

KERALA WATER AUTHORITY



***Providing additional 100MLD Water to
Thiruvananthapuram city and 20MLD to
adjoining Panchayaths from Neyyar Reservoir***

DETAILED ENGINEERING REPORT

PROJECT DIVISION
OBSERVATORY HILLS
THIRUVANANTHAPURAM

JANUARY 2022

CONTENTS

- 1. INTRODUCTION**
- 2. EXECUTIVE SUMMARY**
- 3. GENERAL ABSTRACT**
- 4. PROJECT AT A GLANCE**
- 5. PROJECT PROPOSAL**
- 6. DESIGN OF VARIOUS COMPONENTS**
- 7. ESTIMATE**
- 8. DRAWINGS**

PROVIDING ADDITIONAL 120 MLD WATER FROM NEYYAR RESERVOIR TO THIRUVANATHAPURAM AND ADJOINING VILLAGES

INTRODUCTION

This proposal is to provide potable water supply to entire population of Thiruvananthapuram Corporation and nearby Panchayaths. The water demand of Thiruvananthapuram city is increasing day by day beyond predication. Especially in the context of during summer seasons, severe water scarcity is being observed on all the elevated zone of TWSS. Currently, the lone source feeding drinking water to the Thiruvananthapuram city is Karamana River, the main pumping source at Aruvaikkara. At present, the total draw from Karamana River is 353.50 mld. In drought season the inflow in Karamana River is quite insufficient to meet the demand and the storage of Pepara dam is quit insufficient. Increasing the storage capacity of Pepara is not permitted by the Environment and Forest department, due to environmental impact/deforestation. Hence it is high time to provide an additional source of supply to the capital city. The only possible solution is tapping from Neyyar Reservoir.

Government of Kerala accorded Administrative Sanction for the construction of 120 mld Water Treatment Plant at Neyyar dam for an amount of Rs. 60 crores in order to provide additional 100 mld to Thiruvananthapuram corporation limits and 20 mld to the adjoining Panchayats viz. Maranallo, Malayinkezhu, Vilavoorkkal and vilappil Panchayats vide GO(Rt) no.214/2017/WRD dated 21.3.2017. Accordingly, Kerala Water Authority had identified an ideal land in survey no.241/5, in Block no 31 of Kallikkadu village which was originally in possession by Irrigation department. However, based on the recommendation of Irrigation department, Govt. have allotted another 3.62 Acres of elevated vacant land at Marakootam in Block no. 32, Resurvey no.1(Clamala reserve forest), later increased to 6 acres considering the request of Kerala Water Authority

As Kerala Water Authority proceeded with the construction work, disputes regarding the status of the land surfaced with the support of local people and the land issue came up

before Courts. As it will take time to decide on legal disputes, the originally proposed land in Survey no. 241/5, Block no.31 of Kallikkadu village came to live consideration again and based on the recommendation of Kerala Water Authority, Government of Kerala has granted permissive sanction to utilize the above land, which was under Irrigation department to Kerala Water Authority for the construction of the proposed 120 mld water treatment plant vide GO(Rt) no.139/2021/WRD dated 18.2.2021.

EXECUTIVE SUMMARY

PROVIDING ADDITIONAL 120 MLD WATER FROM NEYYAR RESERVOIR TO THIRUVANATHAPURAM AND ADJOINING PANCHAYATS

Currently the main source of the Existing water supply to the capital city, Thiruvananthapuram is Aruvikkara dam and various pump houses in its downstream in Karamana River. The inflow of Karamana River during summer is feeble which does not cater to the demand of TWSS and other drinking water supply for schemes which are functioning source as Karamana River. In this situation feeding the capital city from another perennial source is looked into. The nearest feasible perennial source is the neyyar reservoir and a point in the downstream of reservoir.

