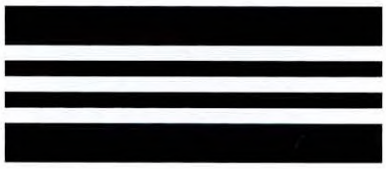

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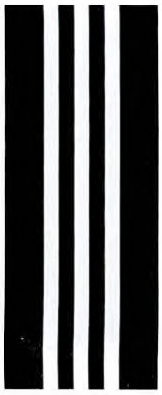

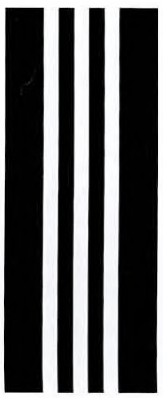

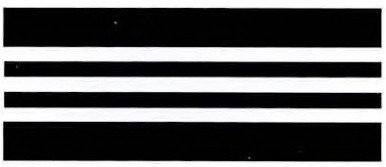

CYPRUS

DEPARTMENT OF WATER DEVELOPMENT

ANNUAL REPORT FOR 1956

BY

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

Director

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C O N T E N T S

/Appendix 15

DEPARTMENT OF WATER DEVELOPMENT

ANNUAL REPORT FOR 1956.

The engineering and geological side of all Government water development work is in the hands of the Department of Water Development whose duties include the search for new sources, the conservation and development of supplies for irrigation, domestic and industrial use, and the problems connected with river training, flood protection and land drainage. The administration of Village Irrigation Divisions and Associations and 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 Departments of Land Registration 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.

2. In 1956 the main features of the work of the Department of Water Development were the start of the £950,000 Greater Nicosia water supply scheme, the execution of a regional domestic water scheme for the thirteen "dry villages" of the Eastern Mesaoria following the acquisition of a small part of the Kythrea Spring, and the completion of the first stage of construction of a 105 foot high dam at Trimiklini. A degree of mechanisation in the work of the department has been achieved by the purchase of new plant and by extending the workshops. On the debit side the disturbed political atmosphere has prevented the investigation of a number of proposed major irrigation projects and has caused the cancellation of a seismic geophysical survey of the gravel river beds along the south coast of the island.

3. Rainfall in the winter of 1955/56 was on the whole slightly above average. It was mostly of low intensity and evenly distributed throughout the winter months. The only heavy rain occurred in the Paphos district where there were moderate floods at the beginning of February. The summer of 1956 was hotter than usual with temperatures at Nicosia reaching 112° F. No special demands were made upon the department in 1956 for either drought relief works or for flood damage repairs.

4. The activities of the department are divided into

/five chief

five chief services dealing respectively with (a) Irrigation and Drainage, (b) Town Water Supplies, (c) Village Domestic Water Supplies, (d) Geology and Drilling and (e) Hydrology. There is continuous liaison between these services so that their work is co-ordinated in the best interests of the over-all water supply problems of the island. Thus a source of water may be developed for domestic water supplies in excess of the requirements of a particular village and the surplus may be utilised for irrigation; where gravity water supplies are not available, geological investigations may locate underground sources from which water can be pumped for irrigation or domestic use. A sixth branch of the department, the workshop, serves all the other branches and is growing in importance as mechanisation increases.

IRRIGATION AND DRAINAGE

5. As in previous years, the policy of the department is still to undertake many small schemes rather than a few large ones but the size and complexity of these schemes is tending to increase. As time passes the number of simple irrigation schemes awaiting execution is getting fewer and the cost and technical difficulty of irrigating each additional donum of land is increasing.

6. The total number of irrigation and drainage schemes completed during the year was 63 providing sufficient water to irrigate 11,086 donums, of which 2,220 donums can be irrigated perennially. Seven more schemes were in progress at the end of the year and a further 83 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)	Total
	Perennial Donums	Seasonal Donums	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 1955	86,500	345,000	113,500	545,000
New Irrigation 1956 (say)	2,000	9,000	9,500@	20,500
Estimated total at end of 1956	88,500	354,000	123,000*	565,500
Percentage increase since 1946 census and commencement of Ten-Year Programme of Development.	49%	24%	132%	42%

@ Includes 1,000 donums resulting from private drilling.

* Includes 2,500 donums resulting from private drilling.

8. The total area of arable land in Cyprus amounts about 3,900,000 donums of which 80% to 85% is cultivated; 14% is now irrigated in an average winter and 5.4% in an average summer. It is estimated that irrigation works carried out under the irrigation development programme are causing the value of agricultural production in Cyprus to increase by about £1,000,000 each year.

9. The irrigation and drainage 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 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 sources 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.
(f) Gravity drainage of small marshes.
(g) Flood protection and river training.

10. The lining of irrigation channels in concrete has continued 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. In the past when channels were lined to prevent leakage the materials used were most often masonry blocks cemented together with lime or lime and cement mortar, but these have now been superseded by reinforced concrete. During the year 10 miles of channels were lined in reinforced concrete. These works were

/carried out

carried out chiefly in the village areas of KaloKhorio (Klirou), Perapedhi, Dhierona, Kato Mylos, Yerolakkos and Ora.

11. The usual quota of small schemes involving the excavation and building of springs, and the conveyance of water in pipes or channels to small irrigation tanks has been completed in the hill areas. Among the villages that have received this type of small but popular schemes are Pelendria, Kalopanayiotis, Pharmakas, Agridhia, Pano Koutraphas, Kato Mylos, Stavrokonnou and Melini.

12. Only one storage dam has been under construction in 1956. This is at Trimiklini where the foundations of a concrete dam in the upper Kouris River have been completed and where work is now in progress on the main structure above the river bed. The dam, which is situated in a narrow gorge cut by the river through a mass of volcanic agglomerate, will be 105 feet high from the lowest foundation level to the crest of the spillway and 90 feet high above the river bed. The capacity of the reservoir will be 55 million gallons. The estimated cost, including a system of concrete irrigation channels, is £50,000.

13. In Cyprus dams are built chiefly for the purpose of extending the period of spring irrigation into early summer by supplying water during the critical irrigation month of mid-April to mid-May, the time when streams are rapidly drying up and when late waterings are required to produce a good crop. A dam of relatively small storage is, at this season, sufficient to make possible a final watering when it is most needed and to turn a poor crop into a successful one. The cost of dams built in Cyprus is usually high in relation to storage capacity because of unfavourable topography, the valleys being for the most part too steep and narrow to hold much water without a disproportionately high dam. Because of the special need for water in April and May, however, there are many places where the construction of dams up to about 100 feet high will be economically sound. Plans for a number of these have been or are being prepared as described in paragraphs 20 and 21 below. The highest completed is 70 feet and the storage capacity 28 million gallons. The Trimiklini dam, now under construction, will be 105 feet high as explained in the preceding paragraph.

/14. A number

14. A number of schemes was carried out with funds provided by other departments. For the Department of Agriculture the following works were completed: (a) irrigation pipes at Athalassa Farm (b) irrigation improvements at Potima Chiftlik (c) repairs to an irrigation tank at Argaka (d) main drains at Akhyritou (e) irrigation improvements at Nicosia garden nursery (f) pumping installation at Akhelia (g) concrete channels at Mamonia (h) tank and pumphouse at Kouklia. For the Forest Department a booster pump and pipe-line was installed at Athalassa and for the Education Department a small pumping scheme was carried out at the Pergamos School Farm. The expenditure in 1956 on the above works amounted to £16,200.

