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# A New Project for Augmenting Drinking Water Supply to Chennai City by forming new Reservoir near Kannankottai and Thervaikandigai, Thiruvallur District, Tamilnadu – An Alternative Efficient & Cost Effective Proposal

**ER. A. Veerappan and M. Lakshmipathy**

SRM Institute of Science & Technology, Chennai - 603203, Tamil Nadu ; India; er_a_veerappan@hotmail.com, lakshmipathy_ml@rediffmail.com

## Abstract

**Objectives:** Since the present storage capacity of drinking water by four reservoirs (Poondi, Chembarambakkam, Red Hills & Cholavaram) is only about 11 TMC, there is an urgent necessity to create additional storage facilities. A new project by taking an open canal from Krishna Water Canal, storing the same in the proposed two tank - reservoir and again pumping into Krishna Water canal, leading to the existing Poondi Reservoir is now implemented by TN Public Works Department. **Methods/Statistical Analysis:** By inadequacy in studying all other alternate measures available, Government of Tamilnadu officials embarked upon in creating a new reservoir of 0.5+0.5TMC (2 fillings) storage capacity-by converting 2 existing tanks, namely Kannankottai and Thervai Kandigai near Uthukkottai in Thiruvallur district at an estimated cost of Rs.330 Crores, including Rs.160 Crores towards land acquisition. Again, by a bad planning, this new reservoir water is initially taken from Krishna Water canal at +2200m and again pumped into the same canal at LS +3850m –which flows another 21.425KM to reach the Poondi Reservoir. It causes considerable quantity loss of precious drinking water by evaporation, seepage and illegal pumping en-route besides causing pollution of drinking water. **Findings:** This research paper analyses the deficiencies in the above Government sponsored project proposals and suggests 3 alternative efficient and cost effective proposals without involving land acquisition, no loss of water as well as no pollution for implementation in the best interest of the stakeholders, taking all the field realities into account. The proposal of Water Resources Organization, TNPWD does not actually create additional storage except an intermediate transit point. Further it does not increase the storage capacity after spending Rs.330+Rs.100Crores. Instead, the deepening the Poondi Reservoir by 1.00m depth creates an additional storage of about 1.152TMC at cost of Rs.198.85Crores only. Alternatively it is further suggested that if an off take canal from KW canal at LS + 2200m is taken – by closed RC concrete pipes directly to nearby Red Hills Reservoir it cost about Rs.280.23 Crores without land acquisition, thereby reducing the cost of transporting water from Poondi Reservoir to Red Hills tank (P2). **Improvements:** By these alternative proposals, time and cost over run towards implementation of the project is reduced very much besides elimination of evaporation loss and pollution of drinking water en-route.

**Keywords:** Bulk waterdrawal by RC Concrete Pipes, Drinking Water Supply, Open Canal.

## 1. Introduction

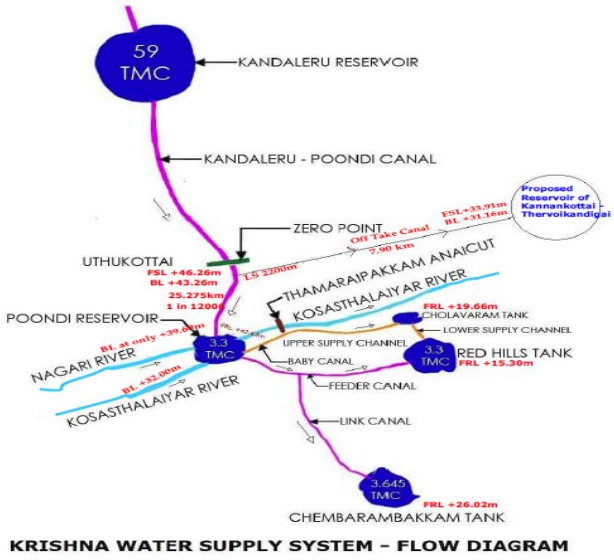
Augmenting drinking water supply to Greater Chennai City by forming a new reservoir near Kannankottai and Thervaikandigai villages of Thiruvalluvar district, Tamilnadu and supplying (0.5 TMC + 0.5 TMC) of water by diverting

**Author for correspondence*

from the existing Krishna Water Canal near Uthukottai through an Offtake Canal has been evolved and executed by Water Resources Organization, TNPWD in 2014 -16.[1]

It is due to the misconception of officers of Water Resources Organization, TNPWD, Chennai Metro Water and Chennai Corporation on the projection of demand of drinking water supply for Greater Chennai City during 2020 would be around 16TMC whereas the available storage capacity of Poondi, Chembarambakkam, Cholavaram and Redhills is only 11TMC, and hence there is an urgent necessity for creating additional storage facility. The officers neither applied their mind nor studied the above proposal in totality, by considering other possibilities that can be easily implemented with ease, at less cost and time. Here again the above proposal wholly depends on Krishna Water Supply from neighboring Andhra Pradesh as shown Figure 1.