Water flow can be ensured through gravity from Neyyar dam to Thiruvananthapuram city without pumping. More over the pipes can be laid mostly through Canal bund and Panchayath roads. The pipe line passes through minimum distance in PWD roads and it do not enter major junctions and hence can reduce disturbance of public and vehicular traffic as well. The land area proposed for the project is in the vicinity of Sivananda Asramam to the left bank of Neyyar reservoir which was under Irrigation department under Perumkadavila Block Panchayath, Kallikadu Grama Panchayath, Kattakada Taluk, Thiruvananthapuram District, Parassala Assembly Constituency and Thiruvananthapuram Parliament Constituency.

Government of Kerala has granted permissive sanction to Kerala Water Authority for the construction of 120 mld water treatment plant which will cater to the water requirements of Thiruvananthapuram city and adjoining Panchayaths. The topography of the project area is generally hilly in nature.

**PROVIDING ADDITIONAL 120 MLD WATER FROM NEYYAR RESERVOIR
TO THIRUVANATHAPURAM AND ADJOINING PANCHAYATHS-
Construction of 120 MLD WTP at Neyyar Dam(Lamella Technology)**

GENERAL ABSTRACT

Sl.No	DESCRIPTION	AMOUNT
1	Providing additional 100MLD water from Neyyar dam to Thiruvananthapuram City and 20 Mld to adjoining Panchayaths - Construction of 120MLD WTP at Neyyar Dam (Lamella technology) -(PART-1)	389300000.00
2	Providing additional 100MLD water from Neyyar dam to Thiruvananthapuram City and 20 Mld to adjoining Panchayaths - Construction of 120MLD WTP at Neyyar Dam (Lamella technology) -PART-2- Recycling Plant,lab equipment and office furniture etc	8900000.00
3	Providing additional 100MLD water from Neyyar dam to Thiruvananthapuram City and 20 Mld to adjoining Panchayaths - Construction of 120MLD WTP at Neyyar Dam (Lamella technology) -PART-3. ,Construction and maintenance of Floating intakestructure,Supplying and Laying raw water Pumping main,supplying and installationof Raw water Pump sets .	185600000.00
4	Providing additional 100MLD water from Neyyar dam to Thiruvananthapuram City and 20 Mld to adjoining Panchayaths - Construction of 120MLD WTP at Neyyar Dam (Lamella technology) -PART-4.- Mechanical items,Electrical items,SCADA,and all other connected items.	274700000.00
5	Providing additional 100MLD water from Neyyar dam to Thiruvananthapuram City and 20 Mld to adjoining Panchayaths - Construction of inspection bungalow at Neyyar dam 120MLD WTP Site.	10410000.00
6	Contingencies and unforeseen items	31090000.00
7	GRAND TOTAL	900000000.00

(Rs. 9000.00 Lakhs)

PROJECT AT A GLANCE

Neyyar dam is located in Thiruvananthapuram district, Kattakada taluk and comes in Kallikadu Grama Panchayath .It is Located along the East side of Thiruvananthapuram district and sharing boundary of Kerala and Tamilnadu. These are located $18^{\circ} 23' 3''$, longitude and $102^{\circ} 46''$ E, Latitude and, 30 km away from Thiruvananthapuram central. The Panchayath is of semi urban nature. The topographic nature of these Panchayaths are hilly terrain with was exposed to hard rock surface. The land was belonged to Irrigation department under Perumkadavila Block Panchayath, Kallikadu Grama Panchayath, Kattakada Taluk, Thiruvananthapuram District, Parassala Assembly Constituency and Thiruvananthapuram Parliament Constituency.

Thiruvananthapuram Corporation and nearby adjoining Panchayaths viz., Maranalloor, Malayinkeezhu, Vilappil and Vilavoorkkal. The water demand of Thiruvananthapuram city is increasing day by day beyond prediction. Especially severe water scarcity being observed on all the elevated zone of TWSS. The only reliable feeding source at present to Thiruvananthapuram city is Karamana River-Aruvikkara. The total draw from Karamana River is 353.50MLD.