15. Two small schemes that are worth special mention are the Kapilio river training works and the KaloKhorio sub-surface weir. The former is a somewhat experimental attempt to reclaim part of a wide river-bed by limiting the flood channel to a strip between parallel lines of precast concrete posts connected together with wire to form two fence lines which are designed to act as permeable training banks. Similar methods have been used in other countries but this scheme is the first of its kind in Cyprus. The KaloKhorio sub-surface weir is a concrete cut-off wall built across a river bed that was formerly dry in summer. The length of the weir is 320 feet, its depth to lowest foundation level 23 feet and its height above the river bed 3 feet. It was instrumental in bringing a flow of about 450,000 gallons per day to the surface in July and 250,000 in September. Both these schemes are described in greater detail in Appendix 6.

16. At Ayios Loucas, near Famagusta, the third phase of an interesting scheme was in progress at the end of the year. This is a ground water 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 first phase of the works was described in the 1954 Annual

/Report and

Report and includes the repair of an old earth embankment across the Harangas river to form a 30 million gallon reservoir, the construction of a 100 foot spillway, and the driving of a mile of re-charge tunnels in a porous stratum slightly above 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. The second phase was completed early in 1956 and is described in detail in Appendix 6 of this report. It will enlarge the scope and effectiveness of the works by bringing in water from Kouklia reservoir, nine miles away, and from intervening catchments. The third phase, recently started consists of 19,600 feet of re-charge tunnels running roughly parallel to the coast at an average distance of about 4,000 feet from the sea at a level of 2.90 feet above sea level. They will connect the recently completed recharge tunnel of the Ay. Loucas scheme with the original tunnel that was driven experimentally at Ay. Memnon in 1952. The cost of Phase I was £9,000, of Phase II £13,750, and the estimated cost of Phase III £21,000.

17. In a scheme of this sort an unknown factor must necessarily be the extent to which the sides of the porous sandstone tunnels will eventually clog with particles of silt brought into the tunnel by the exfiltrating water. Although much of this silt will be deposited in the Ay. Loucas reservoir and in Paralimni Lake it is certain that large quantities will also find their way into the tunnels to cause clogging and a reduction in the exfiltration rate. Remedial measures may take the form of cleaning and enlarging the tunnels or of excavating new galleries at right angles or parallel to the present tunnels.

18. The degree of success that will be obtained eventually cannot of course be foreseen accurately at present. It will depend on two chief factors one of which is the volume of water that can be made available from year to year for use in the scheme and the other is the rate at which the tunnels will continue to absorb water after continued use.

/19. The

19. The following works that are representative of the 1956 programme are described in detail in Appendix 6:- Ayios Lucas Recharge Scheme, Akhyritou Drainage, Kalokhorio (Lefkas) Subsurface Weir, Kapilio River Training and Irrigation, Athalassa Irrigation, Dhierona Channels, Kalokhorio (Klirou) channels, and Pergamos Irrigation.

20. Schemes examined and ready for construction include a 60 foot concrete dam for Pyrgos (Tylliria), a 50 foot concrete dam for Argaka and Magounda, 18 miles of lined channels for Kythrea costing £60,000, a drainage scheme for the Syrianokhori Marshes, river training works on the Xeros River at Mandria and Nata-Kholetria, and a 30 foot earth dam for Lapathos.

21. Preliminary or partially complete investigations have been made for many other works including concrete dams at Ay. Marina (Paphos), Pomos, Palekhori, Lefka, earth dams at Ay. Georghios (Akhna) and Meniko, lined channels at Polis and Kandou. The disturbed security conditions and the lack of suitable technical staff prevented investigations proceeding on many other major schemes, some of which appear promising.

22. Arrangements were made with the Colonial Geological Service for a seismic geophysical survey to be carried out to determine the depth of river gravels in many of the "dry" river beds, in particular in those which drain into the sea along the south coast of the island. The depth of the gravels as determined by such a survey, will provide useful information concerning the quantity of water held in the gravels and the most favourable sites and the best means for extracting the water. Unfortunately the survey had to be postponed because of the disturbances but it is hoped that it will take place as soon as conditions return to normal.

23. A proposal for a Water Use Research Centre has received study during the year by members of the Land Use Co-operative Committee. This research station, if established, would be a centre for studying irrigation methods and practices in Cyprus and for advising irrigators about the efficient and economical use of water. It is estimated that if better methods and practices in the use

/of irrigation

of irrigation water could be made to increase perennial irrigated production by 15% the value of the products of irrigated land would be increased by more than £1,000,000 annually. An effort is being made to obtain a report on this proposal from a suitably qualified expert.

TOWN WATER SUPPLIES

24. Under present conditions 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. This system of administering the town water supplies is under review, as described in paragraph 36 below.

25. The Department of Water Development advises all the above authorities on the technical aspects of their water supplies and in 1955 completed major schemes for Nicosia, Limassol and Famagusta at a total combined cost of £1,190,000. In 1956 a start was made on a £950,000 extension to the Nicosia scheme and minor works were carried out for most of the other towns. The Larnaca water supply is operated and maintained by staff of the Department.

26. More improvements are needed in all the chief towns of the island and are planned or under construction, as described paragraphs 32 to 35.

27. In 1956 great difficulties were experienced in Nicosia where restrictions upon consumption were in force from June to November, during which period the water was turned off for 46% of the total time. During the worst month, September, the water was off for 65% of the time. The consumption within the Water Board area rose to 34 gallons per head per day in June but was less in July, August and September when the works could supply only 31,30 and 28 g.h.d. respectively.

28. No restrictions were necessary in Limassol, Famagusta or Larnaca in 1956 where the July consumption

/rose to

rose to 40, 36 and 56 gallons per head per day respectively. At Limassol the old pumping station was brought into use for 16 weeks and supplied a maximum of 450,000 gallons per day or 40% of the total summer demand. The water from this source was formerly brackish but is now of good chemical quality due to the highly successful re-charge operations described in Appendix 4. As regards Famagusta considerable anxiety is felt as to the ability of the Phrenaros boreholes to maintain this year's output in future and even this year it has been necessary to pump small quantities of brackish water from the old wells of the town.

29. Appendix 11 gives the approximate water consumption per person in the four chief towns of Cyprus in the summer of 1956, and other information on this subject is given in Appendix 12.

30 The need for more domestic water in the towns, particularly in Nicosia, has become very evident and is caused by a number of contributary factors. The increase in population is not less than 3% per annum. 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. In Famagusta the need is equally or perhaps more urgent because the present sources might not be able to maintain their present output and because the population and water requirements may increase faster than in the other towns owing to the proposed port development and probable military expansion.

31. A satisfactory summer supply under present conditions would probably require 35 to 40 or 45 gallons per person per day in the chief towns. Rising standards indicate that a prudent figure to use for the design of future works should be not less than 50 gallons per person per day. If the population increases at 3% per annum and if it takes 5 years to plan and complete a new

water supply scheme it follows that plans should be prepared for a population at least 15% more than existing.

