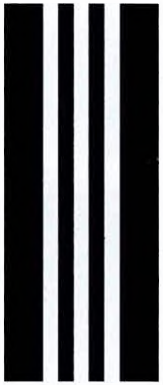


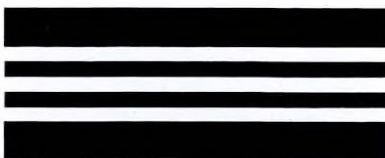
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CYPRUS

DEPARTMENT OF WATER DEVELOPMENT

ANNUAL REPORT FOR 1954

BY

I. L. WARD, B.E., M.I.C.E., M.INST.W.E.

Director

NICOSIA

PRINTED AT THE CYPRUS GOVERNMENT PRINTING OFFICE

1955

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WEIGHTS, MEASURES AND CURRENCY.

| | | | | |
|------------|----------------|---|---------------------------------------|---------|
| WEIGHT : | 400 drams | = | 1 oke. | |
| | 1 oke | = | 2 ⁴ / ₅ lbs. | |
| | 44 okes | = | 1 kantar. | |
| | 180 okes | = | 1 Aleppo Kantar (carobs). | |
| | 800 okes | = | 1 ton. | |
| CAPACITY : | 1 Cyprus litre | = | 2 ⁴ / ₅ quarts. | |
| | 1 kile | = | 1 bushel. | |
| | 1 kouza | = | 9 quarts | } wine. |
| | 16 kouzas | = | 1 load | |
| LENGTH : | 1 pic | = | 2 feet. | |
| AREA : | 1 evlek | = | 3,600 sq. feet. | |
| | 1 donum | = | 14,400 „ | |
| | 3,025 donums | = | 1 acre. | |
| CURRENCY : | 1 piastre | = | 1 ¹ / ₃ penny. | |
| | 9 piastres | = | 1 shilling. | |
| | 20 shillings | = | 1 pound. | |



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DEPARTMENT OF WATER DEVELOPMENT. ANNUAL REPORT FOR 1954.

The title of the former Water Supply and Irrigation Department was changed to Department of Water Development on the 1st July, 1954.

2. The engineering and geological side of all Government water development work is in the hands of the Department 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. The administration of village Irrigation Divisions and Associations and of Domestic Water Commissions is supervised by the District Commissioners. Disputes over water rights are handled chiefly by the Commissioners in consultation with the Law Officers, the Department of Lands and Surveys and the Department of Water Development. Soil conservation and the agricultural problems involved in the economic use of water are responsibilities of the Department of Agriculture.

3. During 1954 the Department of Water Development increased its activities. The main features of the year's work were good progress of the new town water supplies at Nicosia and Famagusta, and the drilling of a record number of boreholes, chiefly for irrigation. Fewer gravity irrigation works and village domestic water supplies were completed than in 1953 but requests from village communities for such works continued as usual. A hydrological service was established towards the end of the year for the purpose of keeping records of the flow of rivers, streams and springs and, more particularly, for observing and studying the effect of the recent expansion of irrigation by pumped groundwater upon the underground water resources of the island.

4. The rainfall year 1953-54 was one of less than average rainfall. No special demands were made upon the Department for either drought relief works or for flood damage repairs. The months of October, November and December, 1954, however, brought some very exceptional early rainfall and by the end of the year a total of 11.80 inches had fallen in Nicosia against an average for these months of 4.3 inches and an approximate annual average of 13 inches. There were floods resulting from these rains but only minor damage was caused to irrigation works.

5. The work of the department is divided into four chief branches dealing respectively with (a) Irrigation, (b) Town Water Supplies, (c) Village Domestic Water Supplies and (d) Geology and Drilling. A fifth branch, for hydrological studies, is now coming into operation. There is continuous liaison between these branches so that their work is co-ordinated in the best interests of the over-all water supply problems of the island. Thus the village domestic water branch may develop a source of water in excess of the requirements of a particular village and the surplus may be utilised for irrigation; where gravity water supplies are not available, investigations by the geological branch may locate underground sources from which water can be pumped for irrigation or domestic use.

IRRIGATION.

6. As in previous years, the policy of the department has been to undertake many small schemes rather than a few large ones. These have become very popular and a steady flow of proposals for new works continues to come in. The total number of irrigation schemes completed during the year was 60, providing sufficient water to irrigate 10,888 donums, of which 3,648 donums can be irrigated perennially. Although only 60 schemes were completed in 1954 as compared to 72 in 1953, the area of new irrigation was slightly greater, the difference being 944 donums or 9%. Fourteen more schemes were in progress at the end of the year and a further 76 have been planned in detail and are ready to be carried out as opportunity occurs.

7. The rate of progress in irrigation since the commencement of the Ten-Year Programme of Development in 1946 is shown in the following table :—

| | Gravity Irrigation | | Mechanical Irrigation (i.e. Pumped) Donums | Total Donums |
|--|-------------------------|---------------------------|--|---------------------------|
| | Perennial | Seasonal | | |
| | Donums | Donums | | |
| 1946 Census.. .. . | 59,409 say 59,500 | 284,977 say 285,000 | 53,131 say 53,000 | 397,517 say 397,000 |
| Estimated at end of 1953 .. | 81,000 | 334,500 | 93,000 | 508,500 |
| New Irrigation, 1954 | 3,500 | 7,000 | 9,000 | 19,500 |
| Estimated totals at end of 1954 | 84,500 | 341,500 | 102,000 | 528,000 |
| Percentage increase since 1946 census and commencement of Ten-Year Programme of De- velopment | 42% | 20% | 92% | 33% |

8. The irrigation works carried out by the department may be classified in the following groups :—

- (a) Schemes developing small springs by excavation at their source, by lining channels in masonry or reinforced concrete to prevent loss of water, and by constructing masonry tanks for night storage.
- (b) Schemes involving the diversion of seasonal or perennial flow from rivers and water courses by means of weirs and channels.
- (c) Irrigation from infiltration galleries constructed in slow yielding aquifers, in fissured rock, or in river gravels either by gravity or by pumping.
- (d) Water conservation in reservoirs for periods of a few days to several months.
- (e) Installation of pumping plant on wells and boreholes and the construction of distribution channels.

9. The lining of irrigation channels in both cement-concrete and lime-concrete has been one of the chief activities of the irrigation branch of the department during the year and this type of work is now widely recognised among Cypriot cultivators as a very effective means of increasing the volume of water reaching the fields. By the elimination of seepage losses between source and field, additional water becomes available for extending the area under cultivation. In addition less labour is required for cleaning and maintaining channels. During the year 8 miles of channels were lined in reinforced concrete, 10 miles in unreinforced lime-cement concrete, and $1\frac{1}{2}$ miles in masonry. These works were carried out chiefly in the village areas of Lapithos, Tembria, Argaka, Magounda, Meniko, Prastio, Nikitas and Tala.

10. Some thirty small schemes involving the excavation and building of springs, and the conveyance of water in pipes or channels to small irrigation tanks have been completed in the hill areas. Among the villages that have received this type of scheme are Agridhia, Akapnou, Ayios Theodoros (Ll), Moutoullas, Pedhoulas and Omodhos.

11. A 60 feet high concrete and masonry gravity dam on the Kryos River near Perapedhi was started and the first season's work was completed. This included the pouring of the concrete foundations and the cutting away of cracked surface rock from both abutments. Further progress might have been made before the winter, had it not been for labour difficulties which caused work to stop in October. The reservoir will have a capacity of ten million gallons which is sufficient to compensate the irrigation Divisions of Perapedhi and Kilani for water pumped from the river for domestic use at Troodos, further upstream.

12. A small earth dam, 16 feet high and 1,700 feet long, with a storage capacity of 22 million gallons is under construction near Gypsos. This season's works consists of two 100 foot spillways and the outlet arrangements. The earth bank will be formed in 1955.

13. At Ayios Loucas, near Famagusta, the first phase of an interesting scheme was nearing completion at the end of the year. This is a groundwater recharge scheme designed to improve underground water conditions around Famagusta town where heavy pumping in past years has caused a general lowering of the water table, to such an extent that it is now more than 20 feet below sea level in some places, and the sea is penetrating into wells and boreholes along the coast, causing them to turn brackish or saline, and making the water unfit for irrigation. The works include the repair of an old earth embankment across the Harangas river to form a 50 million gallon reservoir, the construction of a 100 foot spillway, and the driving of a mile of re-charge tunnels in a porous stratum at sea level. The tunnel is intended to convey water from the reservoir into the aquifers that provide irrigation water in and about Famagusta town. It is hoped that the fresh water introduced both through the tunnel and by seepage through the bed of the reservoir will tend to retard the advance of sea water. This first phase of the scheme is experimental. If it is successful the work may be enlarged in scope and effectiveness by bringing in more water from the Kouklia reservoir, some nine miles away. The cost of the works now nearing completion will be about £9,000.

14. The following works that are representative of the 1954 programme are described in detail in Appendix 6.

- (a) Ayios Loucas—groundwater re-charge works. (Also in Appendix 4).
- (b) Amargeti—river intake, protection wall.
- (c) Tala—concrete channels.
- (d) Ayios Ioannis—weir, channel, pipes and masonry tank.
- (e) Mitsero—concrete channels.

15. Schemes examined but not yet under construction include a 100 foot dam for Trimiklini, a 40 foot masonry dam for Kandou, a 35 foot earth flood detention dam for Exometokhi, sub-surface weirs for Kalokhorio (Lefka) and Pyrgos (Limassol) the re-modelling of the canalisation system at Syngrasis including some anti-erosion weirs, and the lining of channels at Krini, Pano Dheftera, Kilani, Limnitis, Akaki, Nikitari, Bellapais and other places.

TOWN WATER SUPPLIES.

16. The principal suppliers of water in Nicosia, Limassol and Famagusta are the respective Water Boards. The members are nominated half by Government and half by the Municipality and the Chairman is appointed from among these six 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 these authorities on the technical aspects of their water supplies and is at present carrying out major schemes for Nicosia, Limassol and Famagusta. Minor works are in progress or have been completed recently in Larnaca, Paphos and Kyrenia.

17. Good progress has been made on the new schemes for Nicosia and Famagusta but work had to be interrupted at Limassol because the department has insufficient staff to proceed with all three of these large schemes concurrently with its many other commitments. Each of these schemes, although incomplete, is already in operation and is supplying its designed quantity of water partly through new distribution pipes and partly through old ones not yet replaced. A total length of 106 miles of pipes of from 4" to 10" diameter was laid during the year in the above three towns. The estimated construction costs of the present Nicosia, Famagusta and Limassol schemes are £540,000, £400,000 and £400,000 respectively.

18. Details of the various town water supply works are given in Appendices 10 and 11. Some additional or summarised information is given briefly below.

Nicosia.—Except for two small pumping stations the new works are now virtually complete. They provide an entirely new distribution system for the Water Board's Area of Supply including the Kermia estate near Orta Keuy but excluding that part of the town which is within the old city walls. The total length of pipes in the distribution system is 100 miles. The suburban villages of Strovolos, Engomi Ayios Dhometios, Orta Keuy, Trakhona and parts of Omorphita and Palouriotissa are not within the Board's Area of Supply and have not yet been provided with water.

Famagusta.—Water from the new Phrenaros North boreholes was first delivered to the town in May in time to prevent a summer shortage. The new reservoir works are now nearing completion and about 62% of the pipes for the new distribution system have been laid.

Limassol.—Work was brought to a standstill in March due to shortage of staff for supervision but was re-commenced in October. A severe shortage of labour in the Limassol district then made it impossible to engage more than about 50 labourers and progress was therefore slow. About 57% of the new pipe distribution system is complete. The remaining portion includes the two distribution areas in the busy central part of the town.

Larnaca.—Some minor distribution works were carried out.

Kyrenia.—An artesian borehole drilled in 1953 was connected to the town supply and some small diameter distribution pipes were laid.

Paphos.—A pump was placed on a borehole drilled in 1952 near Mesoyi some 4½ miles from the town and pipe connections were made to the Ktima supply. This pump will normally be used only in summer when the demand increases and when the gravity water from the springs diminishes.

19. In addition to the execution of the new works briefly described above a considerable amount of planning for extensions and improvements has been carried out during the year. The need for more domestic water in the towns is becoming very evident and is caused by a number of contributory factors. The increase in population is not less than 3% per annum; if 5 years are required for planning and completing a major scheme it becomes necessary to plan for a population at least 15% more than existing. The quantity of water required is more than indicated by the numerical rise in population because there is also a growing *per capita* consumption caused by better standards of living and, in particular, by the increasing use of water borne sanitation. Furthermore, many of the wells in urban areas that formerly gave, in the aggregate, large quantities of water are now partly drying up or becoming subject to contamination as a greater area becomes "built up". It is now necessary to assume that all town domestic water must come from the piped town supply. Appendix 11 gives the approximate *per capita* water consumption in the four chief towns of Cyprus in the summer of 1954, and other information on this subject is given in Appendix 10.

20. The position in the suburban villages adjoining Nicosia has become very acute. These villages as yet have practically no modern water supply facilities although they are virtually part of the town. The combined population is estimated at about 15,000 as compared with 49,000 within the Nicosia Water Board's Area of Supply. A scheme, called the Greater Nicosia Water Supply Scheme, has been prepared for supplying water to the suburban villages and at the same time for providing against the future needs of both town and villages for the next few years. If the average summer consumption is 35 gallons per person per day the proposed scheme should be satisfactory until 1964. The scheme will also provide a 24 hour pressure system within the town walls for both domestic use and for fire fighting. The new water sources for the scheme are in the Kokkini Trimithia area, in the Kyrenia Hills near Dhikomo, and in the Yalias valley near Dhali. The construction cost of the first stage was estimated in June, 1954, to be £525,000 and of the whole scheme £827,000.

21. A plan of water supply improvements for Larnaca town has also been prepared. It has been drawn up for three reasons, (a) in order that minor extensions of the existing water supply system caused by an expanding population may conform to an overall plan, (b) in order that the proposed distribution system may be modified to prevent the falling off of pressure in the high level areas during periods of peak demand and (c) to store water that now frequently overflows from the source. The proposed works include the duplication of the existing 15" main from the tunnels to the town, the construction of an 800,000 gallons covered reservoir, and the division of the distribution system into six independent areas of supply, each fed from a ring main. The cost of the works is estimated at £150,000.

VILLAGE DOMESTIC WATER SUPPLIES.

22. The work of the village domestic water section is confined mostly to water supplies for villages and rural municipalities. Sources of water are examined, measured, and where suitable, developed. Supply and distribution pipe lines are laid and storage tanks and public "fountains" constructed. A "fountain" is a combined public standpipe, trough and drainage soak-pit. With the exception of certain of the larger villages no house connections are made. The sources may be springs, infiltration galleries, boreholes or wells.

23. During the year 65 village water supply schemes were completed. This figure includes 19 schemes that are entirely new and 46 that improve supplies that were formerly unsatisfactory or inadequate. This raises the total of new schemes and improvements completed since 1946 to 431 and it is now estimated that of the total of 627 villages named in the census of 1946 the number with piped supplies is 471 or 75%. Of these 356 (57%) may be considered to be satisfactory and 115 (18%) need fundamental repairs or replacements. The 156 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.

