L. & M.
2,000—12-97

Local & Munl. (1898) Department.

MISCELLANEOUS.

G.O., No. 2170 Mr.

DATED 16-12-98.

INDEXED.

[Despatch Abstract.]

Water Supply — Forwarding to the municipal council of Vizianagram for remarks the papers relating to the — scheme of the town & requesting the council to ascertain & report whether the contribution promised by the late Maharaja of Vizianagram will now be realized & how it proposes to finance the scheme

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

FURTHER PAPERS.

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Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Read. } 1898. *Enclosures*

Regd. } 1898. *Spare copies*

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

Letter—from A. S RUSSELL, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages :—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

ENCLOSURE.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water. and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{4}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows :—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings :—

	FEET.
14 inches piping	= 8,208
12 do.	= 2,232
10 do.	= 1,566
9 do.	= 1,521
8 do.	= 2,349
7 do.	= 504
6 do.	= 3,825
5 do.	= 3,915
4 do.	= 12,958
3 do.	= 24,831
2½ do.	= 1,260
	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below :—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water-supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme*.—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000}$ = 28 pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

26. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0·014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute 1½ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

	Rs.
Eleven acres required for works	150
Thirteen acres above infiltration gallery at Rs. 100 an acre ..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre ..	12,000
Total ..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every ¼ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Visagapatam).
,, Sanitary Board.

Local & Munl. (1898) Department.

CURRENT No. 3000 M

15P

Misc

Order No. 2170 Mins dy 16/12/98
Hon. Mr. 14.12.98

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the Contribution of Rs 150000 promised by the late Maharajah of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the Scheme

with understanding that the Government Contributes a moiety of the estimated Cost and advances the balance from Provincial Funds at 4 per Cent interest, repayable in twenty years.

13 12 98

13/12/98

Vote

Please see 2nd draft in pencil to the Estimate of Vizianagaram Water Supply Scheme — Flag E below Mr

To the Chairman Municipal Council Vizianagaram (with plates & estimate to be returned)
for information

From The Secretary Sanitary Board

No. 556/S

Dated 23d September 1898

Received 26th Sept. 1898

Registered

Enclosures 8 (1 counterfoil of plans)

Spare copies.

SUBJECT.

Vizianagaram Water Supply Scheme

Submitting with remarks — for the orders of Government.

BACK PAPERS.

G.O.	No.	Department.	Date.

FURTHER PAPERS.

G.O.	No.	Department.	Date.

S.E. 10 No. 21704 16-12-97.

S. E. 6. 1,000—6-12-97.

No. 372

GOVERNMENT OF MADRAS.

OFFICE OF SANITARY ENGINEER,

Fort St. George, 30th. March 189 8.

Recd 2nd April 1898

From

A.S.Russell Esq.,
~~J. A. JONES, Esq., MEM. INST. C.E., F.R.S.E.,~~

Ag SANITARY ENGINEER TO GOVERNMENT,

To

The Secretary ,Sanitary Board,
Chepauk .

SIR,

Referring to G.O.No.318.M,dated 3rd. February 1898,I have the honor to forward Report,plans, and estimate for the Vizianagram Water Supply .The works consist of an Infiltration gallery parallel to the Oottai Gedda ,of an Engine house and Service Reservoir, with ~~the~~ main and distribution pipes to the town .

2. There are three sources of supply available. First-The Mentada stream, 19½ miles from the town.Second-The Nellimarla stream, 4 miles from the town.Third- The Oottai Gedda stream ,1½ miles from the town.Appendix I to the Report gives particulars of the three schemes ,and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest ,and it has on that account been worked out in detail and recommended for adoption.In addition to cheapness ,it has the following advantages (1) The source of supply being near,i.e, only 1½ miles from the town,the works will be easy of access and less liable to stoppage from accident than in the other schemes.-(2) The catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani Rivers. The former consists almost wholly of bare hills ,while th

Ex 598.S 17/2/98

two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to shew that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897, and the current year, its surface flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs 10,500/- including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the Cantonment. If it is decided that the Cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the Report. The subsidiary reservoir and distribution works in the Cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the Cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs 2,82,000. The annual pumping and maintenance charges are estimated at Rs 9,000.

6. The late Maharajah of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water supply scheme, (Vide G.O.No.1023.M.Mis, dated 17th. June 1896) and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz, Rs 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

Not available
RT 1691.S
25/6/96.

7. A lump sum provision of Rs 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream, and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shewn on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to 1/3rd. of the total quantity required for the supply of the town, viz, 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic ft per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

I have the honor to be,

Sir,

Your most obedient servant,

A. Kennedy

Ag: Sanitary Engineer to Govt.

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I have the honor to be,

Sir,

Your most obedient servant,

A Kinnell

Ag: Sanitary Engineer to Govt.

Enclosure 1 to letter No. 372 of 1898

3

38.8

Report on the Vizianagram Water - Supply Project.

1.- Population and Supply.-The population of Vizianagram ,as enumerated at the census ,was

in 1881---------- 22,577.

in 1891----------30,881.

For the purpose of this scheme ,the population is assumed at 40,000,which allows a reasonable margin for future increase in population .The allowance per head per diem is 15 gallons.The supply required is,therefore,40,000 x 15 = 600,000 gallons per day,which is equal to an average demand of 420 gallons per minute.

2.- The source of supply.- The source of supply is the valley of the Oottai Gedda ,a stream which flows about a mile and a half to the north of the town.There are evidences of the existence of a copious supply of underground water in the valley,and it is proposed to obtain this by the construction of an Infiltration gallery .The Oottai Gedda ,as its name implies,is a perennial stream,the flow in which is said to have never dried up even in years of extreme drought.The flow was gauged over a weir board from 11th.to 30th.April 1897,and was found to equal 290 gallons per minute,which amounts to 417,600 gallons per day.April is usually the month in which the subsoil water level is at its lowest at Vizianagram ,and it is remarkable that 1897 succeeded a year in which the rain fall was the lowest on record within the past 20 years (Vide appendix II). The inference would be that the quantity gauged from 11th.to 30th.April 1897 was the minimum flow in the stream ,but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5.24 inches of rain .The flow was again gauged this year (1898)on the 18th.& 19th.of March,and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream ,there must be,as indicated by the wells adjacent, a large quantity of water flowing underground down the valley,and it is not unreasonable to suppose that 600,000 gallons per day , which is the full supply required for the town,can be obtained from

from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles .The lowest rainfall of any year since 1876 was in 1896,when it was 23 inches.The soil in the valley is favorable for the rapid absorption of rain water,and it may be assumed that about 1/3rd.of the fall would be absorbed by the ground .On this assumption the quantity of water percolating into the ground,even in the worst year, would be

$$\frac{4 \times 27878{,}400 \times 23}{3 \times 12} \times 6\tfrac{1}{4}$$

or say 440 million gallons.

The quantity of water required for the town ,at 15 gallons per head per diem for a population of 40,000,will be about 220 million gallons .There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year,& that the supply in good years will be ample.

3. Quality of water. The water from the Oottai Gedda has been analysed & has been pronounced to be "usable".A copy of the Analysis is given in Appendix III.

4. Infiltration Works.- The infiltration gallery will consist of a trench parallel to the Oottai Gedda ,& about 100 feet distant from it. The length of gallery estimated for is 1,700 ft.Whether this length will suffice or not can only be ascertained after the trench has been actually dug .If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda,as shewn by a dotted red line on sheet No.I Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160.00,which is 10 ft.below the bed of the stream.

The trench will be 8 ft.wide at bottom,and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram.Longitudinally, along the bottom of the trench ,two rows of9" stoneware pipes will be laid with open joints.The trench will then be filled up to a height of 7 feet above the pipes with broken stone,& gravel varying in size from 4" in the bottom layer to $\frac{3}{4}$ " at the top.Above this a layer of 3 ft.of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required,because the bottom of the trench is at the level of 160.00,and the bed of the stream just below the anicut is about 159.00.The trench can thus be easily drained off by a line of 18" stoneware pipes laid as shewn on the plan.It is proposed to lay these drainage pipes into the ground permanently,with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern, from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange jointed steel pipes,14" in diameter.As these pipes will not be easily accessible ,it is desirable to take all reasonable precautions against any accident to them .With this object ,a double row of pipes has been provided ,and the pipes will also be laid over a layer of concrete ,but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground ,there would be no engineering difficulty in sinking the suction well inside the house,but there are objections to a well inside the house on sanitary grounds.It has been found that with a well inside the house , it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. Engine House.- The engine house consists of an engine room,19 x 23 ft,and a boiler room,23 x 23 ft, with a seven-foot verandah on three sides.The floor of the engine house is 190.00 or 30 ft.above inlet to suction well.

6. Pumping Machinery.- As the scheme provides a service reservoir,the engines need pump only the average supply of 420 gallons per minute.The engines will require to lift water to a total lift of 90 ft.,as follows:-

Maximum water level in service reservoir---	250.00
Inlet to suction well -------- ----------	160.00
Total lift.---	90 feet.

The Pump Horse-Power required

$$= \frac{420 \text{ gls} \times 90 \times 10}{33{,}000} = \text{say } 12 \text{ P.H.P}$$

or say three engines ,each of 6 P.H.P, so that one may be always in reserve.

It is ,however,proposed to erect only two engines at first, leaving

leaving room for a third engine to be erected in future, & the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, & thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's Vertical type with locamotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14" in diameter and will be 1,500 ft. long.

