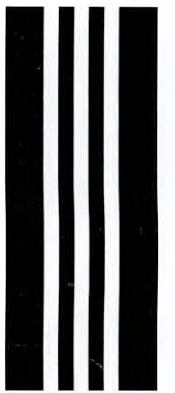


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DEPARTMENT OF WATER DEVELOPMENT

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ANNUAL REPORT FOR 1959

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DEPARTMENT OF WATER DEVELOPMENT

ANNUAL REPORT FOR 1959

The engineering and geological side of all Government water development work has been in the hands of the Department of Water Development whose duties include the search for new sources, the conservation and development of supplies for irrigation, domestic and industrial use, and the problems connected with river training, flood protection and land drainage. As a result of the London Agreement of Feb. 1959 and the subsequent setting up of Interim Ministries under the Cyprus Joint Council the Department has, since 1st July 1959, been responsible in all its actions to the Interim Minister of Agriculture and Natural Resources. The administration of Village Irrigation Divisions and Associations and domestic Water Commissions has been supervised by the District Commissioners. Disputes over water rights have been handled chiefly by the Commissioners in consultation with the Law Officers and the Departments of Land Registration and Water Development. Soil Conservation and the agricultural problems involved in the economic use of water for irrigation are responsibilities of the Department of Agriculture.

2. Because of the unsettled political conditions prevailing in Cyprus at the beginning of 1959 the works programme of the Department of Water Development, during the first half of the year, was considerably restricted due to the scarcity of public funds which could be devoted to this work. Consequent to the London Agreement money was latterly made available from Colonial Development and Welfare funds and in the second half of the year the Department was able to undertake a fairly full programme of both domestic and irrigation waterworks. The chief works undertaken during the year included the commencement of construction on the first stage of the Morphou Bay, £900,000 scheme, which when completed will provide an additional 2 million gallons per day to Nicosia; the completion of a 65 feet high irrigation dam near Pyrgos and of an £80,000 scheme for the lining of irrigation channels at Kythrea, and the construction of a 85 feet high irrigation dam on the Marathasa river, near Lefka which will be completed in 1960. In addition new boreholes were drilled by the Department and village domestic and irrigation works were undertaken to the value of £198,640. The total expenditure of the Department in 1959 amounted to £500,872.

3. The winter of 1958/59 was one of very low rainfall. The average precipitation over the whole island was only 14.05 inches or about 70.9% of normal. It was below normal almost everywhere and was exceptionally low in the central Mesaoria Plain and around Limassol and Larnaca where the rainfall was only between 55-60% of normal. This low rainfall was reflected by a considerable diminution in the flow of springs during the summer of 1959 and by a reduction in the output of wells and chains-of-wells tapping shallow aquifers. Many villages suffered severely from shortage of domestic supplies and irrigation water.

4. The department is divided into seven technical services dealing respectively with:-

- (a) Irrigation and drainage
- (b) Investigations for major irrigation projects
- (c) Town water supplies
- (d) Village domestic water supplies
- (e) Hydro-geology and drilling
- (f) Hydrology
- (g) Workshops

Other sections dealing with accounts, administration and clerical matters together comprise a head office which serves all the above technical services. There is continuous liaison between all branches so that their work is co-ordinated in the best interests of the over-all water supply problems of the island. Thus a source of water may be developed for domestic water supplies in excess of the requirements of a particular village and the surplus may be utilised for irrigation; where gravity water supplies are not available geological investigations may locate underground sources from which water can be pumped for irrigation or domestic use.



IRRIGATION AND DRAINAGE

5. As in previous years the majority of the irrigation and drainage works carried out by the department were small in size. They may be classified in the following groups.

- (a) Excavation of springs to increase yield
- (b) Diversion of stream flow
- (c) Lining channels with concrete
- (d) Construction of concrete or masonry storage tanks
- (e) Construction of infiltration galleries
- (f) Construction of concrete and earth dams
- (g) Installation of pumping plant on wells and boreholes
- (h) Flood protection and river training
- (i) Land drainage.

6. The total number of irrigation and drainage schemes completed during the year was 26, providing sufficient water to irrigate 3688 donums, of which 1993 donums can be irrigated perennially. Four more schemes were in progress at the end of the year and a further 110 have been planned in detail and are ready to be carried out as opportunity occurs. These figures are not inclusive of many small works carried out by landowners following the drilling of boreholes by Government or by private contractors.

7. The rate of progress in irrigation in the period of development since the 1946 census is shown in the following table:-

/4. ...

	Gravity Irrigation		Pumped Irrigation	Total
	Perennial Donums	Seasonal Donums	Donums	Donums
1946 Census	59,409 (say) 59,000	284,997 (say) 285,000	53,131 (say) 53,000	397,517 (say) 397,000
Estimated at end of 1958	89,000	359,500	149,000	397,500
New Irrigation in 1959 (say)	2,000	1,500	13,500 <sup>@</sup>	17,000
Estimated total at end of 1959	91,000	361,000	162,500 <sup>*</sup>	614,500
Percentage increase since 1946 census	53%	27%	203%	55%

@ Includes 4,500 donums resulting from private drilling.

\* Includes 10,000 donums resulting from private drilling.

8. The total area of arable land in Cyprus amounts to about 1,3,900,000 donums of which 80% to 85% is cultivated; 15.7%/now irrigated in an average winter and 6.5% in an average summer. It is estimated that new irrigation works are causing the value of agricultural production in Cyprus to increase by about £750,000 each year.

9. The lining of the Kythrea irrigation channels was continued and completed at the end of the year. Work on this scheme was started in 1958 and by the end of 1959 a total length of 22 miles of the main earth distribution channels had been lined in reinforced concrete at a cost of £80,000. The works were carried out entirely at Government expense as compensation for compulsory acquisition of 5% of the water from the Kythrea spring in 1956 which has been used for the domestic supply of the dry villages in the Eastern Messaoria. Whereas it was anticipated that the saving in water resulting from lining

the channels would be some five times the quantity acquired, the actual benefit from these works in terms of water saving, effective distribution and management is now proving to be very much greater. This increased benefit has been very readily recognised by the irrigators in Kythrea and they are now applying for the lining of other distribution channels within the area.

10. The final stage of the distribution system at Trimiklini was completed during the year and the works were handed over to the Irrigation Division. The project which was first started in 1957 forms a typical example of establishing perennial irrigation by the storage of winter water for use during the latter part of the summer, when the flow of streams is normally at a minimum. The scheme consists of a 105 foot high dam and a combined distribution system of lined channels and steel pipes of a total length of 5 miles. A detail description of the works will be found in the 1957 Annual Report.

11. Work on the construction of a 65 foot concrete dam at Pyrgos (Tyllirias) was resumed in 1959 after a suspension of the works during the emergency. It has been possible to complete the work in time to close the sluices of the dam before Christmas and to impound the first winter flow. The dam and storage reservoir forms part of an irrigation scheme which was started in 1958 and includes a distribution system of reinforced concrete channels 5 miles in length which was completed before the suspension of the works. The storage capacity of the reservoir is 60 million gallons and the total area to be irrigated is 1600 donums out of which 600 donums will be irrigated in early summer. The total volume of mass concrete used in the construction of the dam was 6,700 c.yards out of which a volume of 4,000 c.yards was placed in 1959. The total expenditure on this scheme amounted to £45,000.

12. Late in the year a start was made on the construction of a large concrete gravity dam and reservoir on the Marathassa river near M.P.38 on the Lefka-Pedhoulas road. By the end of the year the main foundations had been completed and work is now in progress for the construction of the main undersluices. A total volume of about 2,000 cubic yards of 1:2:4 concrete has been placed in the foundations

which go down to a maximum depth of 25 feet below river bed level and incorporate a system of grout holes to render the foundations watertight. The dam which will have a height of 85 feet above river-bed will form one of the largest reservoirs of its kind in Cyprus with a capacity of about 85 million gallons and will provide perennial irrigation for 780 donums of land, mainly orange groves, in Lefka. Part of the main road to Pedhoulas will be submerged when the reservoir is full and will be re-aligned at a higher level. The scheme is being carried out for Lefka Marathassa Irrigation Association and includes other works such as an 8"  $\phi$  steel conveyor pipeline,  $1\frac{1}{4}$  miles long from the dam to the distribution system which was constructed in 1958.

13. At Geunyeli near Nicosia a new weir has been constructed in place of the old DJINAR DERE weir which was built in the early nineteen forties and washed away last year. The weir rises to a spillway height of 11 feet above river bed level and is built in mass concrete. It is equipped with a 100 foot spillway, appropriate wing and side walls and intake arrangement capable of diverting a flow at the rate of 9 cubic feet per second into the old distribution system for spate irrigation of cereals. The cost of the work was £7,000 and was met entirely by Government on the grounds that the old weir was destroyed by an abnormal flood. The new works were completed in time for testing during the spate flow that came down at the end of the year.

14. A work similar to Geunyeli was put in hand very late in 1959 at Tseri near Nicosia. The spillway of the old weir which had been severely damaged by floods was reconstructed in mass concrete. It has a length of 100 foot which is twice as wide as the old structure. The spillway section of the weir was completed by the end of the year and work is proceeding on strengthening and underpinning the old wing walls. The cost of the work estimated at £3,000 is being met entirely by Government as in the case of the new Djinar Dere weir at Geunyeli.

15. A River training scheme on the Xeros River, Paphos has been completed during the year under review. It consists of 8 gabion groynes and reinforced concrete wired staking just over one mile in length of a type adopted by the Department for river training and reclamation of riverine land.

16. At Koloni, Paphos a system of perforated concrete pipes were laid in the river gravels for the collection of underground water. These collector pipes lead water, which hitherto ran to waste, into a system of gravity steel pipes and irrigation channels thereby augmenting the supply of summer water available to the Irrigation Division of Koloni Yeroskipos.

17. A tunnel 1865 feet long was driven and lined with concrete blocks to replace part of the underground pipe line which conveys the water of the Xeros River and Kaphizes Dam to Lefka for the Lefka Co-operative Irrigation Society.

18. Other works completed during 1959 include a pipe distribution system at Ayios Nicolaos as an extension to the existing irrigation scheme which was carried out in earlier years. A method of pressure grouting has been tried at Kandou on the right abutment of the dam which was constructed in 1954 and has since developed minor leakages from cracks and fissures through the rock face of the river bank. It is expected that if the experimental work at Kandou proves satisfactory the method will be more extensively applied in future where necessary. At Akhna in Famagusta District a pumping scheme was completed with funds provided by the Commissioner Famagusta and pumps were installed at Kyra in the Nicosia District with funds provided by the Kyra Irrigation Association. Other minor irrigation schemes completed during the year appear at Appendix 6.

19. Works which were in hand by the Irrigation Section of the Department at the end of 1959 include the lining of channels at Ay. Therapon as an extension to the old irrigation scheme carried out in recent years; a complete renovation of the irrigation works at Statos in the Paphos District where the old works were severely damaged during the earthquakes.

20. Irrigation works which were planned and are ready for construction but not yet started include the Ayia Marina dam and reservoir in the Paphos District where the ancillary works such as intake and 4 miles of pipes were completed in 1958. A dam and reservoir and channels at Argaka, Magounda; lining of channels at Syrianokhori

Kato Lakatamia, Zodhia-Angolemi, Polis, Peristerona; infiltration works at Phinikas, flood diversion works at Famagusta etc. as per Appendix 8.

INVESTIGATIONS FOR MAJOR IRRIGATION PROJECTS

21. Field Surveys and Drawing Office work for the larger irrigation projects has continued throughout the year but the scale of these activities were reduced towards the end of the year owing to the reduction of staff caused by the departure of several ex-patriate engineers. The schemes which are described in the following paragraphs have been examined during the year under review.

22. The Peristerona River Storage Scheme in the form now being planned will consist of two large mass concrete dams to form reservoirs in the Peristerona river which can be used for large scale storage of water for controlled irrigation. Two sites have been surveyed, one at the locality "Kambos-tou-Tourkou" above Kato Moni and one at the confluence of the two rivers near Panayia Forest Station. Water impounded by these reservoirs can serve to irrigate lands in Peristerona, Astromeritis, Orounda, Katokopia, Zodhia and Morphou. The system of conveying water from the reservoirs to the lands in accordance with existing rights is now being studied in connection with irrigation development and recharge works in the Morphou area. Optimum heights and storage capacity of these two dams are as follows:-

Dam	Height above River bed	Storage Capacity Mill.galls.	Approx. Cost
Kambos-tou-Tourkou	90 ft.	300	£150,000
Panayia	100 ft.	200	£150,000

23. Upper Pedia Storage Scheme. Plans have been completed for the construction of a large storage dam at a site near Kambia village which is very favourable as regards storage but has long been suspect geologically. As the result of recent investigations, however,

the site has now been accepted provided reasonable precautions are taken with the construction of the foundations. Two other sites where smaller dams can be built as alternative to Kambia have been surveyed, one opposite the deserted village of Philani and the other half-a-mile downstream at "Lekani" locality. Water from these reservoirs can be distributed to the villages of Episkopio, Politiko, Argades, Psomolophou etc. in accordance with existing water rights.

24. A scheme has been drawn up for the construction of an earth dam to form a reservoir on the Almyros River near Geunyeli. The dam will impound about 140 million gallons of water and will have a height of 35 feet from river-bed to spillway level. An earth spillway will be provided to discharge into an adjacent stream which will be fully protected from erosion by gabion and concrete cascade weirs. Water from the reservoir can be delivered into the existing irrigation system for controlled irrigation in winter and spring. The scheme is estimated to cost £27,000, including compensation for land.

25. A site has been surveyed for an earth dam on the Elea river which is earmarked for recharge purposes in the Morphou area. Surveys for dams have also been carried out at Kapilio and Nikitari. A complete list of dam sites surveyed in 1958 and 1959 is given at Appendix 9.

26. Investigations in hand at the end of the year for major projects include surveys and drawing office work for large scale extensions to the Famagusta-Dherinia recharge project and irrigation development and recharge in the Morphou area; a small-scale experiment is now being carried out near the site of the pumping stations at Syrianokhori for the Nicosia Water Supply with a view to determining the quantity of water that can be recharged into the underground aquifer through boreholes.

### TOWN WATER SUPPLIES

27. Under present conditions the Water Boards of Nicosia, Limassol and Famagusta are responsible for the supply of Water to their respective towns. The members are nominated half by Government and half by the Municipal Council and the Chairman is appointed by the Governor. In Larnaca the water authority is the Evcaf Department while in both Paphos and Kyrenia it is the Municipality. The Department of Water Development advises all the above authorities on the technical aspects of their water supplies. In the case of Nicosia the Department itself now supplies a large proportion of the water.