32. To relieve the very acute position in the central part of Nicosia and to provide new supplies for the suburban villages which now have practically no piped water a £950,000 scheme is under construction by the Department. This Greater Nicosia scheme was prepared in June 1954 but its execution was delayed for financial and other reasons until May 1956, when it was finally approved following examination by consulting engineers. This scheme will make available an additional million gallons per day from boreholes at Dhikomo, Kokkini Trimithia, and Dhali and from an old adit at Sykhari. Three covered service reservoirs of 1.70, 0.85 and 0.85 million gallons respectively are included as well as new pipe distribution systems for the suburban villages of Strovolos, Engomi, Ay. Dhometios, Orta Keuy, Trachonas, and Eylenja. Progress on these works is described in Appendix 10.

33. The above scheme will not, of itself, satisfy the needs of Nicosia and a long-term project to pump 4 million gallons daily from boreholes near Morphou Bay is under examination. Fifteen prospecting boreholes have been drilled for this scheme and at the end of the year 11 of these had been tested each at rates exceeding 25,000 gallons per hour. The water will be pumped through twin 23-mile pipe lines against a gravity head of more than 600 feet. It is probable that only one of the two pipe lines will be laid in the first instance, to give a supply of two million gallons per day. A preliminary estimate of cost is £700,000 for the first stage, with a single pipe line and £1,300,000 for the completed scheme. The Westminster firm of Messrs. Howard Humphrey and Sons has been engaged as consulting engineers for the collecting tank, pumping station, and main pipe lines.

34. The water supply at Famagusta is in a dangerous state. The water level in the Phrenaros boreholes, from which practically all the water is drawn, is declining from year to year with very little recovery after the winter rains and it is unlikely that the present output will be maintained for many more years. The position will be aggravated by the increased demand that

is likely to follow the construction of the new port. A preliminary scheme has been prepared for supplying an additional one million gallons per day in the first instance, from near Xylophagou, through a main pipe line designed for a future flow of 2.2. m.g.d. The sources are ten boreholes that have been tested at various rates from 9,000 to 16,000 gallons per hour per borehole. The proposed main pipe line is of asbestos-cement, 15" diameter and 10 miles long. A one million gallons covered service reservoir that can be enlarged in future is included in the scheme, and from the reservoir separate pipes will deliver the water to the existing Stavros reservoir, to the northern part of the town, and to the military camps at Karaolos and Ay. Nicolaos. No street distribution pipes are included. A preliminary estimate of cost, made in June 1956, was £325,000.

35. Investigations and studies have been continuing for improvements and extensions to the water supplies of all the other chief towns in the island and proposals await approval and the provision of funds. For Limassol proposals exist for laying a 2-mile pumping main from the Chiftlikoudhia pumping station to the reservoir so that in dry seasons, when the springs are low, the pumped water may mix uniformly with the spring water instead of being supplied directly to certain quarters of the town. In Paphos plans have been prepared for extending the distribution system and it is proposed to pipe water to the town from the Trozena springs near Yerovasa through a 24/pipe line. At Larnaca proposed works mile/ 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 districts each fed from a ring main at sustained pressure.

36. The present system of administering the water supplies of the chief towns by means of independent water boards has given rise to some anxiety both on the financial and technical sides. Considerable sums of money have been lent to the water boards by Government for capital works but it is doubtful if in every case the management has the necessary experience or receives the

/necessary guidance

necessary guidance to administer the works under its control with reasonable efficiency and economy. For the purpose of advising how the administration of the water boards can be strengthened a Commission from the United Kingdom visited Cyprus in July and later submitted its report which is now being studied by Government. The Commission consisted of Mr. L. Millis Secretary of the British Waterworks Association (Chairman), Mr. C.A. Risbridger Chief Engineer of the Birmigham Water Department, Mr. S.B. Morgan, Accountant of the East Surrey Water Company and Mr. R. Fairall, (Secretary).

VILLAGE DOMESTRIC WATER SUPPLIES

The work of the Village Domestric 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.

38. During the year 57 village water supply works were completed and the length of pipes laid, 180 miles, is roughly equivalent to the distance by road from Paphos to the Cape Andreas monastery. Fourteen of these schemes are entirely new, 40 are improvements to existing supplies that were formerly unsatisfactory or inadequate, and the remaining 3 are for schools or police stations. It is now estimated that of the total of 627 villages named in the census of 1946, the number with piped supplies is 502 or 80%. Of these 415 (66%) may be considered satisfactory and 87 (14%) need fundamental repairs or replacements. The 125 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.

39. In addition to the 57 schemes completed in 1956

/a further

a further 16 schemes were under construction but incomplete at the end of the year. The number of schemes prepared and awaiting execution in due course after revision as necessary and as staff and money become available is 200. The following table indicates the works done on village water supplies during the year under review:-

VILLAGE WATER SUPPLIES
MILES OF PIPE LAID IN
1956.

Size of Pipe	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	Total Miles
Galvanised steel pipes	4.6	23.2	30.4	11.3	28.1	16.8	26.0	19.5	159.9
Asbestos cement pipes	-	-	-	2.8	4.1	-	4.3	9.2	20.4
									180.3

Storage tanks: 43. Fountains: 320. Distribution boxes: 25.

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

(a)	New schemes to village standard where previously there was no piped water	14
(b)	Total replacement of an obsolete scheme	4
(c)	Improvements to village standard only	28
(d)	Improvements including house connections	8
(e)	Water supplies to schools and police stations	3
		57

Of the above 57 schemes, 41 obtain their water from springs, 4 from infiltration galleries by gravity, and 12 from wells or boreholes by pumping.

41. The problem of the water supply of the dry villages of the Eastern Mesaoria has at last been settled after many

/years of

years of unfruitful effort. Under the Water (Development and Distribution) Law 5% of the water of the Kythrea spring was acquired for the domestic use of the villages in the plain and the water has now been piped to 13 of the villages, namely Petra-tou-Dhiyeni, Chatos, Knodhara, Kourou Monastir, Mora, Angastina, Marathovouno, Mousoulita, Yenagra, Pyrga, Ornithi, Aphania and Ashia. The total length of pipe in this scheme amounts to 63 miles. The first 2½ miles through the Kythrea village was laid by the Army (Royal Engineers) as a precautionary measure against possible sabotage. The volume of water available will vary between about 100,000 and 250,000 gallons per day according to the discharge of the Kythrea spring and will be used for supplying a population which at the time of the 1946 census was 8,961 and is now probably about 11,000. The average consumption will therefore be about 17 gallons per person per day. At the end of the year the new pipelines have reached all thirteen villages but some of the distribution works are still incomplete. The domestic water scheme, which is expected to cost approximately £90,000, is described in detail in Appendix 13. It has not yet been decided how the Kythrea irrigators will be compensated for the loss of their water but Government has offered to line in concrete 18 miles of irrigation channels at an estimated cost of £60,000 without asking for a village contribution which would normally be one third of the total cost or £20,000. When this is done there is no doubt that the water saved by the elimination of waste will more than compensate for the water piped to the dry villages.

42. The following village water supply schemes that are typical of the year's work are described in Appendix 13:- Agros, Lymbia, Trikomo, Lefka, Dry Villages of Eastern Mesaoria.

DRILLING FOR WATER

43. The activities of the Drilling Section in finding and developing new sources of underground water may be assessed by the fact that during the period 1946-1956 a total of 2140 new boreholes has been sunk with an aggregate of over 400,000 feet of drilling. Two-thirds of these boreholes were successful and the tested total quantity of water

/pumped therefrom

pumped therefrom was 8.7 million gallons per hour. It is estimated that, as a result of the drillings, the total additional volume of water now available for irrigation, domestic, and industrial purposes is of the order of one hundred million gallons per day. The agricultural development which has taken place as a result of the perennial irrigation from borehole pumping is clearly visible in many areas throughout the island, such as in the Western Mesaoria, the Akrotiri Peninsula and around Xylophagou and Liopetri. 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 greatly enhanced.