8. Service Reservoir.- The maximum water level in the service reservoir is 250.00 . The delivery main to the town will leave the service reservoir at the level of 240.00, which is sufficiently high to deliver water 10 ft . above ground level all over the town (but not the Cantonment) even during the hours of maximum demand.

The Cantonment can, however, be served by a subsidiary reservoir placed near the Cantonment itself . This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, & the statical head over the town mains will be practically the same as the water in the service reservoir , which will vary from 240.00 to 250.00 . The highest part of the Cantonment is 217.00 - A subsidiary reservoir with its maximum water lwvel at 230.00 , will suffice , and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the Cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of 10 annas per million gallons lifted one foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000.} \times 365 = 2050 \text{ Rs annually.}$$

With a subsidiary reservoir , as above proposed , the supply to the Cantonment will be just as constant & secure as it would be if the supply were obtained direct from the Main Reservoir, and the arrangement will not involve any additional cost in pumping.

The

The reservoir provided is capable of holding 600,0 gallons , which is a day's supply to the town for the in population & maximum demand. For many years to come , the mand will not exceed 300000 gallons a day. The capacity of the reservoir therefore represents about 2 days' actual sup ply required at present to the town. When the demand of water increases , additional storage can be easily provided.

The reservoir is in two compartments , in order to enable its being cleaned. Each compartment measures 70 ft x 70 ft., and has a depth of 10 ft up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity .

9. Distribution pipes.- The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14" to 2½".

The following are the details of pipes & fittings:-

14" Piping	=	8208 ft.
12" "	=	2232 "
10" "	=	1566 "
9" "	=	1521 "
8" "	=	2349 "
7" "	=	504 "
6" "	=	3835 "
5" "	=	3915 "
4" "	=	12258 "
3" "	=	24831 "
2½" "	=	1260 "
Sluice Valves		No.73
Air Valves		No. 3
Hydrants		No.25
Pillar fountains		No.12
Single Wall Tap fountaind		No.40
Double-do		No.13

10. Capital cost.- The scheme is estimated to cost Rs 2,82,000 as shewn below-

		Rs
Infiltration works ---------- ----------		28,430
Pumping Station-		
Engine house -----	12,220	
Drivers' Quarters ----	3,000	
Store shed -------	2,000	
Compensation for land-	3,500	20,720
Two engines & boilers each capable of lifting 210 gallons to a height of 90 ft.---		28,000
Service reservoir to hold 600,000 gallons---		24,000
Pipes and fittings ----------		1,33,900
Laying and jointing do----------		27,200
		2,62,250
Contingencies ,tools & plant		19,750
		2,82,000

Note- The rates for masonry & earthwork in the estimate have been supplied by the Executive Engineer from his Schedule of Rates for 1897-98.

11. Annual charges.- The annual pumping charges for the immediate supply of 300,000 gallons per day at 10 annas per million gallons lifted one foot high will be

$\frac{300,000 \times 90 \times 10}{16 \times 1000000}$ = Rs 17 per day = Rs 6200 per annum.

Boiler Inspector's fees,repairs to Machinery and works &c will cost about Rs 2800 annually. The total pumping & maintenance charges for the present will be Rs 9,000 per annum.

A Kennell

Office of Sanitary Engineer,
Fort St.George, 30th March 1898 } Ag:Sanitary Engineer to Govt

T.C.No 225 of 98
S.C.No 264 of 98

8/3000/Mu/98

to letter No. 372 1898 9

6 S.P.

Appendix I.

A memorandum on the various schemes investigated for the Vizianagram Water-Supply, with particulars of their cost.

---

1. Some time about the year 1891 ,Mr.H,Turner (who was previously the Collector of Vizianagram) on behalf of the late Maharajah of Vizianagram commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W.M. Beckett ,A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme ,nothing further was done until 1896,when the Sanitary Commissioner revived the question of the water-supply to the town.In view of the heavy cost of the scheme prepared by Mr. Beckett,Dr.King suggested the possibility of obtaining a supply from the sub-soil flow in the valley of the Oottai Gedda ,which flows about a mile and a half to the north of the town.This scheme was referred to the Sanitary Board for remarks ,which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr.J.A.Jones made a preliminary inspection of Vizianagram & the various sources of supply . Mr.Jones had an interview with the late Maharajah and Mr.Beckett,who happened to be there at the time ,with reference to the scheme prepared by the latter.It is understood that Mr.Beckett refused to give the report ,plans & estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof,until he (Mr.Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution ,with a remuneration amounting to 6½ per cent of the actual cost of the works.Mr.Jones was not in a position to say whether Mr.Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance.A few days later Mr.Beckett left for England without giving over

the

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A.S. Kinnell

Office of Sanitary Engineer,
Fort St.George, 30th March 1898 } Ag:Sanitary Engineer to Govt

L&B

T.C.No. 226 of 98.
S.C.No. 2640 of 98.

L 8
3000/Mu/98

Ag't to letter No. 372 1898 9

6 S.P.

Appendix I.

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the

the plans or furnishing any particulars of his scheme ,for the preparation of which he was handsomely paid by the Maharajah.

3. While the relative merits of the Mentada & Oottai Gedda schemes were being discussed ,Mr. W.A Willock ,I.C.S.,recommended another scheme for the supply of the town from the bed of the Colhani river,near the village of Nellimarla ,some 4 miles from Vizianagram.

4. At this stage, the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed ,with the view of ascertaining the relative costs of the schemes.The results of the investigation are given below-

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs , interest & sinking fund is reckoned on the whole capital cost of each scheme ,without allowing for any contribution from Government or other sources.It is likely that in a small scheme contribution will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

Mentada Scheme.

6. Nothing is known definitely by this Department about Mr.Beckett's scheme except the place from which he proposed to obtain the supply . This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr.Ramamoorthi Pantulu ,the late Samasthanum Manager,who has seen the plans ,Mr.Beckett's scheme appears to be as follows-To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi Tank (3½ miles from the anicut), which would serve as a storage reservoir; & finally to convey the water from the tank to the town ,a distance of 16 miles ,by 12" iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr.Beckett is about 60 square miles. The rain fall record of the past 20 years shews the annual fall to vary from 24 to 78 inches .There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr.Beckett ,the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year,& for another three months on an average 1½ ft. deep .The storage tank must,therefore, be capable of holding at least six months' supply to the town;a larger supply, say a nine months'supply, would be desirable .The Konsi tank ,which is said to be the storage tank proposed by Mr.Beckett ,is a very shallow tank, with about 7 or 8 feet depth of water.From the river ,where it is proposed to build the anicut ,to the crest of the Calingula there is only a fall of about 2 ft.,and,therefore,the Konsi tank does not admit of its being increased in depth. The Mentada river has,however,a great fall,and by placing the anicut higher up ,i.e, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised.This, however, means not only a new anicut,but also a new channel some 3½ miles long.The length of the anicut required will be about 400 ft.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town;but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys & a large number of streams ,necessitating high embankments & many masonry works ,which would bring the cost of the conduit to very little less than the cost of iron piping .In these circumstances ,it is preferable to use iron pipes,which are superior ,both from an engineering and sanitary point of view ,to a masonry conduit.It was doubtless these reasons that lead Mr.Beckett to propose iron piping-

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme-

Bed

the plans or furnishing any particulars of his scheme ,for the preparation of which he was handsomely paid by the Maharajah.

3. While the relative merits of the Mentada & Oottai Gedda schemes were being discussed ,Mr. W.A Willock ,I.C.S.,recommended another scheme for the supply of the town from the bed of the Colhani river,near the village of Nellimarla ,some 4 miles from Vizianagram.

4. At this stage, the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed ,with the view of ascertaining the relative costs of the schemes.The results of the investigation are given below-

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs , interest & sinking fund is reckoned on the whole capital cost of each scheme ,without allowing for any contribution from Government or other sources.It is likely that in a small scheme contribution will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

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6. Nothing is known definitely by this Department about Mr.Beckett's scheme except the place from which he proposed to obtain the supply . This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr.Ramamoorthi Pantulu ,the late Samasthanum Manager,who has seen the plans ,Mr.Beckett's scheme appears to be as follows-To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda, to convey the water by a channel to the Konsi Tank (3½ miles from the anicut), which would serve as a storage reservoir; & finally to convey the water from the tank to the town ,a distance of 16 miles ,by 12" iron piping.

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8. At the point of the offtake proposed by Mr.Beckett ,the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year,& for another three months on an average 1½ ft. deep .The storage tank must,therefore, be capable of holding at least six months' supply to the town;a larger supply, say a nine months'supply, would be desirable .The Konsi tank ,which is said to be the storage tank proposed by Mr.Beckett ,is a very shallow tank, with about 7 or 8 feet depth of water.From the river ,where it is proposed to build the anicut ,to the crest of the Calingula there is only a fall of about 2 ft, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has,however,a great fall, and by placing the anicut higher up ,i.e, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised.This, however, means not only a new anicut,but also a new channel some 3½ miles long.The length of the anicut required will be about 400 ft.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town;but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys & a large number of streams ,necessitating high embankments & many masonry works ,which would bring the cost of the conduit to very little less than the cost of iron piping .In these circumstances ,it is preferable to use iron pipes,which are superior ,both from an engineering and sanitary point of view ,to a masonry conduit.It was doubtless these reasons that lead Mr.Beckett to propose iron piping-

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme-

Bed

1704
16-12-99.