In drought season the inflow in Karamana River is quite insufficient to meet the surging demand and the storage of Peppara dam is quite insufficient. Increasing the storage capacity of Peppara is not permitted by the Environment and Forest department, due to Environmental impact/deforestation. Hence it is high time to time provide an additional source of supply to the capital city. The only possible solution is to harness the perennial source of potential Neyyar Reservoier.

The source of the existing water supply to the capital city, Thiruvananthapuram is Karamana River and Aruvikkara reservoir. The inflow of Karamana river during summer is feeble which does not meet to the demand of TWSS and other drinking water supply for schemes which are functioning source as Karamana river. In this situation alternative

feeding source to the capital city is explored and Neyyar reservoir is identified as the lone source which can cater to the ever increasing water demands of the capital city population. In addition, tapping from Neyyar reservoir is both economical and profitable also for long run, as water flow can be assured through gravity from Neyyar dam to Thiruvananthapuram city without pumping. The pipe can be laid through Canal bund, Panchayath roads also. Minimum distance of PWD road cutting was warranted. Also it will not enter town areas and thus can avoid disturbance of public and traffic.

Project Proposal

Water Treatment Plant

The land suggested for the construction of Water Treatment Plant is in the vicinity Sivananda Asramam adjacent to the Neyyar dam Reservoir. The land can be utilized for the construction of 120MLD Water Treatment Plant. Government of Kerala has granted permissive sanction to utilize the above land in survey no.241/5, Block no.31 in Kallikkadu village which was under Irrigation department to Kerala Water Authority for the construction of the proposed 120 mld water treatment plant vide GO(Rt) no.139/2021/WRD dated 18.2.2021. Lamella clarifier with plate settler technology is employed for the WTP. Irrigation chairman already agreed to spare sufficient land which is available on the back of Neyyar reservoir. The construction of 120MLD WTP is as per the following requirements. Based on the meeting convened in the chamber of Additional Chief Secretary on 5.3.2021, provision for round the clock working and all season work execution was incorporated in the estimate.

Thiruananthapuram City – 100 MLD

Maranloor Panchayath – 5 MLD

Malayinkeezhu Panchayath - 5 MLD

Vilappil Panchayath – 5 MLD

Vilavoorkal Panchayath - 5 MLD

The transmission main is to be laid along the boundary of Kallikaudu, Kattakada, Malyinkeezh, Vilappil Panchayaths. These Panchayaths are also facing acute water scarcity. Since the reduced level of the proposed plant site at Neyyar Dam and Water Authority campus at PTP Nagar reservoirs / Vellayambalam is 34.00m, through gravity flow from for Neyyar dam to PTP / Vellayambalam is economical.

The transmission main are to be laid with 1422mm MS pipe for a length of 24.00 Km. The clear water transmission main is to be laid through Irrigation canal Bund, Panchayath Road and PWD road viz-Aruvikkuizhi to Veeranakave School Jn, Killi Jn to

Moongodu and Peyad to Kundamankadava-8000.M. After reaching Authority campus, GLSR at Water works campus OHSR at Observatory Hill.

Supply and erection of Raw water pumpsets

Supply and erection of Suitable pump sets (100% stand by) designed suitable for pumping 120 MLD raw water from the intake to the proposed Water Treatment Plant. Variable head type Submerged Centrifugal pump sets with adequate standby provisions are proposed.

Floating Pumphouse

A floating pump house is proposed as intake structure in order to ensure all season water availability. The successful bidder has to furnish the most congenial and cost effective design for the same taking into consideration of all the safety aspects and guidelines of Govt. departments/ Agencies. The floating pump house consists of an intake structure with a platform sufficient enough space to accommodate the pump sets and necessary walkway and header for pump set connections. 1400mm HDPE pipes for a length of 150m are proposed for connecting to the raw water pumping main. Additional provisions are to be included in the Pump house to accommodate the lifting equipments and other electrical equipments etc. as per requirement the Electrical Inspectorate.