28. In 1959, in the early part of the year, the Town Water Supply Section of the Department was chiefly occupied in the completion of the distribution system of the Greater Nicosia Scheme and in the laying of a pipeline from an additional source at Akaki. Subsequently as a result of the decision by the Joint Council for the undertaking of the construction of the Morphou Bay Scheme by the Water Development and Public Works Departments, and not by contract as originally intended, the Section was fully occupied from July to the end of the year in the laying of borehole feeder pipelines and of the 16" steel pumping main. It was also engaged on the construction, along a re-aligned route, of a section of the Abu Bekir Pasha chain-of-wells for Larnaca Water Supply. Details regarding Town Water Supplies, including consumption figures, are given in Appendices 10, 11 and 12.

29. The restriction of water supplies to consumers was required in Nicosia, Limassol and Larnaca during the summer of 1959, and to a lesser degree in Famagusta. Because of the rapid increase in urban population, rising standards, and the deterioration of many of the sources it will be necessary to spend large sums of money on town water development in the next few years. The position as regards each of the main towns is briefly described in the following paragraphs.

30. In Nicosia the distribution system for the Greater Nicosia Scheme was completed to provide a house supply to some 4,800 consumers in the suburban area. This Government project also supplies water in bulk to the Water Board of Nicosia. It is designed for eventual integration with the Board's Works and with the Morphou Bay Scheme. With the exception of the old part of the town within the wells, where



There is still no proper piped distribution system, Nicosia and its immediate suburbs now have an adequate reticulation system which can provide water (measured by meter) to every house within the area of supply. The quantity of water available from the sources is at present sufficient to provide a reasonable adequate supply for 8-9 months of the year but during the hot summer months, when the demand is great, these sources cannot meet the requirements of the town. In July, August and September 1959, during which period water restrictions had to be imposed in Nicosia, the average daily quantity provided from all sources was 3.0 million gallons, equivalent to 32 gallons per head of an estimated population of 93,000. Outside the old walled town the consumption averaged 37 gallons per head per day. It is considered that to provide a supply sufficient to meet the summer peak demands a quantity of 45-50 gallons per capita per day is necessary.

31. Good progress was made in the construction of the Morphou Bay Scheme for the supply of additional water to Nicosia, on which work was commenced in July 1959. The laying and testing of some 22,000 feet of feeder pipelines from the 14 borehole sources to the main pumping station was completed and a 35,000 feet section (2/7ths of the total length) of 16" diameter steel pumping main was laid by the end of 1959. The Public Works Department who have undertaken the construction of the main pumping station, the 100,000 gallons collecting reservoir and the access roads have also made good progress although somewhat delayed by the non-arrival of essential materials. The scheme is expected to be completed before the summer of 1961.

32. Because of the steady deterioration of one of the present main pumping grounds at Kokkini Trimithia, it is unlikely that the present rate of supply to Nicosia can be maintained. Allowing for a decreased output from the present sources and an additional supply in 1961 of 2 million gallons per day from Morphou Bay the maximum available daily supply to Nicosia will then be of the order of 4.3 million gallons for a population of 100,000 or 43 gallons per head. This quantity will still be insufficient to meet the peak summer requirements of the town and for this reason and because the population of Nicosia is increasing at more than 5% per year, and living standards are rising, there is clearly a pressing need for planning for the future. The second stage of the Morphou Bay scheme provides for another pipeline to deliver

an additional 2.00 million gallons per day from boreholes in the same general groundwater area. The effects of this proposed additional pumping on local irrigation cannot however be entirely disregarded. The possibilities are being investigated of providing Nicosia with a gravity supply sufficient for the needs of Nicosia during the winter months from the upper reaches of rivers whose water at present runs to waste to the sea. By this means it should be possible to save pumping costs and to conserve the groundwater sources for summer supply.

33. The present system of administering the Nicosia water supply is far from satisfactory. Water is sold directly or indirectly, by three chief authorities namely Government, the Water Board and the Water Administration and in the case of the Board the current charges are not sufficient to recover expenses including such matters as loan charges and adequate maintenance costs. With a view to improving the organisation and to safeguard its investments Government, in 1959, introduced legislation setting up a new provisional Board with powers to integrate and control the supply to the whole of the Greater Nicosia area. The new Board has been studying this matter with a view to making recommendations to the future Republican Government. At the end of 1959 however the situation was virtually unchanged, with this Department still responsible for the supply of the suburban area and the Board selling water within the central area at uneconomic rates.

34. In Famagusta, in the summer of 1958 water restrictions had to be imposed only for very short periods but the water supply position is in a dangerous state because the levels in the Phrenaros boreholes, from which most of the water is drawn, are declining from year to year with very little recovery after each winter's rain. It is unlikely that the present output can be maintained for many more years. During the summer the total consumption was slightly over one million gallons, or approximately 32 gallons per person for a population of 31,000. In the 10 years 1946-1956 the number of inhabitants increased by 68.1% the highest rate of any town in Cyprus. This rapid expansion, and the improbability of maintaining the supply at its present level, emphasises the very urgent need for additional water.

35. In 1956 a scheme was prepared for supplying 1.00 million gallons per day in the first instance from boreholes near Liopetri and Xylophagou at an estimated cost of £325,000 but the scheme was held up through lack of money. If as has been proposed, the establishment of a separate British base at Dhekelia makes it inadvisable to proceed with the Xylophagou scheme then the future supply for Famagusta will have to be from Liopetri and from the present War Department boreholes at Kalopsida. A revised scheme will be submitted as soon as a settlement is reached regarding the boundaries and water supplies of the Sovereign Areas.

36. It will not of course be possible to extract very large quantities of water for Famagusta from the Liopetri or Kalopsida areas because of the villagers needs for irrigation. If therefore the population of Famagusta continues to increase at its present rate it is probable that before very many years serious consideration will have to be given to de-salting sea water either by distillation or by freezing methods. Present day costs are excessive but considerable research is being carried out in this field in various countries and improved techniques may result in reduced production costs.

37. In Limassol the population has increased by 63% in 10 years. It now has 42,000 inhabitants and as the town grows more difficulties are to be expected each summer in providing sufficient water. In winter the springs in the Khalassa area provide a supply of from 1.3 to 1.5 million gallons, which quantity is considerably in excess of the present winter requirements of the town and about one third can be used for recharging the Chiftlikoudhia ground water area. In summer, however, the flow of the springs fall of considerably particularly after low rainfall as in the winter of 1958-59. During the summer of 1959 it dropped to 350,000 gallons per day and although the supply was augmented by pumping from Chiftlikoudhia and private boreholes the total quantity of 1,300,000 gallons thus available was able to provide only 31 gallons per head of population per day and for long periods restrictions had to be imposed. Although these exceptionally low discharges of the Khalassa springs are not to be expected every year there is clearly an urgent need for additional sources for the summer supply of the town. To this end the Department, in 1959, sunk several prospecting boreholes to test the potential resources of the water bearing gravels of the Garyllis and Yermasoyia rivers. The

The results of the drilling in the Yermasoyia valley were particularly encouraging and it seems likely that this source may be able to provide an answer to Limassol's more immediate water supply problems.

38. In Larnaca, in the summer of 1959 after an exceptionally dry winter, the flow from the ancient Abu Bekir Pasha chain-of-wells dropped to 590,000 gallons per day or 31 gallons per person of a population of approximately 19,000. In a normal summer, however, the flow is sufficient to provide between 45 and 50 gallons per day which is considered adequate for this town whose population is increasing only very slowly. The chief cause of shortage in certain areas of this town is not lack of water so much as the absence of a storage reservoir and because there is no satisfactory zoning of the street mains into distribution areas. An outline scheme for a reservoir, a new pipeline from the chain-of-wells and the division of the town into 6 independent distribution areas was prepared in 1954 and work can be commenced as soon as funds can be provided. This scheme, together with minor improvements, is estimated to cost £200,000 at 1959 price levels. It would provide for storage of water, now frequently wasted at night and for a more uniform distribution to the higher parts of the town.

39. In the smaller towns and municipalities works have also been planned and constructed. In Paphos as an interim measure to relieve an acute water situation an additional supply of 50,000 gallons per day was provided from a new borehole near the town and new distribution pipes were laid in newly built areas. These works cost £11,000. Even with this new supply the daily quantity of water available in Paphos in the summer of 1959 was only 170,000 gallons or 22 gallons per head of a population of 7,700. The £200,000 scheme submitted in 1958 for the provision of 300,000 gallons per day from Yerovasa which would solve the supply problem of this town has had to be deferred through lack of money. Kyrenia was also very badly off for water in the summer of 1959 when the supply fell to 65,000 gallons per day equivalent to only 16.7 gallons per person and at the request of the Municipality several proposed sources of additional water were investigated and some minor works were undertaken. There seems however to be no solution to this problem other than the scheme of 1958 which recommended the piping of water from the Karavas and Lapithos springs.

VILLAGE WATER SUPPLIES

40. The work of the Village Domestic Water Section is confined mostly to water supplies for villages and rural municipalities but it also includes the towns of Paphos, Kyrenia which are mentioned in the preceding paragraph. Sources of water are examined, measured, and where suitable, developed. Supply and distribution pipelines are laid and storage tanks and public "fountains" constructed. A "fountain" is a combined public standpipe, trough and drainage soak-pit. House connections are not normally made but there is a growing demand for this convenience. The sources of a village water supply may be springs, infiltration galleries, boreholes or wells. The use of boreholes and wells has been much favoured in places where there are no suitable springs for a gravity supply. Turbine pumps are installed, which pump water into ground level or elevated re-inforced concrete tanks, whose function is not only to provide adequate storage, but at the same time to act as a reservoir from where a restricted and uniform quantity of water can be withdrawn.

41. During the year 45 village water supply works were completed and 66 miles of pipes were laid. Fifteen of these schemes were new or complete replacements and the remainder were improvements to existing supplies that were formerly unsatisfactory or inadequate.

42. It is now estimated that of the total of 627 villages named in the census of 1946, the number with piped supplies is 525 or 83.73%. 380 (60.60%) may be considered satisfactory and 145 (23.13%) need fundamental repairs or replacements. Because of rising standards a number of village water supplies that were formerly considered satisfactory are now inadequate and require improvements. The 102 villages still without piped supplies are on the whole situated far from reliable sources, and the cost and difficulty of supplying them with piped water will, in most cases, be greater than in past schemes.

43. In addition to the 45 schemes completed in 1959, a further 5 schemes were under construction but incomplete at the end of the year. Plans have been prepared for a further

96 and although some need modification in view of changing circumstances, most are ready for starting as soon as money becomes available. One of the rural communities which is in great need of additional water supply is the small municipality of Pano Lefkara. A gravity supply scheme has been prepared at an estimated cost of £36,000. This scheme involves the laying of 19 miles of pipelines of 4 inches and 3 inches diameter, for the conveyance of water from springs in the area of Ayii Vavatsinias. The pipeline will provide for the supply of over 85,000 gallons per day, during winter, which in addition to supplying the needs of the town will also be used for recharging the aquifer of the present borehole, which is exhausted by the continuous pumping. By this arrangement the borehole will recover during the winter, and its water will be used only during the summer, when the yield of the springs will be low.

44. The following table indicates the work done on village water supplies during the year under review :-

LENGTH OF PIPES LAID IN 1959  
(Galvanised mild steel pipes)

Size:	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	6"	Total
Miles	3.2 <sup>0</sup>	10.50	9.00	5.60	5.60	11.00	6.60	3.20	1.50	56.20

(Asbestos cement pipes)

Size:	3"	4"	6"	Total
Miles	1.50	1.60	6.25	9.35 miles

Elevated Tank/ 2: Ground Level Tanks/ 35:

Pumphouses/ 5: Fountains 176: Distribution boxes 13:

45. The schemes completed may be classified as shown below. "Village standard" means that the distribution of the water is effected by street fountains only, not by house connections.

(a)	New schemes where previously there was no piped water to village standard and including house connections	..	..	..	..	..	9
(b)	Total replacement of an obsolete scheme to village standard	..	..	..	..	..	3

(c)	Improvements to village standard only	31
(d)	Improvements including house connections	1
(e)	Water Supplies to Schools and Police Stations	1
		<u>1</u>
		45
		=====

Lists showing the village schemes completed, those in hand, and schemes which have been prepared are given in Appendices 13-16.

46. The largest village domestic water works under construction during the year was a combined scheme in the Karpas peninsula for Ayios Seymeon, Korovia and Galinoporni with provision for future extensions to Neta, Vathylakas, Lythrangomi and Leonarisso. The source of the water is a pair of boreholes near Ayios Andronikos, and the works comprise, in the present phase, a pump-house with a 30,000 gallons storage tank, 6,500 feet of 6" pumping main, a 100,000 gallons circular reinforced concrete storage tank, some 11½ miles of supply and distribution pipes, 3 village storage tanks and 42 fountains. Work on the scheme was started in October, 1958, and the scheme for Korovia and Galinoporni was completed in September, 1959.

47. Another large village domestic supply water work undertaken during the year was the combined scheme for Pera-Khorio, Nisou and Louroujina. The source of supply is a typical infiltration gallery in the Yialias river where the water is tapped in the gravels at a depth of 22 feet. A steady continuous quantity of 60,000 gallons per day is conveyed to these three villages through 9½ miles of 6" and 4" diameter pipeline. Each village has been provided with adequate storage and distribution mains in all streets for a house-to-house service. The share of each consumer will be regulated to about 100 gallons per day by means of break-pressure boxes. Work on the scheme was started on the 14th July and completed at the end of the year.

48. A 30,000 gallon elevated storage tank has been constructed for the Military Authorities at Pyla Camp. Another similar elevated storage tank is under construction at the Ormidhia Military Camp.

DRILLING FOR WATER

49. The Drilling Section of the Department of Water Development is largely occupied in sinking irrigation, domestic water and industrial boreholes for public bodies and commercial companies upon repayment. It also sinks, at Government expense, the prospecting boreholes which so often give rise to subsequent development both by Government and by private enterprise. The benefits of perennial irrigation resulting from recent boreholes are clearly visible in the marked agricultural development that is taking place in drilling areas. Where previously the summer landscape was bare and arid, citrus groves and vegetable gardens are being extended year by year and the agricultural economy of these districts is thereby greatly improved.

50. Water for the towns of Nicosia and Famagusta and for most of the villages of the plains is derived from boreholes located and sunk by the Department of Water Development. Schemes for additional supplies for these towns and for other villages from new boreholes are under construction and in course of preparation.