Bed of the Mentada River at Timmarazpet--- 327.00

Bed of the Konsi Tank ---------- 296.00

M.W.L in service reservoir near Cantonment-234.00

12. Roughly the above scheme will cost —

	Rs
Anicut 400 ft.long across river ---------	25,000
Head sluice ---------- ------	5,000
3½ miles of channel to Konsi tank----------	42,000
Enlarging & improving Konsi tank----------	50,000
Filter beds to filter 600000 gallons daily----	30,000
16 miles of iron piping 12" diameter --------	512,000
Service reservoir to hold 2 days' supply 1,200,000 gallons)----------	60,000
11 miles of distribution pipes from 14" to 2½"	130,000
	854,000
Tools & plant,contingency 7½ % ----------	64,000
	Rs 918,000

13. The sinking fund & interest on Rs 9,18,000 will be Rs 55,000 per annum .Maintenance of the works will cost about Rs 5000, or say a total of Rs 60,000 per annum.

Nellimarla Scheme.

14. This was the second scheme investigated .It is the scheme recommended by Mr. Wa Willock. The chief features of the scheme are- To construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram ; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; & finally to distribute the water by iron pipes in the usual manner .

15. The river is 800 ft. wide,has a drainage area of over 500 square miles and has a deep sandy bed .There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are-

Bottom of gallery or inlet to pump well------	80.00
Lowest water level in river ----------	90.00
Bed of river ----------	90.00
M.W.L in service reservoir ----------	297.00

17. The total lift of the pump will be 297 - 80 = 217 feet. The quantity

quantity of water to be pumped per minute

$$= \frac{40,000 \times 15}{60 \times 24} = \text{say } 420 \text{ gallons.}$$

The Pump Horse Power required is $\frac{420 \times 10 \times 217}{33000} = 28$ P.H.P.,

or say three engines each of 14 P.H.P, allowing one reserve engine.

18. The scheme will cost approximately - Rs.

Infiltration works ----------	40,000
Pumping station ----------	25,000
3 engines & boilers,each of 14.P.H.P----54,000	
Service Reservoir to hold 600,000 gallons (one day's supply)--------	24,000
15 miles of main & distribution pipes 14" to 3", including laying & jointing ----------	2,60,000
	4,03,000
Tools & plant and contingencies at 7½ % ----------	30,000
Total	4,33,000

19. The cost of pumping will be

$$\frac{600,000 \times 217 \times 10}{16 \times 1000000} = \text{Rs } 82 \text{ per day}$$

= say Rs 30,000 per annum.

20. The total annual charges will be — Rs

Interest & sinking fund on Rs 4,33,000 ------	26,000
Pumping ----------	30,000
Maintenance ----------	3,000
Total	59,000

Oottai Gedda scheme .

21. This is the scheme suggested by Dr.King ,and the one that is proposed to adopt .The source of supply is the sub-soil water in the valley of the Oottai Gedda ,a stream which passas about a mile and a half to the north of the town .

22. The scheme proposed is briefly as follows- To construct an infiltration gallery or trench 1700 ft.long parallel to and about 100 ft.from the river,commencing from a point opposite the lower anicut;to pump the water to a service reservoir at

at a sufficient elevation on the adjoining hill; and finally to distribute the supply from the reservoir in the usual manner by pipes, &c.

23. The lift of the pumps will be 90 feet as shewn below-

M.W.L in Service Reservoir---------- --	250.00
Bottom of infiltration gallery ---------	160.00
	90 feet.

The pump Horse -Power required is

$\frac{420 \times 90 \times 10}{33000}$ = say 12 P.H.P,

or 3 engines each of 6 P.H.P, allowing one reserve engine -

24. The scheme will cost-

	Rs
Infiltration works ----------	28,430
Pumping station ----------	30,720
3 engines & boilers, each of 6 P.H.P------	42,000
Service Reservoir to hold 600000 gallons (one day's supply) --------	24,000
12 miles of main & distribution pipes 14" to 2½", including laying & jointing--	161,100
	276,250
Tools & plant and contingencies at 7½% --	21,750
Total	298,000

25. The cost of pumping will be —

$\frac{600000 \times 90 \times 10}{16 \times 100000} \times 365$ = Rs 12400 per annum.

26. The total annual charges will be —

	Rs
Interest & sinking fund on Rs 2,98,000 ---	17,880
Pumping ----------	12,400
Maintenance ----------	2,920
Total	33,200

Conclusion

27. The following tabular statement shews the relative merits of the three schemes-

* 2 Engines only are actually allowed in estimate submitted

7
3000/m/98

Name of Scheme.	Distance of head-works from town.	Gravitation or Pumping	Initial Cost.	Annual charges. Interest and sinking fund.	Maintenance	Total	Remarks:
			Rs	Rs	Rs	Rs	
Mandapeta	19½ miles	mil	9,18,000	55,000	5,000	60,000	Gravitation scheme.
Nallimarla	4 "	217 ft	4,33,000	26,000	3,000	59,000	Pumping scheme.
Gottati pada	1½ "	90 ft	2,98,000	17,880	2,920	33,200	Pumping scheme.

Note:— All the schemes are on the Gentz system of a supply of 15 gallons per head per diem for a population of 40,000.

Interest & sinking fund are calculated on the entire capital cost.

Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

at a sufficient elevation on the adjoining hill; and finally to distribute the supply from the reservoir in the usual manner by pipes, &c.

23. The lift of the pumps will be 90 feet as shewn below-

M.W.L in Service Reservoir---------- --	250.00
Bottom of infiltration gallery ---------	160.00
	90 feet.

The pump Horse -Power required is

$\frac{420 \times 90 \times 10}{33000}$ = say 12 P.H.P.,

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Interest & sinking fund on Rs 2,98,000 ---	17,880
Pumping ----------	12,400
Maintenance ----------	2,920
Total	33,200

Conclusion

27. The following tabular statement shews the relative merits of the three schemes-

* 2 Engines only are actually allowed in estimate submitted

7
3000/m/98

Name of Scheme.	Distance of head-works from town.	Quantity of Water per day.	Initial Cost.	Annual charges			Remarks.
				Interest and sinking fund.	Pumping	Maintenance	
			Rs	Rs	Rs	Rs	
Mandapeta	19½ miles	1 mil	9,18,000	55,000	mil	5,000	Gravitation scheme.
Nallamada	4 —"—	27 ft	4,33,000	26,000	30,000	3,000	Pumping scheme.
Cocanada	1½ —"—	90 ft	2,98,000	17,880	12,400	2920	Pumping scheme.

Note:— All the schemes are on the Gravitation system.

Rs 40,000.

Interest & sinking fund are calculated at the rate of 6 p.c.

Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages. (1) It is the cheapest scheme of the three. (2) It is within access of the town, and its comparatively short length of Main renders it less liable to temporary stoppages from accident. (3) There are no villages in the water-shed of the Oottai Gedda, and there is very little cultivation. There is much cultivation, and there are many villages in the water-sheds of the Mentada & Kolhani rivers. Hence, Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

Office of Sanitary Engineer,
Fort St. George, 14th March 1898.

Asst. Sanitary Engineer to Govt.

Appendix II

Statement shewing monthly rainfall in inches at Vizianagaram from 1876 to 1897.

372 1898

Years	Jan:	Feb	March	April	May	June	July	Aug:	Sept:	Oct:	Nov:	Dec:	Total
1876	"	"	"	"	3·00	1·90	1·00	9·80	5·30	17·28	"	"	38·28
1877	"	5·50	7·50	2·00	12·80	2·00	5·90	2·40	5·40	2·40	"	"	45·90
1878	"	"	1·40	0·20	2·40	5·55	8·65	6·15	8·80	19·00	4·50	21·95	78·60
1879	"	"	"	"	10·20	2·90	4·20	6·90	4·10	2·70	3·70	0·10	34·80
1880	0·10	0·10	"	1·10	5·20	9·10	9·00	9·00	9·80	9·15	1·70	"	54·25
1881	"	"	4·00	0·50	1·80	9·80	6·10	4·20	4·20	12·60	2·70	"	45·90
1882	"	"	"	"	6·30	2·40	4·40	8·80	8·50	4·00	5·80	0·90	41·10
1883	"	"	1·10	0·50	2·10	5·20	2·70	8·50	1·80	7·60	0·80	0·90	31·20
1884	"	"	"	1·00	0·40	1·80	3·00	6·30	17·40	4·20	"	2·20	36·30
1885	"	1·05	1·60	0·40	0·30	5·70	4·55	2·70	7·20	10·00	5·30	3·10	41·90
1886	"	"	0·90	"	3·30	4·30	5·70	17·15	9·20	18·00	11·30	6·00	72·85
1887	"	"	2·20	"	1·38	10·10	4·80	6·20	7·10	10·35	3·75	"	45·88
1888	"	"	"	"	0·60	6·10	2·90	4·30	3·45	2·75	7·95	0·10	28·15
1889	"	"	"	"	0·95	3·55	10·23	7·47	8·60	6·15	4·25	0·90	42·10
1890	"	"	1·70	"	0·70	3·35	2·40	10·15	7·90	2·90	5·65	0·30	35·05
1891	"	0·40	3·65	0·25	2·00	1·59	4·87	5·57	4·87	0·35	0·75	"	24·30
1892	"	"	"	"	0·76	5·94	9·92	9·18	7·61	17·69	0·33	"	51·43
1893	0·15	1·68	3·57	6·88	3·87	6·55	2·41	7·00	10·88	5·72	4·40	"	53·11
1894	0·13	"	"	1·14	0·53	4·99	4·58	4·03	11·83	15·85	2·72	"	45·80
1895	0·25	0·21	"	0·30	0·94	7·36	5·59	10·10	5·97	15·10	0·65	"	46·47
1896	"	"	0·69	"	1·84	6·36	3·42	4·96	5·84	"	0·08	"	23·19
1897	"	1·62	*5·24	0·45	6·75	2·83	3·22	6·89	14·25	11·27	2·68	"	55·20

*Abnormal fall.