Construction of Substation

A Substation of 11KVA Capacity with 2500KVA transformer and 11KVA, 400KVA indoor transformers are proposed at the Treatment plant site, for meeting power requirement of plant and raw water pump sets, yards lighting etc. The substation has to be constructed to accommodate all the necessary electrical equipments necessary for Raw water Pump House at WTP site. Since land is available at intake site is within the boundary of WTP site a substation can be constructed for utilizing for raw

water Pumps sets and WTP. A 2500 KVA, transformer is proposed for uninterrupted power supply providing excluding power line.

Raw water Pumping main

Size of the raw water pumping main proposed is 1422mm MS Spirally welded with internal and outer side lining for a length of 400m including distance from the 150m distance 1400mm HDPE pipe.

Service reservoirs

The Ground Level or Over Head Service reservoir is not required. The water flows through gravity to Thiruvananthapuram city and water is collected in the Existing GLSR and JBIC Tanks at PTP and tapped into distribution network.

PROVIDING ADDITIONAL 120 MLD WATER FROM NEYYAR RESERVOIR TO THIRUVANATHAPURAM AND ADDJOINING VILLAGES

Necessity of Project

The water demand of Thiruvananthapuram city is increasing day by day beyond prediction. Especially severe water scarcity is being observed on almost all the elevated zone of TWSS. At present, the lone source feeding Thiruvananthapuram city is Karamana River- Auvikkara. The schemes which are fed from Karamana River is

1. TWSS to Thiruvananthapuram	- 335.00mld
2. TWSS to Thirumala	- 29.00mld
3. TWSS to Mudavanmugal	- 5.00mld
4. UWSS to Nedumangadu	-13.50mld
5. RWSS to Kuttical	- 2.00mld
6. RWSS to Aryanadu	- 2.00mld
7. RWSS to Uzhamalakkal	- 25.00mld
8. RWSS to Vellanadu	- 3.00mld
9. RWSS to Karakulam	- 5.00mld
10. RWSS to Villappil	- 33.00mld
11. RWSS to Vilavoorkal	- 2.00mld
12. RWSS to Pallical, Balaramapuram and Vilavoorkal	- 15.50mld
13. RWSS to Thrikkannapuram	- 5.00mld
Total	- 475mld

At present, the total draw from Karamana River is 475 mld. In drought season the inflow in Karamana River is quite insufficient to meet the demand and the storage of Peppara dam is quit insufficient. Increasing the storage capacity of is not permitted by the Environment and Forest department, due to adverse impact on environment owing to deforestation. Hence it is high time to provide an additional source of supply to the capital city. The only possible and viable solution is tapping from Neyyar dam reservoir. It is proposed to tap water from the Reservoir and Construct Water Treatment Plant at the top portion of reservoir and distribute through Gravity. The perennial source of water at the

Neyyar dam reservoir can be utilized for the construction of the 120mld Water Treatment Plant (100mld for TWSS, and 5 mld each for Malayinkeezhu and Maranalloor Panchayaths , 10mld for for Vilappil and Vilavoorkal Panchayaths, since the transmission main is to be laid along these Panchayaths.

DESIGN OF RAW WATER PUMPING MAIN

Length of pumping main	-	400.00m	
Ultimate water demand	-	120mld	
Pumping hours	-	24 hours	
Rate of pumping	-	120 mld	-1.38 m ³ /sec
Assume velocity of flow	-	1m/sec	
Diameter of pipe	-	$\frac{\sqrt{1.38 \times 4}}{3.14}$	
	-	1.325m	

Provide 1422 mm MS Spirally Welded pipe for length of 400m

Design of Raw water pump set

Aerator level	-	+115.00
Foot valve level	-	+62.00
Static head	-	+63.00
Length of Pumping main	-	400.00
Size	-	1422mm dia MS pipe with lining
Discharge	-	1.38m ³ /s
Head loss due to friction	-	0.45m for 1000m i.e - 0.18m
Minor loss	-	10% of 0.18m i.e – 0.018m
Total loss	-	0.198m
Total head	-	63.198m Say 64m
Power, $P = \frac{WQH}{75 \times \mu}$	-	$\frac{1000 \times 1.38 \times 64}{75 \times 0.70}$
	-	1682 HP

Say 1800 HP

Provide 6nos. of 300 HP submerged centrifugal pump sets with 3nos. standby so that with the combined operation of 6 pump sets shall discharge 120mld in 24 hrs time of pumping.