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

45. The majority of the boreholes has been sunk for private persons for irrigation under a Government subsidized drilling scheme. Other boreholes have been sunk on a full-cost basis for private individuals, public bodies and commercial companies for irrigation, domestic supply and industrial purposes. Boreholes have also been sunk for military camps and installations and each year Government has drilled a considerable number of prospecting boreholes to test the potential resources of new areas. Applications for drillings continue to pour in, and at the end of 1956 there was a waiting list of 180.

46. Thirteen modern drilling rigs and one old Toronto rig were employed during the early part of 1956 but in August two rigs which were on loan from the Army were withdrawn. These were replaced late in December by two new departmental rigs which were being made ready for use at the end of the year. A new Ruston Bucyrus rig of a heavier type, capable of drilling

/24" holes

24" holes, was received at the beginning of December, and started work later in the month. All these rigs are of the percussion drilling type but one has a rotary attachment which enables it to be used either for rotary or percussion drilling. Boreholes are mainly 8" or 10" in diameter. In 1956 the average drilling depth of boreholes sunk for water was 214 feet and the greatest depth 520 feet.

47. The number of boreholes sunk by the department during the year was 213. Of these 116 were for irrigation, 30 for domestic water, 35 for prospecting for water and 8 for industrial water supplies. In addition 7 observation boreholes were drilled and a further 17 for technical and engineering purposes. Of the 189 boreholes for water, 73% produced more than 1000 gallons per hour on test and are classified as successful. The tested outputs show that, if pumped together, these boreholes are capable of a total output rate of 1,315,000 gallons per hour. This is a new high borehole water production record for Cyprus.

48. In addition to the above Government work, a considerable amount of drilling for water was carried out by registered contractors. Fourteen privately owned percussion drilling rigs, most of them of a light, locally built, type operated during 1956. They are suitable only for drilling boreholes in favourable rock strata. Private drillers have sunk 109 new boreholes for water during 1956, of an average depth of 150 feet and a total estimated (but not tested) output rate of 290,000 gallons per hour.

49. The widespread and intensive drilling operations which have been carried out in recent years have undoubtedly discovered and demarcated most of the island's aquifers so that it is unlikely that any extensive new areas of underground water remain untapped. During 1956 Government prospecting drilling was devoted mainly to the finding and testing of new sources of supplying the urgent additional water requirements of Nicosia and Famagusta. Some 20 successful and high yielding boreholes were sunk for this purpose. For Nicosia the boreholes have been

/located along

located along the landward edge of the Syrianokhori Marsh and on the southern slope of the Kyrenia hills near Dhikomo. For Famagusta the borehole sources are near Xylophagou and Liopetri. Prospecting drillings near Elea (Morphou) have proved that there is a considerable extension inland of the free yielding coastal gravel aquifers which may be developed to good purpose.

HYDROLOGY

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

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

Special intensive studies are being made of groundwater conditions in the Phrenaros and Kokkini-Trimithia areas, which are respectively of special importance to the Famagusta and Nicosia town water supplies. Hydrological information is summarised regularly by the Engineer-Hydrologist in monthly and annual reports. Notes for the year 1955/56 are given in Appendix 4 of this report.

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

/the aquifers

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

52. In order to study the effect of the recent developments it is necessary to keep a careful watch upon changes of ground water level in pumped areas. For this purpose a total of 45 special observation or control boreholes has been drilled at key points and the level of the water in each is measured regularly each month. The chemical quality of the water is also checked periodically so that any increase in salinity can be detected at an early stage. The information obtained from these observation boreholes is showing beyond doubt that in certain areas such as Phrenaros, Famagusta, Kokkini Trimithia, Laxia and elsewhere new drilling must be rigidly controlled if existing public and private interests are to be protected and if further groundwater development is to proceed on sound lines.

53. A summary of the water levels over the past five years is given in Appendix 5. This shows, among other things, that the minimum ground water level at Kokkini Trimithia, which is the chief source of the Nicosia town water supply, fell by about 8.9 feet in the past five years. At Phrenaros West, one of the two chief sources for Famagusta, it fell by an average of 10.4 feet in five years and at Phrenaros North, the other source for Famagusta, by 3.6 feet in one year. It is not possible at present to assess the real significance of this rapid decline in water level because the time that has elapsed since regular pumping began is insufficient; it is clear, however, that these places as well as others, should be watched most carefully in future.

54. Elsewhere in the island the year's records show reasonably satisfactory results. In the Morphou Bay area there are places where the water level has fallen and other places where there is considerable variation but these are mostly of limited extent and the region as a whole is holding up well under the greatly increased pumping of recent years. Around Xylophagou in the Famagusta district the decline in water level has been relatively little in spite of a

/large increase

large increase in pumping. The increased extraction, however, may in this case be offset by above-average rainfall during the past two seasons. At Famagusta itself the former rapid decline has stopped, at least for the time being, probably as the combined result of a number of contributary factors which include (a) two consecutive seasons of good rainfall, (b) the re-charge operations at Ay. Memnon, (c) the strict control of well sinking, and (d) the replenishment effect of the new town water supply. This latter brings an average of about 0.65 million gallons per day to the town throughout the year from Phrenaros and since there are no sewers most of this water finds its way through cess-pits and the upper sandy strata into the soft sandstone aquifer where the water surface is below sea level.

55. At Phrenaros the special study described in Appendix 4 shows that the total extraction for the year from the 24 square miles observed amounted to 1630 million gallons of which 234 million were taken to Famagusta for the water supply. The fall in minimum water level during 1955/56 was 2'3" at the Phrenaros West town water supply pumps and 3'6" at the Phrenaros North pumps. The water extracted at these two sites was almost in proportion to the decline in water level being 90 million gallons and 144 million gallons respectively. Over the whole study area the average decline in water level was probably about 2 feet.

56. The Kokkini Trimithia special study is less advanced than that at Phrenaros but it is proceeding on similar lines. Maps are being prepared of an area of 18.6 square miles showing contour levels of the ground water surface so that year-to-year changes can be recorded not only at observation boreholes but also at all wells throughout the study area. The water pumped will be measured by water meters fixed on typical pumps at more or less uniform spacing. Rainfall will be measured by special gauges and the total surface run-off by a recently completed measuring weir with an automatic water level recorder. The average fall in water level was probably about 2 feet 6 inches during the past year.

57. Artificial re-charge operations can now

/normally be

normally be carried out at two places in Famagusta and one in Limassol. In 1955/56 neither of the Famagusta schemes functioned because at Ay. Lucas there was lack of water and, as regards Ay. Memnon, there was a dispute regarding the ownership of the Paralimni Lake in which the re-charge water is usually collected. The Ay. Lucas catchment is now being extended to provide more water as described in paragraphs 16 to 18 of this report and in Appendix 6, and legal action is being taken regarding the Paralimni dispute. The Limassol operations were highly successful and are described in Appendix 4. In this case the Chiftlikoudhia wells, formerly too saline for domestic use, yielded water of excellent chemical quality, which was pumped into the Limassol town mains at an average rate of about 360,000 gallons per day during the summer. This rate could have been exceeded if necessary.