A S Russell
Asst: Sanitary Engineer to Govt.

Appendix III

Analysis of the water of the Cottai Gedda.

Docket No. 760 dated 3rd August 1897 from the Chemical Examiner, Madras

No. 372 of 1898.

	Cottai Gedda River water from well Bottle A	Cottai Gedda River water from flowing river Bottle B
Total solids ..... Grms. per litre	0.220	0.220
Volatile solids .... do do	0.090	0.080
Chlorine ..... do do	0.014	0.014
Total hardness ..... Clark's scale	4°.200	4°.900
Permanent hardness ..... do do	1°.400	Trace
Free ammonia Mlgrms per litre	0.048	0.052
Albumenoid ammonia do do	0.064	0.088
Nitric acid do do (as ammonia)	0.450	0.510
Apparent quality of the water as inferred from the results obtained on examination	usable	usable

(True copy)

A. Russell

Acting Sanitary Engineer to Govt.

(Sd) Robert Robertson

M.B., C.M.,

Surgeon Captain

Ag: Chemical Examiner.

No. 242/S

11P

NOTE by the Sanitary Commissioner for Madras, dated

25th April 1898.

Reference.— Resolution of the Sanitary

NBd No 248 - S ,dated 19th April 1898.

U/S considers the sanitary requirments of the scheme have been carefully subserved -within the limits allowed by Government . The only matter of doubtful expediency seems to him to be the "catch drain " . If in after years it be carelessly maintained - a not unlikely con tingency - it will present the disadvantage of being the receptacle of undesirable matters ,whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. D. Thuillier

Surgeon Lt Col.

Sanitary Commissioner for Madras.

To, The Secretary, Sanitary Board, Madras.

with papers & one Counter foil of plans returned.

4/S.C.No 226/98

4/S.C.No 26 do 98

4/3000/M/98

Sanitary Current 264

Recd: 27-4-98.

Encs: 7 (1 counterfoil of plans)

Vizianagram Water Supply Scheme

1/3000/116/98

Government of Madras.

SANITARY BOARD OFFICE.

PROCEEDINGS OF THE SANITARY BOARD, No. 556/S, DATED 23rd September 1898.

LOCAL & MUNICIPAL DEPT.
CURRENT No. 3000/98

Read the following:—

Letter from the Sanitary Engineer to Government No. 372, dated 30th March 1898.

Note by the Sanitary Commissioner for Madras, No. 942/S, dated 25th April 1898.

Letter from the Sanitary Engineer to Government, No 1115, dated 24th June 1898.

Do — do — No. 1261, dated 16th Aug 1898.

Resolution.

With his letter No. 372 dated 30th March 1898 read above, the Sanitary Engineer submits plans and estimates for the Vizianagram Water Supply Scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Ottai Vedda, of an Engine house and Service Reservoir, and of main and distribution pipes to the town.

3. There are 3 sources of supply available, and in Appendix I attached to the Report each of these schemes is discussed

and

and the reasons are given for selecting the Pottai Gedda scheme. They are briefly as follows :—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest watershed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug, and the yield tested. the cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the Cantonment. This can be taken up separately if required by the military authorities who would pay the cost of the extension, and a separate water rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. the supply required is therefore 6,00,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In para 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram Zamindary, the late Maharajah having expressed his willingness to contribute 1½ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rs. 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261 dated 16th August 1898 the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs 1,450 must be paid for the 2¼ acres of land required for the gallery and

and the reasons are given for selecting the Ottai Gedda scheme. They are briefly as follows :—

(1) It is the cheapest.
(2) Is within easiest access to the town.
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9. In his subsequent letter No. 1261 dated 16th August 1898 the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs 1,450 must be paid for the 24 acres of land required for the gallery and

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9. In his subsequent letter No. 1261 dated 16th August 1898 the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs 1,450 must be paid for the 24 acres of land required for the gallery and

and service reservoir, and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may as an outside estimate, be set down as follows:-

	Rs.
11 acres required for works	150.
13 acres above infiltration gallery at Rs 100 an acre	1300.
120 acres lower down at Rs 100 per acre	12,000.
	13,450.

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (para 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer I Circle has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the Zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only 3 air valves provided. One at every summit would be an improvement, and where there are no summits, one in every 1/4 mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract)

K. Barton
Secretary, Sanitary Board.

To
The Secretary,
Local and Municipal Dept.
with papers in original & roll of plans

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Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Read.	1898.	*Enclosures*
Regd.		*Spare copies*

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

Letter—from A. S RUSSELL, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages:—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

ENCLOSURE.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{2}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows :—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long. —e whole cost

8. *Service reservoir.*—The maximum water level in the service r—ug de— delivery main to the town will leave the service reservoir at the l—orks reservoir is 250·00. The ciently high to deliver water 10 feet above ground level all over —al level of 240·00, which is sufficeven during the hours of maximum demand. —g the town (but not the cantonment)

The cantonment can, however, be served by a subsi— itself. This subsidiary reservoir can be filled at nig—diary reservoir placed near the cantonment town, since at night there will be little or no de—nts by a branch from the nearest pipe in the head over the town mains will be practically t— mand for water in the town, and the statistical will vary from 240·00 to 250·00. The high—the same as the water in the service reservoir, which reservoir with its maximum water leve—nest part of the cantonment is 217·00. A subsidiary reservoir at nights. —n at 230·00 will suffice and can be filled by the main

It would be very expensive to r— cantonment both during night an—place the main reservoir at a sufficient elevation to command the lifted some 15 feet higher than —d day. It will necessitate the whole supply to the town being would, at the rate of As. 10 — the lift involved in the present scheme. The extra cost of pumping 60— per million gallons lifted 1 foot high, be about

$\frac{\text{—,000} \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365$ = Rs. 2,050 annually.

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings :—

		FEET.
14 inches piping	=	8,208
12 do.	=	2,232
10 do.	=	1,566
9 do.	=	1,521
8 do.	=	2,349
7 do.	=	504
6 do.	=	3,825
5 do.	=	3,915
4 do.	=	12,958
3 do.	=	24,831
2½ do.	=	1,260
		NO.
Sluice valves		73
Air valves		3
Hydrants		25
Pillar fountains		12
Single wall tap fountains		40
Double do.		13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below :—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000}$ = 28 pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{38,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14" to 2½" including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

26. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0·014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute $1\frac{1}{2}$ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

	Rs.
Eleven acres required for works	150
Thirteen acres above infiltration gallery at Rs. 100 an acre ..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre ..	12,000
Total ..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every $\frac{1}{4}$ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Visagapatam).
,, Sanitary Board.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Recd.	1898.	*Enclosures*
Regd.		*Spare copies*

G.O., No. 2170 M., 16th December 1898.

[Original not available]
from

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

Read—the following paper :—

Letter—from A. S Russell, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town ; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages :—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes ; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

Enclosure.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{2}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows :—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings :—

	FEET.
14 inches piping	= 8,208
12 do.	= 2,232
10 do.	= 1,566
9 do.	= 1,521
8 do.	= 2,349
7 do.	= 504
6 do.	= 3,825
5 do.	= 3,915
4 do.	= 12,958
3 do.	= 24,831
2½ do.	= 1,260
	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below :—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr. H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water-supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme.*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000}$ = 28 pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr. H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water-supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme.*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000} = 28$ pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

26. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	MILES.	FEET.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0·014	0·014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute 1½ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

		Rs.
Eleven acres required for works	..	150
Thirteen acres above infiltration gallery at Rs. 100 an acre	..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre	..	12,000
Total	..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every ¼ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

9-1-09.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Recd. } 1898. *Enclosures*

Regd. *Spare copies*

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

Read—the following paper :—

Letter—from A. S Russell, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages :—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

Enclosure.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{2}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows :—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings :—

	FEET.
14 inches piping	= 8,208
12 do.	= 2,232
10 do.	= 1,566
9 do.	= 1,521
8 do.	= 2,349
7 do.	= 504
6 do.	= 3,825
5 do.	= 3,915
4 do.	= 12,958
3 do.	= 24,831
2½ do.	= 1,260
	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below :—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000}$ = 28 pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

	Rs.
18. The scheme will cost approximately—	
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

	Rs.
20. The total annual charges will be—	
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

	Rs.
26. The total annual charges will be—	
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

Note.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0·014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute $1\frac{1}{2}$ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

	Rs.
Eleven acres required for works	150
Thirteen acres above infiltration gallery at Rs. 100 an acre ..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre ..	12,000
Total ..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every $\frac{1}{4}$ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Visagapatam).
,, Sanitary Board.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Read. } 1898. *Enclosures*

Regd. } 1898. *Spare copies*

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

Letter—from A. S RUSSELL, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages:—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at night as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

ENCLOSURE.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{2}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows :—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33,000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600,000 \times 15 \times 10}{16 \times 1,000,000} \times 365 = \text{Rs. } 2,050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings :—

		FEET.
14 inches piping	=	8,208
12 do.	=	2,232
10 do.	=	1,566
9 do.	=	1,521
8 do.	=	2,349
7 do.	=	504
6 do.	=	3,825
5 do.	=	3,915
4 do.	=	12,958
3 do.	=	24,831
2½ do.	=	1,260

	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below :—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300,000 \times 90 \times 10}{16 \times 10,00,000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr. H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000} = 28$ pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

26. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	MILES.	FEET.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0·014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

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27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

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Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute $1\frac{1}{2}$ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

	Rs.
Eleven acres required for works	150
Thirteen acres above infiltration gallery at Rs. 100 an acre ..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre ..	12,000
Total ..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every $\frac{1}{4}$ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Read.
Regd. } 1898.