**Figure 1.** Krishna Water Supply System – Flow Diagram.




It is learnt that this proposal has been mooted out since the existing damaged Krishna Water canal (from Zero point to Poondi Reservoir) is not capable of drawing 1000 cusecs as designed and now it is capable of drawing a maximum 600 cusecs only. It is recorded here that the Poondi Reservoir has already been strengthened to receive 12 TMC water from Krishna Water Canal per year. However only 5 to 6 TMC of water alone is drawn per year in the past due to the deficiency of our Krishna Water Canal from Zero point to Poondi Reservoir (which is unlined as well as unstabilised one). Further a considerable quantity of water is lost due to by illegal pumping of this canal water enroute in the Andhra Pradesh area by Andhra Farmers.[2]

It is again understood that the Chennai Metro Water planned to "Pump this new reservoir water through ductile Iron Pipes of 900mm dia, run along the road sides for a length of 17.50Km, and finally letting into Poondi canal at LS +3850m[2]. The entire project proposal lacks proper planning and hence alternative efficient cost proposals are furnished by the author below.

## 2. Salient Features of the Government

### 2.1 Project – Proposal

The proposals consist of the following components:[1]

- Formation of earthern dam for 6800m length by connecting 2 tanks namely Kannankottai Hissa Rajaneri and Thervai kandigai in Thiruvallur District to have a new reservoir.
- Excavation of an open off take canal for a length of 8300m from LS + 2200m of existing Krishna Water Canal zero point near Uthukkottai to the proposed new Reservoir
- Excavation of a Diversion canal for 3300m length to collect run off from the catchment area falling in Andhra Pradesh and taking it to the proposed new reservoir.[3]
- Construction of a Surplus weir at L.S. 4125m at the proposed new reservoir
- Total storage capacity of the proposed reservoir is 0.5TMC with 2 fillings totaling to 1.00TMC per annum
- Discharge capacity of the Off- take canal is 1035 cusecs–by gravity flow
- It involves land acquisition to the tune of

i) Proposed new Reservoir-1154.28 acres-Rs. 139.37 crores
ii) Off take canal-98.20 acres-Rs. 20.63 crores

| | |
|---|---|
| Total: 1252.48 acres | Rs. 160.00 crores |

- The proposed new Reservoir is reported to act as an additional storage for Chennai city water supply for meeting out the growing demand in the year 2020.
- The above estimated cost of Land Acquisition may get increased to 4 x Rs. 160 = Rs. 640 crores due to enhancement of compensation to be paid as per recent new directions Supreme Court & Government of India.

The proposed present cost: Rs. 330 crores including the cost of Land Acquisition of Rs. 160 crores and Civil works Rs. 170 crores. Off-take canal alone costs Rs. 107.78 Crores including LA of Rs. 20.63 crores

## 2.2 Deficiencies observed in the Government Project Proposals (P1-1 & P1-2)

i) It involves land acquisition of lands including wet lands, dry lands, Forest Lands & Government Porambokku lands, a time consuming process besides increasing the Project cost manifold

ii) There is stiff opposition from local farmers, NGOs & Political parties for the proposed land acquisition.

iii) This being a Drinking Water Supply Project, open canal carrying water is prone to loss of considerable quantity of water by means of evaporation seepage, illegal theft by pumping en-route for a distance of 8.30 KM + 25.275 KM ~ 34 KM besides pollution of drinking water.[4]

iv) The water is to be stored in the proposed new reservoir. Then, the necessity to draw a huge quantity of 1035 cusecs thru the off take canal within 6 days for the quantity of 0.5 TMC is not required. There is no warrancy for such a drawal of huge quantity when compared to the drawal of 100 to 150 cusecs from Veeranam Tank to Chennai City Water Supply. Further it is pointed out that water supply from Krishna Water canal is available for a staggered long period of 60 to 90days in a year. Also, the Chennai Metro water is pumping this water into Poondi Canal through 900mm dia D.I Pipes with a discharge capacity of 70 Cusecs only.

v) Therefore this huge drawal of 1035 cusecs, not only increases the cost of Off take canal but also requires a greater area of land acquition.

vi) Further it is to be mentioned that drinking water supply to Chennai City is drawn from Puzhal (Red Hills Tank & Chembarambakkam which is very nearer. Instead, the off take canal is taking off from the Poondi Canal at LS + 2200mm, traversing a length of 8.30KM and after pumping into the same canal at LS +3850m, again 21.425KM to Poondi Reservoir and further it travels a distance of 25 KM to Puzhal, thereby unnecessarily increasing the loss of water by evaporation, seepage and theft in between besides causing greater pollution. These aspects are not properly considered by the Government officers while planning and designing the size of the off take canal to the proposed new reservoir.