51. Fourteen <sup>drilling</sup> rigs were available for use during the year but because of the unsettled conditions in January and February only eight were operating during these months. Subsequently the other rigs were sent out and from June onwards all fourteen rigs were in the field. Two of the rigs are on loan from the War Department.

52. All the department's rigs are of the percussion drilling type and with one exception have a normal capacity range of 8" to 10" diameter holes to a depth of about 600 ft. One rig, a Ruston-Bucyrus 60 R.L., is a heavier type, capable of drilling to over 1000 feet or shallower large-diameter boreholes. One Ruston-Bucyrus 22 R.L. machine has a rotary attachment which enables core samples to be taken. In 1959 the average drilling depth of boreholes sunk for water was 258 feet and the greatest depth 760 feet.

53. The number of boreholes sunk by the department during the year was 191. Of these 140 were for irrigation, 33 for domestic water and the remainder for hydro-geological or miscellaneous technical purposes. Of the boreholes drilled for water 80.3% produced more than 1000 gallons per



hour on test and are classified as "successful". The total tested output rate of the year's well drilling was more than 40 million gallons per day, sufficient to irrigate 20,000 donums in summer if pumped regularly at half the tested yield.

54. In addition to the above Government work a considerable amount of drilling was carried out by registered contractors. Twenty private drillers were licensed and operating during 1959. Most of the rigs are of a light, locally built type but there are also two Ruston-Bucyrus 22 R.L.s and one 60 R.L. working. Private drillers have sunk 135 known new boreholes for water during 1959, of an average depth of 158 feet and a total estimated (but not tested) output rate of 18.4 million gallons per day.

55. In the past 10 years some 2,300 boreholes have been drilled for water by the Department of Water Development and, together with old wells and boreholes and others that have been sunk privately, they now produce some 20,000 million gallons per annum. The area under pumped irrigation has risen from about 60,000 donums in 1949 to 160,000 donums in 1959, an increase of 160%. This rapid development has been of immense importance and benefit to the economy of the Island, but it has caused a general lowering of the water table in most pumping areas, making it abundantly evident that this high rate of expansion cannot continue and that in some places pumping will have to be reduced or within a few years the aquifers will become exhausted.

56. Among the places which are causing concern are the well developed groundwater areas around Morphou, Kokkini Trimithia, in the area between the Kondea - Famagusta road and the south coast of the island and between Limassol, Kolossi and Phassouri. The question of the control of pumping and of the sinking of new boreholes is becoming a matter of the utmost importance. If existing capital investment is to be protected it will be necessary, in the common interest, to restrict the output from old established wells as well as from new ones. Control measures will have to be rigidly enforced or the inevitable result will be the failure or partial failure of many sources of water upon which much money and labour has been spent in the past and on which the economic well-being of the island so largely depends. The strict control of private drilling to prevent illegal well sinking which unfortunately

has been increasing in recent years, is also a matter of prior importance.

57. The widespread and intensive drilling operations of recent years have undoubtedly discovered and demarcated most of the island's aquifers so that it is unlikely that any extensive new groundwater areas remain untapped. During 1959 the very little money which was made available for prospecting drilling was devoted to finding domestic water for rural communities.

#### HYDROLOGY

58. The hydrological service continued and increased its work of collecting and recording information on the following subjects:-

- (a) Changes in ground water levels
- (b) Quantity of water pumped from wells and boreholes
- (c) Annual re-charge of aquifers
- (d) Flood run-off in rivers
- (e) Summer discharges of streams
- (f) Discharges of springs
- (g) Run-off from different types of catchments
- (h) Chemical and bacteriological analyses of water.

Special intensive studies are being made of groundwater conditions in the Phrenaros area which is the chief source of the Famagusta town water supply and in the Kokkini Trimithia and Morphou Bay areas which are of special importance to Nicosia water supply. Hydrological information is summarised regularly in monthly and annual reports.

59. Among the results obtained from hydrological surveys and research one of the most useful is the information concerning the effect of the recent expansion of borehole pumping upon the underground water resources of the island. The increased agricultural production resulting from irrigation with pumped groundwater is of great economic value to the island and it is very important that the present pumping output should not only be maintained but that it should be increased from year to year where possible. The reservoirs of underground water, however, are not unlimited and so in developing irrigation from wells and boreholes, one must take care not to exhaust the aquifers by drawing off more

water than can be replaced naturally from the rainfall or in some cases artificially by re-charge works.

60. In order to study the effect of the recent developments it is necessary to keep a careful watch upon changes of ground water level in pumped areas. For this purpose a total of 57 special observation or control boreholes have been drilled at key points, and within the special study areas some 2,000 privately owned wells and boreholes are observed at regular intervals. The chemical quality of the water is also checked periodically so that any increase in salinity can be detected at an early stage. The information obtained from these observation boreholes is showing beyond doubt that in certain areas such as Phrenaros, Famagusta, Kokkini Trimithia, Laxia, Morphou Bay and elsewhere new drilling must be rigidly controlled if existing public and private interests are to be protected and if further groundwater development is to proceed on sound lines.

61. A summary of the water levels over the past years is given in Appendix 5. This shows, among other things, that the minimum groundwater level at Kokkini Trimithia, which is still the chief source of Nicosia town supply, fell by nearly 20 feet in the past 9 years. At Phrenaros, the chief source of the Famagusta supply, the water table has fallen by over 19 feet in 7 years. This rapid and continuous decline in water levels indicates clearly that both these groundwater areas are becoming seriously depleted and that unless the rate of pumping is reduced or unless artificial recharge is found possible, it is only a matter of a very few years before disaster overtakes the sources used in these areas for the town water supplies of Nicosia and Famagusta. It is therefore imperative that these two towns should develop alternative sources.

62. In groundwater areas near to the sea the fall is generally less marked. Along the Morphou Bay coast the observation boreholes a few hundred feet from the shore show a decline of 2.8 feet in the past 4 years while about 2 miles inland the decline over the same period is nearly 12 feet. This represents a flattening of the groundwater gradient which undoubtedly has resulted in a reduction in the underground flow to waste to the sea. But it also shows that steps to avoid overpumping of the area are most necessary. At Xylophagou, where the observation boreholes are on average about a mile

from the sea, the recorded fall over the past 8 years was about 4 feet. Around Famagusta the groundwater level has remained substantially constant since 1953 when recharge operations began both directly by the Famagusta Recharge Schemes and indirectly from the water of the new town supply.

63. At the end of 1958 there was fairly heavy rainfall in the Famagusta area and as a result a considerable quantity of water was collected in the Ayios Loucas reservoir and Paralimni Lake. This water was recharged and absorbed in the Famagusta Recharge Tunnel. There was however very little rainfall subsequently. The total volume of water artificially recharged into the Famagusta aquifers in the hydrological year 1958-59 has been estimated at 125 million gallons.

64. At Limassol in the winter of 1958-59 the total recharge effected by the Limassol Water Board into the Chiftlikoudhia chain-of-wells from the surplus water of the springs supplying the town was only 60 million gallons as compared with 102 million in the previous year. This can be accounted for by lower spring discharges in a season of very low rainfall. On the other hand the quantity pumped from Chiftlikoudhia in the summer and autumn of 1959 rose to nearly 120 million gallons, twice the quantity extracted in the previous summer. As a result of this heavy pumping the NaCl content rose sharply to 937 parts per million towards the end of the season but this is still far below the 1000 parts per million which this water contained prior to the introduction of recharge operations in the winter of 1954-55. This rise in salinity is however a warning that the Chiftlikoudhia source must not be overpumped and still further emphasizes the need for additional summer supplies for Limassol.

65. As might be expected in a year of low rainfall no exceptional floods occurred in the winter of 1958/59 although the rains in December and January caused a number of fairly heavy discharges in some localities. Among these was a short period of flood of 3,500 - 4,000 cusecs on the Trimithios river at Ayia Anna, Larnaca District and 1,700 cusecs on the Stavros River, Paphos District. The percentage run-off over the whole hydrological year was much less than average ranging from nil at sea-level on some rivers to 20% at others. At Trimiklini (1,900 ft. above sea level) the average percentage run-off was 14% as compared with 22% in the previous year and on the Peristerona River at Panayia (1,450 ft. above the sea) it was 21% as compared with 32% in 1957-58.

66. The measurement of spring discharges was continued at regular intervals as part of the normal hydrological survey and also, in special cases, for proposed village water supplies. A total of 109 springs or small streams was measured regularly, involving 1785 measurements.

67. Totals of 1549 samples of water for chemical analysis and 683 samples for bacteriological analysis were collected during 1958-59 and submitted to the Government Analyst and the Government Pathologist respectively for their reports. The samples were taken mainly from domestic supplies all over the island during periodic checks and from control boreholes to check groundwater quality. Samples were taken from all new boreholes during pumping tests and from various springs, streams and rivers used for irrigation purposes.

68. Notes on the work of the Hydrological Section for the year 1958-59 together with summarised information are given in Appendices 4 and 5.

#### WORKSHOPS

69. Changing labour conditions, rising costs and the increased use of pumping both for irrigation and domestic supplies have made it necessary in recent years for the department to operate and maintain a considerable amount of mechanical plant.

70. The Workshop Section of the Department attends to the maintenance of all departmental plant and in addition serves all the other sections of the Department in respect of such matters as the building of forms for concrete work, carpentry, the supply of precast concrete products, the installation of pumping plant, the fabrication of special pipe connections and steel sluice gates, the cutting and bending of steel reinforcement, the slotting and perforation of pipes and drilling casing, etc. etc.

71. The workshops and store accommodation of the department include workshop office, garage, fitters shop, plant maintenance bay, precast concrete yard, welders shop, smithy, a small moulding shop, a water-meter testing room and three store buildings. In addition there are two open storage sites one of  $1\frac{1}{2}$  donums, used mostly for interchangeable timber formwork, and one of 12 donums for pipes.

72. A list of the chief items of plant now on charge is given in Appendix 17. Other plant is hired from contractors or borrowed from other departments as required. Heavy lorry transport is all hired from contractors but some departmental Rovers and light "Countryman" vans are used for the transport of personnel, light tools, etc.

#### MISCELLANEOUS ACTIVITIES

73. Technical advice is frequently sought for and given to public bodies including the War Department and Air Ministry and advice is also given to private individuals on water supply problems. The department is also asked to provide expert opinion on water disputes. A total of 16 prolonged test pumpings of boreholes and wells was made during the year for Government, the Services, public bodies and private individuals. Miscellaneous activities such as the above, and the necessity for the department to be represented at numerous committee meetings on a wide range of subjects, absorbed a very large proportion of the time of the technical staff.

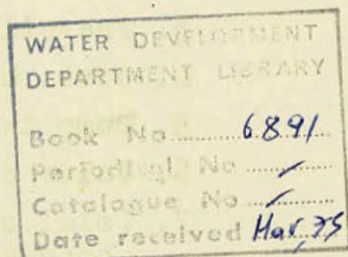
74. A technical paper "Cyprus Water Development 1959" was prepared by Mr. I.L. Ward, C.B.E., B.E., M.I.C.E., M.I.W.E., Director, before he was transferred to Tanganyika. This excellent and concise report presents a resume of the progress in water development in Cyprus in recent years both in construction and planning and makes recommendations of how this work can best be continued in the future.

LEGISLATION

75. The only new law concerned with water enacted in 1959 was the Nicosia Water Supply (Special Provisions) Law which provides for the temporary reconstitution of the Water Board of Nicosia with powers to manage and control all water undertakings for the supply of the Greater Nicosia area, including those at present operated by Government. This law is due to expire on the 31st December, 1960.

76. New orders under the Wells Law issued on 30/4/59 and 26/11/59 provide for the control of all new well-sinking in the groundwater areas north of the Kyrenia Range, both to the east and west of Kyrenia town and in the area of Makedonitissa between Nicosia and Kokkini Trimithia, respectively.

77. The urgent need for considerable revision of the present Wells Law has been recognised by Government. This is required to provide for the control both of pumping and of the repair or replacement of old wells within conservation areas; for the inspection of drilling works carried out by private drillers and for a tightening of the rules for licensing drillers and their equipment. A Committee has been set up to make recommendations to Government on this matter. Government has also decided that in future the administration of the Wells Law, the Government Waterworks Law and the Public Rivers (Protection) Law shall be the responsibility of the Department of Water Development.



FINANCE

78. The following is a summarised statement of the expenditure of the Department of Water Development in 1959:-

	Government Funds	Contribution from Beneficiaries	Total
1. Irrigation & Drainage	59,147	26,000	85,147
2. Village Water Supplies	60,493	53,000	113,493
3. Subsidized Drilling	-	-	-
4. Prospecting for water	2,459	-	2,459
5. Drilling upon repayment	-	28,027	28,027
6. Greater Nicosia water supply scheme	34,500	-	34,500
7. Morphou Bay Scheme	38,946	-	38,946
8. Town Water Supplies upon repayment	-	15,731	15,731
9. Hydrological Research	7,090	-	7,090
10. Purchase of Plant	960	-	960
11. Miscellaneous Works for Government Authorities	6,127	-	6,127
12. Maintenance and Running of Gr. N. S.	24,676	-	24,676
13. Departmental and Maintenance	143,716	-	143,716
	378,114	122,758	500,872

79. Included in the above statement are :-

1. Personal emoluments	£65,000
2. Wages for labour (approx.)	195,000
3. Travelling	16,677
4. Govt. controlled irrigation works	8,187
5. Pump testing wells and boreholes	825
6. Value of casing pipes fixed in boreholes	6,249
7. Total cost of drilling and cleaning boreholes excluding items 5 and 6	45,084
8. Maintenance of Govt. water supplies and purchase of water	4,910



9. Expenditure under 1956/61  
Development Programme including  
funds provided by other departments £108,552

80. Two C.D. & W. Schemes were approved during 1959. One was for £100,500 to cover the cost of certain village water supplies and irrigation schemes and the other one was for £160,000 to cover expenditure on the Morphou Bay Scheme.

81. The average cost of a new borehole in 1959 was £195 and the cost per foot of drilling £0.773 mils. A sum of £5,469 was collected as departmental charges for works carried out for water boards upon repayment and for other miscellaneous works.