Enclosures
Spare copies

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Read. } 1898. *Enclosures*

Regd. *Spare copies*

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GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

Letter—from A. S RUSSELL., Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town ; second, the Nellimarla stream, 4 miles from the town ; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages :—(1) the source of supply being near, *i.e.*, only 1½ miles from the town the works will be easy of access and less liable to stoppage from accident than in other schemes ; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut, A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

ENCLOSURE.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census, was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water. and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{4}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows :—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings :—

	FEET.
14 inches piping .. .. =	8,208
12 do. .. .. =	2,232
10 do. .. .. =	1,566
9 do. .. .. =	1 521
8 do. .. .. =	2,349
7 do. .. .. =	504
6 do. .. .. =	3 825
5 do. .. .. =	3,915
4 do. .. .. =	12,958
3 do. .. .. =	24,851
2½ do. .. .. =	1,260

	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below :—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water-supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, whether Government would avail itself of his assistance. A few days later Mr. Beckett left England without giving over the plans or furnishing any particulars of his scheme, for preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being cussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town, the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate a the three schemes proposed, with the view of ascertaining the relative costs of the schemes. Th results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme*.—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000}$ = 28 pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or tren 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposi the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

26. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	MILES.	FEET.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,15,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) is within access of the town and its comparatively short length of main renders it less liable to porary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai da and there is very little cultivation. There is much cultivation and there are many ges in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0 220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0 014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. King, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, befo execution of the other works estimated for, the infiltration trench should be dug an the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute 1½ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

	Rs.
Eleven acres required for works	150
Thirteen acres above infiltration gallery at Rs. 100 an acre ..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre ..	12,000
Total ..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the merous deep gullies. It should be revetted with stone in bed as well as sides to ure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an ovement, and where there are no submits, one in every ¼ mile.

17. With these remarks the Sanitary Board resolves to submit the project to vernment for orders.

(True Extract.)

R. Parsons,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

Order—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. Tremenheere,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Recd.	1898.	*Enclosures*
Regd.		*Spare copies*

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

Letter—from A. S RUSSELL, Esq, Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages:—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. As shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

ENCLOSURE.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census, was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{2}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows:—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings:—

	FEET.
14 inches piping	= 8,208
12 do.	= 2,232
10 do.	= 1,566
9 do.	= 1,521
8 do.	= 2,349
7 do.	= 504
6 do.	= 3,825
5 do.	= 3,915
4 do.	= 12,958
3 do.	= 24,831
2½ do.	= 1,260

	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below:—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme.*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000}$ = 28 pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Ootai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

	Rs.
26. The total annual charges will be—	
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0 014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute 1½ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

		Rs.
Eleven acres required for works		150
Thirteen acres above infiltration gallery at Rs. 100 an acre ..		1,300
One hundred and twenty acres lower down at Rs. 100 per acre ..		12,000
	Total ..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every ¼ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Recd. } 1898. *Enclosures*

Regd. *Spare copies*

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

Letter—from A. S. RUSSELL, Esq., Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages:—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

ENCLOSURE.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{4}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

Read—the following paper :—

Letter—from A. S Russell, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
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2. There are three sources of supply available: First, the Mentada stream, 10½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages :—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

Enclosure.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{2}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows:—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift ..	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings:—

	FEET.
14 inches piping	= 8,208
12 do.	= 2,232
10 do.	= 1,566
9 do.	= 1,521
8 do.	= 2,349
7 do.	= 504
6 do.	= 3,825
5 do.	= 3,915
4 do.	= 12,958
3 do.	= 24,831
2½ do.	= 1,260
	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below:—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total ..		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr. H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water-supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000} = 28$ pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

18. The scheme will cost approximately—

	Rs.
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

20. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

26. The total annual charges will be—

	Rs.
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

Interest and sinking fund are calculated on the entire capital cost.

Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0·014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute 1½ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

		Rs.
Eleven acres required for works	..	150
Thirteen acres above infiltration gallery at Rs. 100 an acre	..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre	..	12,000
Total	..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every ¼ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

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It is the scheme suggested and approved by the Sanitary Commissioner.

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6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

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(True Extract.)

R. Parsons,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

Order—No. 2170 M., dated 16th December 1898.

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(True Extract.)

H. Tremenheere,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Recd. } 1898. *Enclosures*

Regd. *Spare copies*

G.O., No. 2170 M., 16th December 1898.

[No notes]

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

READ—the following paper :—

Letter—from A. S RUSSELL, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages :—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

ENCLOSURE.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{4}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows :—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings:—

	FEET.
14 inches piping	= 8,208
12 do.	= 2,232
10 do.	= 1,566
9 do.	= 1,521
8 do.	= 2,349
7 do.	= 504
6 do.	= 3,825
5 do.	= 3,915
4 do.	= 12,958
3 do.	= 24,831
2½ do.	= 1,260

	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below :—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897–98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr. H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water-supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme.*—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000} = 28$ pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

	Rs.
18. The scheme will cost approximately—	
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

	Rs.
20. The total annual charges will be—	
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

	Rs.
26. The total annual charges will be—	
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,18,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0·014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. (as ammonia)	0·064	0·088
Nitric acid	Do.	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute 1½ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

		Rs.
Eleven acres required for works	.. ..	150
Thirteen acres above infiltration gallery at Rs. 100 an acre	..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre	..	12,000
Total	..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every ¼ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

Government of Madras.

LOCAL AND MUNICIPAL DEPARTMENT.

MISCELLANEOUS.

Read. } 1898. *Enclosures*

Regd. } *Spare copies*

G.O., No. 2170 M., 16th December 1898.

Water-supply.

Forwarding to the Municipal Council of Vizianagram, for remarks, the papers relating to the — scheme of the town, and requesting the Council to ascertain and report whether the contribution promised by the late Maharaja of Vizianagram will now be realized and how it proposes to finance the scheme.

GOVERNMENT OF MADRAS.

LOCAL AND MUNICIPAL DEPARTMENT.

Read—the following paper :—

Letter—from A. S Russell, Esq , Acting Sanitary Engineer to Government.
To—the Secretary, Sanitary Board, Chepauk.
Dated—the 30th March 1898.
No.—372.

Referring to G.O., No. 318 M., dated 3rd February 1898, I have the honour to forward report, plans and estimate for the Vizianagram water-supply. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir, with main and distribution pipes to the town.

2. There are three sources of supply available: First, the Mentada stream, 19½ miles from the town ; second, the Nellimarla stream, 4 miles from the town; third, the Oottai Gedda stream, 1½ miles from the town. Appendix I to the report gives particulars of the three schemes and approximate cost. It will be seen that the Oottai Gedda scheme will be the cheapest, and it has on that account been worked out in detail and recommended for adoption. In addition to cheapness, it has the following advantages :—(1) the source of supply being near, *i.e.*, only 1½ miles from the town, the works will be easy of access and less liable to stoppage from accident than in the other schemes ; (2) the catchment area of the Oottai Gedda is much cleaner than that of the Mentada or Colhani rivers. The former consists almost wholly of bare hills, while the two latter consist largely of plains with villages having much cultivation near them.

3. There is evidence to show that a sufficient supply of water can be obtained from the subsoil flow of the Oottai Gedda. The stream, though having but a small catchment, is said never to run dry, and in the driest month of 1897 and the current year, its surface-flow was considerable. To make sure of the supply, it is, however, recommended that, before execution of the other works contained in the estimate, the infiltration trench should be dug in accordance with the design and the yield tested. This work will cost about Rs. 10,500 including supervision and contingencies.

4. The scheme does not provide for the distribution of water in the cantonment. If it is decided that the cantonment should also have a supply from the new works, it can be done by constructing a subsidiary reservoir, which would be filled at nights as explained in paragraph 8 of the report. The subsidiary reservoir and distribution works in the cantonment will form a separate estimate by itself, and the whole cost might be borne by the Military Department, no contribution being demanded from the Military Department towards the capital cost of the works. The water supplied to the cantonment should be measured by a meter and paid for at a rate to be fixed by Government. This will be a more satisfactory arrangement than getting a contribution towards the capital cost.

5. The scheme is estimated to cost Rs. 2,82,000. The annual pumping and maintenance charges are estimated at Rs. 9,000.

6. The late Maharaja of Vizianagram expressed his willingness to contribute 1½ lakhs of rupees towards the water-supply scheme—*vide* G.O., Mis. No. 1023 M., dated 17th June 1896—and if Government contributes the balance, which is less than a moiety of the cost, the annual charges to the Municipality on account of the scheme will be limited to the cost of pumping and maintenance, viz., Rs. 9,000. If the Municipality has to find any considerable portion of the capital cost, it is feared the scheme will be beyond its means.

