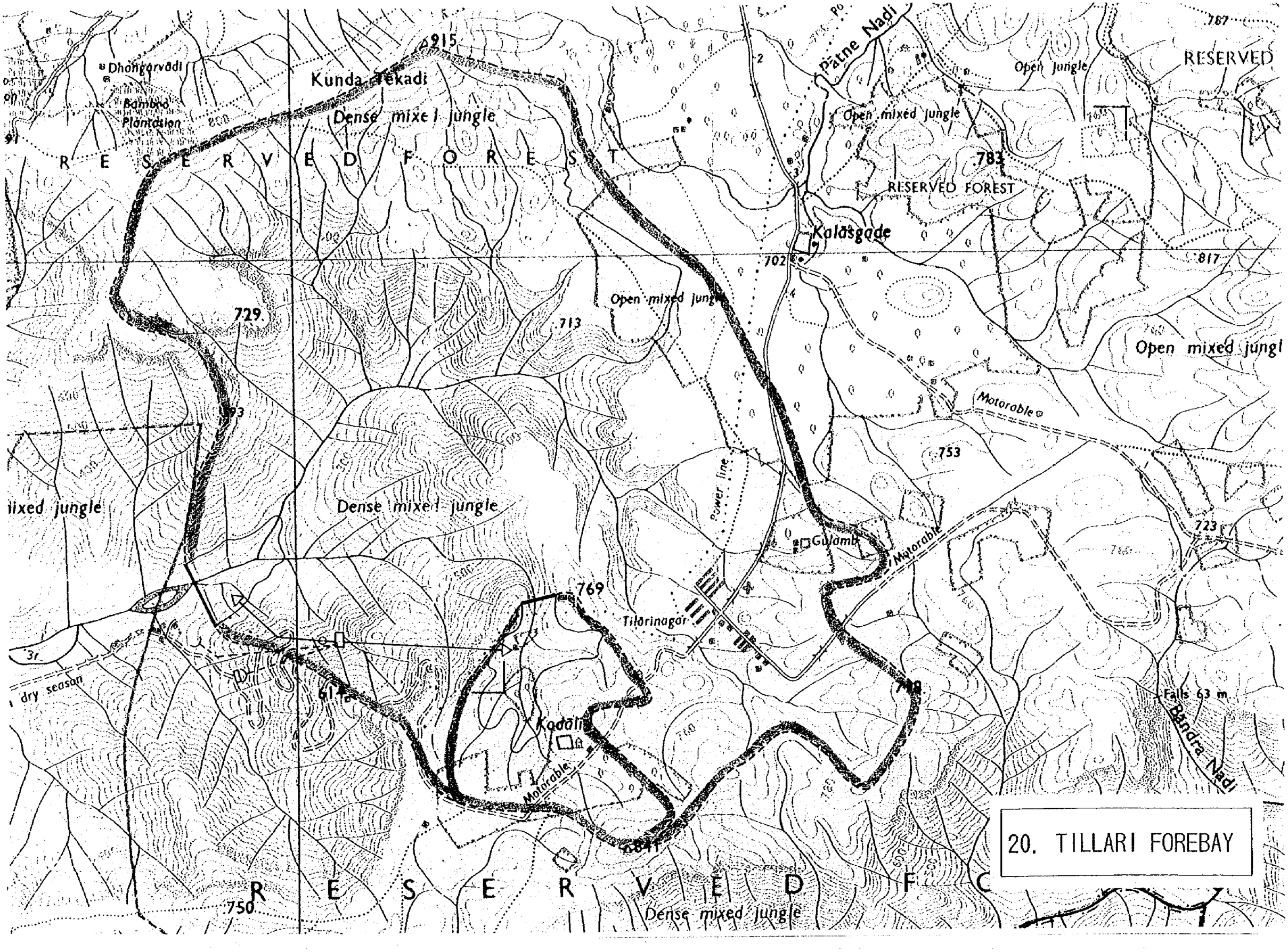
466 △ Mūk Dongar

806 △ Läsni Temb

18. JALWARE

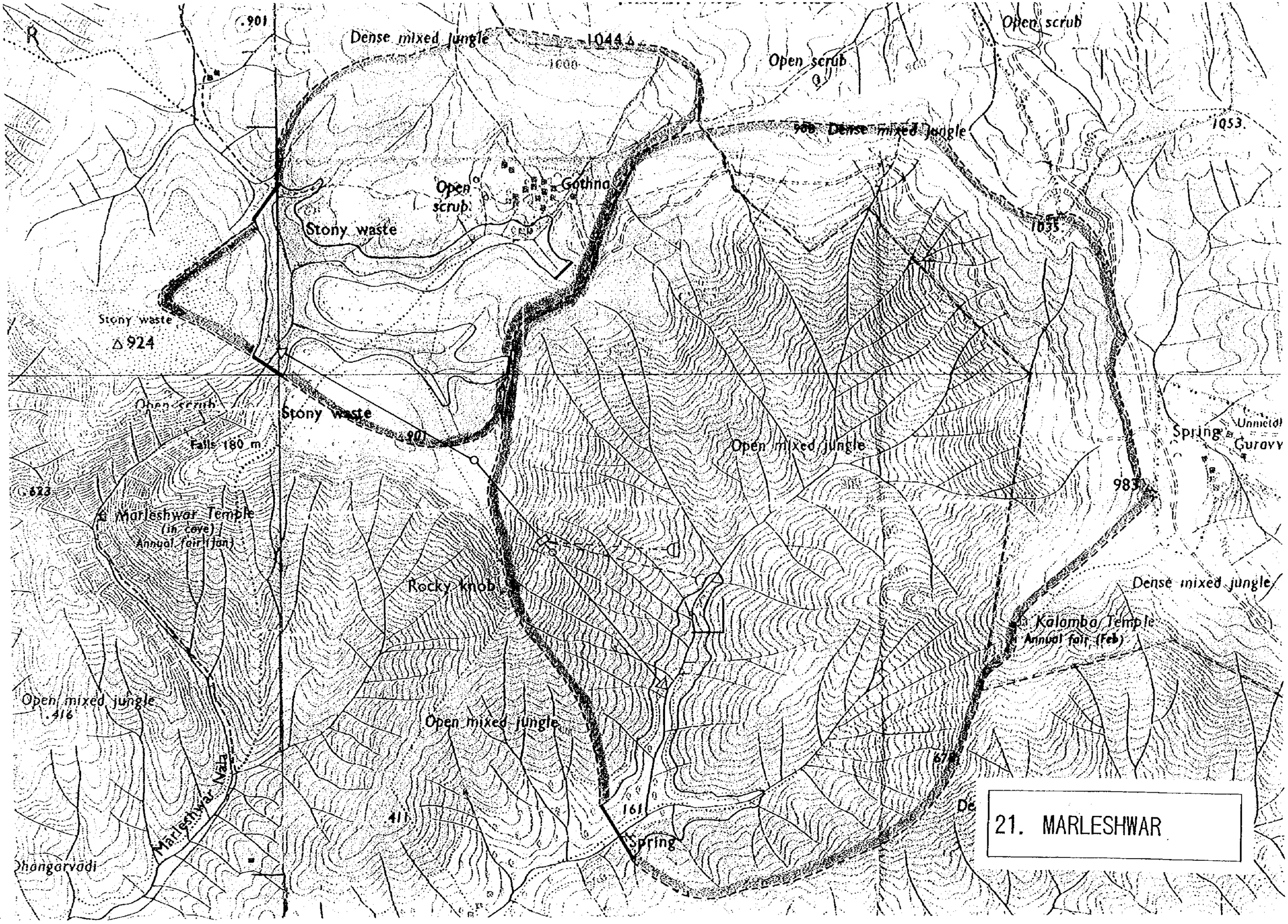
20: General Description of the TILLARI FORBAY Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 32 ha of forest including 24 ha of reserved forest as well as 8 ha of agricultural land
	(2) Lower reservoir		The submerged area involves 50 ha of reserved forest
2. River basin conditions	(1) Upper reservoir	(1) River basin	This basin is situated in the most upstream part of the river Kharal Nadi, a tributary of the Tillari Forebay river. The basin topography consists of a tableland plateau, with no ups and downs. Similarly, the river also exhibits a gentle gradient.