24. In addition to the 65 schemes completed in 1954, a further 16 were under construction but incomplete at the end of the year. The number of schemes prepared and awaiting execution in due course as staff and money become available is 135. The following table indicates the works done on village water supplies in the period under review :—

VILLAGE WATER SUPPLIES 1954.

| Size of Pipe | ¾" | 1" | 1¼" | 1½" | 2" | 2½" | 3" | 4" | Total |
|--------------|-----|------|------|------|------|-----|------|------|-------|
| Miles laid | 4.7 | 26.4 | 23.0 | 24.7 | 21.9 | 9.4 | 14.7 | 30.1 | 154.9 |

Storage Tanks : 58

Fountains : 462

Distribution Boxes : 46.

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

| | | | | | | | | |
|---|----|----|----|----|----|----|----|-------|
| (a) New schemes to village standard where previously there was no piped water | .. | .. | .. | .. | .. | .. | .. | 10 |
| (b) Total replacement of an obsolete scheme | .. | .. | .. | .. | .. | .. | .. | 9 |
| (c) Improvements to village standard only | .. | .. | .. | .. | .. | .. | .. | 41 |
| (d) Improvements including house-to-house connections | .. | .. | .. | .. | .. | .. | .. | 5 |
| | | | | | | | | <hr/> |
| Total | .. | .. | .. | .. | .. | .. | .. | 65 |
| | | | | | | | | <hr/> |

Of the above 65 schemes, 53 obtain their water from springs, 4 from chains of wells by gravity, and 8 from wells or boreholes by pumping.

26. The tendency for village communities to seek more facilities for their domestic water supplies continues and is reflected in the large number of improvement schemes indicated in the above paragraph. Villagers are now asking for more water per person than formerly and they seek a greater number of fountains per hundred inhabitants.

27. The largest village water supply scheme of the year was Stage II of Appidhes in the Paphos District. Stage I. of this scheme supplied 10 villages and was completed in 1953 at a cost of £82,000 and was described in the 1953 annual report. Extensions supplying 14 more villages were completed in 1954 at a cost of £49,500. The total length of pipes laid was 62 miles in Stage I and 37 miles in the 1954 extensions. Details of this year's work are described in Appendix 12.

28. The Paphos earthquake of 10th September, 1953, caused the department some unforeseen work in 1954. Nine badly stricken villages were moved or partly moved to new sites and were provided with new water supplies. Of these 5 obtained water from the Appidhes scheme and are included among the works mentioned in the foregoing paragraph. The nine villages are Kithasi, Lapithiou, Phasoula, Mamoundali, Axylou, Eledhiou, Anadhiou, Stroumbi and Kallepia.

29. The dry villages of the Eastern Mesaoria have again been the subject of more investigation but so far without concrete results. No suitable new source of water within reasonable distance of this group of waterless villages has yet been discovered and there would appear to be no practical alternative to the proposal of acquiring 3% of the water of the Kythrea spring and distributing it among the villages for their domestic use. The users of the Kythrea water would be amply compensated if some of their unlined channels were lined with concrete. The cost of lining an appropriate length of channels and of piping water to ten villages in the plains would be well over £100,000.

30. The following village water supply schemes that are typical of the year's work are described in Appendix 12: Appidhes, Skarinou-Ayios Theodoros-Alaminos, Ayios Ioannis-Salamiou-Kelokedhara, Stroumbi, Kilani-Vouni, Prastio-Livadhi and Evdhimou.

DRILLING FOR WATER.

31. The Drilling Section is largely occupied in sinking irrigation boreholes for private persons under a subsidised drilling scheme. It also sinks prospecting boreholes for Government, and irrigation, domestic water, and industrial boreholes for public bodies and commercial companies on a full cost basis. 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. These beneficial results are reflected in an increased demand for subsidised and full-cost boreholes. In spite of a record year's drilling the waiting list of applications for new boreholes stood at 90 at the end of 1954.

32. Thirteen drilling rigs were continuously employed throughout the year and a further old machine was used occasionally for simple cleaning jobs. All these are of the percussion type. Boreholes are mostly of 8", 10", or 12" diameter. In 1954 the average depth was 194 feet and the greatest depth 520 feet.

33. A record total of 254 boreholes was sunk by the Department during the year and of these 162 were for irrigation, 11 for domestic water, 31 for prospecting purposes, 15 for industry, and 35 for other miscellaneous uses. Of the boreholes drilled for water 69% produced more than 1,000 gallons per hour on test and are classified as "successful". The total tested output of all the year's boreholes was 955,300 gallons per hour.

34. In addition to the above Government work, a considerable amount of drilling for water was carried out by registered contractors with improvised drilling machines. These contractors have drilled 58 new boreholes of average depth 117 feet and have cleaned or improved a large number of old boreholes during the year. The diameter of these boreholes is usually either 4" or 6".

35. The most interesting results from the year's drilling and test pumping have perhaps been obtained in the following places :—

- (a) in the Kyrenia Hills near Dhikomo.
- (b) in Miocene beds near Xeri and Yeri.
- (c) in Miocene beds north of Mitsero.
- (d) at the foot of the escarpment north of Ktima, Paphos.
- (e) south of Lysi.

These are described in Appendix 1. A further interesting development has taken place some three miles east of Polis where the Cyprus Sulphur and Copper Mines have now installed some 12 submersible pumps on different boreholes for the purpose of supplying water to their ore treatment plant.

36. The large number of boreholes drilled in recent years has caused a proportional increase in pumping in the island generally, and in particular in the Morphou area, and in the peninsula between Famagusta and Larnaca. The increased agricultural production resulting from irrigation by the pumped water 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 reserves 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 each year from the rainfall.

37. In the Morphou area there is so far no sign of any serious fall in the ground water table and further development can no doubt continue for a number of years. At the other end of the island, in the peninsula between Famagusta and Larnaca, the position is not so hopeful and measurements from the department's observation boreholes indicate that the limits of safe development are being approached and in some cases already exceeded. The area around Kokkini Trimithia is causing similar concern.

HYDROLOGY.

38. An engineer-hydrologist was appointed to the Department at the end of October and is now in charge of the new hydrological service which has been formed chiefly for studying the following subjects :—

- (a) Flood run-off in rivers.
- (b) Summer discharges of streams.
- (c) Spring discharges.
- (d) Run-off from different types of catchments.
- (e) The quantity of water pumped from wells and boreholes.
- (f) Changes in ground water levels.
- (g) Chemical analyses of water.
- (h) Annual re-charge of aquifers.
- (i) Special studies of certain ground water areas.

Among the results expected from the above studies one of the most useful will be information regarding the effect of the recent expansion of borehole pumping upon the underground water resources of the island. This should indicate if it is advisable to continue drilling at the present rate or if new drilling should be reduced or prohibited in certain areas.

39. A certain amount of hydrological work has been carried out by the department over the past few years. During 1954 the number of observation boreholes was increased from 24 to 34. Regular records of flow were kept on 238 springs and streams and many odd flow measurements were recorded on others. More than eight hundred samples of water were collected and taken to the Government Analyst for examination. Some two hundred and fifty new boreholes and wells were given routine 8-hour pump tests for yield, either for Government or for private persons. Automatic water level recorders provide information about flood discharges on six typical rivers. The results of all these measurements, tests and observations are systematically recorded for easy reference and interpretation.

40. Artificial re-charge of aquifers was carried out at Ayios Memnon during the rains of December, 1954. Some thirty million gallons were diverted from Paralimni Lake to the re-charge area and almost the whole of this quantity is thought to have been absorbed into the aquifers either by surface water spreading or through the tunnels completed earlier in the year as described in the 1953 departmental annual report. The larger Ayios Loucas re-charge scheme described in paragraph 13 and Appendices 4 and 6 of this report had not come into operation at the end of the year.

41. Details of the year's hydrological work are given in Appendix 4 and tabulated information is in Appendix 5.

MISCELLANEOUS ACTIVITIES.

42. Three small Government water supplies in Nicosia, and the Larnaca town supply are operated and maintained by the Department. A total of 35 special prolonged pump-tests of wells and boreholes was made during the year for Government, the Military, public bodies and private individuals. A sub-surface weir was built for the military at Kissousa. Technical advice is frequently given to public bodies and private individuals on their water supply problems, and the department is often asked to provide expert opinion on water disputes. 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 absorb a very large proportion of the time of the technical staff.

LEGISLATION.

43. An important new law, the Water (Development and Distribution) Law, was published as a draft bill on 5th August. This provides for the compulsory acquisition of privately owned water in places where it appears to the Governor-in-Council that the conservation and better use of water resources, the provision of sufficient water, its equitable distribution and availability at fair prices, or the effective execution of an island-wide policy relating to water, may be more effectively secured thereby. Upon the application of the law to any given area private water rights will vest in a Committee and the former right-holders may claim compensation from the Committee. Some of the chief functions of the Committee are to promote the conservation of water resources, to develop their use, and to co-ordinate their distribution.

44. The Water Supply (Municipal and Other Areas) Law was amended in October in three respects: (a) Powers are given to the Governor-in-Council to ascertain by arbitration the cost of acquisition of a private water undertaking by a Water Board, before acquisition is sanctioned. If the cost is high the Board may not proceed with the acquisition, (b) Rules are laid down for the compensation of

persons having a share in, or rights over, a water undertaking acquired by a Water Board, (c) Powers are given to Water Boards to dispose of undertakings they have compulsorily acquired and the procedure for doing so is defined.

45. An order under the Water Supply (Municipal and other Areas) Law, dated 30th September, extends the Area of Supply of the Water Board of Nicosia to include the lands of Kermia. This order issued following an agreement between the Board and the management of the Kermia Estate regarding the transfer of a borehole at Kokkini Trimithia to the Board free of charge and the payment of the cost of piping water to Kermia.

FINANCE.

46. The following is a summarised statement of the expenditure of the Department of Water Development in 1954.

| Nature of Work. | Government Funds. | Contributions from Beneficiaries. | Totals |
|---|-------------------|-----------------------------------|---------|
| | £ | £ | £ |
| 1. Gravity Irrigation Schemes | 93,000 | 39,500 | 132,500 |
| 2. Village Water Supplies .. | 136,500 | 114,200 | 250,700 |
| 3. Subsidised Drilling | 10,800 | 3,700 | 14,500 |
| 4. Prospecting for Water .. | 18,100 | — | 18,100 |
| 5. Drilling upon Repayment .. | — | 16,000 | 16,000 |
| 6. Nicosia Water Supply .. | — | 121,650 | 121,650 |
| 7. Limassol Water Supply .. | — | 8,450 | 8,450 |
| 8. Famagusta Water Supply .. | — | 173,800 | 173,800 |
| 9. Miscellaneous Works upon Repayment | — | 8,700 | 8,700 |
| 10. Departmental and Maintenance | 77,500 | — | 77,500 |
| Totals | 335,900 | 486,000 | 821,900 |

47. Included in the above statement are :—

| | |
|---|---------|
| | £ |
| 1. Personal emoluments | 44,500 |
| 2. Wages for labour (approx.) | 252,000 |
| 3. Travelling and subsistence | 8,450 |
| 4. Government controlled irrigation works | 6,500 |
| 5. Pump testing | 10,700 |
| 6. Value of casing pipes fixed in boreholes | 7,400 |
| 7. Total cost of drilling excluding Items 5 and 6 above | 30,500 |
| 8. Maintenance of Government water supplies | 7,850 |
| 9. Fire hydrants at Nicosia, Limassol and Famagusta | 20,400 |

48. A sum of £11,750 was collected as departmental charges for works carried out for the Water Boards, for drilling upon repayment, and for miscellaneous works upon repayment.

49. The average cost of a new borehole in 1954 was £120 and the average cost per foot drilled was £0.620. Details of drilling costs are given at the end of Appendix 1.

50. 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 two years was 45%. 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. Occasionally it is paid partly or wholly in cash or in free labour. A borehole under the Subsidized Drilling scheme is carried out for a private person at a fixed price to him of £32.10.0 for the first borehole, and the balance of the cost which, in 1954 has on the average amounted to about £95 is paid by Government. Private individuals requiring a second or third borehole are charged the actual cost in full including departmental charges. Municipal Corporations, companies, etc., also usually pay the full cost and departmental charges. The new town water supply schemes are paid for in full by the respective Water Boards, which have raised the money by special loans from Government. Village domestic water schemes are paid for half by Government and half by the village if no house-to-house connections are wanted. If there are house-to-house connections the extra cost is borne entirely by the village.

STAFF AND LABOUR.

51. On 26th October, 1954, Mr. M. Grehan was appointed Engineer-Hydrologist to take charge of the Hydrological Section. An Inspector of Water Supplies resigned on 27th December. There were no other noteworthy additions or changes to the strength of the staff during the year. On 31st December, it was as follows :-

| | | | | | | | | |
|--------------------------------------|----|----|----|----|----|----|----|----|
| Director | .. | .. | .. | .. | .. | .. | .. | 1 |
| Assistant Director | .. | .. | .. | .. | .. | .. | .. | 1 |
| Senior Engineers | .. | .. | .. | .. | .. | .. | .. | 2 |
| Engineer-Hydrologist | .. | .. | .. | .. | .. | .. | .. | 1 |
| Superintendent of Waterworks | .. | .. | .. | .. | .. | .. | .. | 1 |
| Senior Inspectors of Water Supplies | .. | .. | .. | .. | .. | .. | .. | 2 |
| Assistant Engineer | .. | .. | .. | .. | .. | .. | .. | 1 |
| Inspectors of Water Supplies | .. | .. | .. | .. | .. | .. | .. | 11 |
| Technical Assistants | .. | .. | .. | .. | .. | .. | .. | 15 |
| Foremen | .. | .. | .. | .. | .. | .. | .. | 76 |
| Accounts, Clerical and Miscellaneous | .. | .. | .. | .. | .. | .. | .. | 38 |

52. The average number of labourers employed during the year was 1,580 of whom 155 were unpaid, their work being considered as a contribution to the village share of irrigation works. These figures compare with 1,740 and 140 in 1953. About 28% were classed as "skilled" labourers of Special Grade or Grades I and II, and 16% were regular employees. The approximate monthly averages were as shown :—

| Month | Paid Labour | Free Labour | Total |
|-------------------|-------------|-------------|-------|
| January | 1,450 | 100 | 1,550 |
| February | 1,500 | 80 | 1,580 |
| March | 1,400 | 120 | 1,520 |
| April | 1,300 | 120 | 1,420 |
| May | 1,350 | 230 | 1,580 |
| June | 1,350 | 210 | 1,560 |
| July | 1,350 | 180 | 1,530 |
| August | 1,450 | 200 | 1,650 |
| September | 1,500 | 80 | 1,580 |
| October | 1,650 | 100 | 1,750 |
| November | 1,600 | 230 | 1,830 |
| December | 1,200 | 210 | 1,410 |
| Average | 1,425 | 155 | 1,580 |

53. As in other Government Departments a 44-hour week is observed by all labour. From Monday to Friday the working day is 8 hours, but on Saturday 4 hours only. The 4 hours on Saturday is considered a full day, and wages are paid for 8 hours. In drilling for water a bonus system is used, whereby a drilling crew, if it exceeds a certain prescribed monthly output, receives an addition to its normal weekly wages.