## 2.3 Cost Data of this Government's Project Proposal Open Earthen Canal:

To carry 1035 cusecs from LS +2200m Poondi Canal intersection to the proposed new reservoir at Kannankottai-by Gravity flow

Distance of open off take canal=8300m= 8.30 KM

- Earthwork excavation, sectioning etc 66.33 $m^3$ x Rs.15000/$m^3$=Rs. 99,495
- Packing side slopes with gravel 150mm thick

3.72 $m^3$x Rs. 800/$m^3$ = Rs. 2,976

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= Rs. 102,471 / RM

- Removal of heavy Jungle for distance of

21.40 Km x Rs. 6.50/$m^2$ =Rs. 139 / RM

- Unforeseen miscellaneous expenditure=Rs. 2,390 / RM

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= Rs. 105,000 / RM

For 1 KM length = Rs. 105000 x 1000 m

Sub Total = Rs. 1050 Lakhs / KM

For a length of 8.30KM = Rs. 8715 Lakhs

Land Acquisition cost for Off take Canal = Rs. 2063 Lakhs Total: =Rs. 10778 Lakhs = Rs. 107.78 Crores Then final cost of off take Canal =Rs. 107.78 Crores

## 2.4 Total Project Cost Data of the Government

Original Proposal by Water Resources Organization, TNPWD

Open Channel– Civil Works-Rs. 170 crores
Land Acquisition Works-Rs. 160 Crores
Total Cost - Rs. 330 Crores
Plus + the cost of pumping water from the newly formed reservoir and letting into Poondi canal at LS +3850m which was executed by the Chennai Metro Water = Rs. 93.77 Crores (vide GO Ms. No. 116 MA & WS (MW) Deptdt. 25-09-2014.[2]

## 3. Alternative Efficient, Cost Effective Proposals suggested by Author

### 3.1 Three Alternate proposal for Government Project

The author, who is the Former Special Chief Engineer, TNPWD having good experience and rich expertise in evolving and executing such Irrigation and Water Supply Projects and also presently Ph.D. Research Scholar, suggests three alternative, proposals which are most efficient and cost effective for the above Government project as show Figure 2.

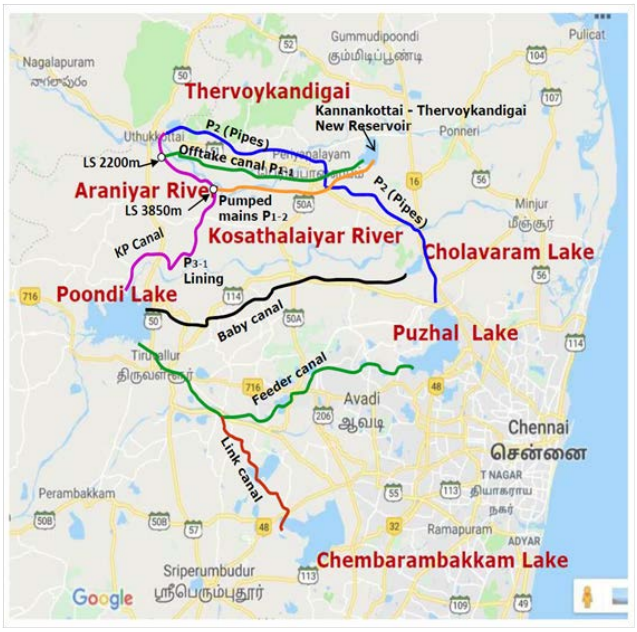


**Figure 2.** Layout Map of the Study Area for the Proposed Project.

a. Drawing water from Krishna Water canal at LS + 2200m to Kannankottai-Thervai Kandigai (new reservoir formed) through a closed RC Concrete Pipe of 2000mm dia with a discharge capacity of 200 cusecs and again taking the water direct to Red Hills Reservoir by closed RC Concrete Pipes Proposal to be laid along the National Highways (NH),State Highways (SH) & Major District (MD) Roads by gravity flow without involving land acquisition and without loss of water due to evaporation, seepage and illegal theft en-route.[5]
b. Second alternative proposal suggested involves concrete lining and stabilizing of Krishna Water canal from zero point to Poondi Reservoir for a length of 25.275KM and deepening Poondi reservoir by a depth of 1m, thereby creating an additional storage of 1.152TMC.
c. Third Proposal suggests deepening and stabilizing the Poondi Reservoir, Red Hills and Chembarambakkam reservoir by 1m depth for creating additional storage of 2.79TMC to meet out the drinking water demand of Chennai city in the year 2020[1].