		(2) Submerged dwellings	There are some villages and temples in the upper reaches of the basin. In the reservoir, however, there is no the evidence of any dwelling.
		(3) River bed condition	The basin forms a tableland, with the river also flowing at a gentle gradient. It is likely that weathered rock debris and sand may have deposited.
		(4) Circum-reservoir terrain	The terrain surrounding the reservoir forms a plain. Towards the dam site, however, the river suddenly increases its gradient of flow. Around the reservoir, the terrain is dipped at a gentle gradient so that it appears likely for rock debris and sand to have deposited.
	(2) Lower reservoir	(1) River basin	The river basin is located upstream of the Kharal Nadi and the most upstream part of this river forms a hilly plateau of over 700m elevation. Past this plateau, the relief is one of steep mountains with overhanging cliffs in some parts. From the skirting areas of the reservoir, the terrain marks a drop in elevation toward the river with its gentle gradient of flow.
		(2) Submerged dwellings	There is no submerged dwellins in the reservoir, as the reservoir is planned, at a location which the steep mountain terrain becomes somewhat gentler.
		(3) River bed condition	At a position approximately 0.5km upstream of the dam site, the river branches off into two streams extending to the plateau which forms the watershed peak of the basin. These streams divide into innumerable mountain streams and the signs of erosion are in evidence. Near the dam site there are rock debris layers which are not thought to be of any considerable depth.
		(4) Circum-reservoir terrain	In the terrain around the reservoir on the left bank in the upper reaches, the topography is relatively gentle and there are somewhat deposits of rock debris. Apart from this, the surrounds of the reservoir present a gentle topography. The rock bed is exposed with the thin depsit.
	(3) Changes in river basin		There will be no need to change the flow of the river which takes a meandering course from the upper reservoir. This make the site ideal for the project.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	The dam site is located on the boundary of the plateau and the gorge or valley. Yet, the rock debris and washed down from the plateau is deposited and on the both banks the terrain is marked by a small mountain ridge so that the foundation rock bed at the both sides of the dam site has weathered.
		(2) Dam	There is an existing masonry dam with a main dam of which dams are connected with an open canal, the plan for the upper reservoir is to raise the existing dam height to secure the necessary reservoir capacity for the pumped storage power project. The result of the reconnaissance study carried out at the second survey in India is found out the dam height raising is difficult and costly because it is necessary to reconstruct the open canal with approximately 15km length and other reasons. An original plan is however described in this table.
	(2) Lower reservoir dam	(1) Dam site status	On both banks of the dam site, the relief has a steep gradient and the rock bed is not deep. Near the river bed the gradient eases to a gentle slope, with evidence that there are somewhat deposits at the both banks of the river.
		(2) Dam	On both banks of the dam site, the rellief has a steep gradient, and the dam basement has a relatively width. Great increase of the storage capacity by raising the dam height is not an economically tenable proposition, as the water storage efficiency is poor because of the steep relief on both banks around the reservoir.
	(3) Waterway route	(1) Geographical profile	The layout for the waterway system has been selected by taking into account the natural relief of the basin. The topography is marked by a gentle gradient from the upper to the lower reservoirs. The powerhouse is to be positioned roughly in the middle of the waterway system.
		(2) Layout	The waterway system has a total extended length of only approximately 2.5km so that it is an economically favorable waterway system. Yet, the layout cannot avoid locating the powerhouse somewhere midway on the waterway system.
	(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 short length of the waterway, it is not necessary to provide a surge tank on the headrace. The tailrace, however, needs a surge tank to control the water pressure.
	(6) Powerhouse		The powerhouse needs to be situated somewhere midway in the waterway system.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the upper reservoir, no new road is needed because the existing road is passing through the dam site. For access to the lower reservoir, there is already an existing road passing along the left bank to the site, however some road repair is necessary.
	(2) Access tunnel to powerhouse		The plan is to be constructed 1.5km long access tunnel from the left bank of the dam site on the lower reservoir to grain access to the underground powerhouse.