54. The various labour committees have been pressing for improved conditions and higher wages during the year. Agreement has been reached in most cases and works have not been delayed by labour disputes except through one isolated strike which occurred at Perapedhi dam. A shortage of labour in Limassol delayed progress on the town water supply scheme.

DEMAND FOR SCHEMES.

55. Requests for irrigation works including subsidised boreholes have on the whole been satisfied during the year but the demand for more persists and there is still a long waiting list. The problems of flood control, river training, anti-erosion works in river beds, and the reclamation of river beds and marsh lands are coming into greater prominence than formerly. The demand for village domestic water schemes is such that it can only be satisfied with the present resources of the department after a long period of years. The immediate town water supply problems are being solved except in the case of the suburban villages around Nicosia, but more extensions will soon be required to keep pace with the rapidly expanding populations and the rising standard of living. In general it may be said that the demand for irrigation works is being met for the present but the rate at which the domestic water problems can be tackled is limited by the availability of money and suitable technical staff.

January, 1955.

I. L. WARD,
Director.

APPENDIX I.

DRILLING FOR WATER.

BY D. P. MCGREGOR, B.Sc., A.M.I.M.M., *Assistant Director.*

The department's drilling plant consists of thirteen modern rigs of which nine are Ruston-Bucyrus 22-W, one is a Ruston-Bucyrus 33-W and three are Edecos. Five of the Ruston-Bucyrus rigs are on loan from the Army but operated and maintained by this department. All these rigs were operating in the field continuously throughout the year, except for minor breakdowns and periodical overhauls.

2. In addition the department has four transportable pumping units used for long continuous test-pumpings of boreholes and wells. These consist of one 8", one 6" and one 4" deep well reciprocating pumps with diesel engines and a new diesel-electric generating set used in conjunction with 7½" diameter electro-submersible pumps. This latter unit was obtained during 1954 and has proved most useful for testing high yielding boreholes particularly where the water has to be pumped from depths of over 200 ft. These test pumping units were in constant demand throughout the summer and autumn. Thirty-five test pumpings, of from 48 to 360 hours duration, were carried out involving a pumping time of 5,700 hours and a total quantity of over 42 millions gals. of water.

3. The total number of boreholes sunk during 1954 was 254 with an aggregate footage of 49,159. The average depth drilled per borehole was 194 ft. Many of the drillings were however carried out in the bottom of existing wells so that the average depth reached was 212 ft. The average time taken to complete a borehole, which in the case of a successful drilling normally includes the time taken to lay borehole casing and to carry out an 8 hours test pumping, was 13 days. This figure is exclusive of the time spent in drilling three very slow and difficult borings in the hard crystalline limestone of the Kyrenia Range. These drillings which aggregated 879 ft. occupied a total drilling time of 277 days. The total tested yield of the boreholes drilled for water in 1954 was 22,926,480 gals. per day. In addition to new drillings thirty-four old boreholes were cleaned and renovated. This work involved a total of 303 rig-days or roughly the time of one rig for the whole year.

4. One hundred and sixty-two boreholes were sunk for irrigation, of which 112 or 69.1% produced, on test, water in excess of 1,000 gals. per hour and may be classified as successful. The aggregate tested output was 17.5 million gallons per day which is considered sufficient to irrigate 9,000 donums in summer.

5. The number of successful irrigation boreholes drilled since the beginning of the Ten-Year Development Programme in 1946 is now 647 with a tested output of 103.5 million gallons per day, sufficient to irrigate 52,000 donums of summer crops. Making an allowance for boreholes which have not yet come into production, the actual area irrigated from new boreholes may be conservatively estimated to be of the order of 49,000 donums. The census of 1946 estimated that there was then some 53,000 donums of land being irrigated perennially by pumped water. By the end of 1954, as the result of Water Department drilling, this area has been increased by 92% to 102,000 donums.

6. During 1954 drilling operations were more widespread throughout the Island than in previous years, with rather less concentration of rigs in areas previously developed. This was due partly to prospecting drilling in new areas, to applications for boreholes in areas where water had been found by prospecting drilling in previous years and to a general increased interest in, and demand for,

drilling from all over the island. In these circumstances the percentage of successful boreholes has fallen below the figures for previous years but in spite of this the total quantity of water found during the year was approximately the same as last year.

7. The majority of the boreholes was drilled in the Pleistocene/Pliocene formations and the aquifers in these rocks again provided most of the water found. Fifty-five boreholes were drilled in the Western Mesaoria and a further 16 in the Tylliria coastal valleys as far west as Pyrgos. Of these, 58 were successful with an aggregate tested yield of 10.8 million gallons per day. Other areas in which successful drillings provided water from the Pleistocene/Pliocene rocks were at Kokkini Trimithia ; in the Famagusta District between Lysi and Akhna ; around Xylophagou in the Larnaca District and on the southern coastal plain both east and west of Limassol. The most successful drillings of the year were in this latter area where out of 21 boreholes sunk 19 were successful yielding on test a total of 3.7 million gallons per day or an average daily yield per borehole of 196,000 gallons. In the Paphos District, four successful boreholes were sunk on the coastal plain south of Yeroskipos and it is hoped that further drilling will prove that much of this strip of excellent agricultural land extending south-eastwards towards Mandria is capable of being irrigated perennially by pumped water.

8. An interesting feature of the year's drilling was the results obtained from boreholes sunk in the older Miocene rocks and in the Cretaceous-Jurassic limestones of the Kyrenia Range. The percentage of successful drillings was not large but out of some 60 boreholes sunk in these formations 27 were successful and yielded on test a total of 3.7 million gallons of water per day.

9. Thirty-one prospecting boreholes were sunk during 1954. Of these probably the most interesting were the two boreholes sunk through limestone in the Kyrenia Range near Pano Dhikomo. A previous borehole sunk in 1953 had found water in fissures in this formation but owing to the depth at which water was found and to the borehole being crooked no test pumping was possible. During 1954 a shaft was sunk at this site to 95 ft. and a new borehole (59/54) drilled in the bottom to 265 ft. It found water in fissured and cavernous limestone from 200 ft. to 234 ft. When test pumped with an electro-submersible pump over a period of 158 hours it gave a continuous output of 15,000 gallons per hour, while the water level was depressed by only 6 inches. Unfortunately Dhikomo spring, which is used for irrigation and is about 1,800 ft. distant, was considerably affected by the pumping, its output being gradually reduced from 14,000 gallons per hour to 9,000 gallons per hour. Towards the end of the test pumping the flow of the spring did not further reduce but remained steady and when pumping was stopped the spring quickly recovered. From measurements taken it has been calculated that while 2.4 million gallons was being pumped from the borehole, the reduction of the output of the spring was only 0.83 million gallons. The borehole obviously tapped the same reservoir as supplies the spring but it is interesting to note that by pumping this borehole during the summer months a considerable additional supply can be provided to augment the seasonal diminishing water from Dhikomo spring.

10. A second borehole (22/54) was sunk some 4,000 ft., to the west of 59/54 at a slightly higher elevation. Water was found in similar fissures at from 295 to 312 ft. The rest water level in this borehole was 36 ft. lower than in borehole 59/54 indicating that there is no connection between the waters of these two boreholes. A test pumping over a period of 298 hours gave an output of 8,600 gallons per hour with no effect on the water level. This was the maximum output of the electro-submersible pumping unit and it is possible that this borehole may be capable of a much greater output. It is intended to use this borehole, the water of which is of excellent quality, as one of the sources of the Greater Nicosia Water Supply.

11. South of Nicosia 12 prospecting boreholes were sunk to try to find the lateral extent of the buried Miocene water-bearing sands and gravels previously discovered near Laxia in 1951. Six boreholes were drilled near Xeri. All were successful giving outputs of from 3,000 to 10,000 gallons per hour from varying depths down to 350 ft. Five of the boreholes were semi-artesian and in the sixth the water struck at 253 ft. produced a small surface flow. These facts confirm the highly folded rock structure. Like the Laxia boreholes the water is noteworthy for the presence of Na_2CO_3 and its consequent low permanent hardness. The NaCl content varies between 400 and 700 parts per million, rather saline for use by itself for domestic supply but most suitable for mixing with a hard water of low salinity. A further prospecting borehole was sunk deep into the Miocene north-west of Dheftera to try to trace the westward extension of this aquifer towards Ayii Trimithia. Although similar sands were located and seem to indicate the same geological horizon they are much finer and produced only very little water. Eastward around Yeri 5 prospecting boreholes were sunk. Two of these were successful and three failed to find water. The successful boreholes encouraged six private drillings, three of which found water in good quantity. The water in this area is rather more saline than at Xeri and has a higher permanent hardness. It is however suitable for irrigation. Although by no means conclusive the results of the drilling so far carried out in these Miocene rocks appear to show that the aquiferous sands and gravels are confined to a narrow belt, probably not more than half a mile in width extending in a rough semi-circle around the south of Nicosia from Ayii Trimithia, through Dheftera, Xeri and on to the 7 mile point on the Nicosia-Limassol road. Thence it bends north-east towards Yeri village. Further exploratory work is still required to delimit more accurately the extent of this aquifer.

12. Around Mitsero the Hellenic Mining Co. Ltd. have been prospecting for water required for their ore treatment plant and a drilling rig of this department has been employed on a full-cost basis. Three boreholes, two successful, were sunk in 1953. In 1954 a further 9 boreholes were sunk. Three of these found water and gave tested yields of 4,800, 6,000 and 8,000 gallons per hour respectively. The water occurs in all cases in Miocene reef limestone or in a marly facies of the same rock. The limestone outcrops along the hills between Kato Moni and Agropikia and dips northwards below the Pliocene. Unfortunately drilling results indicate that the limestone is neither very thick nor very extensive laterally and its shape is most irregular. One borehole cut through a 3 ft. thickness of limestone between 116 and 119 ft. and a tested yield of 6,000 gallons per hour of water was obtained while 600 ft. to the north and 1,500 ft. to the east two other deep boreholes failed to find either limestone or water. The limestone is usually associated with gypsum and the water has a fairly high calcium sulphate content. It is however quite suitable for use in the ore treatment plant.

13. In Paphos District, near Temithousa, two subsidized boreholes drilled along the line between the two successful prospecting boreholes sunk in 1952 were successful in obtaining good yields of water. The water here is also in Miocene limestone, outcrops of which can be seen in nearby ravines. The strike of the Miocene rocks in this area is N.W.—S.E. and they dip north-east towards the Tsadha escarpment. Small springs overflow from the base of the limestone outcrops but continuous test pumping of two nearby boreholes, for periods of 8 and 11 days respectively, did not appear to affect the flow of these springs. Borehole 209/52, which is now used to augment the water supply of Ktima during the summer yielded approximately 1 million gallons in the first 60 hours of the test pumping but towards the end of the eleven-day test the output dropped to 3,600 gallons per hour. The conclusion reached is that the aquifer is not very extensive and may not be capable of sustained pumping over long periods. It should however be re-charged to full capacity each rainy season.

14. Two successful prospecting drillings, found good quantities of water south and west of Lysi. The aquifer is a calcareous sandstone probably of Pliocene age. The water will be used for the village domestic supplies of Kouklia, Kondea, Sinda and Lysi. As a result of these drillings applications have been received for subsidized boreholes to be sunk for irrigation water from this undeveloped aquifer.

15. Three out of five boreholes sunk in the comparatively thin capping of Pliocene rocks which form the higher ground south of Lapatios (Famagusta District) found water in medium to coarse shelly sandstone at depths of 60 to 80 ft. When test pumped the output of these boreholes was of the order of 3,000 gallons per hour. Experimentally, a well was sunk at one of these boreholes and 5 horizontal auger holes, varying in length from 223 to 138 ft. and 2 inches in diameter were drilled out radially into the aquifer. While one hole was being drilled the others were plugged to enable the pump to cope with the inflow of water. When the auger drilling was completed the plugs were withdrawn and a subsequent test pumping of 200 hours duration yielded an increased output of over 10,000 gallons per hour. The catchment area of this aquifer is not very extensive and there are a number of other wells and boreholes at no great distance. It will be interesting to see whether or not the aquifer holds sufficient water to maintain this rate of pumping throughout the dry season. The water is to be used for irrigation and after a full season's pumping it may be possible to decide how many similarly developed wells can safely be sunk in this area without danger of overpumping the aquifer.

16. The further development of the underground water of the Akrotiri Peninsula, north of the Salt Lake, was continued during the year. Eight successful boreholes were sunk with tested outputs ranging from 6,000 to 21,000 gallons per hour. In spite of the large number of high production boreholes which are being pumped in this area, there are as yet no signs that this excellent aquifer is being overpumped.

17. An interesting development in this locality has been the finding of water in 2 boreholes drilled near the Limassol-Paphos road between Ypsonas and Polemidhia. The output of these boreholes is not large, of the order of 3,000 gallons per hour, but it is a most useful find in an area where it is difficult to provide either domestic or irrigation water from other sources.

18. During 1954 a further 10 observation boreholes were sunk bringing the total to 34. Five were drilled in the Kalopsida-Makrasyka Water Conservation Area, one between Kolossi and Phassouri and four along the Morphou coast between Syrianokhori and Pendayia. Further particulars of these and of the results of measurements of water levels in the other control boreholes are given in the Appendices 4 and 5. A total of 25 boreholes aggregating to 1,880 ft. were drilled for technical and geological purposes such as building and bridge foundations and electrical earthing connections.

19. Nineteen private drilling contractors were licensed during 1954 and these sunk a total of 58 boreholes. Each of these operate a single drilling rig which, with the exception of a Ruston-Bucyrus 22-W belonging to the Cyprus Sulphur and Copper Mines Ltd., Limni, are locally made and are usually of rather primitive design. Apart from 6 boreholes drilled near Limni most of the borings were carried out in the Famagusta District where drilling is comparatively easy and where borehole casing, although advisable, is locally considered unnecessary. The majority of these drillings, of 4" to 6" diameter, were sunk in the bottom of hand dug wells. By law private drillers are obliged to give notice of drilling, to keep records of depth and static water level and to retain borehole samples. These provide useful geological and hydrological data. Test pumpings are not normally carried out, but from information received it is possible to arrive at an approximate figure of the total yield of these private drillings.