58. Regular flood measurements were made in the winter of 1955/56 at twenty automatic recorder gauging sites as shown in Appendix 4. During the summer additional gauging stations were established for the same purpose and in winter of 1956/57, 31 recorders are in action. Of this number 10 operate at bridge sites or at other places without the advantage of specially built measuring weirs and although they indicate the level of flood water sufficiently accurately for practical purposes they do not provide the information required for accurate calculations of volume which can only be found approximately. At the remaining 21 sites special masonry measuring weirs have been built and accurate volumetric results can be obtained. Six of the gauging sites are on streams where there is a perennial flow and they are therefore observed throughout the year.

59. The surface run-off records for 1955/56 are tabulated in Appendix 4. It will be seen that on the plains the percentage of run-off to rainfall is low, below 4%, and that in the foothills it is slightly more. In the hills where the rainfall is high and the ground steep, and where the geological formation is of impermeable rock the percentage run-off ranges between 19.7% and

/35.5%.

35.5%. There is not yet sufficient information to indicate the effect of the forests upon run-off.

60. Measurements of the flow of 320 springs at different places throughout the island are made at regular intervals and many odd flow measurements are recorded at others, usually for some specific purpose such as the improvement of a village water supply or irrigation works.

61. A total of 1473 samples for chemical analysis and 395 for bacteriological analysis has been collected during the year mostly in connection with pump tests on wells and boreholes, routine checks on town water supplies, the examination of sources for proposed village water supplies, or for irrigation. The samples are all sent to the Medical Department for analysis.

WORKSHOPS AND PLANT

62. Changing labour conditions, rising costs, and the increased use of pumping both for irrigation and domestric water have made it necessary for the department to operate and maintain additional mechnical plant and the workshops have accordingly been enlarged so as to be capable of attending to their increased responsibilities.

63. New plant to the value of about £92,000 was received during the year. A list of the chief items now on charge is given in Appendix 18. Other plant is hired from contractors or borrowed from other departments as required. Heavy lorry transport is all hired from contractors but some light departmental "Countryman" vans and some Rovers are used for the transport of personnel, light tools, etc.

64. During the year a new garage and a new carpenters shop were added to the workshops which, with the stores, now include workshop office, garage, fitters and plant maintenance shop, precast concrete shop, carpenters' shop, welders and smiths' shop, a water-meter testing room and three store buildings. A small new open storage site was obtained during the year and is already filled to

/capacity.

capacity. A larger additional area of twelve donums has been leased on the Trachona Bypass for the temporary storage of pipes and other materials arriving for the Greater Nicosia water supply scheme.

MISCELLANEOUS ACTIVITIES

65. Technical advice is frequently given to public bodies including the military and to private individuals on their water supply problems. The department is often asked to provide expert opinion on water disputes. Flood discharge estimates are sometimes required by public authorities. A total of 41 prolonged pump tests of wells and boreholes was made during the year for Government, the Military, public bodies and private individuals. Three small Government water supplies in Nicosia are run by the Department. The security of water supplies throughout the island has this year caused the department a certain amount of extra work. 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

66. No new laws concerned directly with water development have been enacted in 1956. Two laws have been amended, several proposed amendments have been under consideration, and some important orders have issued under the Water (Development and Distribution) Law and the Wells Law.

67. The Irrigation Divisions (Villages) Law was amended on 14/3/56 to include drainage and flood protection within the defined meaning of irrigation. This, in practice, enables Irrigation Divisions to carry out drainage and flood protection schemes in conjunction with or independently of the more usual irrigation works.

68. A draft Land Drainage Law has been prepared. If enacted in its present form it will provide (a) for the establishment of committees to drain and reclaim

/land and to

land and to maintain river and drainage channels within declared areas (b) for the maintenance of river and drainage channels outside a declared area and (c) for the prevention of pollution of drainage channels. A number of changes to the draft bill has been proposed and the matter is still under study.

69. Minor proposed amendments to the Water Supply (Municipal and Other Areas) Law have been shelved pending decisions on proposals made in the report of the Millis Commission (see paragraph 36). Some minor amendments to the Water (Domestic Purposes) Village Supplies Law are also under consideration.

70. An amendment to the Water (Development and Distribution) Law was made on 22/5/56 to enable rights to the use of water acquired by a Committee to be handed back to the former owners in whole or in part compensation. Following this amendment an important order issued on 1/6/56 regarding the Kythrea spring, which is the largest spring in the island, and which was thereby acquired by a Committee set up under the law. At the same time an official statement was made to the effect that the intention was to pipe 5% of the water to the "dry villages" of the Eastern Mesaoria for domestic use and to return the remaining 95% to the original owners who were permitted to use the undiverted water in the meantime. The "dry villages" scheme was duly carried out and 95% of the water now remains in the possession of the Kythrea villagers.

71. Four orders were made under the Wells Law to control drilling and to prevent over-pumping in certain ground-water areas. These orders were in respect of (a) An area along the coast between Limassol and Akrotiri where there is a danger of increased salinity from infiltrating sea water if the underground water is over-pumped (b) The Larnaca-Famagusta peninsula in parts of which the water table has been falling rapidly and from which the Famagusta Water Supply is drawn. This is a consolidation and enlargement of other areas declared under earlier orders, (c) Syrianokhori where a strip of land two miles wide along the coast of Morphou Bay is

/controlled for

controlled for the purpose of protecting the future Nicosia water supply and the present irrigation, (d) Dhali where a small protected area now covers one of the new sources of the Nicosia water supply.

FINANCE

72. The following is a summarised statement of the expenditure of the Department of Water Development in 1956:-

	Government Funds	Contributions from Beneficiaries	Total
1. Irrigation & Drainage	£ 89,026	£ 36,250	£125,276
2. Village Water Supplies	136,955	144,000	280,955
3. Subsidized Drilling	9,797	2,275	12,072
4. Prospecting for water	28,528	-	28,528
5. Drilling upon repayment	-	16,540	16,540
6. Greater Nicosia water supply scheme	133,889	-	133,889
7. Town water supplies upon repayment	-	18,587	18,587
8. Hydrological Research	19,626	-	19,626
9. Purchase of Plant	91,987	-	91,987
10. Miscellaneous works upon repayment	-	25,824	25,824
11. Departmental & Maintenance	98,888	-	98,888
	£608,696	£243,476	£852,172

73. Included in the above statement are:-

1.	Personal emoluments	£ 48,802
2.	Wages for labour (approx.)	294,754
3.	Travelling	12,897
4.	Government controlled irrigation Works	15,626
5.	Pump testing wells and boreholes ..	12,645
6.	Drilling, casing, and testing boreholes at Morphou Bay for Nicosia Water Supply	6,294
7.	Value of casing pipes fixed in boreholes	7,192

/8. Purchase

8.	Purchase of drilling tools	8,436
9.	Total cost of drilling and cleaning boreholes excluding items 5, 7 and 8	37,303
10.	Maintenance of Government water supplies and purchase of water	13,348
11.	Fire hydrants at Nicosia, Limassol and Famagusta	1,684
12.	Extensions to office and workshops	10,688
13.	Expenditure under the 1956/61 Development Programme	513,637

74. The average cost of a new borehole in 1956 was £160 and the cost per foot of drilling £0.797. Indents for pipes and other materials for the Greater Nicosia Scheme were placed to the value of about £387,000. A sum of £2,665 was collected as departmental charges for works carried out for water boards upon repayment, and for miscellaneous works upon repayment.