	(3) Cable tunnel		The switchyard is to be layouted on the dam site of the lower reservoir and an inclined tunnel to link to the underground transformer room.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 95km from Tillari Forebay 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			While both the upper and lower reservoirs have limited water storage capacity, this capacity is large and the waterway system is very short. These two advantages combine to make this an economically very favorable and attractive project. There will be no need for river flow diversion and the submerged forest is relatively small.


Dhongarvadi
Bamboo Plantation
Kunda Tekadi
Dense mixed jungle
RESERVED FOREST
915
729
713
Open mixed jungle
Patne Nadi
Open Jungle
RESERVED
Open mixed jungle
783
RESERVED FOREST
Kalasgade
702
817
Open mixed jungl
Motorable
753
723
Gulamb
Motorable
Power line
Dense mixed jungle
769
Tilorinagar
Kadali
Motorable
Falls 63 m
Bandra Nadi
dry season
750
Dense mixed jungle
20. TILLARI FOREBAY

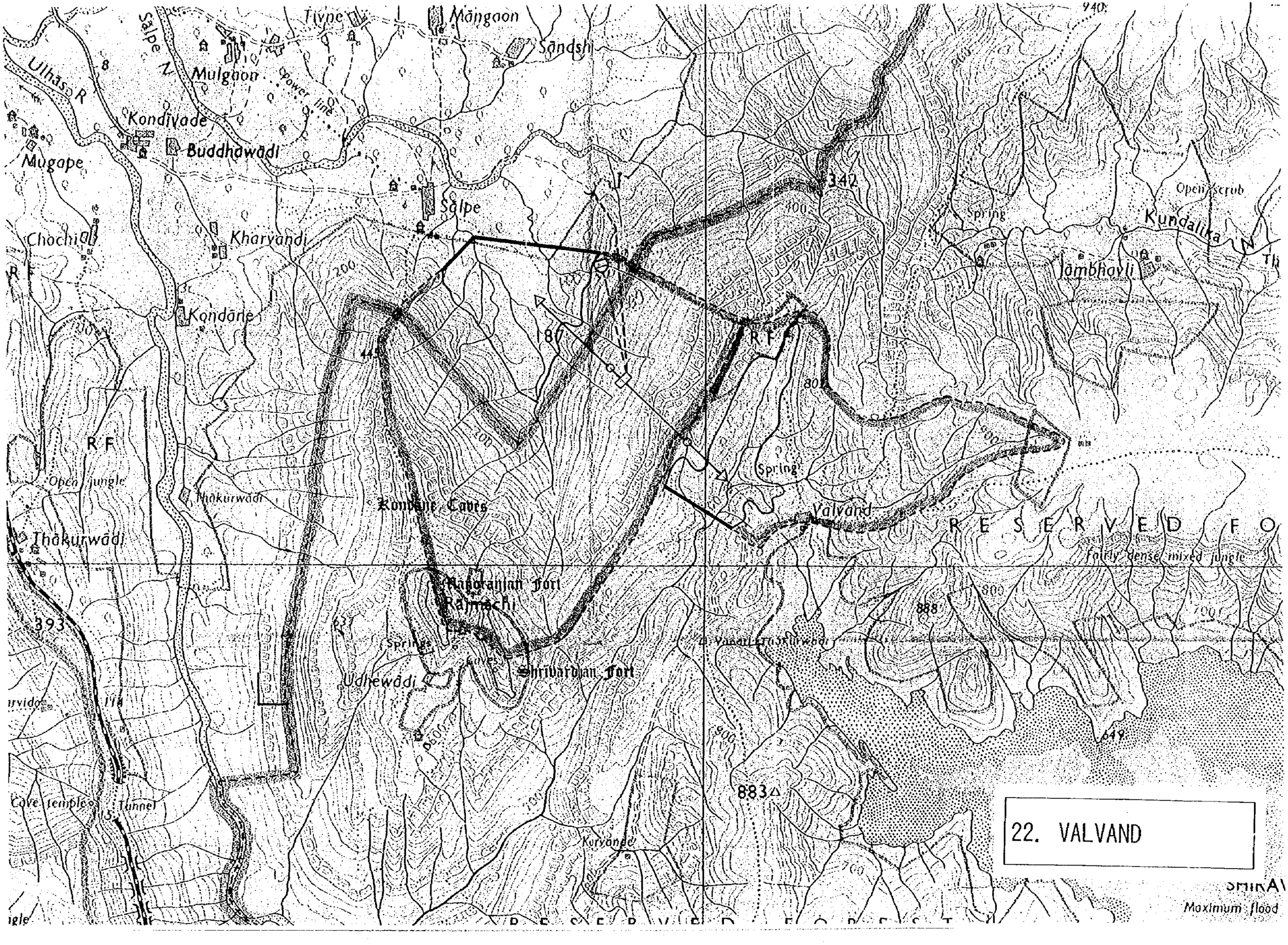
21: General Description of the MARLESHWAR Project Site

1. Environment conditions	(1) Upper reservoir			The submerged area involves 150 ha of non-reserved forest and 7 ha of ag
	(2) Lower reservoir			The submerged area involves 50 ha of non-reserved forest and 25 ha of agricultural land
2. River basin conditions	(1) Upper reservoir		(1) River basin	This basin is located on the most upstream part of the Marleshwar river, a tributary of the Bad Nadi river. Practically the entire basin reports stony waste and constitutes a tableland.
			(2) Submerged dwellings	In the open scrub in the upper reaches, there are some villages. On the evidence of the 1/50,000 scale topographical map which is far from clear it appears that there might be some submerged parts. A detailed site survey will therefore be required after completion of a detailed topographical map.
			(3) River bed condition	The river flows through a plateau of 850 - 900m elevation, dipped a little gentle gradient. The river bed around the dam site is exposed with various sized stones and the upper stream is generally covered with deposits.
			(4) Circum-reservoir terrain	The reservoir is surrounded by stony waste practically everywhere. Near the reservoir there are rock debris deposits, but these are not considered to present a problem.