PRIVATE DRILLINGS.

| Rig | No. of B.H. | No. Successful. | Total Footage | Average Depth (ft.) | Estimated output gallons p.h. |
|------------------------------|-------------|-----------------|---------------|---------------------|-------------------------------|
| Locally made | 52 | 34 | 6,185 | 119 | 2,400,000 |
| Ruston-Bucyrus 22.W. | 6 | 6 | 584 | 97 | 1,224,000 |
| Totals | 58 | 40 | 6,769 | 117 | 3,624,000 |

20. The average cost of departmental drilling in 1954 was £120 per borehole or 12/5d. per foot of drilling. These costs are inclusive of the expenses of laying casing pipes and for an 8 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 and workshop maintenance fitters and blacksmiths, fuel and lubricating oils, bit sharpening and repairs and replacements of drilling tools and equipment but do not include depreciation of drilling plant and the salaries and expenses of the supervisory staff. One hundred and fourteen subsidized boreholes were drilled. These boreholes cost £126.9 each or 12/6d. per foot. The contribution of the beneficiaries to this cost was £32-10 per borehole and Government provided the balance of approximately £95. Forty-one prospecting and observation boreholes drilled out of Government funds, cost £200 per borehole or 15/9d. per foot. They include the Dhikomo drillings and are accordingly high. Ninety-nine full-cost boreholes cost £79 each or 10/1d. per foot of drilling. The low price of full-cost boreholes is due to the large proportion of shallow drillings. Forty of these had an average depth of only 41 feet.

APPENDIX 2.

NUMBER AND FOOTAGE OF BOREHOLES.

NUMBER OF BOREHOLES DRILLED.

1947-1954.

| Purpose | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 |
|---|--------|--------|--------|--------|--------|--------|--------|--------|
| For private individuals and Companies | 35 | 92 | 135 | 132 | 157 | 195 | 169 | 182 |
| For Government | 17 | 25 | 46 | 32 | 41 | 21 | 51 | 57 |
| For War Department and Air Ministry | 15 | — | — | 27 | 32 | 26 | 10 | 15 |
| Total | 67 | 117 | 181 | 191 | 230 | 242 | 230 | 254 |
| Aggregate Footage drilled | 12,171 | 21,397 | 33,610 | 40,751 | 47,766 | 41,022 | 44,563 | 49,159 |
| Average Depth | 182 | 182 | 186 | 231 | 208 | 170 | 194 | 194 |

Boreholes drilled in 1954.

| Purpose | No. | Existing Well Footage | Footage drilled | Percentage Successful* | Total Tested Yield in Gallons per day |
|--|-----|-----------------------|-----------------|------------------------|---------------------------------------|
| Irrigation | 162 | 4,127 | 30,374 | 69.1 | 17,544,720 |
| Domestic Water Supplies | 11 | 294 | 2,275 | 72.8 | 1,450,320 |
| Prospecting | 31 | 403 | 7,746 | 64.5 | 3,156,240 |
| Industrial | 15 | — | 4,244 | 40.0 | 775,200 |
| Total for Water | 219 | 4,824 | 44,639 | 66.7 | 22,926,480 |
| Observational Boreholes (not tested) | 10 | — | 2,632 | — | — |
| Technical and Geological Boreholes | 25 | — | 1,888 | — | — |
| Total Drilled | 254 | 4,824 | 49,159 | — | — |

Old Boreholes cleaned : 34.

* A successful borehole is one that yields on test more than 1,000 gallons per hour of usable water.

APPENDIX 3.

BOREHOLES DRILLED FOR WATER IN 1954.

Summary of Results.

| District | Locality | No. of boreholes drilled | No. successful (*) | Percentage successful (*) | Total tested Output Gals. per day | Average Yield per successful borehole Gals. per day | |
|-------------------------------|---------------------------------|---------------------------------|--------------------|---------------------------|-----------------------------------|---|---------|
| Nicosia .. | Western Mesaoria .. | 55 | 45 | 81.8 | 8,662,800 | 192,700 | |
| | Karavostasi-Limnitis-Pyrgos .. | 16 | 13 | 81.3 | 2,146,800 | 165,000 | |
| | Kokkinotrimithia .. | 6 | 5 | 83.3 | 868,320 | 173,700 | |
| | Lakatamia, Dheftera-Xeri .. | 8 | 7 | 87.5 | 973,440 | 139,000 | |
| | Dhali-Nisou-Yeri .. | 13 | 5 | 38.5 | 641,520 | 128,000 | |
| | Nicosia .. | 7 | 2 | 28.6 | 142,560 | 71,000 | |
| | Mitsero .. | 9 | 3 | 33.3 | 451,200 | 150,000 | |
| | Palekythro .. | 5 | 2 | 40.0 | 343,440 | 171,700 | |
| | Kyrenia .. | Kyrenia-Lapithos .. | 6 | 2 | 33.3 | 176,640 | 88,000 |
| | | Kyrenia Range .. | 9 | 4 | 44.4 | 672,960 | 168,000 |
| Famagusta | Kondea-Makrasyka-Akhna .. | 12 | 11 | 91.7 | 1,210,320 | 110,000 | |
| | Dherinia-Phrenaros .. | 3 | 2 | 66.7 | 194,400 | 97,000 | |
| | Trikomo-Lapathos .. | 6 | 4 | 66.7 | 315,840 | 79,000 | |
| | Karpas .. | 1 | — | — | — | — | |
| | Kyrenia Coast .. | 2 | 1 | 50.0 | 38,880 | 39,000 | |
| | Lysi-Kondea .. | 10 | 6 | 60.0 | 887,760 | 148,000 | |
| | Larnaca .. | Xylymbou-Xylophagou-Ormidhia .. | 8 | 7 | 87.5 | 576,720 | 82,000 |
| Kophinou-Pano Lefkara .. | | 3 | — | — | — | — | |
| Larnaca .. | | 2 | — | — | — | — | |
| Limassol | Phasouri-Kolossi-Akrotiri .. | 10 | 9 | 90.0 | 2,433,360 | 270,000 | |
| | Limassol-Polemidthia-Ypsonas .. | 7 | 6 | 85.7 | 771,120 | 128,000 | |
| | Evdhimou .. | 3 | 3 | 100.0 | 415,680 | 135,000 | |
| | Kandou .. | 1 | 1 | 100.0 | 103,680 | 104,000 | |
| | Paphos .. | Mesoyi-Trimithousa .. | 7 | 4 | 57.2 | 464,880 | 116,000 |
| Ktima-Yeroskipou-Khlorakas .. | | 10 | 4 | 40.0 | 434,160 | 108,500 | |
| Total .. | | 219 | 146 | 66.7 | 22,926,480 | 157,000 | |

* A successful borehole is one that yields on test more than 1,000 gallons per hour of usable water.

APPENDIX 4.

HYDROLOGICAL NOTES.

BY D. P. MCGREGOR, B.Sc., A.M.I.M.M., *Assistant Director.*

Rainfall in Cyprus during the winter of 1953-54 was subnormal in all districts of the island. The records of some 16 rainfall gauging stations, representing various parts of the island, show that it was on the average about 18% below the mean of the last 50 years and about 22% lower than the rainfall of 1952-53. As in 1952-53, precipitation was generally light and there were very few periods of high intensity rainfall.

During the year the number of measurements of spring flows was greatly increased and a total of 238 springs and streams is now measured regularly. Of these 16 are measured each month, 95 bi-monthly and the remainder at three month intervals. In addition numerous flow measurements of other springs were taken for investigation in connection with applications from villages for their use for domestic supply or irrigation works.

The effect of the light rainfall of 1952-53 is reflected in the fairly general reduction in the spring discharges. Noteworthy exceptions were some of the springs which issue from the limestone at the western end of the Kyrenia Range near Lapithos which gave a slight increased discharge. An analysis of the spring flow measurements of other districts for September and October 1953 and 1954 shows that the reduction in output was of the order of 20% which, as might be expected, is in direct proportion to the rainfall variation.

Eight hundred and fifty-one samples of water from boreholes, wells and springs have been taken and sent to the Government Analyst for analysis during the year to test their suitability for domestic or irrigation purposes. The records of these results, which include regular periodic sampling of many domestic supplies, enable a close check to be maintained on variations in quality of water.

Automatic water level recorders were in operation at six flood-water discharge sites throughout the 1953-54 rainy season. These were on the Pedieos river at Nicosia, on the Yialias river at Nisou, on the Serakhis and Ovgos rivers near Morphou, on the Marathasa river near Lefka and on the Xeros river at Xeros. Some difficulties were encountered in obtaining continuous records at one or two of these sites due to deviations in the river courses and to silting of the recorder float compartment but on the whole results may be considered as providing a reasonably accurate assessment of the run-off from the various catchments. Flood run-offs were in general infrequent and low in volume. The largest recorded discharge was at the Pedieos recorder site on May 14th, 1954, when during a period of 24 hours the total volume of a flash flood was 40 million cubic feet. A summary of the run-off measurements is given below :—

| Discharge Site | Total Rainfall Catchment (10 ⁶ c.ft.) | Total Run-off (10 ⁶ c.ft.) | Maximum Run-off in 24 hrs. period. (10 ⁶ c.ft.) | Percentage Run-off. |
|------------------------------|---|--|---|---------------------|
| Pedieos River at Nicosia .. | 2,400 | 138 | 40.4 | 5.9 |
| Serakhis River at Morphou .. | 8,218 | 136 | 35.0 | 1.6 |
| Ovgos River at Morphou .. | 2,118 | 79.7 | 4.0 | 3.8 |
| Yialias River at Nicosia .. | 2,029 | 65.7 | 32.0 | 3.1 |
| Marathasa River at Lefka .. | 1,976 | 500 | 26.0 | 25.3 |
| Xeros River at Xeros .. | 1,786 | 561 | 18.0 | 31.4 |

It is interesting to note the low run-off figures, and therefore the correspondingly high infiltration, in those catchments which for the greater part extend over Pleistocene/Pliocene sedimentary rocks. On the other hand the Marathasa and Xeros catchments cover areas, much of it forested country, where the underlying rocks are igneous and where the percentage of run-off is comparatively high.

With the drilling of 10 new observation boreholes during 1954 there are now a total of 34 of these boreholes located in areas where considerable amounts of underground water are being pumped from wells and boreholes. Regular monthly measurements, and in special cases, water samples for analyses, are taken at all these boreholes and these records allow a study of the seasonal and annual variations and provide a warning of any likelihood of any particular area being overpumped. The figures in Appendix 5 show the annual average and minimum water level variations in underground water tables during the period 1951-54.

In the Kokkini Trimithia area of the Western Mesaoria the records of the three observation boreholes (Nos. 1-3) show that between 1951 and 1954 there has been a general lowering of the water table by about 4.5 feet or at the rate of 1.5 feet per year. The records also show a seasonal variation between maximum and minimum water levels of between 4 and 5 feet. This area is being fairly intensively pumped for irrigation, and also for Nicosia Water supply, and although the depression of the water table is comparatively small it is obvious that restriction on the additional extraction of water is necessary.

At Astromeritis (Observation Borehole No. 4) the average rate at which the ground water table has been lowered between 1951 and 1953 was approximately 1.4 feet per year with no appreciable seasonal variation. Between August and September, 1954, however, the water level dropped sharply, by 30 feet from 362 to 332 feet above sea level and remained at this level, until October. The November measurement showed a recovery to 359 feet. This can be accounted for by heavy pumping for irrigation from new boreholes which were developed during 1954. Pumping ceased early in October as a result of heavy rainfall with the consequent rapid recovery of the water level. Further evidence is required to assess the overall effects of this heavy concentrated pumping and an additional observation borehole is advisable. It is certainly an area over which careful watch must be maintained.

Despite the very large number of boreholes which are being pumped in the Morphou coastal area, there is a remarkable absence of any signs of a lowering water table. The measurements of the 5 observation boreholes (Nos. 5 to 9), covering an area from north of the Ovgos river to Pendayia all show, on the contrary, a small rise of the annual minimum water level. There is quite a large seasonal variation. During the summer season when pumping is at its greatest, the water level is depressed, below the maximum, by as much as 12 feet. The aquifers are however fully recharged each rainy season by numerous rivers and streams many of which have their sources in the heavy rainfall area of the Troodos mountains. The potential output of this area is still much in excess of the large quantity of water at present being extracted. This is however no reason why timely precautions should not be taken to ascertain the limiting production of these aquifers and prevent the catastrophic results of uncontrolled development and the consequent encroachment of the sea, as has occurred at Famagusta. To this end four new observation boreholes have been sunk in 1954 near the sea-shore between Syrianokhori and Ghaziveran and two more will be drilled on the eastern side of the marsh in 1955.

At Xylophagou in the south-eastern Mesaoria 5 observation boreholes (Nos. 10-14) serve as controls on the trend of water level in an area which has been highly developed by boreholes during the past few years. Here the measurements show that there is a tendency for the water level to fall slightly. While as yet there is no cause for alarm, sufficient hydrological data is not yet available to ascertain the

extent of the recharging area. If, as may well be, no water enters the area from outside the limited topographical catchment, and the recharge is entirely dependent on the local low rainfall, then it is most important that the extraction of water should be restricted accordingly. The effects of increased pumping on the water level must be carefully watched.

At Phrenaros similar hydrological conditions probably exist. The surface catchment area is however much smaller and the effect of pumping water in excess of the recharging rate is more pronounced. Observation boreholes Nos. 16-19 are situated near the four boreholes which have been pumped for Famagusta water supply since August, 1952. Measurements of these have shown a steady decline in the water level since that date, relieved only by a slight increase in January and February, 1954, and a more accentuated one during the last three months of 1954, during periods of comparatively heavy rainfall. The average of the measurements of the observation boreholes shows a depression of the water table between August 1952 and October 1954 of 9.2 feet. The three observation boreholes at Phrenaros North (Nos. 20-22) show a similar downward trend of the water level since pumping to Famagusta was commenced in this locality in May of 1954. The average of measurements taken shows a total depression of 4.1 feet in five months. Rainfall in this locality during the past three years has been considerably less than normal and it is to be hoped that a heavy 1954-55 rainfall, which already appears to be having a beneficial effect on the aquifer, may serve to retard any further depression of the water table. If, on the other hand, the water table continues to be lowered the only solution will be to restrict the quantity of water pumped so as to achieve a state of equilibrium, and to ensure that the future water supply position of Famagusta is not seriously affected.

Water level measurements in the two observation boreholes at Ayios Memnon, on the coast two miles south of Famagusta, show that despite the efforts which have been made by Government to control pumping in this area the water level, which in some places is as much as 20 feet below mean sea level, is continuing to fall at an alarming rate. Borehole 69/38 which is now used as an observation borehole (No. 23) was originally drilled in 1938. The recorded water level at that time was approximately minus 2 feet. The average water level in this borehole during 1954 was minus 16.6 feet showing a drop of 15 feet in 16 years. That the water level is still continuing to fall is shown by the records of this borehole and of the other observation borehole (No. 24) during the past two years. These show average drops of 0.6 and 1.7 feet respectively. This state of affairs is most serious for the future of the irrigators of this locality, for the greater the depression of the water table below sea level, the faster the sea water will enter and contaminate the water of the aquifer. If complete destruction of the thriving orange groves is to be prevented it is imperative that further immediate steps should be taken to curtail the quantity of water which may be permitted to be pumped and for the prevention of additional lands being brought under irrigation from existing wells.