7. A lump sum provision of Rs. 2,900 has been allowed in the estimate for possible demands for compensation owing to interference with vested rights of washing in the stream and diminution of water to irrigated land under it. The Collector has been asked to restrict the washing to a site not higher than 3 furlongs below anicut. A shown on the plan, and to state what provision should be made for compensation. The supply that will be taken off from the surface flow of the stream will be comparatively small, and can hardly amount at any time to one-third of the total quantity required for the supply of the town, viz., 420 gallons per minute. The surface flow cannot thus at the outside be diminished by more than 139 gallons per minute, which, at the rate of 1 cubic foot per second for 66 acres, is only sufficient to supply 24 acres. The provision made for compensation in the estimate for converting this extent of wet into dry land is thus likely to be sufficient, and, since it is not possible to determine, until the works have been executed, to what extent existing rights will be interfered with, the submission of the estimate has not been delayed pending the result of correspondence with the Collector on the matter.

Enclosure.

Report on the Vizianagram Water-supply Project.

1. *Population and supply.*—The population of Vizianagram, as enumerated at the census was—

In 1881	22,577
In 1891	30,881

For the purpose of this scheme, the population is assumed at 40,007, which allows a reasonable margin for future increase in population. The allowance per head per diem is 15 gallons. The supply required is, therefore, 40,000 × 15 = 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

2. *The source of supply.*—The source of supply is the valley of the Oottai Gedda, a stream which flows about a mile and-a-half to the north of the town. There are evidences of the existence of a copious supply of underground water in the valley, and it is proposed to obtain this by the construction of an infiltration gallery. The Oottai Gedda, as its name implies, is a perennial stream, the flow in which is said to have never dried up even in years of extreme drought. The flow was gauged over a weir board from 11th to 30th April 1897, and was found to equal 290 gallons per minute, which amounts to 417,600 gallons per day. April is usually the month in which the subsoil water level is at its lowest at Vizianagram, and it is remarkable that 1897 succeeded a year in which the rainfall was the lowest on record within the past 20 years—*vide* appendix II. The inference would be that the quantity gauged from 11th to 30th April 1897 was the minimum flow in the stream, but this is somewhat vitiated by the fact that in the preceding month there was an abnormal fall of 5·24 inches of rain. The flow was again gauged this year (1898) on the 18th and 19th of March, and was found to be 150 gallons per minute or 216,000 gallons per day. In addition to the surface flow in the stream, there must be, as indicated by the wells adjacent, a large quantity of water flowing underground down the valley, and it is not unreasonable to suppose that 600,000 gallons per day, which is the full supply required for the town, can be obtained from the valley by suitable infiltration works.

The area of the valley above the proposed site of the infiltration works is about 4 square miles. The lowest rainfall of any year since 1876 was in 1896, when it was 23 inches. The soil in the valley is favourable for the rapid absorption of rain water, and it may be assumed that about one-third of the fall would be absorbed by the ground. On this assumption the quantity of water percolating into the ground, even in the worst year, would be $\frac{4 \times 27,878,400 \times 23 \times 6\frac{1}{2}}{3 \times 12}$ or, say, 440 million gallons.

The quantity of water required for the town, at 15 gallons per head per diem for a population of 40,000, will be about 220 million gallons. There are thus reasonable indications that the requisite supply for the town can be obtained from the valley even in the worst year and that the supply in good years will be ample.

3. *Quality of water.*—The water from the Oottai Gedda has been analysed and has been pronounced to be "usable". A copy of the analysis is given in Appendix III.

4. *Infiltration works.*—The infiltration gallery will consist of a trench parallel to the Oottai Gedda, and about 100 feet distant from it. The length of gallery estimated for is 1,700 feet. Whether this length will suffice or not can only be ascertained after the trench has been actually dug. If the yield is found to be inadequate, the gallery could be easily extended along the southern slope of the Bonthee Konda, as shown by a dotted red line on sheet No. 1. Along the southern slope of the Bonthee Konda there are several springs that irrigate rice fields all the year round.

The bottom of the infiltration trench at its lower end will be at the level of 160·00, which is 10 feet below the bed of the stream.

The trench will be 8 feet wide at bottom, and the infiltration arrangements will be somewhat similar to that so successfully adopted at Cuddapah and Conjeeveram. Longitudinally, along the bottom of the trench, two rows of 9-inch stoneware pipes will be laid with open joints. The trench will then be filled up to a height of 7 feet above the pipes with broken stone and gravel varying in size from 4 inches in the bottom layer to ¾ inch at the top. Above this a layer of 3 feet of clean sand will be spread.

The excavation of the trench will not present any difficulties. The soil is gravelly and no timbering will be required. Pumping during construction will not be required, because the bottom of the trench is at the level of 160·00 and the bed of the stream just *below the anicut* is about 159·00. The trench can thus be easily drained off by a line of 18-inch stoneware pipes laid as shown on the plan. It is proposed to lay these drainage pipes into the ground permanently with a controlling valve in the collecting cistern.

The infiltration pipes will terminate in the collecting cistern from which the water will be conveyed to the suction well adjoining the engine house by two rows of flange-jointed steel pipes, 14 inches in diameter. As these pipes will not be easily accessible, it is desirable to take all reasonable precautions against any accident to them. With this object, a double row of pipes has been provided and the pipes will also be laid over a layer of concrete, but will not be bedded in it. The suction well is placed just outside the engine house. From the nature of the ground, there would be no engineering difficulty in sinking the suction well inside the house, but there are objections to a well inside the house on sanitary grounds. It has been found that with a well inside the house, it is not possible to keep it altogether free of contamination when washing the floor of the engine house.

5. *Engine house.*—The engine house consists of an engine room 19 feet × 23 feet, and a boiler room 23 feet × 23 feet with a 7-feet verandah on three sides. The floor of the engine house is 190·00 or 30 feet above inlet to suction well.

6. *Pumping machinery.*—As the scheme provides a service reservoir, the engines need pump only the average supply of 420 gallons per minute. The engines will require to lift water to a total lift of 90 feet as follows:—

	FEET.
Maximum water level in service reservoir	250·00
Inlet to suction well	160·00
Total lift	90

The pump horse-power required $= \frac{420 \text{ gallons} \times 90 \times 10}{33{,}000}$ = say 12 pump horse-power or, say three engines, each of 6 pump horse-power so that one may be always in reserve.

It is, however, proposed to erect only two engines at first, leaving room for a third engine to be erected in future, and the estimate accordingly provides for two engines only. The present population is about 30,000, and for many years to come the consumption will not exceed 10 gallons per head per diem. One engine will be capable of pumping 300,000 gallons, and thus two engines will meet requirements for many years to come.

The engines will be of the Triple Worthington's vertical type with locomotive boilers. The boilers will have iron chimneys attached to the crown of the boilers, as masonry chimneys with down-flues do not give satisfactory results with locomotive boilers.

7. The pumping main is 14 inches in diameter and will be 1,500 feet long.

8. *Service reservoir.*—The maximum water level in the service reservoir is 250·00. The delivery main to the town will leave the service reservoir at the level of 240·00, which is sufficiently high to deliver water 10 feet above ground level all over the town (but not the cantonment) even during the hours of maximum demand.

The cantonment can, however, be served by a subsidiary reservoir placed near the cantonment itself. This subsidiary reservoir can be filled at nights by a branch from the nearest pipe in the town, since at night there will be little or no demand for water in the town, and the statistical head over the town mains will be practically the same as the water in the service reservoir, which will vary from 240·00 to 250·00. The highest part of the cantonment is 217·00. A subsidiary reservoir with its maximum water level at 230·00 will suffice and can be filled by the main reservoir at nights.

It would be very expensive to place the main reservoir at a sufficient elevation to command the cantonment both during night and day. It will necessitate the whole supply to the town being lifted some 15 feet higher than the lift involved in the present scheme. The extra cost of pumping would, at the rate of As. 10 per million gallons lifted 1 foot high, be about

$$\frac{600{,}000 \times 15 \times 10}{16 \times 1{,}000{,}000} \times 365 = \text{Rs. } 2{,}050 \text{ annually.}$$

With a subsidiary reservoir, as above proposed, the supply to the cantonment will be just as constant and secure as it would be if the supply were obtained direct from the main reservoir, and the arrangement will not involve any additional cost in pumping.

The reservoir provided is capable of holding 600,000 gallons, which is a day's supply to the town for the increased population and maximum demand. For many years to come the demand will not exceed 300,000 gallons a day. The capacity of the reservoir therefore represents about two days' actual supply required at present to the town. When the demand of water increases additional storage can be easily provided.

The reservoir is in two compartments in order to enable its being cleaned. Each compartment measures 70 feet by 70 feet and has a depth of 10 feet up to maximum water level.

A bye-pass arrangement is provided for pumping direct into the town in case of necessity.

9. *Distribution pipes.*—The distribution pipes are all calculated to deliver double the average supply. The main from the reservoir is 14 inches in diameter, and is capable of delivering 840 gallons per minute, which is double the average supply. The sizes of the pipes have been calculated with reference to the population in each block.

The distribution system consists of about 12 miles of piping varying in size from 14 inches to 2½ inches.

The following are the details of pipes and fittings:—

	FEET.
14 inches piping	8,208
12 do.	2,232
10 do.	1,566
9 do.	1,521
8 do.	2,349
7 do.	504
6 do.	3,825
5 do.	3,915
4 do.	12,958
3 do.	24,831
2½ do.	1,260
	NO.
Sluice valves	73
Air valves	3
Hydrants	25
Pillar fountains	12
Single wall tap fountains	40
Double do.	13

10. *Capital cost.*—The scheme is estimated to cost Rs. 2,82,000 as shown below:—

	RS.	RS.
Infiltration works		28,430
Pumping station—		
Engine-house	12,220	
Drivers' quarters	3,000	
Store shed	2,000	
Compensation for land	3,500	
		20,720
Two engines and boilers each capable of lifting 210 gallons to a height of 90 feet		28,000
Service reservoir to hold 600,000 gallons		24,000
Pipes and fittings		1,33,900
Laying and jointing		27,200
		2,62,250
Contingencies, tools and plant		19,750
Total		2,82,000

Note.—The rates for masonry and earthwork in the estimate have been supplied by the Executive Engineer from his schedule of rates for 1897-98.