	(2) Lower reservoir		(1) River basin	The watershed peak in the basin is formed by a plateau of approximately 1,000m elevation and a ridge in the background. In the basin, a mountainous zone sloping at a steep gradient runs down to the vicinity of the reservoir.
			(2) Submerged dwellings	The mountainous cliffs dipping at a steep gradient come close to the reservoir, so that there is no sign of dwellings in sight.
			(3) River bed condition	Immediately upstream of the dam, the river forms two streams and both the main river and the streams branch off into numerous mountain streams. From roughly midstream of the main river and the streams, there are noticeable signs of intense erosion. The river near the reservoir flows at a gentle dip so that somwwhat rock debris is likely to have deposited.
			(4) Circum-reservoir terrain	The terrain around the reservoir presents a steeply inclined topography. It is estimated that the rock formations consist of stable exposed rock, though there are some landsliding evidences.
	(3) Changes in river basin			The upper and lower reservoirs consist of the same river which is a tributary of the Bav Nadi river. The project is therefore situated in the same river basin
3. Location and condition of structures	(1) Upper reservoir dam		(1) Dam site status	The river flows gently through the plateau and the basin as a whole is relatively narrow, with practically the entire basin reporting stony waste. The rocks washed down from the upstream and both river banks are scattered and the both river banks are covered with thin deposits.
			(2) Dam	The dam site is located at a position in which the plateau abruptly dips into a deep gorge. On both banks, the terrain has a little gentle gradient with some rock debris deposits, however, that this is a favorable dam site. On the southern end of the reservoir, however, a saddle dam may be needed and the northern small streams may be also necessary.
	(2) Lower reservoir dam		(1) Dam site status	On the banks of the dam site, the terrain slops at a somewhat gentle gradient . The rock debris deposits are thought not to be deep. The river bed is located at the rapid end of the river so that rock stone deposits are quite minor. Similarly, the dam foundation rock is eroded but fresh.
			(2) Dam	While there are no particular factors likely to become a problem without the wide river bed when the dam is provided, the fact remains that the project is somewhat economically favorable as for the storage efficiency.