82. Water Development works are usually assisted by Government grants or loans, or by both grants and loans. Towards the cost of gravity irrigation works the village contribution varies from 20% to 60% according to the type of work and the nature of the ownership of the water. Where the water is owned collectively as by the members of an Irrigation Division, the usual rate is 20% for spate irrigation and 33.3% for perennial irrigation. In Irrigation Associations there is private ownership of water and the village share is usually higher than for a Division; each case is considered on its merits with the result that the average village contribution over the past year was about 47%. The village share of the cost of a scheme is usually raised by a loan from the Government Loan Commissioners at a low rate of interest but occasionally it is paid partly or wholly in cash or in free labour. In respect of drilling, private individuals are charged the actual cost including 20% departmental charges on works and 25% on the cost of casing pipes. Municipal Corporations, companies, etc., also usually pay the full cost and departmental charges at the rate of 20% on labour and 25% on materials. Town water supply works are paid for in full by the respective authorities including departmental charges at the rate of 6% on labour and 10% on materials. The new Greater Nicosia Scheme and the Morphou Bay Scheme are, for the time being, financed wholly by Government. Domestic water schemes for rural municipalities and villages are paid for half by

Government and half by the village if no house connections are wanted. If there are house connections the extra cost is borne entirely by the village.

STAFF AND LABOUR

83. At the beginning of 1959 the staff of the Department was as follows :-

Director	1
Assistant Director	1
Senior Engineers	3
Executive Engineers	6
Geologist	1
Superintendents of Works	3
Senior Inspectors of Works	7
Inspectors of Works	9
Technical Assistants	26
Foremen	79
Clerical, Accounts and Miscellaneous	40
	<hr/>
	176
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84. However because of the forthcoming transfer of power to the Republic of Cyprus on 19th February 1960 the Senior Staff of the Department was, during the latter half of 1959, considerably depleted by the transfer, retirement or termination of Contracts of most of the senior officers. Mr. I.L. Ward<sup>1</sup>, C.B.E., B.E., M.I.C.E., M.I.W.E., formerly Director was transferred in July to Tanganyika, where he was appointed Director of Water Development. Mr. Ward had served as Director in Cyprus since 1948. Mr. O.J.E. Gething<sup>2</sup> and Mr. R.S. Wood<sup>3</sup>, Senior Engineers left Cyprus on retirement in July and August respectively. Messrs. A.R.H. Deverill<sup>4</sup>, L.C. Mock<sup>5</sup>, T.E. Scales<sup>6</sup>, A.J.B. Staveley<sup>7</sup> and C.F. Sayer<sup>8</sup>, Executive Engineers and Mr. R.D. Morris<sup>9</sup>, Geologist, who were serving on ageement had their contracts terminated and left Cyprus during the period July - September, 1959. Mr. J.K. Karapetian, B.E.M., Superintendent of Works, also retired on age limit on 1st July, 1959. Mr. Karapetian's long service

and experience in irrigation in Cyprus dates back to 1922 when he first joined the Public Works Department. A further loss sustained by the department was by the accidental death of Mr. Christos Stylianou, Assistant Chief Foreman.

85. Three Government scholars who had been studying for University degrees in the United Kingdom completed their courses and returned to Cyprus during 1959. Two of these Messrs. C.H.A. Konteatis and Mr. T. Mirata were appointed Executive Engineers and Mr. Y. Hji Stavrinou was appointed Geologist in the Department. Three more scholars are completing their studies in the United Kingdom.

86. The average number of labourers employed during the year was 761 as compared with 929 in 1958. About 52% were classed as skilled labourers and about 39% were regular. The approximate monthly averages were as shown below:-

<u>Month</u>	
January	416
February	377
March	390
April	429
May	420
June	498
July	721
August	1009
September	1153
October	1309
November	1192
December	1220
	<hr/>
Average	761
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There were no labour disputes or strikes but work had to slow down during the first half of the year due to the shortage of funds. There were no appreciable variations to the wages structure during the year except the usual annual increases granted to regular employees.

87. I would like to take the opportunity of recording and acknowledging the devotion to duty and enthusiasm with which the staff<sup>of</sup> the Department, at all levels, have at all times, sometimes under difficult conditions, carried out their work.

CONCLUDING NOTE

88. In Cyprus, where both the population and living standards are rising fast, there is an ever increasing demand for more and more water both for the domestic supply of villages and towns and for irrigation. Because the rainfall on the Island is relatively light the sources of water, which all depend on rainfall, are limited and will never be able to fully meet all the needs of the inhabitants. The potential water resources can however be exploited and developed to a much greater extent, and for their more efficient use, than at present and there is therefore an urgent and pressing need for a steady programme of investigations and works at the highest possible level of expenditure.

D. P. MacGregor,  
Ag. Director of Water Development.

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APPENDIX 1.

DRILLING FOR WATER

By Yiangos Hji Stavrinou, B.Sc., A.R.C.S., F.G.S., Geologist.

During 1959 the department's drilling plant consisted of 14 rigs but at the beginning of the year, owing to the unsettled political situation, only 8 of them were operating in the field. The remaining 6 joined in from March onwards. Early in January, one of the three rigs on loan by the Army, was withdrawn by the War Department Authorities. This rig is not included in the figure, given above, of the rigs in use for the year 1959. At the beginning of the year there were one Ruston-Bucyrus 60 R.L., eleven Ruston - Bucyrus 22-Ws, and in April and June two Edecos were brought to the field. All these rigs are of the percussion type but one 22-W is fitted with a rotary attachment enabling the rig to be used for either percussion or rotary (shot crown or tungstem-carbide crown) core drilling. The normal capacity range of the rigs is 8" to 10" diameter boreholes to depths of up to 500 feet but the 60 R.L. is a much heavier duty rig. Under normal conditions it can drill an 8" diameter borehole to a depth of over 1,000 feet or, alternatively, can be used to drill 18" diameter holes to over 250 feet depth.

The department has also a number of transportable deep-well pumping units for long, continuous test-pumpings of wells and boreholes. In addition to several old reciprocating pumping units, there are two diesel-driven turbine pumps of 5,000 and 15,000 gallons per hour capacity respectively, at 100 feet head and two 25 K.V.A. mobile diesel-electric generating sets which are used in conjunction with 7½" diameter electro-submersible pumps. With these units borehole testpumping may be carried out in the capacity head range of 18,000 gallons per hour from 100 feet to 8,000 gallons from 400 feet. In all 16 long test pumpings, from 48 to 960 hours continuous duration, were carried out, involving a total pumping time of 2747 hours and a total volume of 40 million gallons of water. Experience has proved that such exhaustive test-pumpings are absolutely essential for proving the potential reliability of the aquifers.

The number of boreholes drilled during 1959 was 191 with an aggregate footage of 48,250 and an average depth of 253 feet. One hundred and seventy three boreholes with a total footage of 44,665 were drilled for water. The average drilling depth for water was 258 feet. The average time taken to complete a borehole, including the time taken to lay casing and to carry out an eight hour test-pumping of a successful borehole was 16 days. The average footage drilled per day was 15.8 feet. The total tested yield of boreholes sunk for water in 1959 was 40,116,000 gallons per day. In addition to new drillings 43 old boreholes were cleaned and renovated involving 286 drilling days, equivalent to the average time taken to drill 18 new boreholes. Two of the existing boreholes, in the Government Morphou Experimental Farm were giving trouble due to the infiltration into the wells of considerable quantities of very fine sand which was causing wear in the pumps and pump drive shafts. The fine sand was stopped from entering the boreholes by enlarging them to 21" and 18" diameter, placing 8" diameter casing in the well and filling the annular space outside the casing with grade coarse sand and fine gravel. This gravel packing technique is costly and involved 93 days drilling operations but the result to the life and performance of the pumps is expected to fully justify the expenditure. A total of 140 boreholes were sunk for irrigation of these 118 or 84.3% produced on test an aggregate of 35.62 million gallons per day.

The number of successful irrigation boreholes drilled by Government since 1946 is now 1174 with a tested output of 234 million gallons per day, sufficient to irrigate 117,000 donums of summer crops.

The actual area now being irrigated as a result of these drillings is conservatively estimated to be of the order of 99,500 donums. The census of 1946 estimated that at the time some 53,000 donums of land were being irrigated perennially by pumped water. By the end of 1959 as a result of Water Development drilling alone this has been increased by 188% to 152,500 donums.

Apart from the necessity of meeting the continual heavy demand for new boreholes from the highly productive

Western Mesaoria. drilling for water has been fairly evenly distributed throughout Cyprus in 1959. By districts, the borehole distribution was as follows:-

Nicosia & Kyrenia	108
Famagusta	22
Larnaca	15
Limassol	27
Paphos	18

Nine prospecting boreholes were sunk in 1959. Most of these were drilled for domestic water supply purposes. Although all the major underground sources of water must by now be known several prospecting boreholes have produced interesting discoveries of water. A particularly useful find, both in quantity and quality, of groundwater, was the Yermasoyia river valley where prospecting is being carried out for Limassol water supply. It must be pointed out that this discovery has been the result of the useful seismic survey carried out in 1958 under the auspices of the Water Development Department by the Directorate of Overseas Geological Surveys. By this rapid and comparatively inexpensive method of investigation the depths of water bearing gravels as well as the profiles of the underlying bed-rock was determined. It was exceedingly interesting to find from the favour prospecting boreholes drilled in the Yermasoyia river valley that the depth of the gravels as actually checked by drilling showed the accuracy of the seismic survey to be within 10%.

A borehole drilled a little outside Terra Village penetrated the Terra Limestone series which is the basic formation of the Dhali group in this area. This borehole penetrated pervious chalk at the top but from 40'-197' the Miocene reef limestone of this series was struck. This borehole was pumped continually for about two and a half months at the constant rate of 7,500 gallons per hour which is a useful find of good quality water in an area about which little was known before.

Another useful find has been the result of deep drilling in Paphos district between Ktima and Koloni village. Drilling here has proved that in a localised area pervious Lepithos chalks and marls exist which yield water from

joints bedding planes and solution channels. Two boreholes near Koloni went down to depths of over 600 feet. In these boreholes water was struck at two lower levels at about 350' - 450' and 520' - 630' in addition to water found at higher levels. Drilling here has shown that the supply of water from this type of aquifer is localized, for a few hundred feet from a successful borehole which has already been developed a second borehole was unsuccessful although it penetrated similar strata. Sufficient boreholes have now been drilled in the vicinity for a general trend of flow to become apparent.

An extensive hydro-geological and geophysical research programme of the areas between Ormidhia and Xylophagou as well as north of the Nicosia-Famagusta main road round the Ayios Nicolaos Camp near the 4 M.P. to Famagusta, was undertaken by the Army in 1959. Part of this programme included the drilling of 5 boreholes in the Ormidhia and 4 boreholes round the Ayios Nicolaos area.

There were twenty five privately owned drilling rigs, licensed to drill for water, operating in Cyprus at the end of 1959, showing an increase in number of five rigs compared with 1958. Altogether they drilled 135 new boreholes all for water with an aggregate footage of 21351. Unfortunately there were quite a number of illegal drillings of which no information is available. Of these legal boreholes 77% were successful and gave an estimated total output of 768,000 gallons per hour. Seventeen of the rigs are locally made, some of them quite well constructed, but they are of a rather light type generally only suitable for drilling in favourable rock conditions. There has been a tendency towards the use of imported drilling rigs by private contractors. In 1959 in addition to the 17 locally made rigs there were three Ruston - Bucyrus 22W, one Ruston Bucyrus 60 R.L., 3 Swedish made rigs and one rotary "Sailing" rig. As in previous years the majority of boreholes have been sunk in the Famagusta and Larnaca districts where drilling is comparatively easy and wells may be sunk without casing. There has, however, been increased activity in the Nicosia district during 1959 where drilling rigs were operating near Nicosia and two in the vicinity of Morphou.



By law, private drilling contractors are obliged to give notice of drilling, to keep records of depth of boreholes and static water levels and to retain borehole samples for inspection by an officer of the Water Development Department. Test pumpings are not normally carried out but from information received it is possible to arrive at an approximate figure of the total water yield of these private drillings. As many of the boreholes were drilled in the bottom of existing wells the increase in yields is somewhat conjectural but it is conservatively estimated that the increase in perennial irrigation as a result of these drillings is of the order of 4500 donums in 1959.

The average cost of departmental drillings in 1959 was £195 per borehole or £0.773 mils per foot of drillings. These costs are inclusive of the expenses of laying casing pipes and of an eight hour test pumping of successful boreholes. They are exclusive of the purchase price of borehole casing pipes and the capital cost and installation charges of permanent pumping plant. They include the wages of the drilling crews, fitters and blacksmiths, and the cost of workshop maintenance, fuel and lubricating oils, but sharpening and repairs and replacements of drilling tools and equipment. They do not include depreciation of drilling plant and the salaries and expenses of the supervisory staff.

No subsidized boreholes were drilled in 1959 as no funds were made available for subsidized drilling. 182 boreholes were drilled on a full repayment basis and 9 were drilled entirely from Government funds. No new observation boreholes were drilled in 1959 but three old boreholes were brought into use for this purpose making the total to 57. Provision for a considerable number of additional observation boreholes is most essential but unfortunately funds were not made available for this purpose in 1959.

APPENDIX 2

NUMBER AND FOOTAGE OF BOREHOLES

NUMBER OF BOREHOLES DRILLED

1952 - 1959

Purpose	1946-52	1953	1954	1955	1956	1957	1958	1959
For Private individuals & Companies	807	169	182	170	128	202	106	155
For Government	185	51	57	101	55	62	35	9
For War Department and Air Ministry	119	10	15	62	30	29	16	27
Totals	1111	230	254	333	213	293	157	191
Aggregate Footage Drilled	208403	44563	49159	58437	42681	51420	32842	48250
Average Depth	188	194	194	175	200	175	209	253

Boreholes Drilled in 1959

Purpose	No.	Existing Well Footage	Footage Drilled	%age successful	Total Tested Yield in g.p.d.
Irrigation	140	4,210	36,375	84.3	35,618,400
Domestic Water Supplies	24	964	6,646	66.6	4,183,200
Prospecting	9	-	1,644	55.5	314,400
Total For Water	173	5,174	44,665	80.3	40,116,000
Observation Borehole	1	103	219	-	-
Technical & Geological Boreholes	17	-	3,366	-	-
TOTAL DRILLED	191	5,277	48,250	-	-

Old Boreholes Renovated: 43

APPENDIX 3

BOREHOLES DRILLED FOR WATER IN 1959

SUMMARY OF RESULTS

District Locality		No. of B/Hs. Drilled	No. Success- ful *	%age Success- ful	Total tested output g.p.d.	Average yield per suc- cessful borehole g.p.d.
Nicosia	Western Mesaoria	61	59	96.7	27,421,800	464,776
	Akaki- Paleometokho- K/Trimithia- Yerolakkos	17	15	88.3	1,368,000	91,200
	Lefka- Angolemi- Evrykhou- Elea- Keravostasi	7	5	71.4	648,400	121,680
	Ayia Varvara- Potamia	4	2	50.0	360,000	180,000
	Potami	1	1	100.0	45,600	45,600
	Dheftera- Lakatamia	10	8	80.0	2,026,800	253,350
	Nicosia- Strovolos- Engomi	3	1	33.3	129,600	129,600
	Larnaca	Ormidhia	1	1	100.0	144,000
Dhromolaxia		1	1	100.0	43,200	43,200
Pergamos		6	1	16.6	144,000	144,000
Tremetousha		1	-	-	-	-
Xylotymbou		1	-	-	-	-
Paphos	Koloni	4	2	50.0	117,600	58,800
	Ktima- Yeroskipos	4	4	100.0	361,600	90,400
	Mandria	5	3	60.0	368,800	122,930
	Nata	1	1	100.0	24,000	24,000
	Terra	1	1	100.0	160,800	160,800
Famagusta	Akhna	2	2	100.0	529,200	264,600
	Ay. Andronikos	2	2	100.0	230,400	115,200
	Famagusta- Larnaca Road	4	4	100.0	626,400	156,600
	Lysi- Strongylos- Sinda	4	1	25.0	33,600	33,600
	Spathariko	1	1	100.0	52,200	52,200
Vatyli-Kondea	7	6	85.9	753,600	125,600	
					/38.	...