Hydraulic calculations

Output Capacity	120 mld				
Losses	4 %				
Input Q	124.8 mld	1E+05 m3/day	5200 m3/hr	86.667 m3/min	1444 lps

All unit dimensions are in metres unless specified

Multiple Tray Aerator

Inner dia of aerator pipe reqd(d)	Q/0.785*0.8	1.517 m	
	Provide	1.8 m	
Outer dia of pipe(D)	d+2*0.2	2.2	
Provide multiple tray aerator with 4 trays and one collection tray			
		Diameter	Area
Dia of top tray (D1)		2.6	5.31
Offset of other trays	w= 0.7		
Dia of next tray (D2)	D1+2w	4	8.76 Reqd Area
Dia of next tray (D3)		5.4	22.89
Dia of next tray (D4)		6.8	32.50 0.03m2/m3/hr
Dia of next tray (D5)		8.2	48.98
Dia of next tray (D6)		9.6	68.55
Dia of collection tray	D5+1.2*2	12	Total Area 186.99 156 of trays provided

Flash Mixer

No. of units	n	5	
Detention time	DT	30	Sec
Volume required	Vol	8.70	m3
Size of flash mixer provided	Sq d	1.7	m
Depth required	Vol/(d2)	3.01	m

FLOCCULATOR-sq

Flocculator

Detention time	DT	30	min
No. of units	n	5	
Volume required	Vol	520	m3
Side water depth of Clarifier	SWD	3	m
Outer dia of central shaft		0	m
Size of flocculator	sqrt[d	13.17	m
	Size provided	13.20	m

Parallel plate Clarifier (Lamella type)					
Detention time	DT		0.5	hours	
Surface overflow rate	SOR		144	m ³ /m ² /d	Rate 5-7.5 taken av. 6 m ³ /m ² /hr
No. of units	n		5		
Plan Area reqd	A	Q/SOR/n	173.3	m ²	Size
Side water depth			3	m	
Volume required	Vol	Q*DT/n	520	m ³	
Square tank Size required		Plan Area	173.3		
	D	Size provided	13.17	m	
			13.2	m X	13.1 m
Filter					
Rate of filtration	R		80	lpm/m ²	
No. of compartments	NB		32		twin bed
Area required for each bed		Q/(NB*R)	33.85	m ²	24 hrs
Breadth of filter bed	b		5.20	m	
Length	1.25b	provide	5.20	m	
		provide	6.51	m	
Area provided	AF		6.60	m	
			34.32	m ²	Total 1098.2
Wash Water Tank					
Washing time	WT		7	min	
No. of beds to be washed at a time (n)			6		
Wash water application rate			600	lpm/m ²	
Wash water tank capacity reqd. AF*rate*WT*n			864.9	m ³	
Washing losses			2	%	
Capacity of Wash water tank			882.2	m ³	
Alum Tanks					
Alum requirement			50	ppm	
Solution strength			5	%	
No of alum tanks provided			3		3 +1
Capacity of alum tank required			13.87	m ³	
Size of tank (if cubical)			2.40	m Provide	2.80 x 2.8 x 1.8 LD

Lime tanks			
Lime requirement	30	ppm	
Solution strength	5	%	
No of lime tanks provided	3		3+1
Capacity of lime tank required	8.32	m ³	
Size of tank (if cubical)	2.02	m	Provide 2.20 x 2.2 x 1.8 LD OR 2.2X2X1.8M LD