	(3) Waterway route		(1) Geographical profile	The route of the waterway system takes a practically straight layout. The plateau area near the upper reservoir is long, and past the plateau the terrain assumes a gentle gradient. The headrace tunnel in the plateau area, in particular, is long and the overburden is thin so that the design for the headrace will need careful consideration.
			(2) Layout	The waterway system is somewhat long at approximately 4km. In particular, the headrace tunnel has a thin overburden so that it is secured the overburden by using a morning glory type structure for the intake. The powerhouse is to be located as near as possible to the outlet by taking into consideration the natural relief of the basin.
	(4) Intake and outlet			To secure the necessary overburden for the headrace, the intake is to be constructed using a morning glory type structure. For the outlet, however, a normal type structure is adopted.
	(5) Surge tank			The headrace tunnel has a length of 1.8km and the tailrace tunnel one of 1.4km. Both tunnels are thus planned to use the installation of surge tanks to control water pressure.
	(6) Powerhouse			The powerhouse is situated deep underground at a position 1.4km from the outlet.
4. Access road and tunnel	(1) Upper and lower reservoirs			The existing road from Gothna already gives, though repair is necessary, access to the upper reservoir and a new approximately 4km long road is constructed from the existing road. To gain access to the lower reservoir, the plan is to build a new approximately 7km long road as an extension from the existing road leading to Marol.
	(2) Access tunnel to powerhouse			The approximately 1.5km long access tunnel from the right bank of the dam on the lower reservoir is planned to provide to the powerhouse.
	(3) Cable tunnel			The switchyard is layouted on the right bank of the lower reservoir and an approximately 1km long cable tunnel to connect the transformer room with the adjoining powerhouse.
5. Power transmission lines				To construct the 400kV one circuit, double conductors, 60km from Merleshwer PPS to planning the New Koyna S/S.
6. General evaluation				It would be somewhat difficult to raise the dam height beyond their present height on both the upper and lower reservoirs. Yet, the reservoirs have a large capacity and the maximum output is also very high. The waterway makes up of the comparatively long waterway system, however this project offers favorable economic prospects. The submerged area in the upper reservoir is as large as 170ha but almost of the area is consisted of stony waste and grass field, and there are an alternative plan for the upper reservoir with the use of the excavated and embanked pondage type and an alternative dam site at the right tributary for the lower reservoir approximately 1 km upstream from the proposed dam site..


Dense mixed jungle
1044
1000
Open scrub
Open scrub
900 Dense mixed jungle
1053
1035
Open scrub
Gothna
Stony waste
Stony waste
Δ 924
Stony waste
901
Open scrub
Falls 180 m
Open mixed jungle
Spring
Unmetal
Guravv
983
Marleshwar Temple
(in cave)
Annual fair (Jan)
Rocky knob
Dense mixed jungle
Kalamba Temple
Annual fair (Feb)
Open mixed jungle
416
Open mixed jungle
Marleshwar Nala
411
161
Spring
hangarvadi
21. MARLESHWAR

22: General Description of the Valvand Project Site

1. Environment conditions	(1) Upper reservoir		The submerged area involves 78 ha of reserved forest
	(2) Lower reservoir		The submerged area involves 79 ha of forest including 67 ha of reserved forest as well as 5 ha of agricultural land
2. River basin conditions	(1) Upper reservoir	(1) River basin	The basins presents a relatively gently inclined topography with the watershed on the west side. It is a small basin with a catchment area of only 1.0 square km.
		(2) Submerged dwellings	On the evidence of the 1:50,000 scale topographical map, there is no submerged dwelling in the site.
		(3) River bed condition	In broad terms, there are two streams branching off in the basin. In view of the gentle gradient of the terrain, it is likely that rock debris and sand deposits have formed.
		(4) Circum-reservoir terrain	The main river consists of one flow. Near the reservoir, the terrain presents a gently sloping relief. The ground surface is likely to be covered with soil. There is reason to fear that the soil layer may slide as a result of variations in the reservoir water level.
	(2) Lower reservoir	(1) River basin	Watershed peaks of a relatively steep gradient are present in both the east and south, and the basin as a whole is steep. Near the reservoir, however, the steeply inclined river suddenly eases its flow to a gentle gradient to form a plain.