11. *Annual charges.*—The annual pumping charges for the immediate supply of 300,000 gallons per day, at 10 annas per million gallons lifted 1 foot high, will be $\frac{300{,}000 \times 90 \times 10}{16 \times 10{,}00{,}000}$ = Rs. 17 per day = Rs. 6,200 per annum.

Boiler Inspector's fees, repairs to machinery and works, etc., will cost about Rs. 2,800 annually. The total pumping and maintenance charges for the present will be Rs. 9,000 per annum.

APPENDIX I.

A memorandum on the various schemes investigated for the Vizianagram water-supply, with particulars of their cost.

1. Some time about the year 1891 Mr H. Turner (who was previously the Collector of Vizianagram), on behalf of the late Maharaja of Vizianagram, commissioned Sir Bradford Leslie to send out an Engineer from England to investigate a water-supply scheme for Vizianagram. Mr. W. M. Beckett, A.M.I.C.E., was selected. He arrived at Vizianagram in the following year and designed a scheme estimated to cost over 5 lakhs of rupees. Owing to the difficulty of financing the scheme, nothing further was done until 1896, when the Sanitary Commissioner revived the question of the water-supply to the town. In view of the heavy cost of the scheme prepared by Mr. Beckett, Dr. King suggested the possibility of obtaining a supply from the subsoil flow in the valley of the Oottai Gedda, which flows about a mile and a half to the north of the town. This scheme was referred to the Sanitary Board for remarks, which resulted in the Sanitary Engineer being requested to investigate all the possible schemes and select the best.

2. In December 1896 Mr. J. A. Jones made a preliminary inspection of Vizianagram and the various sources of supply. Mr. Jones had an interview with the late Maharaja and Mr. Beckett, who happened to be there at the time, with reference to the scheme prepared by the latter. It is understood that Mr. Beckett refused to give the report, plans and estimates of his scheme to the Sanitary Engineer, or to furnish any details thereof, until he (Mr. Beckett) was assured that he would be appointed Consulting Engineer to the works during their execution, with a remuneration amounting to 6½ per cent. of the actual cost of the works. Mr. Jones was not in a position to say whether Mr. Beckett's terms would be acceptable to Government, or whether Government would avail itself of his assistance. A few days later Mr. Beckett left for England without giving over the plans or furnishing any particulars of his scheme, for the preparation of which he was handsomely paid by the Maharaja.

3. While the relative merits of the Mentada and Oottai Gedda schemes were being discussed, Mr. W. A. Willock, I.C.S., recommended another scheme for the supply of the town from the bed of the Colhani river near the village of Nellimarla, some 4 miles from Vizianagram.

4. At this stage the undersigned was deputed by the Sanitary Engineer to investigate all the three schemes proposed, with the view of ascertaining the relative costs of the schemes. The results of the investigation are given below.

5. All the schemes are estimated on the basis of a supply of 15 gallons per head per diem for a population of 40,000.

With the view of obtaining a true comparison of costs, interest and sinking fund is reckoned on the whole capital cost of each scheme, without allowing for any contribution from Government or other sources. It is likely that in a small scheme contributions will bear a greater proportion to capital cost than what it would be in a larger scheme. Pumping charges are calculated on the full daily supply of 600,000 gallons.

6. *Mentada scheme.*—Nothing is known definitely by this department about Mr. Beckett's scheme except the place from which he proposed to obtain the supply. This point is on the Mentada river 19½ miles distant from Vizianagram. From information gathered from Mr. Ramamurthi Pantulu, the late Samasthanam Manager, who has seen the plans, Mr. Beckett's scheme appears to be as follows:—To construct an anicut across the Mentada river just below the point of its junction with the Gurlu Gedda; to convey the water by a channel to the Konsi tank (3½ miles from the anicut), which would serve as a storage reservoir, and finally to convey the water from the tank to the town, a distance of 16 miles, by 12-inch iron piping.

7. The drainage area of the Mentada river above the point of offtake proposed by Mr. Beckett is about 60 square miles. The rainfall record of the past 20 years shows the annual fall to vary from 24 to 78 inches. There is no doubt, whatever, as to the drainage being sufficient to give the supply required for Vizianagram in all years.

8. At the point of the offtake proposed by Mr. Beckett, the Mentada river is dry for six months in the year. By enquiry from the villagers it was ascertained that the river in ordinary years runs about 3 feet deep for 3 months in the year, and for another 3 months on an average 1½ feet deep. The storage tank must, therefore, be capable of holding at least 6 months' supply to the town; a larger supply, say, a nine months' supply, would be desirable. The Konsi tank, which is said to be the storage tank proposed by Mr. Beckett, is a very shallow tank, with about 7 or 8 feet depth of water. From the river, where it is proposes to build the anicut, to the crest of the Kalingula there is only a fall of about 2 feet, and, therefore, the Konsi tank does not admit of its being increased in depth. The Mentada river has, however, a great fall, and by

placing the anicut higher up, *i.e.*, near the village of Timmarazpet, it will have sufficient elevation to permit of the Konsi tank being raised. This, however, means not only a new anicut, but also a new channel some 3½ miles long. The length of the anicut required will be about 400 feet.

9. It would be advantageous to have the storage tank nearer Vizianagram, since it is proposed to pipe the supply all the way from the tank to the town; but on the line of delivery from Mentada to the town there is no other suitable tank existing, nor can one be formed such as would command the town.

10. The proposal to pipe the supply from the Konsi tank to the town is due to the impracticability of obtaining a suitable route for a masonry conduit. The line traverses deep valleys and a large number of streams, necessitating high embankments and many masonry works, which would bring the cost of the conduit to very little less than the cost of iron piping. In these circumstances, it is preferable to use iron pipes, which are superior, both from an engineering and sanitary point of view, to a masonry conduit. It was doubtless these reasons that led Mr. Beckett to propose iron piping.

11. The following are the levels (above mean sea) of some of the important localities connected with the scheme:—

Bed of the Mentada river at Timmarazpet	327·00
Bed of the Konsi tank	296·00
M.W.L. in service reservoir near cantonment	234·00

12. Roughly the above scheme will cost—

	Rs.
Anicut 400 feet long across river	25,000
Head sluice	5,000
3½ miles of channel to Konsi tank	42,000
Enlarging and improving Konsi tank	50,000
Filter beds to filter 600,000 gallons daily	30,000
16 miles of iron piping 12 inches diameter	5,12,000
Service reservoir to hold two days' supply (1,200,000 gallons)	60,000
11 miles of distribution pipes from 14 inches to 2½ inches	1,30,000
	8,54,000
Tools and plant contingency at 7½ per cent.	64,000
	9,18,000

13. The sinking fund and interest on Rs. 9,18,000 will be Rs. 55,000 per annum. Maintenance of the works will cost about Rs. 5,000, or, say, a total of Rs. 60,000 per annum.

14. *Nellimarla scheme*.—This was the second scheme investigated. It is the scheme recommended by Mr. W. A. Willock. The chief features of the scheme are—to construct infiltration works in the bed of the Colhani river near the village of Nellimarla about 4 miles from Vizianagram; to pump water to a service reservoir on an adjoining hill from which the water would gravitate to the town; and, finally, to distribute the water by iron pipes in the usual manner.

15. The river is 800 feet wide, has a drainage area of over 500 square miles, and has a deep sandy bed. There seems to be no doubt about the sufficiency of the supply.

16. The chief levels in connection with the scheme are—

Bottom of gallery or inlet to pump well	80·00
Lowest water level in river	90·00
Bed of river	90·00
M.W.L. in service reservoir	297·00

17. The total lift of the pump will be 297 — 80 = 217 feet. The quantity of water to be pumped per minute $= \frac{40,000 \times 15}{60 \times 24}$ = say 420 gallons.

The pump horse-power required is $\frac{420 \times 10 \times 270}{33,000} = 28$ pump horse-power, or, say, three engines each of 14 pump horse-power, allowing one reserve engine.

	Rs.
18. The scheme will cost approximately—	
Infiltration works	40,000
Pumping station	25,000
3 engines and boilers, each of 14 pump horse-power	54,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
15 miles of main and distribution pipes 14 inches to 3 inches, including laying and jointing	2,60,000
	4,03,000
Tools and plant and contingencies at 7½ per cent.	30,000
Total ..	4,33,000

19. The cost of pumping will be $\frac{600,000 \times 217 \times 10}{16 \times 1,000,000}$ = Rs. 82 per day = say Rs. 30,000 per annum.

	Rs.
20. The total annual charges will be—	
Interest and sinking fund on Rs. 4,33,000	26,000
Pumping	30,000
Maintenance	3,000
Total ..	59,000

21. *Oottai Gedda scheme.*—This is the scheme suggested by Dr. King and the one that is proposed to adopt. The source of supply is the subsoil water in the valley of the Oottai Gedda, a stream which passes about a mile and a half to the north of the town.