Artificial recharge by bringing in water from outside the affected area and facilitating its absorption into the aquifer is a means whereby the effects of overpumping may be counteracted and if sufficient water could be introduced in this way it might be possible to stop the ingress of the sea water. Unfortunately no such quantities of surplus water are readily available for regular annual recharge in the Famagusta area and the geological and topographical structure is such that there is no easy or cheap method of getting water into the aquifer. Small experimental works are being carried out for the purpose of using for recharge all available flood water which would otherwise run to waste. One of these schemes, whereby the water collected in Paralimni lake is diverted into an absorption tunnel at Ayios Memnon has been described in the Department's Annual Report for 1953. The winter of 1952-53 was a dry one and very little water was collected in the lake so that the quantity of recharge was negligible. In November and December, 1954, however, there was

10.6" of rain at Paralimni and it is estimated that between 4th and 31st of December 1954 about 30 million gallons of water were diverted into the Ayios Memnon area. This quantity was more than the tunnel would absorb and the surplus was allowed to spread over neighbouring fields. This water spreading is a well recognised and effective method of recharging but when orange groves and cultivated fields are subjected to prolonged flooding it can have serious detrimental effects on crop production and there were complaints from the local farmers. Further experimental recharge works are at present being carried out near Ayios Loucas and are described in paragraph 13 page 5 of this report and in Appendix 6. If it is proved that water can be effectively absorbed in large quantities into the aquifer by these means the second phase of the scheme whereby the water from Koukليا reservoir will be incorporated in the recharge should have a considerable beneficial effect on the underground water of Famagusta. This scheme has the added advantage that if it proves unsuccessful as a means of recharging the aquifer, the water which can be stored in Koukليا reservoir and gravitated from there to Ayios Loucas may be pumped from there for the direct irrigation of the Famagusta orange groves and so enable a considerable reduction in the local pumping.

APPENDIX 5.

WATER LEVELS IN CONTROL BOREHOLES.

Feet above sea level.

| Location | Bore-hole No. | Average water level | | | Minimum water level | | |
|---|---------------|---------------------|-------|-------|---------------------|-------|-------|
| | | 1951 | 1953 | 1954 | 1951 | 1953 | 1954 |
| 1. Kokkini Trimithia (Police Station) | 90/50 | 682.9 | 679.4 | 678.2 | 680.1 | 676.5 | 675.9 |
| 2. Kokkini Trimithia (North Side) | 160/50 | 681.1 | 678.3 | 676.7 | 679.4 | 676.5 | 674.9 |
| 3. Kokkini Trimithia (East Side) | 161/50 | 682.5 | 678.7 | 677.9 | 679.4 | 676.5 | 674.5 |
| 4. Astromeritis (Katokopia Road) | 91/50 | 366.0 | 362.4 | 356.8 | 363.9 | 361.0 | 332.2 |
| 5. Morphou (North of Ovgos River) | 168/50 | 86.2 | 89.6 | 89.8 | 83.5 | 85.1 | 86.2 |
| 6. Morphou (Government Experimental Farm) | 92/50 | 77.0 | 76.4 | 76.4 | 69.9 | 71.8 | 70.3 |
| 7. Prastion (27 M.P.) | 93/50 | 25.4 | 24.9 | 25.0 | 22.1 | 22.7 | 22.8 |
| 8. Ghaziveran (between 29-30 M.P.) | 94/50 | 17.0 | 17.6 | 17.5 | 15.5 | 16.7 | 16.2 |
| 9. Pendaria (On road to Peristeronari) | 95/50 | 8.7 | 11.8 | 11.4 | 6.8 | 9.1 | 9.2 |
| 10. Xylophagou (West of village) | 70/51 | 23.6 | 22.2 | 21.5 | 23.1 | 21.3 | 20.4 |
| 11. Xylophagou (West of village) | 71/51 | 17.8 | 16.4 | 15.2 | 16.9 | 15.4 | 13.7 |
| 12. Xylophagou (West of village) | 72/51 | 22.2 | 22.5 | 21.4 | 21.0 | 21.3 | 20.6 |
| 13. Xylophagou (East of village) | 73/51 | 10.9 | 9.7 | 9.8 | 10.3 | 8.7 | 9.0 |
| 14. Xylophagou (East of village) | 74/51 | 11.0 | 11.1 | 11.0 | 10.9 | 10.1 | 10.1 |
| 15. Pergamos | 86/51 | 255.1 | 255.6 | 253.3 | 254.3 | 253.4 | 251.4 |
| 16. Phrenaros (Famagusta W.S.B.Hs.) | 51/51 | 86.7 | 79.4 | 75.7 | 86.5 | 76.7 | 73.9 |
| 17. Phrenaros (Famagusta W.S.B.Hs.) | 52/51 | 85.5 | 79.9 | 76.7 | 85.3 | 78.0 | 74.1 |
| 18. Phrenaros (Famagusta W.S.B.Hs.) | 53/51 | 84.9 | 81.4 | 78.3 | 84.8 | 79.5 | 77.2 |
| 19. Phrenaros (Famagusta W.S.B.Hs.) | 67/53 | — | 80.4 | 78.5 | — | 79.1 | 77.2 |
| 20. Phrenaros North (Famagusta W.S.B.Hs.) | 108/52 | — | 71.5 | 69.2 | — | 70.6 | 65.9 |
| 21. Phrenaros North (Famagusta W.S.B.Hs.) | 109/52 | — | 70.9 | 68.7 | — | 69.9 | 66.1 |
| 22. Phrenaros North (Famagusta W.S.B.Hs.) | 110/52 | — | 70.9 | 68.3 | — | 69.5 | 66.2 |
| 23. Ayios Memnon (South) | 69/38 | — | 16.0 | 16.6 | — | 17.9 | 19.42 |
| 24. Ayios Memnon (South) | 50/53 | — | 11.2 | 12.9 | — | 12.76 | 14.86 |
| 25. Makrasyka (South of village) | 48/54 | — | — | 114.8 | — | — | 113.1 |
| 26. Makrasyka (South of village) | 49/54 | — | — | 119.9 | — | — | 119.0 |
| 27. Kalopsidha (S.W. of village) | 54/54 | — | — | 63.0 | — | — | 60.4 |
| 28. Kalopsidha (S.W. of village) | 55/54 | — | — | 74.3 | — | — | 73.4 |
| 29. Kalopsidha (S.W. of village) | 56/54 | — | — | 75.8 | — | — | 74.9 |
| 30. Kolossi | 88/54 | — | — | — | — | — | — |
| 31. Syrianokhori | 150/54 | — | — | — | — | — | — |
| 32. Syrianokhori | 151/54 | — | — | — | — | — | — |
| 33. Syrianokhori | 152/54 | — | — | — | — | — | — |
| 34. Syrianokhori | 153/54 | — | — | — | — | — | — |

Note.—Boreholes Nos. 25 to 34 inclusive drilled during 1954.

APPENDIX 6.

DESCRIPTION OF CERTAIN IRRIGATION SCHEMES.

By J. KARAPETIAN, B.E.M., *Senior Inspector of Water Supplies.*

(A) *Ayios Loucas Recharge Scheme.*—The object of the scheme is to divert spate water, coming down from the "Harangas" catchment which normally flows to sea through the Fresh Water Lake, for recharging the underground aquifers in the area of Ayios Loucas and Kato Varosha.

The scheme consists of a storage reservoir of 50 million gallons capacity formed by the reconstruction of an old earth dam on which a masonry spillway of 100' × 3'6" waterway has been constructed. A washout pipe has been laid under the bank and can be operated from a small valve tower on the bed of the reservoir. Access to the valve tower from the top of the bank has been provided by a foot bridge. The total depth of water is 12 feet from the reservoir bed (2 feet below sea level) to the sill of the overflow spillway (9.75 feet above sea level). The total length of the earth bank is 900 feet and maximum height at the centre is 15 feet. Some 5,000 cubic yards of earthwork has been involved in the re-construction and improvement of the dam.

The intake from the bed of the reservoir consists of a 10" diameter perforated stand-pipe connected to a precast concrete pipeline 10" in diameter laid underground along the bed of the reservoir for a length of 1,700 feet with inspection concrete manholes at about 300 feet centres.

The pipeline delivers into an underground tunnel size 3' × 4' driven with its invert at 2.75 feet above sea level for a length of 3,800 feet with vertical access shafts 3 feet diameter at 50-75 feet centres. A penstock in a masonry manhole has been provided at the head of the tunnel to control the water flowing into the tunnel.

The scheme was started in September, 1954, and is now completed, except for half the length of the tunnel. The total cost has been estimated at £9,000 of which the beneficiaries paid £3,000.

(B) *Amargeti.*—This scheme was executed for an Irrigation Division in which the irrigators formerly had a brushwood temporary intake weir in the Xeros river for diverting the flow into their earth channel. A considerable proportion of the flow was wasted due to lack of control works and to leaking channels.

Improvement works consisted of a masonry groyne intake, 1,000 feet of masonry channels, lining of 8,000 feet earth channels in lime cement concrete, three R.C.C. aqueducts and four river pipe-crossings.

Before the works were undertaken an area of about 50 donums under summer crops was irrigated and after the completion of the improvement works, it has been possible to bring under irrigation an additional area of 150 donums in summer. For the execution of this project the sum of £6,560 was expended of which the beneficiaries paid £2,186.

The works were started on 3.5.54 and completed on 29.11.54.

(C) *Tala.*—The 96 shareholders of the water of the three springs at the locality "Mylari" having formed an Irrigation Association, petitioned Government for the construction of irrigation works, with a view to increasing the flow of the springs and also, to improve the condition of their irrigation channels.

A scheme estimated to cost £3,450 was prepared. The sum of £3,450 was spent on the excavation and building of the springs, construction of a small weir, lining of 2,800 lineal feet or channels in reinforced concrete and laying of 250' × 8" diameter pipes for stream crossings.

The flow of the springs before the exploratory works were executed was 36,150 gallons per day, and after the excavations were carried out, about 117,720 gallons per day, i.e. an increase of 81,620 gallons per day. The scheme was put in hand on 15.7.54, and completed on 25.11.54. Towards the execution of this project the Committee of the Irrigation Association contributed the sum of £1,875. With the flow made available the beneficiaries can now irrigate most effectively 250 donums of land under winter crops, 120 donums spring crops and 60 donums summer crops.

(D) *Ayios Ioannis, Limassol*.—On the formation of an Irrigation Division by several inhabitants of this village, this Department undertook the construction of irrigation works at the locality "Ayia Marina". In 1954 a weir was constructed across the rocky bed of the river, 2,000 feet of 9" × 9" channels were built in masonry and 1,150 feet of 4" and 3" pipes were laid in precipitous places. An irrigation tank of 45,000 gallons capacity (60' × 24' × 5') is under construction. The work is still in progress and the remaining part of the scheme, which includes the finishing of the tank, building of further 3,000 feet of masonry channels and laying of 1,000' × 4" diameter pipes will be completed in 1955.

The purpose of this project is to bring under irrigation an extent of 150 donums of dry land which would be very suitable for development as orchards. The cost is estimated at £6,160 of which the Committee paid the sum of £1,925 (£193 cash and £1,732 in free labour).

The scheme was commenced on 14.5.1954.

(E) *Mitsero*.—A small typical hill village scheme, costing £1,450 was carried out at this village. The works constructed comprise a small weir across the stream, 500 feet of reinforced concrete channel with 20' × 6" diameter pipe-crossing, in order to convey the flow into the irrigation tank of 25' × 25' × 4'. The flow from the tank is conveyed to the lands for irrigation by 800' × 9" × 9" channels constructed in reinforced concrete and 100' × 4" diameter pipes laid for this purpose. The channels have been provided with the usual outlets.

The village paid the sum of £466 towards the execution of this scheme. An area of 40 donums under summer crops is now irrigated. Works were commenced on 1.5.1954 and completed on 16.9.1954.

APPENDIX 7.

IRRIGATION SCHEMES COMPLETED IN 1954.

| Ser. No. | Location | Nature of Construction | Donums Commanded New Irrigation | | |
|----------|---|--|---------------------------------|--------|-------|
| | | | Winter or spring | Summer | Total |
| 1 | Tymbou (Yialias River) | Groyne intake, lining of channels in lime/cement/concrete .. | 671 | — | 671 |
| 2 | Agridhia (Stremmata) .. | Irrigation tank and channels in masonry | — | 4 | 4 |
| 3 | Argaka-Magounda (Mylos). | Lining of channels in lime/cement concrete | 2,500 | — | 2,500 |
| 4 | Agridhia (Kapsidhin) .. | Spring & piping | — | 4 | 4 |
| 5 | Pedhoulas Dhaskaloudia | Excavation of springs lining of channels in R.C.C. | — | 248 | 248 |
| 6 | Kalokhorion (Ll) Karkadhia. | Spring irrigation tank channels .. | — | 15 | 15 |
| 7 | Zoopiyi (Vrysi tou Khoriou). | Tunnelling and spring | — | 18 | 18 |
| 8 | Ayios Memnon (F) .. | Re-charging Scheme | — | — | — |
| 9 | Omodhos (Ayiasma) .. | Springs & Irrigation tank | — | 25 | 25 |
| 10 | Lefka (Marathasa) .. | Lining of channels in lime/cement/concrete | — | 500 | 500 |
| 11 | Pharmakas (Koskinas) .. | Springs, lining of channels in R.C.C. | 74 | 40 | 114 |
| 12 | Akapnou (Livadhin) .. | Spring, R.C.C. channels, irrigation tank | — | 15 | 15 |
| 13 | Theletra (Vrysi Khoriou) | Spring, channel & piping | — | 12 | 12 |
| 14 | Kinoussa | Irrigation tank & piping | 25 | 25 | 50 |
| 15 | Kivisil | Lining of channels in lime/cement/concrete | 300 | 150 | 450 |
| 16 | Limnatis (Avlakas) .. | Spring, irrigation tank channels in R.C.C. | — | 14 | 14 |
| 17 | Milikouri (Pateritsa) .. | Spring, piping, masonry channels .. | — | 15 | 15 |
| 18 | Ayii Vavatsinia (Kephavryso) | Spring & channels | — | 18 | 18 |
| 19 | Moniatis (Zaraes) | Weirs, R.C.C. channels | — | 150 | 150 |
| 20 | Tersephanou | Repairs to intake channels | — | — | — |
| 21 | Ayios Theodoros (Ll) (Mia-Vrysi) | Weirs & irrigation tank | — | 11 | 11 |
| 22 | Ayios Therapon (Perotis) | Groyne intake & lining of channels .. | — | 10 | 10 |
| 23 | Pelendria (Kardhama Haji Ktori) | Spring, piping and channels | — | 12 | 12 |
| 24 | Ayios Mamas (Vatsellades) | Lining of channels in masonry | — | 3 | 3 |
| 25 | Mennyia (Krommidhitou-Shaka) | Exploratory works | — | — | — |
| 26 | Vyzakia (Oxynia) | Intake channels, aqueducts | 220 | — | 220 |
| 27 | Ayia Irini and Kannavia (Vournes) | Laying of pipes, distribution system .. | — | 10 | 10 |
| 28 | Dhierona (Mylos) | Installation of screw-gate | — | — | — |
| 29 | Kalokhorion (Pano Paschali) | Weir, masonry channel and tank .. | — | 20 | 20 |
| 30 | Meniko (Trakhonas-Yiros). | Lining of channels in lime/cement/concrete | 1,000 | 250 | 1,250 |
| 31 | Tembria (Athasies) | Lining of channels in R.C.C. | — | 110 | 110 |
| 32 | Khrysorroyiatissa (Kritou Marottou) | Piping | — | 10 | 10 |
| 33 | Nata-Kholetria (Xeros River). | Lining of channels in lime/cement/concrete. | — | 15 | 15 |
| 34 | Ayios Theodoros (Tyllirias) | Piping | 80 | — | 80 |
| | | Carried forward | 4,870 | 1,704 | 6,574 |