### 3.2 Main Factors of the Alternate Proposals Suggested

i) It does not require land acquisition of private lands from villagers and farmers
ii) Off take canal – (open earthen) is proposed to be converted into closed RCC concrete pipes (of 2000mm dia) carrying water (200 cusecs), by gravity flow, avoiding losses due to evaporation, seepage, theft etc besides preventing pollution of drinking water.
iii) The Second proposal aims at conveying water through RCC pipes at 200 cusecs- by gravity flow in the east direction along the sides of roads and directly delivering water into Puzhal Reservoir (Red hills) by traversing a length of 40 KM – very nearer to Chennai city

These proposals are designed to carry 200 cusecs through the RCC concrete pipelines along the sides of village roads, District Roads and State Highway Roads without affecting the lands of farmers & others. Even though the length of RC pipes is found to be much larger, the total cost of these proposals is much less than the present Government's proposal.
iv) Further the Third Proposal involves in moldering the canal with concrete lining besides deepening the Poondi Reservoir by an average depth of 1m to store additional water of 1.152TMC at a lesser cost. This

proposal involves the lowest amount which can be directly and advantageously implemented.

## 3.3 Discharge of Water through RCC pipes $NP_2$ - by Gravity Flow

One TMC of water = 1000 x $10^6$ cft

- Quantity per day = 1000 x $10^6$ / 24 x 60 x 60
  = 11574 cft / sec = 11574 cusecs
- Discharge through RCC pipes
  i) Assumed velocity = 2m/ sec
  - by 1no - 2000mm dia pipe – Quantity
  = Area x Velocity = π / 4 (2.002) x 2 m/sec
  = 6.28 $m^3$ / sec = 6280 litres / sec
  = 222cft/ sec = 222 cusecs
  Assuming 90% efficiency,
  net discharge = 200 cusecs
- If 2 nos of 1600mm dia pipes are adopted, then, Discharge
  = π / 4 (1.602) x 2 = 4.02 $m^3$ / sec = 4020 litres / sec = 113.80 cusecs
- With 2 nos of 1600mm φ pipes, discharge
  = 2 x 113.80 = 227.60 cusecs
  With 90% efficiency, discharge = 200 cusecs

## 3.4 Alternative Proposal: Cost Data

With 2000mm dia RCC pipes $NP_2$ class along the sides of the Roads - by Gravity flow

1. Earth work excavation upto 4m depth including the refilling the foundation – Rs. 1200/ RM -
2. Cost of RCC 2000mm dia pipes, pipe specials, transportation, taxes etc complete – Rs. 48000/ RM -
3. Lowering pipes & pipe specials, laying in alignment including jointing & testing- Rs. 400/ RM -
4. Preparation of bottom surface with Stone crusher dust : Gravel Mix 1 : 3 semidry & well compacted – 150mm thick- Rs. 315/ RM-
5. Unforeseen items & miscellaneous expenditure-Rs. 85/ RM

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Total - Rs. 50000/ RM

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For 1000 RM (1KM) length - Rs. 500 Lakhs

Total length of Pipe lines from Poondi Canal to Kannankottai & Thervaikandigai - 17.50 KM (via Roads)
Cost for 17.50 KM of RC pipelines
= Rs. 500 x 17.50 =Rs. 8750 Lakhs
= Rs. 87.50 Crores

- Alternatively, subject to available width of sides of road, with 2 nos of 1600mm dia RCC pipes cost per 1 m length

= Rs. 21500 x 2 Nos / RM
Total Rs.43000/RM = Rs. 430 Lakhs / 1 KM

- For a length of 17.50 KM=Rs. 430 Lakhs x 17.50 KM

= Rs. 7525 Lakhs
= Rs. 75.25 Crores[6]

## 3.5 For Second Proposal

- Distance from Kannankottai to Puzhal Reservoir via Roads = 44.75 KM

i) With one No. of 2000mm dia RCC Pipes, Total Cost = Rs. 223.75 Crores (or)
ii) With 2 Nos. of 1600mm dia RCC pipes, Total Cost = Rs. 192.43 Crores[6]