District Locality		No. of B.Hs. Drilled	No. Successful *	%age Successful	Total tested output g.p.d.	Average yield per successful borehole g.p.d.
Kyrenia	Ay.Epiktitos	1	-	-	-	-
	Aghirda	1	-	-	-	-
	Dhiorios	3	1	33.3	72,000	72,000
Limassol	Ay.Phyla	1	-	-	-	-
	Cherkez Chiftlik Phasouri	4	4	100.0	607,200	151,800
	Episkopi-Erimi-Kandou	4	4	100.0	1,632,000	408,000
	Kolossi	1	-	-	-	-
	Limassol	3	3	100.0	91,200	30,400
	Mandria	1	1	100.0	76,800	76,800
	Moutayiaka-Yermasoyia	6	5	83.3	2,016,000	403,200
	Totals	173	139	80.3	40,116,000	279,716

\* A successful borehole is one that yields on test not less than 1,000 gallons per hour of usable water.

APPENDIX 4

HYDROLOGICAL NOTES 1958-59

By N. Ch. Toufexis, Inspector of Works

(This report covers the period from  
1st October 1958 to 30th September 1959)

Meteorological.

The main characteristics of the total precipitation during the year were :-

- (a) The average rainfall over the whole island was 14.05 inches which is about 70.9% of normal. The average rainfall since 1908 is 19.8 inches.
- (b) October and November were nearly dry months. Normally 16.4% of the year's precipitation falls during these months. This year only about 5.2% was measured.
- (c) Bad weather systems brought heavy rainfall to all parts of the island in December and in January. The highest daily rainfall during this period was 4 inches at Ayios Neophytos Monastery and Platania Forest Station on the 6th December. The precipitation for the remainder of the year was considerably below average and the lowest since 1932.
- (d) Morphou and Mesaoria plain were the parts of the island experienced the lowest precipitation during the year, while the Akamas peninsula together with the Famagusta - Dhekelia - Cape Greco triangle recorded normal rainfall.
- (e) The most intense rainfall occurred on the 17th December in the catchment area of Tremithios river during a storm which lasted about 2 hours. It is estimated that the intensity of rainfall during the storm was about 2/3 inch per hour and caused flood in the Tremithios river.
- (f) Temperatures tended to be below normal during Autumn, Winter and Summer and almost normal during the spring. The highest temperature recorded at Nicosia was 102° F in July and August.

Flood Discharges.

The only serious floods reported in 1958-59 occurred early in winter when isolated heavy rains fell on the east and west slopes of the central massif. The highest flood flows were 4000 cusecs at the Tremithios river recorded near Ayia Anna and 1700 cusecs at the Stavros tis Psokas recorder near Evretou on the 17th December. The rainfalls on this day were 1.2 inches at Perakhorio (Nisou) and 1.3 inches at Stavros tis Psokas.

Summary of some of the larger floods and of the maximum rainfalls measured in the catchment on the day of the flood is given in the following table :-

River	Place	Peak flow in cusecs	Rainfall in inches	Place	Date
Yialias	Kochati	1100 <sup>31</sup>	2.0	Mandra tou Kambiou	17.12.58
Yialias	Kochati	1300 <sup>37</sup>	0.6	Mandra tou Kambiou	4. 6.59
Harangas	Kato Varosha	1100 <sup>31</sup>	2.5	Dherinia	7.12.58
Tremithios	Kiti	1500 <sup>42</sup>	1.2	Perakhorio (Nisou)	17.12.58
Tremithios	Ayia Anna	3500/4000 <sup>113</sup>	1.2	Perakhorio (Nisou)	17.12.58
Khrysokou	Skoulli	1500 <sup>42</sup>	3.0	Stroumbi	16.12.58
Stavros tis Psokas	Evretou	1700 <sup>48</sup>	1.3	Stavros tis Psokas	17.12.58
Stavros tis Psokas	Evretou	1600 <sup>45</sup>	1.4	Stavros tis Psokas	28. 1.59
Alakati	Ayios Amvrosios, (Kyrenia)	1300 <sup>37</sup>	0.9	Halevga	8. 4.59

River Discharges.

As a result of the generally low rainfall intensities experienced over the Island during 1958-59, the total discharges from most of the mountain rivers were below normal. The only gauging stations which recorded above normal total discharges were those situated at Evretou and Khrysokhou rivers as well as at some on the plains west of Famagusta.

At the end of the hydrological year the following water level recorders were in operation :-

No.	Catchment	Location	Type of installation
1	Pedhieos	Nicosia ex-Railway bridge	Depth recorder
2	Yialias	Near Kochati	Recorder on 60 ft. measuring weir
3	Ovgos	Morphou-Kyrenia Bridge	Depth recorder
4	Serakhis	Near Morphou	Depth recorder
5	Xeros (Nicosia)	Xeros bridge	" "
6	Marathasa	Lefka-Skouriotissa bridge	" "
7	Kharangas (F)	Near Kato Varosha	Recorder on 70 ft. irrigation weir
8	Avgorou	Near Avgorou	Recorder on 40 ft. measuring weir
9	Paralimni	Near Paralimni Lake	Recorder on 2 feet flume
10	Pyrgos	Near Phileyia	Recorder on 30 ft. measuring weir.
11	Limnitis	Near Limnitis Sawmill	Recorder on 30 ft. measuring weir
12	Ovgos	Near Syrianokhori	Recorder on 6'7" measuring weir
13A	Kouris	Limassol-Troodos bridge	Recorder on 18 feet measuring weir
13B	Kouris	Near 13A	Recorder on 1'6" flume
14	Peristerona	Near Panayia bridge Forest Station	Recorder on 25 feet measuring weir
15	Tremithios	Kiti	Recorder on 70 feet irrigation weir
16	Yermasoyia	Nicosia-Limassol bridge	Depth recorder
17	Kouris	Near Kandou	Recorder on 300 feet irrigation weir
18	Kolopanes	Near Kalopsidha	Recorder on 25 feet measuring weir
19	Akhna	Near Akhna Police Station	Recorder on 40 feet measuring weir
20	Phrenaros	Near Asprovouniotissa Church	Recorder on 40 feet measuring weir
21	Kokkini Trimithia	Near Kokkini Trimithia	Recorder on 40 feet measuring weir
22	Liopetri	Near Liopetri	Recorder on 40 feet measuring weir

No.	Catchment	Location	Type of installation
23	Akaki	Near Malounda	Recorder on 40 ft. measuring weir
24	Skylloura	Near Ay.Vassilios	Recorder on 60 feet measuring weir
25	Ak-sou	Near Petra-tou-Dhigheni	Recorder on 30 feet measuring weir
26A	Almiros	Near Geunyeli	Recorder on 40 feet measuring weir
26B	Almiros	Near 26A	Recorder on standing-wave flume with 1 ft. throat.
27	Khrysokhou	Near Skoulli	Recorder on 40 feet measuring weir
28	Evretou	Near Trimithousa-Evretou Road Junction	Recorder on 25 ft. measuring weir
29	Syrgates	Near Skarinou	Depth recorder
30	Dhiarizos	Limassol-Paphos bridge near Kouklia	Depth recorder
31	Xeros (Paphos)	Limassol-Paphos bridge near Mandria	Depth recorder
32	Alakati	Platimatis near Ayios Amvrosios (Kyrenia)	Recorder on 22 feet measuring weir
33	Karyiotis	Near Pendayia	Recorder on 60 feet measuring weir
34	Tremithios	Ayia Anna	Recorder on 40 ft. measuring weir.



Measured discharges 1958/59.

The discharges measured at the gauging stations of the previous paragraph are as follows :-

Recorder No.	Catchment	Rainfall 10 <sup>6</sup> c.ft.	Run off 10 <sup>6</sup> c.ft.	Maximum discharge in a day 10 <sup>6</sup> c.ft.	Maximum flow cusecs	Percent Run off
1	Pedhieos	1343	11.74	6.1	630 <sup>18</sup>	0.87
2	Yialias	1050	87.26	11.1	1300 <sup>37</sup>	8.31
3	Ovgos	1652	-	-	-	-
4	Serakhis	4960	5.6	1.4	-	0.1
5	Xeros (N)	1309	0.04	-	-	-
6	Marathasa	931	94.37	4.6	100 <sup>2.8</sup>	10.13
7	Kharangas	240	13.8	12	1100 <sup>31</sup>	5.75
8	Avgorou	220	0.6	0.6	33 <sup>0.9</sup>	0.16
9	Paralimni Lake outfall	-	6.98	-	-	-
10	Pyrgos	722	106.83	8.7	110 <sup>3.1</sup>	14.8
11	Limnitis	1043	225.1	9.8	240 <sup>6.8</sup>	21.58
12	Ovgos Summer flow	-	1.41	-	-	-
13	Kouris (Trimiklini)	1217	169.2	2.8	48 <sup>1.35</sup>	13.9
14	Peristerona	1287	269.6	15.5	200 <sup>5.7</sup>	20.95
15	Tremithios (Kiti)	1426	11.6	10.1	1460 <sup>41</sup>	0.81
16	Yermasoyia	2319	81.9	8.9	650 <sup>18</sup>	3.53
17	Kouris (Kandou)	5512	255.7	2.3	180	4.64
18	Kolopannes (Kalopsidha)	-	3.74	-	-	-
19	Akhna	305	-	-	-	-
20	Phrenaros	127	12.1	5.3	430 <sup>12.0</sup>	9.5
21	Kokkini- Trimithia	206	-	-	-	-
22	Liopetri	153	18	4.5	610 <sup>17</sup>	11.8
23	Akaki	1118	231.1	12.0	360 <sup>10</sup>	20.67
24	Skylloura	586	4.5	0.4	28 <sup>0.8</sup>	0.77
25	Ak-Sou	146	17.25	6.8	220 <sup>6.2</sup>	11.8
26	Almiros	294	2.15	1.1	79 <sup>2.2</sup>	0.73

Recorder No.	Catchment	Rain-fall 10 <sup>6</sup> c.ft.	Run off 10 <sup>6</sup> c.ft.	Maximum discharge in a day 10 <sup>6</sup> c.ft.	Maximum flow cusecs	Present Run off
27	Skoulli	1315	376.84	35.5	1450 41	28.66
28	Evretou	1779	373.27	98.7	1700 48	21
29	Syrgates	1682	32.8	3.2	750 21	1.95
30	Dhiarizos	4526	826.6	36.0	620 17.5	18.26
31	Xeros (P)	3961	159.2	18.1	150 2.2	4
32	Alakati	206	8.68	5.1	1300 37	4.21
33	Karyiotis	1415	32.7	3.1	70 2.0	2.3
34	Tremithios (Ay. Anna)	933	42.1	23.0	3500-4000 100 113	4.5

Spring Discharges.

During the year 1785 spring discharges were measured, giving an average of 149 measurements each month. 109 springs are now measured regularly, 126 at monthly intervals, 81 every three months and 5 every fortnight.

Owing to the below-normal overall rainfall for the third year in succession, nearly all spring discharges were not only well below average, but in most cases the lowest ever measured. In Kyrenia range some springs maintained their low rate of flow nearly throughout the year without having the usual seasonal increase. The Kythrea Kephlovrysos was near to 2,600,000 g.p.d. during the entire twelve months. The Lapithos Kephlovrysos and the Karavas Kephlovrysos similarly discharged steadily at 600,000 g.p.d. and 500,000 g.p.d. respectively.

The Troodos area was affected by the slight and transient snow-falls and by the absence of heavy rain in the early months of 1959. The spring discharges on the heights therefore tailed off earlier than usual and by September the Troodos water supply springs, for instance, were yielding only 19,000 g.p.d. or 11,000 g.p.d. less than last year.

On the southern slopes of the Troodos mountains the combined yield of Kephlovrysos, Kria Pighadhia and Mavrommata springs used for Limassol town water supply dropped to 326,000

g.p.d. by the end of the summer. This is the lowest discharge recorded since regular measurements started in 1950.

On the western end of the Troodos mountains the rainfall was average and some spring discharges were by 20% higher than last year. In the Cape Greco peninsula where rainfall was similarly average, spring discharges were lower than last year. It appears that the deeper strata feeding the springs in this area had not been replenished.

In the Nicosia area chain-of-wells suffered much from the considerable low rainfall. The Upper Arab Ahmet chain-of-wells was flowing in September at the rate of 91,000 g.p.d., the lowest on record. The same behaviour was observed in springs.

Ground-Water used for Town Water Supplies.

Details of the water extracted from underground sources for the three largest towns of Cyprus are given below:-

Nicosia	<u>Quantity</u> (Million cub. ft.)	<u>Percentage</u>
Trimithia	79.3	56
Athalassa	1.7	1
Arab Ahmet	8.0	6
Laxia	10.4	7
Makedhonitissa	5.0	3
Dhali	9.3	6
Sykhari	9.6	7
Dhikomo	8.3	6
Prodhromos (Approx.)	4.0	3
Others (Approx.)	7.0	5
<hr/>		
Total extraction during 1958/59	142.6	100
<hr/>		
Famagusta	<u>Quantity</u> (Million Cub.ft.)	<u>Percentage</u>
Phrenaros West	17.0	32
Phrenaros North	27.0	51
Panayia	4.5	9
Others	4.0	8
<hr/>		
Total extraction during 1958/59	52.5	100
<hr/>		

<u>Limassol</u>	<u>Quantity</u> <u>(Million cub.feet)</u>	<u>Percentage</u>
Kephalovrysos Kria Pighadhia and Mavrommata	61.0	77
Chiftlikoudhia	16.0	20
Others	<u>1.9</u>	<u>3</u>
Total extraction during 1958/59	78.9 =====	100 =====

Ground-Water Levels.