| Ser. No. | Location | Nature of Construction | Donums Commanded— New Irrigation | | |
|----------|---------------------------------------|--|-------------------------------------|--------|--------|
| | | | Winter or spring | Summer | Total |
| | | Brought forward | 4,870 | 1,704 | 6,574 |
| 35 | Khryssorroyiatissa (Hoghladjeri) .. | Piping | — | 13 | 13 |
| 36 | Kato Amiandos (Fournia) | Weir, irrigation tank and channels | — | 22 | 22 |
| 37 | Prastion-Nikitas (Baraji lands). | Pumping scheme, channels in lime/cement/concrete | 500 | 400 | 900 |
| 38 | Orounta (Limni Water) | Tunnels, channels, etc. | — | 80 | 80 |
| 39 | Moutoullas (Eftavrysos) | Weir, channels in R.C.C. and tank | — | 40 | 40 |
| 40 | Apliki | Irrigation tank | — | 3 | 3 |
| 41 | Kouklia (F) (E.M.I.W.) | Pitching of Reservoir's (Main embankment) | — | — | — |
| 42 | Ayios Theodoros (Ll) (Pinakas) .. | Springs, masonry channels, irrigation tank | — | 170 | 170 |
| 43 | Aredhiou (Holetra Dhima) | Lining of channels in lime/cement/concrete | 200 | — | 200 |
| 44 | Kato Platres (Vavatsinia) | Small weirs, R.C.C. channels .. | — | 68 | 68 |
| 45 | Pano Platres (Psilodhentro) | Lining of channels in R.C.C. .. | — | 60 | 60 |
| 46 | Peristeronopygi (F) .. | Weir and irrigation ports | 300 | — | 300 |
| 47 | Mitsero (Kouloupashin) | Weir, R.C.C. channels, irrigation tank | — | 40 | 40 |
| 48 | Mamonia (Dhiarizos) .. | Groyne intake, lining of channels in R.C.C. | — | 400 | 400 |
| 49 | Stylos-Limnia (Kopris) | Irrigation ports, etc. | 400 | — | 400 |
| 50 | Ayios Georghios (Kafkallou) | Weir, channels and irrigation tank | — | 12 | 12 |
| 51 | Exo-Metokhi (Yerondas) | Masonry spillway, protecting wells and ports | 200 | — | 200 |
| 52 | Marathovouno (Djayitika). | Weir | 100 | — | 100 |
| 53 | Statos (Kato Pyghadhi) | Repairs to irrigation tank | — | — | — |
| 54 | Lysi | Pipes and R.C.C. channels | — | 50 | 50 |
| 55 | Kalokhorion (Ll) (Kato Pashali) | Weir, channels and irrigation tank | — | 26 | 26 |
| 56 | Yerasa (Lithosoura) .. | Repairs to channels, piping | — | — | — |
| 57 | Tala (Mylari) | Spring, weir, R.C.C. channels .. | 370 | 60 | 430 |
| 58 | Amargeti (Ziripilli) .. | Groyne, intake and lining of channels | — | 200 | 200 |
| 59 | Lapithos (Kephalovrysos) | Lining of channels in R.C.C. | — | 300 | 300 |
| 60 | Gastria | Intake, irrigation ports, earth bank | 300 | — | 300 |
| | | Total | 7,240 | 3,648 | 10,888 |

APPENDIX 8.

IRRIGATION SCHEMES IN HAND AT THE END OF 1954.

| Ser. No. | Location | Nature of Construction | Donums Commanded New Irrigation | | |
|--------------|------------------------------------|--|---------------------------------|--------|-------|
| | | | Winter or spring | Summer | Total |
| 1 | Akaki-Avlona (Merika water). | Tunnelling, lining of channels in lime/cement/concrete | 150 | 126 | 276 |
| 2 | Ayios Ioannis (Ll) (Ayia Marina). | Weir, masonry channels, pipes, irrigation tank | — | 150 | 150 |
| 3 | Amargeti (Lihoni) | Spring and R.C.C. channels | — | 120 | 120 |
| 4 | Ayios Lucas | Recharge scheme | — | — | — |
| 5 | Dhali | R.C.C. channels, earth channels, piping | — | 100 | 100 |
| 6 | Gypsos (Vathys) | Earthen dam, spillways, etc. .. | 740 | — | 740 |
| 7 | Kambi-Pharmakas (Kokkinoyia) | Lining of channels in R.C.C. .. | — | 65 | 65 |
| 8 | Milikouri (Katsoura) | Small weirs, channels and piping .. | — | 40 | 40 |
| 9 | Moutoullas (Potamos Katouris). | Spring, weirs, irrigation tanks, channels and pipe | — | 50 | 50 |
| 10 | Pano Kyrenia (Boghaz) .. | Springs, piping, irrigation tank .. | 160 | 130 | 290 |
| 11 | Pissouri | Pipes, irrigation tank | 50 | 55 | 105 |
| 12 | Orounda (Maoutsos water). | Chain of wells, lining of channels in masonry | — | 288 | 288 |
| 13 | Trimiklini (Zenonas water). | Spring, R.C.C. channels and irrigation tank | — | 35 | 35 |
| 14 | Xeros (Kouklia) Co-operative. | Lining of channels in R.C.C. .. | — | 100 | 100 |
| Totals | | | 1,100 | 1,259 | 2,359 |

APPENDIX 9.

IRRIGATION SCHEMES READY FOR CONSTRUCTION AT THE END OF 1954,
BUT NOT YET STARTED.

| Ser. No. | Location | Nature of Construction | Donums Commanded New Irrigation | | |
|----------|--|---|---------------------------------|--------|-------|
| | | | Winter or Spring | Summer | Total |
| 1 | Agros (Mylos) | Lining of channels in masonry .. | — | 10 | 10 |
| 2 | Agros (Alonia) | Irrigation tank and gully-crossing | — | 7 | 7 |
| 3 | Agros (Netikon) | Spring, irrigation tank | — | 8 | 8 |
| 4 | Agros (Pano-Taliou) No. (3). | Irrigation tank and channels .. | — | 16 | 16 |
| 5 | Agros (Pano-Taliou) No. (2). | Irrigation tank and piping .. | — | 12 | 12 |
| 6 | Agros (Dhihaloritso) .. | Additional lining of channels and piping | — | 14 | 14 |
| 7 | Agros (Pano Kaoukkaris) | Additional piping (distribution system) | — | 5 | 5 |
| 8 | Agros (Honi) | Excavation of spring | — | 7 | 7 |
| 9 | Athalassa Farm | Pumping scheme, irrigation tank, piping, R.C.C. channels | — | 50 | 50 |
| 10 | Anoyira (Pygadhi) | Spring, piping | — | 14 | 14 |
| 11 | Ayios Isidhoros | Laying of piping (distribution system) | 6 | 6 | 12 |
| 12 | Ay. Vavatsinias (Diploma) | Weir and lining of channels .. | — | 7 | 7 |
| 13 | Ayios Ioannis (Li) (Liva- dhia) | Irrigation tank and channels .. | — | 20 | 20 |
| 14 | Alethriko | Irrigation tank and piping .. | — | 12 | 12 |
| 15 | Agridhia (Kato Platani- dhia) | Channels, irrigation tank | — | 7 | 7 |
| 16 | Agridhia (Pano Platani- dhia). | — | — | 9 | 9 |
| 17 | Ay. Ioannis (Malounda) (Pitsilli) | Tunnels, irrigation ports, etc. .. | — | 100 | 100 |
| 18 | Akaki (Merika water) | Cutting, lining of channels .. | 40 | 60 | 100 |
| 19 | Ay. Epiphaniios (Parizi) .. | Lining of channels and piping .. | — | 14 | 14 |
| 20 | Dhymes (Livadhia) | Lining of channels | — | 46 | 46 |
| 21 | Evretou (Karadja) | Excavation of spring and chan- nelling | — | 170 | 170 |
| 22 | Bellapais (Kephalo- vryso) | Weir, R.C.C. channels and piping | — | 150 | 150 |
| 23 | Exometokhi | Flood-detention dam, channelling etc. | 500 | — | 500 |
| 24 | Klirou (Mega-Pervolia) .. | Tunnelling, construction of irriga- tion tank | — | 15 | 15 |
| 25 | Klirou (Papa Nicola) | Repairs and improvements to tun- nels | 20 | 5 | 25 |
| 26 | Kato Zodhia (Koutra- phas) | Repairs to chain of wells | 500 | — | 500 |
| 27 | Kourdhali-Spilia (Vathys) | Retaining wall | — | 5 | 5 |
| 28 | Kapilio | Subsurface dam, lining of channels in R.C.C. | — | 70 | 70 |
| 29 | Kalokhorion (Lefka) (Karkotis) | Subsurface weir, lining of channels | — | 500 | 500 |
| 30 | Krini (Krini Water) | Lining of channels in R.C.C. .. | 200 | 100 | 300 |
| 31 | Kyperounda (Platanos) .. | Spring, irrigation tank | — | 10 | 10 |
| 32 | Kilani (Skotini) | Groyne intake, lining of channels | — | 105 | 105 |
| 33 | Kandou (Batsouni River) stage II. | Raising of dam, lining of channels | 150 | 250 | 400 |
| 34 | Kakopetria (Lounzides) | Irrigation tank and channels .. | — | 7 | 7 |
| 35 | Kochati Ay. Varvara | Irrigation of channels in lime/ cement/concrete | 200 | — | 200 |
| | | Carried forward | 1,616 | 1,811 | 3,427 |

| Ser. No. | Location | Nature of Construction | Donums Commanded New Irrigation | | |
|----------|--|---|------------------------------------|--------|-------|
| | | | Winter or spring | Summer | Total |
| | | Brought forward | 1,616 | 1,811 | 3,427 |
| 36 | Kolossi | Pumping Scheme | 100 | 100 | 200 |
| 37 | Limnatis (Trypes) .. | Excavation of spring, lining of channels | — | 38 | 38 |
| 38 | Limnitis (Pashokou- zoupos) | Lining and construction of channels | 270 | — | 270 |
| 39 | Livadhi (F) | Spillway and channel repairs .. | — | — | — |
| 40 | Lagouthera (Kannoura) | Spring, channels and piping .. | — | 8 | 8 |
| 41 | Meniko (Kalokerino) .. | Lining of channels in lime/cement/ concrete | 100 | 50 | 150 |
| 42 | Mamonia (Ay. Yeorghios) | Groyne intake and lining of channels | 250 | — | 250 |
| 43 | Nikitari (Neron tou Nomadhou). | Weir, lining of channels | — | 70 | 70 |
| 44 | Nursery (Garden) Nicosia | Pumping scheme, irrigation tank pipes | — | 25 | 25 |
| 45 | Omodhos (Djipia) | Piping additional work | — | 8 | 8 |
| 46 | „ (Pyghadhia) | Irrigation tank and pipes | — | 20 | 20 |
| 47 | Pano Panayia (Monadhia) | Excavation of spring | — | 35 | 35 |
| 48 | Palekhori (Maroullena) | Irrigation tank and channels .. | — | 10 | 10 |
| 49 | Pyrgos (Ll) (Moulos) .. | Subsurface weir and R.C.C. channels | 106 | 66 | 172 |
| 50 | Perapedhi Stage II | Construction of dam | — | 200 | 200 |
| 51 | Palekhori (Angoulos) No. (2) | Channels and piping | — | 3 | 3 |
| 52 | Palekhorin (Yefyrin) .. | Lining of channels and piping .. | — | 4 | 4 |
| 53 | Potima Chiftlik | Lining of channels in lime/cement/ concrete | — | 100 | 100 |
| 54 | Phinikaria | Groyne intake, pipe crossing .. | — | 200 | 200 |
| 55 | Pharmakas (Koskinas) .. | Lining of channels in R.C.C. and piping | 130 | — | 130 |
| 56 | Pano-Koutraphas | Piping and irrigation tank | — | 14 | 14 |
| 57 | Phini (Kambi-tou- Stavrou) | Lining of channels, irrigation tank | — | 65 | 65 |
| 58 | Prodhromos (Limni-tou- Tsangari). | Irrigation tank and channels .. | — | 44 | 44 |
| 59 | Patriki Frangolakkos .. | Repairs | — | — | — |
| 60 | Platani (F) Ay. Yeorghios | Masonry steps, earth bank, channel repairs | — | — | — |
| 61 | Phlasou (Ay. Epiphanos) | Lining of channels | 20 | 30 | 50 |
| 62 | Pelendria (Pano Pylon) | Lining of channels in R.C.C. .. | — | 20 | 20 |
| 63 | „ (Korypis) | Excavation of spring | — | 10 | 10 |
| 64 | „ (Dhimma) | do. | — | 12 | 12 |
| 65 | „ (Kolokasi) | do. | — | 15 | 15 |
| 66 | Peristeronari (Karkotis) | Groyne intake and channels .. | 1,000 | — | 1,000 |
| 67 | Palekhori (Livadhia) .. | R.C.C. channels | — | 8 | 8 |
| 68 | Palekhori (Petrides) .. | Lining of channels in R.C.C. .. | — | 6 | 6 |
| 69 | Milikouri (Kephalo- vrysos) | Masonry channels and piping .. | — | 10 | 10 |
| 70 | Steni (Loukkos) | Weir and piping | — | 28 | 28 |
| 71 | Sinda (Kara Hasan) .. | Control-gate, formation of earth bank | 80 | — | 80 |
| 72 | Syngراسi (Ay. Yeorghios Spathariko) | Spillway, anti-erosion weirs, channels, etc. | 2,000 | — | 2,000 |
| 73 | Tembria | Irrigation tank and piping | — | 22 | 22 |
| 74 | Trimikliini | Construction of dam, channel etc. | 200 | 600 | 800 |
| 75 | Sykhari | Spring, piping, repairs to irrigation tank | — | 12 | 12 |
| 76 | Vitsadha (Ftirkes-Paleo- klissha) | Irrigation ports and retaining work | 100 | — | 100 |
| 77 | Yerolakkos (Ovgos River) | Lining of channels | — | 55 | 55 |
| | | Totals | 5,972 | 3,699 | 9,671 |

APPENDIX 10.