75. Water development works are usually assisted by Government grants or loans, or by both grants and loans. Towards the cost of gravity irrigation works the village contribution varies from 20% to 60% according to the type of work and the nature of the ownership of the water. Where the water is owned collectively as by the members of an Irrigation Division, the usual rate is 20% for spate irrigation and 33.3% for perennial irrigation. In Irrigation Associations there is private ownership of water and the village share is usually higher than for a Division. Each case is considered on its merits with the result that the average village contribution over the past year was about 42%. 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 £32,500 mils for the first borehole, and the balance of the cost which, in 1956 has on the average amounted to about £140, is paid by Government. Private individuals requiring a second or third borehole are charged the actual cost in full including departmental charges.

/Municipal

Municipal Corporations, companies, etc., also usually pay the full cost and departmental charges. The recently completed town water supply schemes were paid for in full by the respective water boards, which raised the money by special loans from Government and the new Greater Nicosia scheme is, for the time being, financed wholly by Government. Village domestic water schemes are paid for half by Government and half by the village if no house connections are wanted. If there are house connections the extra cost is borne entirely by the village.

STAFF AND LABOUR

76. No noteworthy additions or charges to the strength of the staff occurred during the year. On 31st December it was as follows:-

Director	1
Assistant Director	1
Senior Engineers	3
Engineer-Hydrologist	1
Executive Engineer	1
Superintendent of Works	2
Senior Inspector of Works	6
Assistant Engineer	1
Inspectors of Works	9
Technical Assistants	25
Foremen	79
Accounts, Clerical and Miscellaneous	42
Total	171

A new Senior Engineer, Mr. E.H. Booth M.I.C.E. was appointed on 3/7/56 and a new Executive Engineer, Mr. A.R.H. Deverill B.Sc. on 23/12/56. At the end of the year vacancies existed for 6 Executive Engineers, 2 Geologists, 10 Inspectors of Works and 11 Technical Assistants. Five scholars are studying in the United Kingdom for

/university

university degrees under a Government scholarship scheme.

77. Additional office accommodation for the department is under construction by the Public Works Department and is nearly complete.

78. The average number of labourers employed during the year was 1297 of whom 23 were unpaid, their work being considered as a contribution to the village share of irrigation works. These figures compare with 1450 and 200 in 1955. About 34% were classed as "skilled" labourers of Special Grade or Grades I and II, and 26% were regular employees. The approximate monthly averages were as shown:-

Month	Paid Labour	Free Labour	Total
January	1,302	-	1,302
February	1,119	-	1,119
March	1,280	38	1,318
April	1,747	48	1,795
May	1,200	40	1,240
June	1,137	37	1,174
July	1,162	30	1,192
August	1,180	14	1,194
September	1,241	26	1,267
October	1,371	24	1,395
November	1,355	15	1,370
December	1,200	-	1,200
Average	1,274	23	1,297

79. Labour difficulties tended to increase during the year but there were no serious strikes. Extra cost of living and field allowances caused wages to rise by about 16% on the average between 1st January and 31st December.

80. It is a pleasure to record that in spite of unusual difficulties the staff worked with its customary enthusiasm and devotion to duty throughout another very successful year.

/CONCLUDING NOTE

CONCLUDING NOTE

Requests for village irrigation works including the drilling of boreholes have on the whole been met during 1956 but applications have not been pressed so strongly as in earlier years, probably because of the disturbed political conditions. The demand for village domestic water supplies persists and is such that it can only be satisfied with the present resources of the department after a long period of years. In the towns the short term water supply problems are solved or are being solved, but expensive major schemes are needed urgently to provide for the future, particularly in Nicosia, Famagusta and Paphos. In the field of planning and research the time has come to look for major long-term schemes to conserve water that cannot be utilised by small works.

APPENDIX 1

DRILLING FOR WATER

BY D.P. McGREGOR B.SC.,A.M.I.M.M., ASSISTANT DIRECTOR

At the beginning of 1956 the department's drilling plant consisted of thirteen modern rigs - (nine Ruston-Bucyrus 22-Ws, one Bucyrus-Erie 33-W, and three Edecos) and one old Toronto rig. Five of the Ruston rigs were on loan from the Army but operated and maintained by the department. In August 1956 two of the Ruston rigs were withdrawn by the army for use elsewhere leaving 12 rigs operating in the field during the last 5 months of the year. All these rigs are of the percussion drilling type but a rotary attachment was received and fitted to one of the 22-Ws in January 1956 thus enabling the rig to be used for either percussion or rotary (shot crown or tungsten-carbide crown) drilling. This equipment has proved most useful for drilling in the hard crystalline limestone of the Kyrenia range where due to abundant fissures and cavities it is extremely difficult to maintain a vertical bore by percussion methods. In December 1956 three new Ruston-Bucyrus rigs, one 60 R.L. and two 22-Ws, were received from England but only the 60 R.L. carried out a few days drilling before the end of the year.

2. The department has also six transportable deepwell pumping units which are used for long continuous test pumpings of boreholes and wells. These are two 6" diameter and one 4" diameter reciprocating pumps with diesel engines capable of pumping rates between 2,000 and 8,000 gallons per hour according to the pumping lift; two diesel driven turbine pumps, one of 5,000 g.p.hr. capacity and the other 15,000 g.p.hr. at 100 ft. head; and a diesel-electric generating set used in conjunction with $7\frac{1}{2}$" diameter electro-submersible pumps of from 8,000 - 18,000 gallons per hour capacity. These test pumping units were in great demand and, in particular, the turbines and the electro-submersible units were in almost constant use throughout the year. In all, 41 long test pumpings, of from 48 to 711 hours continuous duration, were carried

/out, involving

out, involving a total pumping time of 10,451 hours and a total volume of 173 million gallons of water. Experience has proved that these exhaustive test pumpings are essential for proving the reliability of the aquifers.

The number of boreholes sunk during 1956 was 213 with an aggregate footage of 42,681. This is considerably below the 1955 output but can be mainly accounted for by the loss of the two army rigs and to unavoidable delays due to security restrictions imposed because of terrorist activities. Fewer technical boreholes were drilled in 1956. One hundred and eighty nine boreholes, with a total footage of 40,484, were drilled for water. The average drilling depth was 214 ft. The average time taken to complete a borehole, including the time taken to lay borehole casing and to carry out an 8-hour test pumping of a successful borehole was 16.1 days. The average footage drilled per day was 12.5 ft. The total tested yield of boreholes drilled for water in 1956 was 31,542,000 gallons per day. In addition to new drillings 55 old boreholes were cleaned and renovated, involving 332 drilling days. This was roughly twice the time spent on borehole cleanings in 1955 and is equivalent to the average time taken to drill 20 new boreholes. One hundred and sixteen boreholes were sunk for irrigation. Of these 88 or 75.9%, produced on test, an aggregate of 18.7 million gallons per day, a quantity which is considered sufficient to irrigate 9,300 donums in summer.

The number of successful irrigation boreholes drilled by Government since the beginning of the Ten-year Development Programme in 1946 is now 836 with a tested output of 144.0 million gallons per day, sufficient to irrigate 72,000 donums of summer crops. The actual area now being irrigated as the result of these drillings is conservatively estimated to be of the order of 67,500 donums. The census of 1946 estimated that at that time some 53,000 donums of land were being irrigated perennially by pumped water. By the end of the 1956, as a result of Water Development drilling alone, this area has been increased by 127% to 120,500 donums.