Three new observation boreholes were brought into use during the year 1958-59 the total now being 57. Two of these boreholes sunk in previous years near Ayios Andronikos (Famagusta) and are now being used for the purpose of studying the variations in the water table in the area where underground water is extracted for the water supply of certain villages in the Karpas peninsula and the third is at Kouris river near Khalassa.

During 1958-59 the greatest declines in the underground water levels of large aquifers were recorded at Kokkini-Trimithia, Morphou and Phrenaros.

At Kokkini Trimithia, where there is intensive pumping for irrigation and for Nicosia Water Supply, a depression of 19'10" of the water table has been recorded for the last 9 years. During the last twelve months the decrease in level has been 4'8" and indicates a very disquieting trend.

At Morphou Bay, in the area that is to supply water to Nicosia in the near future, the water table as recorded by observation boreholes 2 miles inland show a total fall of 11.9' in the last four years. The average annual fall is 3.0'. At the coastal boreholes the fall during the last twelve months was 0'10" and the general trend appears to be continuing evenly.

At Phrenaros area, from which water for the Famagusta domestic supply is obtained, the water table continues to

decline at the annual rate of 3'0" for Phrenaros North and 2'1" for Phrenaros West.

The water table in the Xylophagou area has been depressed by an annual average of 0'6" since 1951. Compared with most other ground-water areas this decline is small but as the water-table here is within a few feet of sea level, it is important that careful control of pumping should be retained.

Between 1955 and 1958 the water level at the Kolossi observation boreholes fell by 2 feet but as a result of last years very low rainfall the water table was depressed on 1959 by a further 3 feet.

#### Recharge Activities.

As a result of heavy rains fell near Famagusta during December, the Ayios Loucas and Paralimni Reservoirs were filled from the run-off of streams in this area. Water which thus collected was released into the recharge tunnel of Ayios Memnon from both ends. The total artificial recharge into the aquifer since operations started on 7th December, 1958, to 30th April, 1959, has been about 20.4 million cubic feet.

In Limassol during 1958-59 the following quantities of water were recharged into and pumped from the Chiftlikou-dhia chain-of-wells.

<u>Total recharge into</u> <u>Acquifer</u>	<u>Total pumped from</u> <u>Acquifer</u>
10 million cubic feet	16.4 million cubic feet.

The salinity of the well-water which was 76 p.p.m. of NaCl at the end of recharge in May, had risen to 397 p.p.m. by the end of December, 1959.

#### Chemical Analyses.

During the year 1549 samples of water were sent to the Government Analyst. This number included 24 samples for full chemical analysis, 877 samples for partial chemical analysis from domestic water sources and 648 samples for partial chemical analysis from springs, observation boreholes and irrigation boreholes.

Bacteriological Analyses.

During the year 683 samples of water, taken mainly from town water supplies were analysed by the Government Pathologist.

The total number of samples collected and the number of unsatisfactory are as follows :-

<u>Water Supply.</u>	<u>No. of Samples.</u>	<u>No. of unsatisfactory samples</u>
Nicosia	438	45
Famagusta	105	6
Limassol	45	7
Larnaca	56	16
Paphos	39	10
Totals	<u>683</u> =====	<u>84</u> =====

At Nicosia most of the unsatisfactory samples came from the Arab Ahmet and Makedhonitissa chain-of-wells. The water from these sources tends to be unreliable in Summer. Chlorinated samples at all reservoirs were satisfactory.

The unsatisfactory samples at Limassol and Famagusta were usually of unchlorinated spring water. Chlorinated samples at the reservoir were satisfactory.

At Larnaca and Ktima, samples taken after chlorination at the reservoir were all satisfactory.

Special Investigations at Phrenaros,  
Kokkini Trimithia and Morphou

The hydrological investigations which commenced in certain areas at Phrenaros and Kokkini Trimithia few years ago still continues. The results of the observations indicate that the present rate of extraction exceeds the average rate of replenishment. The water table goes down nearly by 3 feet and if pumping is not reduced soon, many wells and boreholes are certain to fail within the near future. The Morphou area is still under investigation.

Water Duty.

The table on the next sheet shows the actual quantities of irrigation water used in certain localities where meters were installed on private pumps. There is little doubt that if better irrigation methods and practices were smaller quantities of water would produce equal or better results.

Well No.	Area	Chief Crops	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Remarks
283	Phrenaros	Potatoes Melons & Cucumbers	1360 (6)	1403 (26)	1452 (27)	1694 (15)	1313 (13)	1900 (3)	2417 (8)	1626 (3)	798 (4)	815 (8)	Water meters installed in August 1959.
284	-do-	Water Me- lons	- (-)	1350 (20)	948 (20)	1265 (20)	1220 (8)	- (-)	1734 (9)	1800 (7)	865 (2)	- (-)	
416	-do-	Citrus	- (-)	630 (80)	782 (80)	898 (80)	867 (80)	1000 (80)	985 (80)	846 (80)	515 (80)	368 (80)	
355	-do-	Potatoes Melons & Cucumbers	-	-	-	-	-	-	1626 (17)	1426 (12)	1062 (3)	776 (3)	
410	-do-	Potatoes	-	-	-	-	-	-	1235 (17)	880 (17)	- (-)	- (-)	
460	-do-	Potatoes trees and Kolokasi	-	-	-	-	-	-	1346 (25)	1037 (21)	928 (12)	220 (10)	
627	-do-	Potatoes Melons Cucumbers etc.	-	-	-	-	-	-	2118 (34)	1890 (25)	1281 (3)	1138 (4)	

Quantities of water used per day per donum obtained from water meters installed in the Hydrological Area.

No irrigation water was used before March or after December.

Area irrigated every month in donums is shown in brackets.

APPENDIX 5

WATER LEVEL IN CONTROL BOREHOLES  
(Feet above sea level)

Place	Bore-hole No. and year	Maximum water level			Minimum water level		
		Year after drilling	57-58	58-59	Year after drilling	57-58	58-59
1. Kokkini Trimithia	90/50	685.8	669.0	665.8	681.2	666.2	662.0
2. Kokkini Trimithia	160/50	682.7	670.3	667.0	679.8	667.5	663.3
3. Kokkini Trimithia	161/50	686.0	668.2	662.8	680.2	663.3	657.1
4. Astromeritis	91/50	370.4	357.5	356.6	365.1	338.5	337.8
5. Morphou	168/50	89.2	80.5	74.3	84.1	74.8	68.4
6. Morphou	92/50	83.7	67.1	62.8	69.9	47.7	37.2
7. Prastio	93/50	27.1	18.3	15.3	22.1	13.3	7.5
8. "	11/57	-	17.1	15.8	-	11.5	6.8
9. Ghaziveran	94/50	18.5	13.0	10.8	16.2	10.8	8.2
10. Pendayia	95/50	10.6	10.4	7.5	8.0	7.3	5.1
11. Syrianokheri	150/54	9.7	-	7.5	8.4	7.0	4.4
12. "	151/54	9.3	8.3	6.9	8.1	5.3	4.3
13. "	152/54	7.2	5.8	4.6	5.2	3.4	2.5
14. "	153/54	4.3	3.5	2.4	3.4	2.3	1.5
15. "	1/55	23.1	19.4	12.9	17.7	10.0	6.2
16. "	23/55	20.9	15.0	11.3	17.4	10.4	9.6
17. "	201/56	-	16.2	12.0	-	10.5	6.0
18. "	209/56	-	15.2	12.0	-	9.7	5.2
19. "	195/57	-	6.0	5.7	-	4.2	3.2
20. "	209/57	-	3.5	2.3	-	2.3	1.5
21. "	212/57	-	3.7	2.7	-	2.9	1.9
22. "	248/57	-	9.6	6.9	-	5.5	3.8
23. "	253/57	-	9.5	7.5	-	5.8	4.3
24. Xylophagou	70/51	19.1	14.8	13.6	15.9	13.0	11.9
25. "	71/51	13.1	7.0	5.7	10.6	2.5	3.0
26. "	72/51	18.5	15.3	12.9	14.7	13.3	11.4
27. "	73/51	6.0	6.4	4.8	3.7	4.1	4.0
28. "	74/51	6.9	5.9	5.5	4.5	5.3	4.5
29. Ormidhia	189/57	-	1.5	1.7	-	2.3	2.5
30. "	227/57	-	0.7	0.6	0.6	0.4	0.1
31. "	246/57	-	0.8	0.9	-	1.2	1.5



Place	Bore-hole No. and Year	Maximum water level			Minimum water level		
		Year after drilling	57-58	58-59	Year after drilling	57-58	58-59
32. Makrasyka	48/54	117.0	111.3	106.3	110.7	107.1	94.4
33. "	49/54	120.1	114.6	112.4	117.4	112.7	109.9
34. Kalopsidha	54/54	68.5	61.4	59.5	60.3	57.1	51.2
35. "	55/54	73.9	69.2	67.7	72.4	68.0	64.2
36. "	56/54	75.3	71.6	70.1	74.4	70.3	67.5
37. Pergamos	86/51	256.6	246.3	243.9	254.7	242.2	240.4
38. Phrenaros	51/51	87.0	70.1	68.2	86.6	67.5	65.2
39. "	52/51	85.8	69.9	67.2	85.4	65.3	62.6
40. "	53/51	85.2	72.9	70.1	84.9	70.2	67.2
41. Phrenaros	67/53	81.1	72.2	69.7	80.4	70.2	67.5
42. "	108/52	72.2	58.2	54.9	71.3	54.1	51.3
43. "	109/52	70.6	57.6	54.7	67.0	54.1	51.3
44. "	110/52	70.2	57.7	55.0	66.6	54.6	51.7
45. "	76/56	-	55.7	52.9	-	53.2	50.3
46. "	77/56	-	62.7	61.4	-	61.5	60.6
47. "	78/56	-	63.1	60.5	-	60.9	58.5
48. "	79/56	-	71.1	69.5	-	68.5	68.0
49. Ay. Nicolaos (Famagusta)	89/56	-	28.4	28.0	-	27.3	26.6
50. Ay. Memnon	69/38	1.2	1.3	1.0	5.0	6.4	6.6
51. " "	50/53	3.2	2.4	1.5	0.2	1.8	1.8
52. Kolossi	88/54	16.0	12.0	10.0	12.0	8.0	5.5
53. Laxia	208/55	672.2	668.7	660.4	666.3	662.5	653.1
54. Ephtakomi	163/55	496.4	486.0	475.8	490.2	476.2	465.0
55. Khalassa	23/58	-	-	-	-	-	-
56. Ayios Andronikos	249/55	-	-	-	-	-	-
57. Ayios Andronikos	322/55	-	-	-	-	-	-

APPENDIX 6

IRRIGATION SCHEMES COMPLETED IN 1959

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
1	Trimiklini	Distribution system, piping settling tanks etc.	-	-	-
2	Kythrea	Lining of Channels in reinforced concrete	-	1000	1000
3	Xeros (Paphos) Co-operative Farming Society	River training works construction of gabions wire-staking	-	-	-
4	Agriidhia (Kato Netikon)	Irrigation tank and piping	-	13	13
5	Akhelia Chiftlik (Paphos)	Lining of channels in R.C.	-	300	300
6	Ayios Constantinos (Vrysakia)	Springs, piping small weirs	-	20	20
7	Lefka (Kafizes)	Repairs to conveyor pipeline	-	-	-
8	Mamonia (P)	Minor repairs	-	-	-
9	Pergamos (F)	Construction of storage tank	-	7	7
10	Kapilio	Repairs	-	-	-
11	Geunyeli	Re-construction of weir	-	-	-
12	Ayios Loukas	Repairs (Recharge Works)	-	-	-
13	Platres	Desilting of the swimming pool	-	-	-
14	Chakistra	Repairs	-	-	-
15	Kiti (Amnos)	Improvements	-	-	-
16	Akhna Nursery garden	Pumping scheme storage tank	-	7	7
17	Koloni-Yeroskipos	Improvements and infiltration pipeline	-	-	-
18	Tembria Karamides and Emirena	Construction of R.C.C. channels	-	14	14
Carried Forward			-	1361	1361

Ser. No.	Location	Natur of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
		Brought Forward	-	1361	1361
19	Psematismenos Kannoures Irrigation Association	Construction of R.C.C. channels	5	18	23
20	Kouklia (F) E.M.I.W.	Maintenance works to Reservoir embankment	-	-	-
21	Ay. Nicolaos (P) Meletze	Laying of distribution pipes	90	14	104
22	Kandou	Grouting of the leaking dam	-	-	-
23	Pyrgos (N) "Katouris river"	Construction of dam	1000	600	1600
24	Chattos	Minor repairs	-	-	-
Totals ...			1695	1993	3688

APPENDIX 7

IRRIGATION SCHEMES IN HAND AT THE END OF 1959

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
1	Lefka "Marathasa"	Construction of dam	-	780	780
2	Ay. Therapon "Tylliros" "Skotini" "Platania" and Ayios Theodoros locality	Construction of R.C.C. channels and repairs	50	-	50
3	Ayios Demetrios	Construction of Aqueduct	-	-	-
4	Statos "Akres"	Storage tank-tunnel pipe line (Re-construction of works destroyed by the earthquake)	-	-	-
5	Pyrgos (Tyllirias)	Supplementary distribution pipes and ancillary works to Dam - Reservoir	-	-	-
6	Tseri	Reconstruction of diversion weir	-	-	-
7	Mora	Repairs	-	-	-
Totals ...			50	780	830

APPENDIX 8

IRRIGATION SCHEMES READY FOR CONSTRUCTION  
AT THE END OF 1959  
BUT NOT YET STARTED

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
1	Peristerona (Trehaton Neron tis Eterias)	Cleaning and repairs to tunnels, lining of channels in R.C.	1000	600	1600
2	Ay. Ioannis (Malounda) (Neron tou Khoriou)	Tunnelling & lining of channels in R.C.	800	50	850
3	Argaka-Magounda III	Construction of a dam, piping & R.C. channels	1200	200	1400
4	Askas (Pano Ambelia)	Irrigation tank and piping	-	12	12
5	Ay. Epiphanius Orinis (Parisi)	Irrigation tanks and channels	20	14	34
6	Vouni (Klokkaris)	Irrigation tank and piping	-	12	12
7	Vouni (Palea Vrysi)	R.C. channels	-	10	10
8	Phini (Kambi- tou Stavrou)	Weir and channels	-	68	68
9	Vikla	Weir pipes and Irrigation tank	135	32	167
10	Gouphe	Channels and Irrigation ports	100	-	100
11	Sotira	Weir, R.C. channels and irrigation tank	300	150	450
12	Marathounda	Weir, Irrigation tank and piping	-	100	100
13	Potami (Poliati)	Weir - Channels and tank	70	22	92
14	Kholetria-Nata	River-training- staking	-	-	-
15	Psevdhas	Irrigation ports- culverts	200	-	200