TOWN WATER SUPPLIES.

By R. S. WOOD, B.Sc., A.M.I.C.E., A.M.I.W.E., *Senior Engineer.*

(A) NICOSIA.

The whole of the water supply scheme has now been constructed except for the installation of two pumps and $5\frac{3}{4}$ miles of 4" and 6" distribution mains. The pumps which are to be installed at Kokkini Trimithia (Borehole 6/47) and Laxia (Borehole 62/51) have not arrived. The distribution mains are those to be laid in streets which have not as yet been built up, and they will be laid when it is found necessary.

The following pumps and ancillary works were completed during the year :—

(a) *Makedhonitissa*.—Three centrifugal pumps have been installed driven by diesel engines and the pump-house has been painted.

(b) *Arab Ahmet*.—Three electro-submersible pumps installed, steel tower tank 55 feet high erected and pump-house built.

(c) *Hadjikyriacos Well*.—Two electro-submersible pumps and chlorinator installed and switch house built.

(d) *Paraskevaides Well*.—The well was deepened and lined for a further 6 feet, two electro-submersible pumps and chlorinator fitted, and pump-house repaired and painted.

(e) *Athalassa*.—Three electro-submersible pumps installed, 4" steel rising mains laid and steel tower tank 45 feet high erected. A 6" supply main was laid from tower tank to Strovolos Reservoir.

Distribution.—The 10" ring main has been completed, and two pressure recorders installed. The laying of distribution pipes in all built up areas has been completed, and the pipe lines handed over to the Water Board.

Kermia.—Kermia estate was added to the Nicosia Water Board area in August and work was commenced on laying the distribution pipes. All pipes along the existing roads were laid by the end of November. A pump-house has been built at Kokkini Trimithia over the borehole taken over from the Kermia Company and a 6" steel rising main has been laid from the borehole to the tower tank at Kokkini Trimithia.

Government Water Supplies.—Government House and the nearby schools and Government residences within the Water Board area have been connected to the Water Board's mains by new service pipes. The old service pipes have been used to make a separate water supply for gardens from the four Government boreholes in this area.

Operation.—This Department has been responsible for running all the pumps of the new scheme and for the supervision of the reservoirs. Valuable information has been obtained on the capacity of the sources of supply in an average summer and the variation of daily consumption in the distribution system by regularly reading the meters installed for this purpose. The distribution pipes were handed over to the Water Board in areas when laid. The Board has been responsible for making the connections to the new mains and installing meters for the sale of water, and for running the pumps taken over from the private companies.

Water Consumption.—The average total supply and consumption per head per day are given in the following table for August and December together with the percentage of water pumped from the various sources.

| | <i>August.</i> | <i>December.</i> |
|--|----------------|------------------|
| Average total consumption in gallons per day at source | 1,520,000 | 1,146,000 |
| Average in gallons per head per day | 31 | 24 |

The percentage of water from each source was as shown :—

| | August. | December. |
|--|---------|-----------|
| | % | % |
| Trimithia | 18 | 14 |
| Laxia | 9 | 5 |
| Makedhonitissa | 8 | 5 |
| Upper Arab Ahmed | 14 | 11 |
| Haji Kyriacos & Paraskevaides | 10 | 3 |
| Athalassa | — | 11 |
| Nicosia Water Administration | 27 | 37 |
| Acquired Private Companies and others (Approx.) | 14 | 14 |
| Total | 100 | 100 |

(B) FAMAGUSTA.

Four pump-houses have been completed at Phrenaros North and a deep well turbine pump driven by two diesel engines has been installed in the borehole at each pump-house. The 9" pipeline 24,000 feet long from the four boreholes to the Stavros Reservoir was completed in June and the new water was brought in and able to be used through the dry summer period, so that practically no water was required to be pumped from the saline wells in the town. On the line of the Panayia aqueduct 3,300 feet of 8" pipe were laid to replace part of the masonry channel which was choked by three roots.

The following works have been completed at Stavros Reservoir site :—

- Stores building including office.
- Two masonry reservoirs 220,000 gallons capacity each with reinforced concrete roofs.
- Elevated reinforced concrete tank 20,000 gallons capacity over existing pump-house.
- Reception building including meter room, tiled reception tanks and chlorinator room. The connecting pipes between the reservoirs and supply lines are being laid, and the fence round the site is being erected. The completion of the supply system awaits the delivery of the pumps for pumping from the reservoirs to the elevated tank and the pumps for the Panayia supply.

Distribution mains have been laid and fire hydrants installed in 62% of the Water Board area. The underground service reservoirs at the Ramparts and on the Old Town walls have been renovated and adapted for the new supply system. A new main has been laid in the harbour area with metered supply pipes for the ships. Work has proceeded slowly but continuously in the high part of the town where excavation is in hard rock, but progress has been rapid in the lower part of the town where a mechanical trencher could be used for excavation.

Operation.—The pipelines have been handed over to the Water Board in areas on completion as in Nicosia. The new pumps after being installed have been run by the Water Board. The new supply main and the distribution mains have been connected to the existing elevated tank temporarily until the new reception tanks and reservoirs are completed. The Board is responsible for house connection and sale of water.

Water Consumption.—The average consumption figures for August and December and percentage of supply from the various sources are as follows :—

| | August. | December. |
|---|---------|-----------|
| Average total consumption in gallons per day at source | 840,000 | 550,000 |
| Average in gallons per head per day | 34 | 23 |

The percentage of water from each source was as shown :—

| | <i>August.</i> | <i>December.</i> |
|------------------------------------|----------------|------------------|
| | % | % |
| Phrenaros West | 38 | 25 |
| Phrenaros North | 54 | 67 |
| Ramparts and Stavros Wells | 3 | Nil |
| Panayia | 5 | 8 |
| Total | <u>100</u> | <u>100</u> |

(C) LIMASSOL.

Pipe laying stopped at the end of 1953 and only clearing up and finishing off work was done at the beginning of the year so that small progress has been made with the distribution scheme for Limassol. Since restarting work in October the work has proceeded slowly due to labour shortage but continuously. A 6" pipe line has now been laid along the Zakaki road to supply the new factory area and the laying of 4" distribution pipes has nearly been completed in this area up to the old course of the Garillis river. It is hoped that further labour will be available at the beginning of 1955. The main outstanding area for the completion of the distribution pipes is the old part of the town, which is already served by the existing old pipe system from the water tower.

Operation.—The Water Board operates the reservoir and controls the water supply, installs house connections and is responsible for the sale of water. The water supply is now fully metered and only one small outlying district remains to be connected to the new supply.

Water Consumption.—The average consumption figures are as follows :—

| | <i>August.</i> | <i>December.</i> |
|--|----------------|------------------|
| Average total consumption in gallons per day | 917,000 | 562,000 |
| Average in gallons per head per day .. | 33 | 20 |

The consumption is measured at the reservoir and 3% is allowed for losses between sources and reservoir.

(D) LARNACA.

The laying of mains for private developers is being carried out within the framework of the new water supply scheme and this Department has laid about 1 mile of 3" and 6" pipes for this purpose at the request of the Evcaf Department.

(E) PAPHOS.

A pump-house was built over borehole No. 209/52 and a deep well pump of 3,000 g.p.h. capacity driven by a diesel engine was installed in the borehole. A collecting tank of 2,000 gallons capacity was constructed to join the new supply to the existing system. The three old spring sources of supply were cleaned out and improved and the existing collecting tank repaired.

(F) KYRENIA.

The artesian borehole No. 170/53 was connected to the storage tank by 9,700 feet of 3" pipeline of 200,000 gallons per day capacity to replace the existing 2" pipeline. 7,800 feet of 2" pipes were laid to extend the distribution system in the town.

APPENDIX II.

TOWN WATER CONSUMPTION, SUMMER, 1954.

VOLUME SUPPLIED AT SOURCE IN GALLONS PER PERSON PER DAY.

| Town | Estimated population | June ghd. | July ghd. | August ghd. | Sept. ghd. |
|----------------------------------|----------------------|-----------|-----------|-------------|------------|
| Nicosia (Water Board Area) | 49,000 | 29 | 31 | 31 | 30 |
| Limassol | 28,000 | 30 | 32 | 33 | 29 |
| Famagusta | 24,500 | 32 | 37 | 34 | 37 |
| Larnaca | 16,500 | 65* | 65* | 60* | 55* |

* Approx. only.

NOTES : (1) The population figures are taken from a report on Distribution of population and Growth of Towns by Mr. Windyer Morris, dated 30th December, 1952. In the case of Nicosia the figures are modified slightly as shown in Plan No. 1 of the report on Greater Nicosia Water Supply, June, 1954.

(2) *Nicosia*.—The water supplied by Nicosia Water Board is measured by meter at source. The Lower Arab Ahmed and Sykhari water is measured by gaugings. The quantity of water from other sources has been estimated following enquiry and in some cases measurements have been made of pump discharges.

Only part of the town (50%?) was taking its water from the new mains during the period under review. Within the walls water was supplied for only 16 hours per day in June and for 12 hours per day in July, August and September.

(3) *Limassol*.—The water supplied is measured by meter at the outlet from reservoir and an allowance of 3% is made for losses in the main pipelines from the springs. House connections are all metered. Most of the large factories were not taking water from the Board's mains during the period under review and their consumption is not included in the above figures. Part of the area of supply, to the east of the town, is not yet served with piped water but only by tanker lorry.

(4) *Famagusta*.—Consumers are still supplied on the saccoraphi system. The consumption was less in August (34 ghd.) than in September (37 ghd.) because one of the pumps was out of order and because new connections were continually being made. Water sold to ships amounted to 9,300 gallons per day on the average or 0.39 ghd.

(5) *Larnaca*.—The saccoraphia used for irrigation (9% of total) have been deducted. In addition an allowance for overflow irrigation water taken near the source has been deducted as shown: June, 300,000 gpd. (approx.); July, 300,000 gpd.; August, 100,000 gpd.; and September 50,000 gpd.

APPENDIX 12.

DESCRIPTION OF CERTAIN VILLAGE WATER SUPPLY SCHEMES.

By V. TOUNDJIAN, *Superintendent of Waterworks.*

C. G. PAPADAKIS, *Inspector of Water Supplies.*

(A) *Appidhes.*—This is the largest village water supply scheme ever undertaken in Cyprus. Twenty-three villages in Paphos District are now served with piped water from Appidhes springs located deep in the Paphos State Forest.

Stage I of the scheme was completed in 1953, when 62 miles of pipes were laid across some of the most difficult mountainous country conveying water to ten villages. Details of the work then done were given in the Annual Reports for the years 1952 and 1953.

Following the Government's decision to move some of the villages most severely hit by the 1953 (10th September) earthquake at Paphos, the Department of Water Development was asked at short notice to prepare and proceed with the execution of a scheme which would provide for piped water supplies from Appidhes to five re-sited villages, viz. : Mamoundali, Anadhiou, Axylou, Eledhiou and Stroumbi.

Work on the first four out of the five re-sited villages was put in hand early in January, 1954, and completed in record time by the middle of the following month, and work at Stroumbi was commenced in July, 1954, and completed in September, 1954. The main work consisted of 7 miles of new pipelines and the construction of 5 storage tanks with 36 fountains. The total cost for the five re-sited villages amounted to £7,500.

Work on Stage II of the Appidhes scheme for providing piped water to nine additional villages (viz. : Dhrousha, Inia, Pano Arodhes, Kato Arodhes, Dhrinia, Dhrymou, Pendalia, Kannaviou and Polemi) was put in hand in July, 1954. This besides the excavation, development and connection of three new springs not far from the main springs in the Paphos State Forest, consisted of the laying of 30 miles of new pipelines and construction of 9 storage tanks with 75 public fountains—work being completed by the end of the year.

The total cost of the work done in 1954 for a piped supply to the above mentioned nine villages in Stage II amounted to £42,000. This is exclusive of £13,300, representing the share of these villages in the Government reserve of £18,200 provided in Stage I for future extensions.

Below is given a summary of the completed scheme : —

| | Stage I. | Re-sited earthquake villages | Stage II. | Total |
|---|----------|------------------------------|-----------|----------|
| (i) Total number of villages served | 10 | 4* | 9 | 23 |
| (ii) Total population served (1946 census) | 4,910 | 640* | 4,541 | 10,091 |
| (iii) Water supplied in galls. per person per day | 20 | 20 | 20 | 20 |
| (iv) Length of pipelines laid in miles | 62 | 7 | 30 | 99 |
| (v) Normal discharge of the springs in galls. per day . . | — | — | — | 200,000 |
| (vi) Capacity of pipelines in galls. per day | — | — | — | 200,000 |
| (vii) Total number of storage tanks built | 13 | 5 | 9 | 27 |
| (viii) Total number of fountains constructed | 74 | 36 | 75 | 185 |
| (ix) Total cost of the scheme . . | £82,000 | £7,500 | £42,000 | £131,500 |
| (x) Average cost per person . . | — | — | — | £13 |

Note.—* Exclusive of Stroumbi which was included in Stage II.

(B) *Skarinou—Ayios Theodoros—Alaminos.*—These three villages combined together and acquired the privately owned spring “Vrysi-tou-Mylou” situated in Delikipos village area at the price of £2,000. After improvement the minimum flow of the spring was 43,200 gallons per day, sufficient to provide a daily share of about 18 gallons per head of their combined population (2,387 in 1946).

A 4" pipeline 33,400 feet long conveys the water through rocky and undulating country from the spring to a point near Skarinou where a distribution box was constructed for the division of the water between the three villages. The share of Skarinou is conveyed through an independent 2" pipeline 1,800 feet long into a 2,000 gallons circular reinforced concrete storage tank from where it is distributed to the village by means of a system of pipes and 9 street fountains.

The shares of Ayios Theodoros and Alaminos are conveyed through a common 2½" pipeline 10,200 feet long from Skarinou to a second distribution box at the locality “Marmarokremnos” and thence by independent pipeline of 1,900 feet of 2" and 13,600 feet of 1½" to Ayios Theodoros and Alaminos respectively. The distribution of the water in Ayios Theodoros is effected through three 2,000 gallons circular storage tanks and 5 street fountains. The distribution pipes were designed with a view to permitting connections for a house to house service as well. The water at Alaminos is distributed through a system of two 2,000 gallons circular storage tanks and 19 street fountains.

The total cost of the scheme was £24,875 or £10.4 per person. Work commenced in May, 1954, and was completed in December, 1954.

(C) *Ayios Ioannis—Salamiou—Kelokedhara.*—A large unused spring known as “Kakargadja” and situated in the Paphos State Forest was developed in the Summer of 1953 for the water supply of these three villages. The daily flow of the spring fluctuates between 110,000 gallons in May and 60,000 gallons in October. This minimum flow will provide a daily supply of about 28 gallons per person of the combined population of the three villages which was 2,106 in 1946.