Drilling activities have again been fairly widespread throughout the island during 1956 but as in recent years the highly productive Western Mesaoria has been the focus of the greatest concentration of drilling. Out of 73 boreholes drilled 68 or 94.4% were successful, yielding an aggregate

/tested

tested output of over 22 million gallons per day. In the Akrotiri peninsula, north of the Limassol salt Lake, more high yielding boreholes were sunk. Twenty-two out of 25 were successful with an aggregate tested output of 3.8 million gallons per day. Other areas where good water production results were obtained were near Xylophagou and Liopetri and near Pergamos.

Thirty-five prospecting boreholes were sunk in 1956. Twenty-nine of these were successful in yielding a total tested output of 10.6 million gallons per day. Twelve of these were drilled as sources for the proposed new Nicosia Water Scheme, along the landward edge of the Syrianokhori Marsh between Syrianokhori village and Gaziveran. They have been located along a line roughly parallel to and about 1.4 miles from the sea in a newly controlled drilling area. No drilling will be permitted to seaward to prevent the possibility of sea water encroachment. Nine of these boreholes, plus two others drilled in 1955, have each been subjected to 15-day continuous test pumpings at the rate of 25,000 gallons per hour. Three more prospecting boreholes were drilled further inland and to the south, near Elea, and proved that this previously unexploited locality can yield large quantities of underground water from gravel beds.

Another interesting drilling result in the Western Mesaoria, near Peristerona, was the finding, in a subsidized borehole, of a water bearing sandstone at a depth of 270 feet. The static water level is 166 ft. When pumped at 9,000 gallons per hour a drawdown of 100 feet was obtained suggesting that this is a slow yielding aquifer but under this head it may still prove to be reliable. The borehole, drilled late in 1956, is to be subjected to a long test pumping.

For the additional water supply requirements of Famagusta, the drilling and test pumping of a series of boreholes, started in 1955, near Xylophagou and Liopetri, was continued. During 1956 six new boreholes were sunk. Four of these were drilled into the reef limestone west of Xylophagou giving outputs of the order of 15,000 - 16,000 gallons per hour. The two new boreholes sunk in 1956 near Liopetri and the two sunk in 1955 were tested

/this year

this year and gave outputs ranging between 9,000 and 16,000 gallons per hour.

In the 1954 Annual Report mention has been made of the difficult drilling conditions encountered in the hard metamorphosed limestone of the Kyrenia hills near Dhikomo where abundant water was found in fissures and cavities at a depth of 300 feet below the ground surface. To overcome this, a rotary attachment designed by Messrs. George Stow and Co. Ltd. was obtained and fitted to a Ruston-Bucyrus 22-W rig. This attachment enables 8" and 10" diameter rotary core drilling with chilled shot crowns or with crowns fitted with tungsten - carbide steel inserts. Where the rock formation is solid and reasonably homogeneous chilled shot, which is cheaper, can be used but where cavities occur, as is frequent at Dhikomo, it is necessary to use the tungsten-carbide set crowns. The equipment has the advantage of enabling a quick change over from rotary to percussion drilling or vice versa. Although it has been found in practice that rotary drilling in this hard limestone breccia is, if anything, rather slower than by percussion it has been found possible, by this means, to maintain a vertical borehole. The general procedure which has been found most satisfactory has been to drill 8" rotary through 8" diameter casing for about 20 or 30 feet at a time and then to follow up by enlarging the bore by using a percussion under-reamer. Where large fissures occur above water level and drilling water is being lost it is necessary to fill in the bottom section of the hole with concrete and redrill. Some idea of the hardness of the rock and of the drilling difficulties encountered may be judged from the drilling speed. Under reasonable conditions 8" rotary drilling has varied between 3 and 8 ft. per 10 hour day, but the overall drilling rate including reaming to 12" diameter and time spent concreting and redrilling has been only 2.2 ft. per day.

A total of 30 boreholes, amounting to 4,143 feet of drilling, was sunk on behalf of Army and Air Ministry during 1956. Twenty five of these, of which only 8 were successful were for finding water supplies for camps and installations often strategically situated in localities unfavourable from the water supply point of view. One particular case is noteworthy, where 6 boreholes were

/drilled near

drilled near the apex of the Cape Greco peninsula but failed to find water. They have at least proved that this area is potentially poor in underground potable water.

Seven new observation boreholes were sunk during 1956, bringing the total of these boreholes, in which regular measurements are taken of water and samples for chemical analyses, up to 45. Four of the new boreholes were drilled in the Phrenaros locality, from where water is pumped to Famagusta, one near the War Department boreholes at Ayios Nicolaos, Famagusta and two in the vicinity of the new Nicosia supply boreholes between Syrianokhori and Gaziveran. The results of the measurements of water levels in the control boreholes is given in Appendices 4 and 5.

There were fourteen privately owned drilling rigs, licensed to drill for water, operating in Cyprus during 1956. Altogether they drilled 111 new boreholes, 109 of them for water, with an aggregate footage of 16,358. 73% of these boreholes were successful and gave an estimated total output of 290,000 gallons per hour. In addition these rigs carried out 237 borehole cleanings. These rigs are all locally made, some of them quite well constructed but they are, with one exception, of a rather light type generally only suitable for drilling in favourable rock conditions. The majority of the boreholes have been put down in the Famagusta and Larnaca districts where drilling is comparatively easy and wells may be sunk without casing. Several boreholes were, however, sunk in the Kokkini Trimithia area and two of these have yielded excellent results. One of these has recently been supplying an average/about 330,000 gallons per day to Nicosia town of/ and the other, which has test pumped at 12,000 gallons per hour, is supplying War Department and Air Ministry camps near Nicosia.

Another rig which, although also locally made, is of much more robust type, is at present drilling a deep borehole in the vicinity of Lakatamia, south of Nicosia, in an attempt to find artesian water. Up to the end of 1956 a depth of 680 ft. had been reached and although a surface flow of 600 gals. per hour has been obtained, the water, found at a depth of 500 ft. is highly mineralised,

/containing over

containing over 3,000 parts per million. In the writer's opinion, on geological evidence, it is most unlikely that good quality water will be found at/depth in this locality. this/

By law, private drilling contractors are obliged to give notice of drilling, to keep records of depths of boreholes and static water levels, and to retain borehole samples for inspection by an officer of the Water Development Department. Test pumpings are not normally carried out but from information received it is possible to arrive at an approximate figure of the total water yield of these private drillings. As many of the boreholes were drilled in the bottom of existing wells the increase in yields is somewhat conjectural but it is conservatively estimated that the increase in perennial irrigation as a result of these drillings is of the order of 1,000 donums in 1956.

The average cost of departmental drillings in 1956 was £160 per borehole or 15/11d per foot of drilling. These costs are inclusive of the expenses of laying casing pipes and of 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, fitters and blacksmiths, and the cost of workshop maintenance, fuel and lubricating oils, bit sharpening and repairs, and replacements of drilling tools and equipment. They do not include depreciation of drilling plant and the salaries and expenses of the supervisory staff. Seventy subsidized boreholes were drilled during 1956 costing an average of £172.5 each or 14/5d per foot of drilling. The beneficiaries' contribution to the cost was £32:10s per borehole and Government provided the balance of £140. Eighty-eight full-cost boreholes cost £125.5 each or 14/11d per foot of drilling. A total of fifty five prospecting observation and geological boreholes, drilled entirely from Government funds, cost on an average £197.5 each or 19/6d per foot. These latter include the two expensive boreholes drilled at Dhikomo for Nicosia Water Supply (see above) the combined cost of which amounted to £2,594 or 420 feet of drilling at £6.18 per foot.