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
16	Ora	Lining of Channels in R.C.	16	4	20
17	Kalokhorio (L1)	Repairs and lining of channels, weir piping and irr.ports	10	5	15
18	Kyperounda (Khalospities)	Irrigation tank and piping	-	5	5
19	Episkopion	Construction of intake & channels	300	-	300
20	Krini	Lining of channels in R.C.	200	100	300
21	Louroutjina (Armyrkos)	Cleaning and lining of chain-of-wells construction of irrigation tank and channels	-	26	26
22	Kalopanayiotis, Oekos, Pano Gnoudhias	Irrigation tank	-	26	26
23	Pera (Pharseron)	Tunnels, cutting R.C. channels	720	-	720
24	Kyperounda (Appis)	Repairs to channels and wing walls	-	5	5
25	Khalassa (Ypsonas)	Groyne intake and channels	1000	-	1000
26	Ay. Georghios (L1) Kato Piyenia	Piping	-	18	18
27	Plataniskia	Lining of channels in R.C.	-	10	10
28	Kaminaria (Hlios)	Spring-irrigation tank	-	10	10
29	Agridhia (Pano Lahania)	Spring and irrigation tank	-	22	22
30	Agros (Vrysia)	Repairs to irrigation tank	-	3	3
31	Arsos (Pessou)	Lining of channels in R.C.	-	20	20
32	Agros (Pano Vrysia)	Construction of storage tank	-	4	4
33	Athrakos (Halourakes)	Weir channels and piping	-	24	24

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
34	Agros (Kato Netikon)	Storage tanks and channels	-	6	6
35	Kyperounda (Kardhana Paranga)	Spring	-	5	5
36	Ay. Pavlos (Styrakas)	Storage tank and channels	-	24	24
37	Kato Amiandos (Pelendria-Chrysovrysi)	Springs, piping and irrigation tank	-	21	21
38	Pelendria (Filagra)	Weir and storage tank	-	8	8
39	Pelendria (Raftis)	Storage tank and piping	-	8	8
40	Vitsadha	Costruction of anti-erosion weir	-	-	-
41	Ay. Andronikos (F) (Vrysi)	Lining of channels in R.C.	10	60	70
42	Polis Chiftlik	Lining of channels in R.C.	-	330	330
43	Ay. Nicolaos (P) (Kamishlik)	Lining of channels in R.C.	-	20	20
44	Kithasi (Dhiarizos)	Storage tank and piping	12	12	24
45	Pano Archimandrita	Spring and R.C. channels	-	5	5
46	Ora	Storage tank and channels	180	10	190
47	Meneou-(New Mental Hospital)	Tunnels-pump house storage tank, piping	-	40	40
48	Odhou	Lining of channels in R.C.	-	10	10
49	Mousoulita-Marathovounos (Pedhieos river)	Reformation of banks cleaning and regrading of canals	1000	-	1000
50	Pomos (Paliam-bela)	Weir and channelling	700	50	750
51	Kithasi	Storage tank and piping	12	12	24
52	Sarama (Vrysino water)	Weir, channels and piping	200	95	295
53	Phinikas (Xeros River)	Spring, lining of channels in R.C.	-	280	280

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
54	Pelathousa (Vrysi-tou-Khoriou)	Repairs to spring, piping and irrigation tank	20	9	29
55	Terra (Upper Quarter)	Pumping scheme	-	25	25
56	Istinjo (Khalassa)	Weir and channelling	-	25	25
57	Zacharga (Vrysi-tou-Khoriou)	Storage tank and piping	-	12	12
58	Philousa (Khrysokhou)	Weir and lining of channels in R.C.	-	28	28
59	Steni-Ayios Isidhoros	Piping additional	-	10	10
60	Amargeti (Liripilli)	R.C. channels repairs	-	-	-
61	Pyrgos (Patticha)	Weir and channelling	-	30	30
62	Kaminaria (Kryos Potamos)	Weir, piping etc.	-	165	165
63	Paleomylos	Construction of weirs & channels	-	12	12
64	Arakapas	Re-construction of weir	-	-	-
65	Prastio (P) (Katarrakris)	Minor repairs	-	-	-
66	Sinda (kuchuk Dere)	Regrading of channels etc.	100	-	100
67	Famagusta-Dherinia (Ay.Loukas)	Raising of spillway (Recharge works)	-	-	-
68	Famagusta-Dherinia (Ay.Nicolaos Drain)	Construction of drainage canals re-charge works	-	-	-
69	Lakatamia (Kato Mavrovrysi)	Chain-of-wells channelling and Irrigation ports	600	120	720
70	Yerolakkos (Ovgos river)	Pumping scheme	-	20	20
71	Platanistasa (Stavros)	R.C. Channels and tank	-	12	12
72	Pano Zodhia (Kato Koutraphas)	Intake, lining of channels in R.C.	11000	-	11000



Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
73	Kyra (Summer water)	Pumping scheme lining of channels in R.C.etc	-	200	200
74	Kambi-Pharmakas (Vazanousykia)	R.C. Storage tank and piping	-	8	8
75	Pano Koutraphas	Groyne intake and channelling	-	160	160
76	Ayii Trimithias (Asproyi)	Intake & retaining wall	230	-	230
77	Politikon (Moulos water)	Head works extension of chain-of-wells R.C.Channels and storage tank	-	400	400
78	Pedhoulas	R.C. Channels	-	150	150
79	Nisou (Frangos chiftlik)	Chain-of-wells lining of channels in R.C.	-	200	200
80	Morphou Katokopia P.& K.Zodhia (Naos)	R.C. Channels and groyne intake	1800	-	1800
81	Argates	Groyne intake, overflow spillway irrigation ports	370	-	370
82	Syrianokhori	Lining of channels in R.C.	-	700	700
83	Akaki (Merika water)	Repairs to channels	-	-	-
84	Akaki Avlona	Repairs	-	-	-
85	Spilia (Kleftis Kato)	Small weir, channels and storage tank	-	13	13
86	Kato Zodhia (Komitis river)	Screw gates protecting walls	150	-	150
87	Potami (Kashanos)	Repairs to tannels etc.	-	10	10
88	Kato-Pano Pyrgos Selemani	Repairs to channels	-	-	-
89	Tembria-Sina Oros (Makronides)	Lining of channels Repairs to aqueducts	-	15	15
90	Galata-Sina Oros (Kappadhokas)	Lining of channels in R.C.	-	20	20
91	Palaekhori (Skolidros)	Lining of channels	-	500	500
92	Kiti (Kokkines)	Repairs to apron and channels etc.	-	-	-

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
93	Kivizil	Repairs to weir, apron and channels	-	-	-
94	Ay. Theodoros (Pentaskinos)	Channelling, irrigation ports	200	-	200
95	Potamitissa "Potami"	Repairs to weir	-	-	-
96	Alithinou "Vasiloudhia"	Construction of R.C. Channels	20	-	20
97	Alona "Monastiri"	Tunnel - R.C.Channels	-	-	-
98	Alona "Photistra"	Construction of R.C. channels-aqueduct	-	-	-
99	Milikouri "Proto Reximo"	R.C. Channels pipe lines storage tank	-	-	-
100	Milikouri "Pateritsa"	Springs-storage tanks pipe lines	-	-	-
101	Geunyeli "Almyros"	Earth dam	1000	-	1000
102	Nata-Kholetria "Xeros"	Extension of the sub-soil pipes	-	-	-
103	Lapithos "Neron tis Kato Djiamis"	Cleaning and building of tunnel	-	13	13
104	Pomos "Chryso-pateritissa"	Diversion weir and development of spring R.C.channels-pipe lines	750	-	750
105	Dhrousha "Vrysi tou Khoriou"	R.C. Channels pipe line	35	8	43
106	Peristerona "Dhimma tis Peristeronas"	R.C. Channels	15550	-	15550
107	Ayios Loukas Famagusta-Dherynia-Re-charge works	Tunnel (Anti-flood works)	-	-	-
108	Philia "Dhexameni tou Khoriou"	Pipeline - storage tank R.C.Channels	-	-	-
109	Charcha "Vrysi Water"	Pipeline	-	5	5
110	Kato Amiandos (Pelendria)	Diversion Weir, Intake and Conveyor pipes	-	401	401
111	Petra	Earth dam and lining of channels	600	60	660
112	Massari	Lining of channels	400	50	450
113	Paleomylos (Ay.Yeorghios)	Weir-pipeline	-	10	10
114	Agriidhia (Enetikon Water)	Excavation of springs and laying of pipes	-	-	-
115	Lyso (Paradhissos)	Laying of distribution pipes	-	-	-
Totals			41010	5939	46949

APPENDIX 9.

LIST OF DAM SITES INVESTIGATED

1958-59

1958

- 1) Kalokhorio (Klirou) - Upper
- 2) Malounda
- 3) Saitas
- 4) Spitia tous Papades
- 5) Petra
- 6) Lania
- 7) Lania
- 8) Dhoros - Monagri
- 9) Lefka (Marathasa)

1959

- 10) Elea
- 11) Kambos-tou-Tourkou
- 12) Nikitari
- 13) Geunyeli
- 14) Lekani
- 15) Philani
- 16) Panayia
- 17) Kambia (Alternative Scheme)
- 18) Kapilio

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APPENDIX 10  
TOWN WATER SUPPLIES

By V.C. Toundjian, M.B.E., Superintendent of Works

NICOSIA AND SUBURBS

The Greater Nicosia Water Supply Scheme, which was almost completed in the previous year, was maintained and operated during 1959 by the Town Supplies Section of the Department. Extensions to the distribution mains (2.6 miles) were carried out, as well as 3.4 miles of pipes laid for private developers, 11 hydrants installed and 880 house connections made. A length of 4 miles of pumping mains was also laid from Akaki boreholes to Kokkini Trimithia collecting tank and thence to Paleometokho tower tank.

Likewise, the Water Board of Nicosia had extended their own distribution mains by 2.7 miles and their supply mains by 1.0 mile had installed 19 hydrants and made 660 house connections.

Restrictions on the supply of water in the Board's area outside the walls of Nicosia were imposed on 21st April (24 hours on and 24 hours off). As the shortage became more acute in July further cuts in the supply were made, when, water was turned on for 13 hours and off for 35 hours. The situation was somewhat relieved in August, when a supplementary supply was obtained from a newly drilled borehole in the Makedhonitissa area, with a daily yield of about 0.5 million gallons.

The maximum average demand in the Board's area outside the walls of Nicosia was 1.85 m.g.d. in August, of which 0.3 m.g.d. was supplied from sources of the Greater Nicosia Scheme. With the improvement of the supply position, the restrictions imposed earlier were lifted on 16th September.

The maximum average demand in Suburban Nicosia area was 0.7 m.g.d. in August. This demand gradually fell to 0.3 m.g.d. in December.

Morphou Bay Scheme:

Work on the excavation of trenches and laying of the feeder pipelines from the sources to the site of the pumping station at Syrianokhori was commenced in August and completed in October, involving a total length of 4.2 miles of steel and Asbestos-Cement pressure pipes (6" to 15" diameter).

Similarly, the first section of the main pipeline, viz: 7 miles of 16" diameter bitumen coated steel pipes from the site of the Headworks to Kyra-Masari junction east of Morphou, was practically completed by the end of the year, except for water testing the pipes, copper strip bonding and bitumen moulding the couplings, the construction of valve boxes and back filling to gaps in the trenches.

The excavation of trenches was almost wholly done by two of the Department's Ruston Bucyrus excavators (RB 10 & 19), which were also used as cranes for lifting the 32 ft. long, one ton pipes and lowering same into the trenches. Other Departmental mechanical plant used on the job included two caterpillar traxcavators (D.5), one bulldozer (D2) one dumper, two concrete mixers and two compressors. Two more privately owned compressors and one mobile crane were also used on hire for about one month. The transport of the pipes from Famagusta to Morphou was undertaken by the P.W.D., with their own vehicles (two low loaders and one lorry) and cranes.

Work on the construction of the Headworks and approach roads by the P.W.D. was commenced in September and by the end of the year the foundations of the pumping station, circular collecting tank and inlet house were practically completed, including casting of part of the R.C.C. Columns and fence posts. Roadwork was well in hand, and out of a total length of 3 miles, nearly 60% was completed.

LIMASSOL

Water shortage was again experienced in Limassol this summer and restrictions had to be imposed during the period 18th June - 21st October by turning off the

distribution area valves at night between 9 p.m. and 5 a.m. and for longer hours in certain areas.

To meet this shortage (the yield from the springs had fallen to 0.4 m.g.d.), pumping from Chiftlikoudhia chain-of-wells had to be brought into full commission and moreover a supplementary supply of 19 million gallons obtained, between 8th August and 26th October from one War Department and two private boreholes.

Owing to the prevailing dry weather, pumping from Chiftlikoudhia chain-of-wells was still continuing towards the end of the year for certain hours in the day, and this despite a marked improvement in the yield of the springs which had gone up to 0.7 m.g.d. in December.

During the year the distribution mains were extended by 3.5 miles, 4.2 miles of pipes laid for private developers, 28 hydrants installed and 700 house connections made. Improvements to the Chiftlikoudhia pumping station were carried out, including the installation of a new electric motor in substitution of the old "National" engine, and 0.7 miles of pumping mains laid.

A successful borehole (yield on test = 22,000 gallons per hour) was drilled by the Department in Garyllis river within the water Board's area for use as an emergency source of supply. Likewise, negotiations for the purchase of a private borehole (Galatariotis) for the same purpose were completed. As a supplementary source of permanent supply exploratory boreholes were being drilled towards the end of the year by the Water Development Department in the Yermasoyia area east of Limassol, two of which have already proved successful, with a yield of 30,000 gallons per hour each.

#### FAMAGUSTA

Extensions to the distribution mains (3.5 miles) were carried out, including two new water points in the Harbour for "Z" craft of the Navy, 18 hydrants installed, and 550 house connections made during the year. A

pipeline was laid from Panayia spring to a convenient point by the roadside for the domestic water supply of the R.A.F. unit stationed at Cape Greco.

During the last quarter of the year the yield of Panayia spring had considerably diminished following the sinking nearby of a private borehole by an unauthorised person, against whom court proceedings are pending.

Partial restrictions on the supply were imposed beginning with 8th July, but as these measures proved of little or no avail inasfar as any saving was concerned, they were removed on the 28th August.