22. The scheme proposed is briefly as follows :— To construct an infiltration gallery or trench 1,700 feet long parallel to and about 100 feet from the river, commencing from a point opposite the lower anicut ; to pump the water to a service reservoir at a sufficient elevation on the adjoining hill ; and finally to distribute the supply from the reservoir in the usual manner by pipes, etc.

23. The lift of the pumps will be 90 feet as shown below :—

	Feet.
M.W.L. in service reservoir	250·00
Bottom of infiltration gallery	160·00
	90

The pump horse-power required is $\frac{420 \times 90 \times 10}{33,000}$ = say 12 pump horse power, or 3 engines each of 6 pump horse-power, allowing one reserve engine.

24. The scheme will cost—

	Rs.
Infiltration works	28,430
Pumping station	20,720
3 * engines and boilers, each of 6 pump horse-power	42,000
Service reservoir to hold 600,000 gallons (one day's supply) ..	24,000
12 miles of main and distribution pipes 14″ to 2½″ including laying and jointing	161,100
	276,250
Tools and plant and contingencies at 7½ per cent.	21,750
Total ..	2,98,000

25. The cost of pumping will be $\frac{600,000 \times 90 \times 10}{16 \times 1,000,000} \times 365$ = Rs. 12,400 per annum.

* Two engines only are actually allowed in estimate submitted.

	Rs.
26. The total annual charges will be—	
Interest and sinking fund on Rs. 2,98,000	17,880
Pumping	12,400
Maintenance	2,920
Total ..	33,200

27. *Conclusion.*— The following tabular statement shows the relative merits of the three schemes :—

Name of scheme.	Distance of head-works from town	Pump lift.	Initial cost.	Annual charges.				Remarks.
				Interest and sinking fund.	Pumping.	Maintenance.	Total.	
	Miles.	Feet.	Rs.	Rs.	Rs.	Rs.	Rs.	
Mentada	19½	*Nil.*	9,13,000	55,000	*Nil.*	5,000	60,000	Gravitation scheme.
Nellimarla	4	217	4,33,000	26,000	30,000	3,000	59,000	Pumping scheme.
Oottai Gedda ..	1½	90	2,98,000	17,880	12,400	2,920	33,200	Do.

NOTE.—All the schemes are on the basis of a supply of 15 gallons per head per diem for a population of 40,000.
Interest and sinking fund are calculated on the entire capital cost.
Pumping charges given above are for pumping the full daily supply of 40,000 × 15 = 600,000 gallons.

28. It will be seen from the above statement that the Oottai Gedda scheme recommends itself for adoption. It has the following advantages :— (1) It is the cheapest scheme of the three ; (2) It is within access of the town and its comparatively short length of main renders it less liable to temporary stoppages from accident ; (3) there are no villages in the water-shed of the Oottai Gedda and there is very little cultivation. There is much cultivation and there are many villages in the water-sheds of the Mentada and Colhani rivers. Hence Oottai Gedda is free from such sources of contamination as exist in the water-sheds of the other two rivers.

APPENDIX III.

Analysis of the water of the Oottai Gedda (Docket No. 760, dated 3rd August 1897, from the Chemical Examiner, Madras.

		Oottai Gedda river water from well. Bottle A.	Oottai Gedda river water from flowing river. Bottle B.
Total solids	Grams. per litre ..	0·220	0·220
Volatile solids	Do. ..	0·090	0·080
Chlorine	Do. ..	0 014	0 014
Total hardness	Clark's scale ..	4°·200	4°·900
Permanent hardness	Do. ..	1°·400	Trace.
Free ammonia	Mlgrms. per litre ..	0·048	0·052
Albumenoid ammonia	Do. ..	0·064	0·088
Nitric acid	Do. (as ammonia)	0·450	0·510
Apparent quality of the water as inferred from the results obtained on examination		Usable.	Usable.

Note by the Sanitary Commissioner for Madras, dated 25th April 1898, No. 942/S.

[*Reference* :— No. 248 S., dated 19th April 1898.]

The undersigned considers the sanitary requirements of the scheme have been carefully subserved within the limits allowed by Government. The only matter of doubtful expediency seems to him to be the "catch drain". If in after years it be

carelessly maintained—a not unlikely contingency—it will present the disadvantage of being the receptacle of undesirable matters, whilst the protection of the infiltration gallery will as to protection from surface percolation be diminished by the depth of the drain.

W. G. KING, Surgeon-Lt.-Col.,
Sanitary Commissioner for Madras.

To the Secretary, Sanitary Board, Madras.

Proceedings of the Sanitary Board, No. 556/S., dated 23rd September 1898.
Letter from the Sanitary Engineer to Government, Nos. 1115 and 1261, dated 24th June and 16th August 1898.

Resolution—No. 556/S., dated 23rd September 1898.

With his letter No. 372, dated 30th March 1898, read above, the Sanitary Engineer submits plans and estimates for the Vizianagram water-supply scheme, the latter amounting to Rs. 2,82,000.

2. The works consist of an infiltration gallery parallel to the Oottai Gedda, of an engine house and service reservoir and of main and distribution pipes to the town.

3. There are three sources of supply available, and in appendix I attached to the report each of these schemes is discussed and the reasons are given for selecting the Oottai Gedda scheme. They are briefly as follows:—

(1) It is the cheapest.
(2) Is within easiest access to the town.
(3) Is least liable to temporary stoppages from accident.
(4) Has the cleanest water-shed.

It is the scheme suggested and approved by the Sanitary Commissioner.

4. To make sure of the permanence of the supply it is recommended that, before execution of the other works estimated for, the infiltration trench should be dug and the yield tested. The cost of this work will be Rs. 10,500.

5. No provision is made for distribution of water to the cantonment. This can be taken up separately if required by the military authorities, who would pay the cost of the extension, and a separate water-rate for the water supplied.

6. The annual pumping and maintenance charges of the present scheme are estimated at Rs. 9,000. A supply of 15 gallons per head per diem is provided for a population of 40,000. The supply required is therefore 600,000 gallons per day, which is equal to an average demand of 420 gallons per minute.

7. In paragraph 6 of the Sanitary Engineer's letter it is suggested that the capital cost of the scheme be divided between the Government and the Vizianagram zamindari, the late Maharaja having expressed his willingness to contribute $1\frac{1}{2}$ lakhs towards the cost. The Municipality cannot, it is said, provide any considerable portion of the capital cost. It will, however, have to find the maintenance charges of Rupees 9,000 per annum.

8. The Sanitary Commissioner expresses some doubt as to the expediency of the catch drain.

9. In his subsequent letter No. 1261, dated 16th August 1898, the Sanitary Engineer supplies information called for by the Sanitary Board in regard to the cost of extinguishing water rights. He estimates that a sum of Rs. 1,450 must be paid for the 24 acres of land required for the gallery and service reservoir and the lands put out of cultivation above the proposed site of the infiltration gallery. In addition to this land, there will be 120 acres affected lower down, and the compensation to be paid on this account is estimated by the Collector at Rs. 10,000 to Rs. 12,000. The total amount of compensation, therefore, may, as an outside estimate, be set down as follows:—

	Rs.
Eleven acres required for works	150
Thirteen acres above infiltration gallery at Rs. 100 an acre ..	1,300
One hundred and twenty acres lower down at Rs. 100 per acre ..	12,000
Total ..	13,450

10. The estimate contains a provision of Rs. 2,900. The balance, therefore, for which provision will probably have to be made, is 10,550. The amount of the estimate will then stand at Rs. 2,92,550.

11. The Sanitary Engineer suggests that the revision of the estimate might be deferred until after the gallery has been excavated, when it will be possible to determine more definitely the area of irrigated land that will be affected by the scheme.

12. The plans and estimates have been carefully examined and the Sanitary Board considers the project the best obtainable in the locality.

13. Mr. Willock seems to think (paragraph 3 of his letter) that the infiltration gallery will fail to give the required supply, and it is understood that the Superintending Engineer, I Circle, has also expressed a doubt on this point. Under these circumstances the Sanitary Board is disposed to adopt the suggestion of the Sanitary Engineer that the infiltration gallery be first excavated at a cost of Rs. 10,500 and the yield tested during the dry months of the year. If the results are satisfactory the estimate for the whole scheme can then be revised if necessary and approved.

14. The cost of the experimental works might be shared equally by the zamindari and the Government.

15. The catch drain is certainly necessary to take up the water coming down the numerous deep gullies. It should be revetted with stone in bed as well as sides to ensure its keeping its shape.

16. There are only three air valves provided. One at every summit would be an improvement, and where there are no submits, one in every $\frac{1}{4}$ mile.

17. With these remarks the Sanitary Board resolves to submit the project to Government for orders.

(True Extract.)

R. PARSONS,
Secretary, Sanitary Board.

To the Secretary to Government, Local and Municipal Department.

ORDER—No. 2170 M., dated 16th December 1898.

The papers read above will be forwarded to the Municipal Council of Vizianagram for early remarks.

2. The Municipal Council is also requested to ascertain and report whether the contribution of Rs. 1,50,000 promised by the late Maharaja of Vizianagram will now be realized, and if this is not possible, how it proposes to finance the scheme on the understanding that the Government contributes a moiety of the estimated cost and advances the balance from Provincial funds at 4 per cent. interest, repayable in twenty years.

(True Extract.)

H. TREMENHEERE,
Ag. Secretary to Government.

To the Chairman, Municipal Council, Vizianagram
(through the Collector of Vizagapatam).
,, Sanitary Board.

[Ref. 4]

1,000—17-12-06.

Mint DEPARTMENT.

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