Chemical store area			
Area required for storing alum	$\frac{90 \text{ days} * \text{MLD} * 40}{1.8 \text{ ht} * 1200}$	208	m ²
Area required for storing lime	$\frac{90 \text{ days} * \text{MLD} * 20}{1.8 \text{ ht} * 900}$	138.7	m ²
Total area required		346.7	m ²
Providing 20 % extra area for moving space		381	m ²
Provide	400m ²		
Clear Water Sump			
Capacity required		6922	m ³
Water depth provided		3.40	m
Inside width of tank		20.5	m
Inside length. provided considering allowance for haunch etc.		100	m
	Provide 2 tanks		

Design of plates of Lamella Clarifier			
Detention time	DT	0.5	hours
Surface loading rate	SLR	28.8	m ³ /m ² /d
Plate angle		55	deg
No. of units	n	5	
Plate spacing		0.1	m
Proj. Plan Area reqd	A	866.7	m ²
Proj length of plate provided		885.2	m
No of rows of plate		6	
Total Width of plate reqd/row		1.17	m
Width of plate reqd per row			
	Q/SLR/n		
			Length for fixing 10.2
			Plate Length 2.1 m
			Proj length 1.21 m
			No of plates/Unit 612
			Width of Plate 1.2
			OK
			Total plat 3060
			102
			Plate width available=1.2m

Hydraulic Level calculations

Output Capacity	120 mld			
Losses	4 %			
Input Q	124.8 mld	1E+05 m3/day	5200 m3/hr	86.67 m3/min 1444.44 lps
<i>All levels are in metres</i>				
Max. water level for CW Sump	107.5		Floor Lvl	104.10
Dia of Clear water pipe/Channel	1200 mm			
Area of CW pipe a	1.1304 m2			
Velocity Q/a	1.2778 m/sec			
Length of pipe	40 m			
Friction loss in pipe	0.18	But add	1.60	
TWL in filtered water/CW channel	109.10			
TWL in stilling chamber	109.30			
Provide a loss of head of 2.2m in Filter				
TWL in filter but add 2.2m	111.50			
Fix TWL in filter as	111.5			
Top of floor of filter bed	109.3	Floor slab of WW tank	116.3	
Entry loss at filter inlet	0.1			
TWL at filter inlet	111.6			
Width of Clarified Water channel	1.5 m			
Water depth in CW channel	0.9 m			
Velocity Q/bh	1.070 m/sec			
Head loss $V^2/2g$	0.06			
TWL in Clarified water channel	111.66			
Fix this level at	111.7			
Head loss in launder	0.2 m			
		but add	1	
But TWL in launder i Fix at	112.9			
TWL in Plate Settler(add 0.15)	113.15	Level of side wall bottom		110.15

<i>Head loss from Flash mixer to flocculator :</i>		
Dia of Flash mixer to CFL pipe	800	mm
Area of CW pipe a	0.5024	m ²
Velocity Q/na	0.575	m/sec
Length of pipe	15	m
Friction loss in pipe FI	0.02	
Minor loss $(1.5 + 0.38)v^2/2g$	0.0317	
Total head loss=FI + Minor loss	0.06	
Provide	0.1	
TWL in flash mixer	113.25	
<i>Raw water Channel :</i>		
Width of raw water channel (w)	2	m
Water depth in raw water channel	1	m
Velocity Q/bh	0.7222	m/sec
Head loss $V^2/2g$	0.027	
Providing a drop of 0.2 m in flash mixer,		
TWL in RW channel	113.48	
Fix this at	113.50	
Head over notch $(Q/1.376h)^{2/3}$	0.65	
TWL u/s of notch	114.15	
Fix this at	114.2	
<i>Aerator :</i>		
TWL in collection tray	114.2	
Height of fall	0.3	m between trays
TWL in 6th tray	114.5	
TWL in 5th tray	114.8	
TWL in 4th tray	114.5	
TWL in 3rd tray	114.8	
TWL in 2nd tray	115.1	
TWL in 1st tray	115.4	
		diff 7.90

Construction of 120 mld Water Treatment Plant at Neyyar Dam