#### LARNACA

Restrictions on the water supply were again imposed as from the 12th March, when the town was divided into three areas and, to begin with, water was turned off for 6 hours daily. To meet the increasing shortage, the distribution system had to be split into five areas as from 15th August, with a varied daily supply of 3-6 hours. Because of the drought, restrictions were still on towards the end of the year, when the supply had dropped from an average of 0.65 m.g.d. in June-September to 0.52 m.g.d. in December.

During the year 0.8 mile of distribution mains for new development were laid, 4 hydrants installed and 282 metered house connections made (including 43 meters in substitution of 18 saccorafia).

A section of the chain-of-wells of the town supply, which was in a dilapidated condition, was realigned involving 1315 feet of lined tunnelling with 20 shafts of a total depth of 980 feet.

A trial borehole (600 feet in depth) was drilled in the vicinity of the underground collecting tank at the tunnel outlet, but unfortunately it proved unsuccessful.

GENERAL

Water Board meetings were attended and technical advice given as required by the Senior Engineer of the Department in charge of the Town water supplies (Mr. R.S. Wood) until his departure in August, and thereafter by the Executive Engineer attached to the Town Section (Mr. H. Suphi) and Superintendent of Works (Mr. V. Toundjian).

The Government water supply in Nicosia has been maintained. An average of 35,000 gallons of water per day was supplied from Government sources during the summer to Government residences, offices and institutions.

The testing and repairs of water meters is carried out for the Water Boards and other authorities and during the year a total of 350 meters were tested (incl. 40 repaired).



APPENDIX 11

TOWN WATER CONSUMPTION, SUMMER 1959

QUANTITY SUPPLIED AT SOURCE

IN GALLONS PER HEAD PER DAY

Town	Estimated Population	June g.h.d.	July g.h.d.	August g.h.d.	Sept. g.h.d.
Nicosia (within the walls)	25,000	12.3*	13.5*	13.7*	15.0*
Nicosia Water Board Area (Outside the Walls)	43,000	35.4*	42.4*	43.0*	41.6*
Nicosia Suburbs	25,000	31.2	35.8	43.5*	34.3*
Nicosia (whole Town and Suburbs)	93,000	28.1*	32.8*	35.3*	32.5*
Limassol	42,000	35.1*	30.3*	33.2*	34.4*
Famagusta	31,000	36.8	36.6*	36.4*	34.5
Larnaca	19,000	33.9*	33.9*	30.7*	29.2*

\* Restricted or partial supplies - see Appendix 10 and Notes Below: -

Notes:

1. The population figures are extrapolated from graphs based on the "Population Estimates October 1956" published by the Statistics Section of Financial Secretary's Office, Nicosia and "Census of Cyprus 1946". Unless otherwise stated below the quantity of water supplied is measured by meter at source.

2. Nicosia

The area within the walls was supplied with water from the pumps P<sub>1</sub> and P<sub>2</sub> on wells in the Prodhromos quarter, from the Sykhari Adit via the old pipeline now metered at the source, and from the Water Board supply. The water was restricted to a supply of 4 hours per day throughout the year.

The water Board Area outside the walls was supplied from the Water Board's own sources, from private boreholes (18 No. at Kokkinitrimithia, of which 12 No. belong to Mr. Charalambous, and 1 No. borehole at Makedhonitissa) and from the Greater Nicosia supply through meters at Strovolos Reservoir, Ayii Omoloyitadhes and Pallouriotissa.

Water from the former private companies now taken over by the Water Board and from the Kykko supply is included but represents only about 3% of the total supply of the whole town and suburbs.

Notes on Appendix 11 - Continued:-

The Nicosia Suburbs were supplied by the new Greater Nicosia Scheme from sources at Kokkini Trimithia, Dhali, Dhikomo, Sykhari, as well as from two private boreholes at Akaki and also from Kykko private supply.

3. Limassol:

The water is measured by meter at the outlet of the reservoir and an allowance of 3% is added for losses in the supply pipelines from the springs to the reservoir.

4. Famagusta:

The water from Phrenaros is measured by meter at sources, while the Panayia and Stavros supplies are measured by meter at Stavros reservoir.

5. Larnaca:

The water supplied is measured by gauging at source and 6% is deducted for water supplied by saccoraphi for irrigation of plantations and farms.

APPENDIX 12  
DATA CONCERNING TOWN WATER SUPPLIES  
1959

Description		Nicosia			Limassol	Famagusta	Larnaca
		Water Board and Adminis- tration	Government	Total			
a) Sources in regular use	Number	23 <sup>+</sup>	12	35	3	9	1
b) Sources for emergency use	Number	7 <sup>@</sup>	3 <sup>x</sup>	10	4	5	Nil
c) Average Capacity of all sources (Summer 1959)	m.g.d.	1.63	1.36	2.99 <sup>≠</sup>	1.4	1.1	0.65
d) Main reservoir capacity	million gals	0.8	3.2	4.0	0.8	0.7	Nil <sup>+</sup>
e) Supply mains	Miles	42	30	72	18.7	22	3.5 <sup>⊗</sup>
f) Distribution mains	Miles	130.7	78	208.7	71	69	29.1 <sup>+</sup>
g) Pumps in regular use in wells and boreholes	Number	26	11	37	Nil	8	Nil
h) Consumer meters in December 1959	Number	7740	4780	12520	8629	7500	1490
i) Saccoraphia connections	Number	3260	-	3260	-	-	1380 <sup>*</sup>
j) Fire Hydrants	Number	672	416	1088	417	438	25

+ Includes 12 Boreholes at Kokkini Trimithia owned by Mr. Charalambous

@ Privately owned Boreholes: 6 No. at Kokkinitrithia and 1 No. at Makedhonitissa

x includes 2 No. privately owned Boreholes at Akaki

m.g.d. = Million gallons per day

≠ Includes 0.09 m.g.d. from private companies and Kykkos

\* Includes 100 saccoraphia for irrigation

APPENDIX 13

NUMBER AND PERCENTAGE OF VILLAGE  
WITH PIPED DOMESTIC SUPPLY.  
31st DECEMBER, 1959

District	Villages with piped water			Villages with no piped water		Total Villages
	Satisfactory	Needing improvement	Total	No.	%	
	No.	No.	No.	No.	%	
Nicosia	101	39	140	36	21.00	176
Larnaca	41	9	50	9	15.00	99
Limassol	63	40	103	10	8.85	113
Famagusta	54	15	69	29	29.59	98
Paphos	93	30	123	11	8.21	134
Kyrenia	28	12	40	7	14.89	47
Totals	380	145	525	102	16.27	627
Percentage	60.60	23.13	83.73	16.27	16.27	100

Note: The above figures are the result of an up-to-date survey and they do not correspond with others given in the annual reports of former years. Some supplies that were previously satisfactory are now considered unsatisfactory, because with an expanded population and higher standards of living more water and more facilities are required.

APPENDIX 14

VILLAGE DOMESTIC WATER SUPPLY

SCHEMES COMPLETED IN 1959

Ser. No.	Village	District	Nature of work	Date of Completion
1	Kouklia	Paphos	/	7th January, 1959
2	Koloni	"	/	23rd " "
3	Neochorio	"	/	21st " "
4	Klavdhia	Larnaca	/	10th March, "
5	Episkopi	Limassol	/	11th April, "
6	Aghirda	Kyrenia	/	22nd April, "
7	Kantara	Famagusta	/	12th May, "
8	Kellia	Larnaca	/	23rd May, "
9	Ktima	Paphos	/	9th June, "
10	Lefkoniko	Famagusta	/	13th June, "
11	Vouno	Kyrenia	/	13th June, "
12	Aradhippou	Larnaca	/	2nd July, "
13	Argaka	Paphos	*	4th July, "
14	Tokhni	Larnaca	/	4th July, "
15	Mansoura	Nicosia	/	10th July, "
16	Agros	Limassol	/	14th July, "
17	Sinda	Famagusta	/	18th July, "
18	Vouni-Kilani	Limassol	/	30th July, "
19	Makheras	Nicosia	*	1st August, "
20	Gourri	"	/	13th " "
21	Magounda	Paphos	/	17th " "
22	Ay. Georghios (Silikou)	Limassol	/	18th " "
23	Yermasoyia	"	/	29th " "
24	Korovia	Famagusta	*	31st " "
25	Vatyli	"	/	31st " "
26	Vatyli Police Station	"	≠	15th Sept., "
27	Galinoporni	"	*	21st " "
28	Yialousa	"	/	24th " "
29	Perapedhi	Limassol	/	2nd October, "
30	Kandou	"	/	8th " "
31	Zyvi	Larnaca	/	15th " "
32	Ay. Athanasios	Limassol	/	15th " "
33	Ay. Ermolaos	Kyrenia	*	24th " "
34	Trakhypedhoula	Paphos	/	7th November, "
35	Arminou	"	/	7th " "
36	Potamia	Nicosia	*	9th " "
37	Perakhorio	"	*	24th " "
38	Nisou	"	*	24th " "
39	Phasoula	Paphos	/	4th December, "
40	Athienou	Larnaca	/	24th " "
41	Tymbou	Nicosia	*	31st December, "
42	Perivolia-tou- Trikomou	Famagusta	*	31st " "
43	Maronas	Paphos	*	31st " "
44	Sykhari	Kyrenia	/	31st " "
45	Louroujina	Nicosia	/	31st " "

/ Improvements to an existing supply

\* New Schemes

≠ Water Supply to School and Police Station.

APPENDIX 15

VILLAGE WATER SUPPLY SCHEMES  
IN HAND AT THE END OF 1959

Serial No.	Village
1	Ayios Ioannis (Selemani)
2	Ammadhies
3	Anglisidhes
4	Ayios Symeon
5	Marathounda

APPENDIX 16

VILLAGE WATER SUPPLY SCHEMES READY FOR  
CONSTRUCTION AT THE END OF 1959 BUT NOT  
YET STARTED

Serial No.	Village	Serial No.	Village
	<u>Nicosia</u>		<u>Kyrenia</u>
1	Ammadhies	27	Ayia Irini
2	Astromeritis	28	Dhiorios
3	Askas	29	Karpasha
4	Ayii Trimithias	30	Kormakitis
5	Ayios Ioannis (Selemani)	31	Lapithos
6	Ayios Nicolaos (Lefkas)	32	Myrtou
7	Ayios Yeorghios (Lefkas)	33	Photta
			<u>Famagusta</u>
8	Ayios Sozomenos	34	Ardana
9	Anayia	35	Artemi
10	Bey Keuy	36	Akhna
11	Dhenia	37	Ayia Trias
12	Epikho	38	Ayios Khariton
13	Exometokhi	39	Dhavlos
14	Kalokhorio (Lefkas)	40	Engomi
15	Kambos	41	Kridhia
16	Kannavia	42	Liopetri
17	Katokopia	43	Neta
18	Korakou	44	Styllos
19	Kythrea		<u>Larnaca</u>
20	Linou	45	Kalokhorio
21	Neokhorio	46	Kiti
22	Voni	47	Kornos
23	<b>Palekythro</b>	48	Lefkara, Kato
24	Trakhoni	49	Lefkara, Pano
25	Xerovounos	50	Melousha
26	Zodhia, Kato	51	Mosphiloti

Serial No.	Village	Serial No.	Village
	Larnaca (Contd.)		Limassol (Contd.)
52	Ormidhia	75	Sotira
53	Pyla	76	Trakhoni
54	Pyrga	77	Vasa (Kilani
55	Tokhni	78	Yermasoyia
56	Xylotymbou	79	Ypsonas
	<u>Limassol</u>		<u>Paphos</u>
57	Alektora	80	Akourdalia, Pano
58	Amiandos, Kato	81	Androlikou
59	Arsos	82	Archimandrita, Pano
60	Ayia Phyla	83	Ay. Yeorghios
61	Ayios Amvrosios	84	Emba
62	Ayios Athanasios	85	Kallepia
63	Ayios Mamas	86	Khlorakas
64	Dhierona	87	Kholetria
65	Lemithou	88	Khrysokhou
66	Mandria	89	Kissonerga
67	Omodhos	90	Lemba
68	Pelendria	91	Letimbou
69	Pendakomo	92	Mandria
70	Platres, Kato	93	Mesakhorio
71	Polemydhia, Kato	94	Mesoyi
72	Polemydhia, Pano	95	Phasli
73	Prodhromos	96	Vrecha
74	Silikou		



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APPENDIX 17  
MECHANICAL PLANT  
(as on 31/12/59)

MOBILE PLANT :-	<u>No.</u>
Ruston Bucyrus Drilling rigs 22W .. ..	11
"    "    "    "    6ORL .. ..	1
Water Dev. Dept. (1959) drilling rigs ..	1
Edeco Drilling Rigs .. ..	2
Cheshire earth boring machine .. ..	1
Allen Trencher 12"- 21' .. ..	2
Avelling-Barford Trencher .. ..	1
Caterpillar Transcavators 955 .. ..	3
"    "    HT4 .. ..	1
"    Bulldozer .. ..	1
International Bulldozer .. ..	1
Ruston Bucyrus Excavator RB10 .. ..	1
"    "    "    RB19 .. ..	1
Compressors .. ..	11
Morrison diesel alternator on trailer ..	2
Turbine deep-well test pumping units ..	2
Plunger deep-well test pumping units ..	2
Centrifugal pumping units .. ..	4
Portable works pumps .. ..	18
Sheepfoots roller .. ..	1
Granes .. ..	2
Hoists .. ..	3
Concrete mixers .. ..	28
Vibrators .. ..	10
Low Loader .. ..	1
Austin Countryman Vans .. ..	6
Land Rovers .. ..	6
Fordson Lorry 3 ton .. ..	1
Humber Utility Vans .. ..	2
Thornycroft Tractive Unit for Low Loader ..	1
Aveling Barfor Dumpers .. ..	2
Bray Loader .. ..	1
 <u>WORKSHOP PLANT:</u>	
Lathes .. ..	4
Shaping machine .. ..	1
Screwing machine .. ..	1
Drilling machine .. ..	3
Planning Timber Machine .. ..	1
Bandsaw timber .. ..	1
Bar Bender .. ..	1
Bar Cutter .. ..	1
Electric Welders .. ..	3

	<u>No.</u>
Forges .. .. .	3
Pipe slotting machine oxy-acetyline	1
Vibrating table .. .. .	1
Water Meter Testing Plant ..	1
Concrete block making machine ..	2
Concrete testing machine ..	1
Compressor air (Tecalemit) ..	1
Milling machine .. .. .	1
Grinding machine .. .. .	1
Hack-saw Electrical .. .. .	1

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