A 4" pipe line 31,000 feet long of a capacity of 75,000 gallons per day, laid along precipitous country conveys the water to a distribution box at Ayios Ioannis where it is divided between the three villages. The share of Ayios Ioannis flows directly into the village storage tank, while the shares of Salamiou and Kelokedhara are conveyed in a 4" common pipeline 14,000 feet long to another distribution box at the locality “Karamanos” and thence to Salamiou and Kelokedhara through independent pipelines of 4,700 feet of 3" and 14,000 feet of 1½" respectively.

The water in each village is distributed through a system of storage tanks and street fountains. Three storage tanks and 61 fountains were constructed in all. The total cost of the work was £30,130 or an average of £14.3 per person. Work commenced in May, 1954, and was completed in October, 1954.

(D) *Stroumbi.*—This village is one of those most severely stricken by the earthquake of the 10th September, 1953, and although its water supply system installed in the old village in December, 1952, as part of the Appidhes scheme was left intact, this Department, following the Government's decision for the transfer of the village to a new site, was asked, to provide the new village with an entirely new distribution system.

The work consisted of conveying the village share of water from the Appidhes scheme to a new 10,000 gallons circular storage tank and distributing it through a system of 13,300 feet of pipes from 2½" to 1" in diameter to 19 street fountains at sites selected by this Department in consultation with the Town Planning Officer.

Work was started in June, 1954, and was completed in September, 1954, at a total cost of £3,200.

(E) *Kilani-Vouni*.—This is another combined scheme serving two villages. A constant flow of 80,000 gallons per day was purchased from "Arkolakhania" spring for £3,200. This quantity is sufficient to provide their combined population (2,646 in 1946) with about 30 gallons per day per person.

A 3" pipeline 30,300 feet long is shared by the two villages as far as Kilani where the water is divided between them through a distribution box. A further 11,500 feet of 2½" pipeline takes the share of Vouni from Kilani to the village. The water in Kilani is distributed through a 10,000 gallons circular storage tank and 34 fountains. The distribution pipes were designed to allow connection to private installations as well.

The distribution in Vouni was effected through a 10,000 gallons circular storage tank and 15 street fountains.

The total cost of the scheme was £20,750 or £7.8 per person. Work started in October, 1953, and finished in December, 1954.

(F) *Prastio (Morphou)—Livadhi (New settlement)*.—This is a combined pumping scheme serving the two adjacent villages by using a borehole drilled on their south-east outskirts as the source of supply.

One of the two villages, Livadhi, is a new settlement established by the Forest Department for the inhabitants of the former forest village known under the same name and situated in the Paphos State Forest.

The works consist of installing a 2,000 gallons reciprocating borehole pump operated by a 6 h.p. diesel engine and housed in a masonry engine room. The water is pumped into a common 10,000 gallons circular storage tank, built by the side of the engine room and thence it is distributed in the two villages independently by separate distribution systems to a number of street fountains (12 in Prastio and 5 in Livadhi).

The total cost of the scheme was £4,420 or an average of £7.4 per person based on the present combined population of the two villages (600).

Work commenced in October, 1953, and finished in March, 1954.

(G) *Evdhimou*.—This village had since 1939 a satisfactory piped supply from the spring "Kara Yousouf" sufficient to provide 30 gallons per day per head of the village population (715 in 1946). Nevertheless, they had requested, that, the 1½" main pipeline from the spring to the village be replaced by a 3" one with a view to piping to the village the full flow available at the spring (minimum flow 85,000 gallons per day) and also to have a house to house service. The surplus water will be used in establishing small vegetable gardens in their yards. The work for replacing the main (10,000 feet long) and building a new 10,000 gallons circular storage tank has cost £2,940 and was paid by the village and Government on a 50-50 basis.

The house to house service was effected through a system of pipes independent of the existing one which feeds the 9 street fountains and the cost of this work amounting to £1,825 was paid in full by the village.

Work was started in May, 1954, and was completed three months later.

APPENDIX 13.

NUMBER OF VILLAGES WITH PIPED DOMESTIC WATER.

31ST DECEMBER, 1954.

| District | Villages with piped water | | | Villages with no piped water | Total villages |
|----------------|---------------------------|---------------------|-------|------------------------------|----------------|
| | Satisfactory | Needing improvement | Total | | |
| Nicosia | 85 | 32 | 117 | 60 | 177 |
| Larnaca | 38 | 7 | 45 | 14 | 59 |
| Limassol | 79 | 21 | 100 | 13 | 113 |
| Famagusta .. | 37 | 17 | 54 | 43 | 97 |
| Paphos | 94 | 23 | 117 | 17 | 134 |
| Kyrenia | 23 | 15 | 38 | 9 | 47 |
| Totals | 356 | 115 | 471 | 156 | 627 |
| Percentage .. | 57 | 18 | 75 | 25 | 100.00 |

Note.—The above figures were obtained from a new survey and they do not quite correspond with others given in the annual reports of former years. Some supplies that were formerly satisfactory are now considered to be unsatisfactory because with an expanded population and higher standards of living, more water and more facilities are required.

APPENDIX 14.

VILLAGE WATER SUPPLY SCHEMES COMPLETED IN 1954.

| No. | Village | District | Nature of work | Date of Completion |
|-----|--|--------------|----------------|--------------------|
| 1 | Lefka (Supply to Konak) | Nicosia .. | † | 28th January |
| 2 | Phasoula } Earthquake | Paphos .. | * | 3rd February |
| 3 | Axylou } re-sited | " .. | * | 4th " |
| 4 | Eledhiou } villages | " .. | * | 4th " |
| 5 | Ayios Konstantinos .. | Limassol .. | † | 5th " |
| 6 | Pakhyammos .. | Nicosia .. | † | 10th " |
| 7 | Anadhiou } Earthquake | Paphos .. | * | 10th " |
| 8 | Kithasi } re-sited | " .. | * | 13th " |
| 9 | Lapithiou } villages | " .. | * | 16th " |
| 10 | Mamoundali } | " .. | * | 17th " |
| 11 | Asproyia .. | " .. | † | 17th " |
| 12 | Avgalidha .. | Famagusta .. | † | 3rd March |
| 13 | Lyso .. | Paphos .. | † | 5th " |
| 14 | Akrounda .. | Limassol .. | † | 10th " |
| 15 | Kallepia Earthquake re-sited village .. | Paphos .. | * | 13th " |
| 16 | Phinikaria .. | Limassol .. | † | 22nd " |
| 17 | Tembria .. | Nicosia .. | † | 22nd " |
| 18 | Sykopetra .. | Limassol .. | † | 25th " |
| 19 | Prastio (Morphou) .. | Nicosia .. | * | 31st " |
| 20 | Livadhi (new settlement) | Nicosia .. | * | 31st " |
| 21 | Arakapas .. | Limassol .. | † | 21st April |
| 22 | Kolossi .. | Limassol .. | † | 29th " |
| 23 | Saranti .. | Nicosia .. | † | 4th May |
| 24 | Dherinia .. | Famagusta .. | * | 6th " |
| 25 | Yiolog .. | Paphos .. | † | 12th " |
| 26 | Evretou .. | " .. | † | 15th " |
| 27 | Pyrgos .. | Limassol .. | * | 20th " |
| 28 | Kapedhes .. | Nicosia .. | * | 12th June |
| 29 | Ayios Theodoros (Soleas) | Nicosia .. | † | 26th " |
| 30 | Koutraphas, Kato .. | Nicosia .. | † | 26th " |
| 31 | Omodhos .. | Limassol .. | † | 8th July |
| 32 | Yerovasa .. | " .. | † | 15th " |
| 33 | Armenokhori .. | " .. | † | 15th " |
| 34 | Dhavlos .. | Famagusta .. | † | 22nd " |
| 35 | Ephtakomi .. | " .. | † | 29th " |
| 36 | Evdhimou .. | Limassol .. | † | 26th August |
| 37 | Stroumbi (Earthquake re-sited village) .. | Paphos .. | * | 18th September |
| 38 | Salamiou .. | Paphos .. | † | 23rd " |
| 39 | Topju Keuy .. | Famagusta .. | * | 25th " |
| 40 | Kannaviou .. | Paphos .. | * | 11th October |
| 41 | Temblos .. | Kyrenia .. | † | 18th " |
| 42 | Ayios Ioannis .. | Paphos .. | † | 21st " |
| 43 | Kelokedhara .. | " .. | † | 8th November |
| 44 | Ayia Kebir .. | Nicosia .. | † | 10th " |
| 45 | Skarinou .. | Larnaca .. | † | 20th " |
| 46 | Polemi .. | Paphos .. | † | 20th " |
| 47 | Orta Keuy .. | Nicosia .. | * | 1st December |
| 48 | Alaminos .. | Larnaca .. | * | 2nd " |
| 49 | Pendalia .. | Paphos .. | † | 4th " |
| 50 | Karavostasi .. | Nicosia .. | † | 6th " |
| 51 | Prastio .. | Famagusta .. | † | 6th " |
| 52 | Gaidhouras .. | " .. | † | 6th " |
| 53 | Dhrymou .. | Paphos .. | † | 16th " |
| 54 | Kilani .. | Limassol .. | † | 18th " |
| 55 | Vouni .. | " .. | † | 18th " |
| 56 | Dhrousha .. | Paphos .. | † | 20th " |
| 57 | Inia .. | " .. | † | 20th " |
| 58 | Arodhes, Pano .. | " .. | † | 21st " |
| 59 | Arodhes, Kato .. | " .. | † | 21st " |
| 60 | Dhrinia .. | " .. | † | 22nd " |
| 61 | Klepini .. | Kyrenia .. | † | 23rd " |
| 62 | Vavatsinia .. | Larnaca .. | † | 30th " |
| 63 | Ayios Theodoros .. | " .. | * | 31st " |
| 64 | Akanthou .. | Famagusta .. | † | 31st " |
| 65 | Kalavastos .. | Larnaca .. | † | 31st " |

* New scheme where previously there was no piped water.

† Replacement or improvement of an old supply.

APPENDIX 15.

VILLAGE WATER SUPPLY SCHEMES IN HAND AT THE END OF 1954.

| Serial No. | Village | Serial No. | Village |
|------------|-------------|------------|---------------------|
| 1 | Mandres (F) | 9 | Yerakies |
| 2 | Kondemenos | 10 | Emba |
| 3 | Karakoumi | 11 | Lemba |
| 4 | Xylophagou | 12 | Kissonerga |
| 5 | Paramytha | 13 | Kato Dhrys |
| 6 | Spitali | 14 | Kanli Keuy |
| 7 | Palodhia | 15 | Ayios Theodoros (F) |
| 8 | Piyenia | 16 | Mitsero |

APPENDIX 16.

VILLAGE WATER SUPPLY SCHEMES READY FOR CONSTRUCTION AT THE
END OF 1954 BUT NOT YET STARTED.

| Serial No. | Village | Serial No. | Village |
|--|--------------------------------|------------|-------------------------|
| 1 | Evrykhou | 10 | Agridhia |
| 2 | Sha | 11 | Zoopiyi |
| 3 | Dhali | 12 | Kapilio |
| 4 | Kaliana | 13 | Arakapas |
| 5 | Chakistra | 14 | Mamonia |
| 6 | Angolemi | 15 | Mesana |
| 7 | Boghaz (Famagusta) | 16 | Timi |
| 8 | Apesha | 17 | Asproyia |
| 9 | Ay. Theodoros (Limassol) | 18 | Aradhippou |
| Nos. 1-18 have already provided their share in the cost of the work. | | | |
| 19 | Kondea | 23 | Agros |
| 20 | Sinda | 24 | Phini |
| 21 | Kouklia | 25 | Neokhorio |
| 22 | Paralimni | 26 | Karavas |
| Nos. 19-26 have applied for loan to cover their share in the cost of the work. | | | |
| 27 | Ambelikou | 44 | Ayios Epiphanius Orinis |
| 28 | Ayios Theodoros (Tyllirias) | 45 | Ayios Sozomenos |
| | | 46 | Ayios Yeoryios Kafkalou |
| 29 | Mansoura | 47 | Eliophotes |
| 30 | Mosphileri | 48 | Galini |
| 31 | Sellain t'Api | 49 | Gourri |
| 32 | Ay. Yeoryios Soleas | 50 | Kannavia |
| 33 | Ghaziveran | 51 | Lagoudhera |
| 34 | Kambia | 52 | Lazania |
| 35 | Analiondas | 53 | Lefka |
| 36 | Kapouti | 54 | Loutros |
| 37 | Katydhata | 55 | Skylloura |
| 38 | Lymbia | 56 | Varisha |
| 39 | Mandres Morphou | 57 | Yerolakkos |
| 40 | Orounda | 58 | Nikitas |
| 41 | Alevga | 59 | Pelekhori |
| 42 | Alithinou | 60 | Pakhyammos |
| 43 | Ayia Irini (Kannavia) | 61 | Perakhorio |

| Serial No. | Village | Serial No. | Village |
|------------|--------------------------|------------|-----------------------|
| 62 | Petra | 99 | Polemidhia, Pano |
| 63 | Kakopetria | 100 | Polemidhia, Kato |
| 64 | Pyrgos, Pano | 101 | Prodhromos |
| 65 | Pharmakas | 102 | Kyperounda |
| 66 | Galata | 103 | Kaminaria |
| 67 | Apliki | 104 | Lemithou |
| 68 | Phikardou | 105 | Mandria (Limassol) |
| 69 | Kythrea | 106 | Kalokhorio (Limassol) |
| 70 | Mia Milea | 107 | Moniatis |
| 71 | Kalyvakia | 108 | Vasa |
| 72 | Ayios Ermolaos | 109 | Mesayitonia |
| 73 | Ayios Yeoryios (Kyrenia) | 110 | Ayios Ioannis, Agrou |
| 74 | Karpasha | 111 | Khalassa |
| 75 | Myrtou | 112 | Ayios Therapon |
| 76 | Ayios Amvrosios | 113 | Alekhthora |
| 77 | Dhiorios | 114 | Plataniskia |
| 78 | Trapeza | 115 | Khlorakas |
| 79 | Photta | 116 | Tala |
| 80 | Liveras | 117 | Kili |
| 81 | Larnaca tis Lapithou | 118 | Lemona |
| 82 | Akheritou | 119 | Kathikas |
| 83 | Pyrga | 120 | Amargeti |
| 84 | Strongylos | 121 | Lyso |
| 85 | Vatili | 122 | Yiolou |
| 86 | Ayia Napa | 123 | Miliou |
| 87 | Arsos (Larnaca) | 124 | Souskiou |
| 88 | Goshi | 125 | Anarita |
| 89 | Pergamos | 126 | Khoulou |
| 90 | Tersephanou | 127 | Androlikou |
| 91 | Tremethousa | 128 | Peyia |
| 92 | Zyyi | 129 | Trimithousa (Paphos) |
| 93 | Avdhellero | 130 | Kedhares |
| 94 | Kophinou | 131 | Kato Akourdhalia |
| 95 | Tokhni | 132 | Yeroskipos |
| 96 | Ayia Phyla | 133 | Peristerona |
| 97 | Mallia | 134 | Goudhi |
| 98 | Potamiou | 135 | Galataria |

Nos. 27-135 schemes submitted for approval.