		(2) Submerged dwellings	On the evidence of the 1:50,000 scale topographical map, it appears that there is no submerged dwelling in the basin.
		(3) River bed condition	The main river consists of one flow. Except for the river feeding into the reservoir, all rivers are rapidly flowing streams so that their rock bed may be exposed. The reservoir itself, however, forms an alluvial fan-shaped topography with the possibility of rock debris and sand deposits.
		(4) Circum-reservoir terrain	The terrain around the reservoir has a generally steep gradient, and the rock bed around the reservoir is believed to be fresh. In the upper reaches, however, the river has a rapid flow so that the possibility cannot be ruled out that these rock debris may collapse.
	(3) Changes in river basin		The river basins bounded on the watershed peak consist of the diversion of the riverflow.
3. Location and condition of structures	(1) Upper reservoir dam	(1) Dam site status	In view of the gentle gradient of the basin, it is believed that there will be few rock debris deposits, but the rock and soil deposits are believed to be deep.
		(2) Dam	The dam has a short length. The rock and soil deposits are therefore believed to be deep. The dam foundation rock is supposed to be subject to progressive weathering and on both banks, it seems that the finishing of the abutment areas may present problems.
	(2) Lower reservoir dam	(1) Dam site status	The river bed presents an alluvial fan-shaped relief so the rapid rivers in the upper reaches have washed down rock debris and soil which are thought to have accumulated to form the deposit.
		(2) Dam	The reservoir forms a fan-shaped delta. The dam has considerable length and the river bed is believed to be covered with the deposits. On both banks, the terrain is steep, and the abutments are believed to be easy to finish.
	(3) Waterway route	(1) Geographical profile	The basin offers a relatively favorable topography for the planning of a waterway system. Another favorable condition is the short length of the waterway course.
		(2) Layout	The waterway has a total extended length of approximately 2.5km so that there will be no need to provide a surge tank to control water pressure, a feature quite advantageous for a waterway system.
	(4) Intake and outlet		For both the intake and outlet, the ordinary horizontal type structures are planned.
	(5) Surge tank		In view of the short overall length of the waterway, no surge tank will be required to control water pressure.
	(6) Powerhouse		The terrain has a somewhat low elevation from the upper reservoir to the outlet so that the headrace and the penstock line will have to be made short so that the powerhouse is planned to be situated deep underground.
4. Access road and tunnel	(1) Upper and lower reservoirs		For access to the lower reservoir, only a short stretch of road will be needed. For access to the upper reservoir, however, it will be necessary to build a new long road from Samwadi.
	(2) Access tunnel to powerhouse		The access tunnel to the powerhouse has to be driven from the lower reaches of the dam site in view of the natural relief. This has the disadvantage that the tunnel will be somewhat long.
	(3) Cable tunnel		For topographical reasons, the switchyard has to be positioned on the lower reaches of the dam site. The plan also calls for a somewhat long cable tunnel.
5. Power transmission lines			To construct the 400kV one circuit, double conductors, 60km fromValvand PPS to Kalwa S/S along te 220kV one circuit transmission line between Chinchwad S/S and Kalwa S/S through Apta S/S.
6. General evaluation			Though the waterway system is short and the dam on the lower reservoir has a considerable length, the water storage capacity is large and relatively so is the head so that the output is large also. The project is therefore highly recommendable as being economically favorable. One shortcoming, however, is the fact that there are 70ha of reserved forest area in the upper reservoir.


Salpe N
Tivne
Mangaon
Sandshi
Ulhas R
Mulgaon
Power line
Kondivade
Buddhawadi
Mugape
Salpe
Chochi R
Kharvandi
Kondane
RF
Open jungle
Thakurwadi
Kondane Caves
Thakurwadi
Rajmachi
Manoranjan Fort
Springs
Udhewadi
Shrivardhan Fort
Cave temple
Tunnel
Kurvande
Valvand
Spring
Open scrub
Kundalika N
Jambhavli
Fairly dense mixed jungle
RESERVED FO
Vasarlitra Kurwadi
883△
22. VALVAND
Maximum flood