## 3.6 Cost Estimate of Proposal 2

**Pro P2-2 i)** Off-take by RCC pipes of 2000m dia to deliver At Canal via Roads - Rs. 94.50 Crores
ii) Off-take With 2 Nos of RC pipes of 1600mm dia by roads - Rs. 81.27 Crores
**Pro P2-2 i)** Off-take by 2 Nos of 1600mm dia to pipes to Directly deliver at Puzhal Reservoir (Red Hills) Via Roads (cheaper than P1) - Rs.175.87 Crores

## 3.7 Cost Estimate of Alternative Proposal P3

**Pro P3-1** Strengthening and moderning Poondi Canal from Zero Point to Poondi Reservoir and deepening the Poondi Reservoir by an average depth of 1m.

a) by concrete lining to draw 1000 cusecs - Rs. 35.70 Crores
b) by deepening Poondi Reservoir by 1m depth - Rs. 163.15 Crores

Total: Rs. 198.85 Crores[6]

This proposal is cheaper than Rs.330+Rs.99 = Rs.429 Crores spent by **Water Resources Organization,** TNPWD & Chennai Metro Water.

### 3.8 Deepening of Existing Reservoirs by 1.00m (average depth) (P3-2)

Using machinery including for the disposal of excavated earth, lead upto 50m and lift upto 1.50m, disposed earth to be leveled and neatly dressed (2015-16rates)–Rs.50/ $m^3$(Rs.4.25/cft). From the Table-1, it can be seen that, by deepening the 3 reservoirs by average depth of 1m, The additional storage is 2790 Mcft (79.00 $Mm^3$) = 2.79 TMC. And its cost works out to Rs. 395.00 crores. Deepening the Poondi Reservoir alone by an average of 1.00m, in the first phase creates an additional storage of 32.63 $Mm^3$ = 1152 Mcft = 1.152 TMC at a cost of Rs. 163.15 Crores only.

**Table 1.** Additional storage expected

| | **Storage Mcft** | **Water Spread area Sq.Km** | **Addl. Storage In Mcft** |
|---|---|---|---|
| Poondi Reservoir | 3231 | 32.63 | 1152.38 |
| Chembaram -bakkam | 3645 | 25.51 | 900.92 |
| Puzhal/ Redhills | 3300 | 20.86 | 736.70 |
| Total additional storage deepening by 1.00m (av) | | | 2790 Mcft or 2.790 TMC |

## 4. Conclusion

These three alternative efficient and cost effective proposals are suggested by the author:

i) To Increase the storage capacity of Poondi Reservoir by deepening to average depth of 1.00m and creating an additional storage of 1.152 TMC (32.63 $Mm^3$) at a cost of Rs. 163.15 Crores without any obstacles.

ii) To Stabilize the Krishna Water Canal from Zero Point to Poondi Reservoir and provide concrete lining for a length of 25.275km (with a carrying capacity of 2000 cusecs) at a cost of Rs. 35.70 Crores only.

iii) To create further additional storage, the Red Hills Tank and Chembarambakkam Tank are to be deepened by an average of depth of 1m, thereby achieving additional storage of 1.64TMC at a cost of Rs.231.85 crores. Alternatively (since the new reservoir at Kannankottai-Thervaikandigai was already formed), RC concrete pipes of 2 nos of 1600mm dia ($NP_2$ class) are to be laid along the road sides of NH, SH &MDR straight to Puzhal (Red Hills) Tank by traversing a length of 47.5KM, at a cost of Rs.175.87 Crores only which is very nearer to Chennai city wherefrom the drinking water is supplied to Chennai city.

The following new Inputs (new materials & advanced techniques) are adopted in the modified proposals by the author.

1. Adoption of Large dia RCC pipes for transporting huge quantity water.
2. Adoption M25 Grade concrete admixed with Super plasticizer and Synthetic Fibre for Lining
3. Provision of Geo-synthetics (Geo nets & Geo grids) for earth stabilizing and strengthening of earthen canal
4. Adoption of updated specifications for excavation of trenches and refilling
5. Adoption of concrete lining. M25 Grade for canals carrying water with increased the utility and life period.

- Change of mindset is needed to avoid land acquisition for Public Projects in the interest of Farmers and also to satisfy the environmentalists which is the need of the hour.

A new approach is suggested to draw bulk water supply through RC pipes along village roads, District Roads and State Highways for hurdle free, early and easy execution of the project by the Water Resources Organization, Tamilnadu Public Works Department.

## 5. Acknowledgement

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