APPENDIX 2

NUMBER AND FOOTAGE OF BOREHOLES

Number of boreholes drilled

1949-1956

Purpose	1949	1950	1951	1952	1953	1954	1955	1956
For private individuals and Companies	135	132	157	195	169	182	170	128
For Government	46	32	41	21	51	57	101	55
For War Department and Air Ministry	-	27	32	26	10	15	62	30
TOTALS	181	191	230	242	230	254	333	213
Aggregate Footage Drilled	33,610	40,751	47,766	41,022	44,563	49,159	58,437	42,681
Average Depth	186	231	208	170	194	194	175	200

Boreholes Drilled in 1956

Purpose	No.	Existing Well Footage	Footage Drilled	%age Successful *	Total Tested Yield in gals/day
Irrigation	116	2,957	25,081	75.9	18,693,600
Domestic Water Supplies	30	-	4,617	46.7	1,617,600
Prospecting	35	87	8,723	85.3	10,629,600
Industrial	8	23	2,063	85.7	631,200
TOTAL FOR WATER	189	3,067	40,484	73.3	31,572,000
Observational boreholes (not tested)	7	-	1,178	-	-
Technical and Geological boreholes	17	-	1,019	-	-
TOTAL DRILLED	213		42,681		

Old Boreholes Cleaned: 55

* A successful borehole is one that yields on test more than 1,000 gallons per hour of usable water.
Two boreholes, one each for Industrial and Prospecting purposes, were not completed or tested in 1956 and have therefore been disregarded in the 'Percentage Successful' Column.

/APPENDIX 3

APPENDIX 3

BOREHOLES DRILLED FOR WATER IN 1956

Summary of Results

District	Locality	Number of Boreholes Drilled	Number Successful ¤	%age Successful ¤	Total Tested Output Gals/day	Average Yield per Successful borehole Gals/day
Nicosia	Western Mesaoria	73	≠68	≠94.4	22,104,000	325,100
	Petra-Lefka	3	1	33.3	91,200	91,200
	Kokkini-Trimithia	2	2	100.0	177,600	88,800
	Nicosia	7	3	42.9	278,400	92,800
	Dheftera-Xeri-Lakatamia	6	4	66.6	348,000	87,000
	Malounda-Ay. Ioannis	3	-	-	-	-
	Trakhoni	3	2	66.6	314,400	157,200
	Tymbou	2	-	-	-	-
	Kotchati	1	1	100.0	127,200	127,200
Kyrenia	Ay. Amvrosios-Vasilia	5	-	-	-	-
	Kyrenia Range	5	≠3	≠60.0	321,600	107,200
	Sisklipos	1	-	-	-	-
Famagusta	Paralimni-Cape Greco-Ayia Napa	10	1	10.0	122,400	122,400
	Liopetri-Phrenaros	3	3	100.0	621,600	207,200
	Kondea-Lysi-Pyrga	5	2	40.0	96,000	48,000
	Makrasyka-Avgorou	5	3	60.0	230,400	76,800
	Famagusta	2	2	100.0	144,000	72,000
	Ay. Andronikos (Karpas)	2	2	100.0	288,000	144,000
Larnaca	Pergamos-Xylophagou	17	12	70.6	1,804,800	150,400
	Lefkara	2	2	100.0	192,000	96,000
	Athienou	1	-	-	-	-
Limassol	Episkopi-Zakaki-Akrotiri	16	15	93.8	2,868,000	191,200
	Polemidhia-Limassol-Yermasoyia	9	7	77.8	988,800	141,300
Paphos	Emba-Mesoyi	2	1	50.0	33,600	33,600
	Polis-Argaka	4	3	75.0	420,000	140,000
	TOTALS	189	137	73.3	31,572,000	230,500

≠ Two boreholes No. 82/56 (Western Mesaoria) and 169/56 (Kyrenia Range) were not completed or tested in 1956 and have therefore been disregarded in the percentage and successful columns.

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

/APPENDIX 4.

APPENDIX 4.

HYDROLOGICAL NOTES 1955-56

By M.Grehan, B.Sc., A.M.I.C.E., A.M.I.W.E., Engineer-Hydrologist.

(This report covers the period 1st October 1955 to 30th September 1956).

Meteorological

The main characteristics of the Island's rainfall during 1955-56 were:-

(a) Overall rainfall slightly above normal.
(b) Steady rain from October to May; the month-by-month distribution of rainfall represented nearly average conditions.
(c) No high intensities of rainfall except during one short space of three days in February.
(d) Heavy snowfalls at high altitudes during February, the snow-cover on Mt. Olympus persisting until April.

The total precipitation averaged 20.30 inches over the Island. This is 4.5% more than the mean annual rainfall of 19.42 inches but slightly less than last year when the rainfall was 8% above normal.

The rainfall pattern for the year was uneven and the isohyetal map diverged considerably from that based on average rainfalls at all gaugingstations. Coastal areas generally experienced normal or more-than-normal rainfall while inland regions tended to record sub-normal precipitation. The north-west coastal zone from Cape Arnauti to Kyrenia, including the Morphou locality and the western Kyrenia range, together with the Famagusta - Dhekelia - Cape Greco triangle were the areas recording the highest rainfall compared with mean annual figures. The southern slopes of the central massif and the central Mesaoria east of Nicosia were the principal areas with sub-normal rainfall.

Temperatures were generally above normal during the

/winter and

winter and summer months but below normal in the spring from March to May. In August, very high temperatures were reported over the entire Island, a record temperature of 112°F being experienced in Nicosia early in the month.

Flood Discharges

The only serious floods reported in 1955-56 occurred in the valleys of rivers flowing south-west from the central massif to the west between Cape Aspro and Paphos. These floods were caused by exceptionally heavy rains on the 8th February, mainly on the south and west slopes of the Troodos mountains. An inspection of the area immediately after the spates had subsided indicated that the maximum flows were of the order of 1-in-5 year or 1-in-10 year floods. The maximum rates of flow were estimated to be about 2,500 cusecs at the Limassol - Paphos road for the Xeros river, 2,100 cusecs at the same road for the Ezuza river and 1,500 cusecs for the Dhiarizos river.

River and Stream Discharges

The generally low rainfall intensities experienced over the Island during 1955-56 resulted in low flows in the Mesaoria rivers in spite of the above-average total rainfall. Generally all gauging stations situated either near the mouths of rivers or on the plains recorded run-off factors of less than 5%. Summer discharges from hill-streams were about average although the extensive forest fires in July in the Pyrgos and Limnitis catchments reduced the run-off appreciably for the next two months. The normal run-off for these catchments, however, is so small that no great deletereous effect was caused. By the end of September the flows in these rivers were back to average although it is still possible that the 1956-57 winter run-off will be modified by the changed surface conditions in the catchments.

At the beginning of the hydrological year - October 1955 - water-level recorders had already been installed and were in operation at the gauging stations given in the following table:-

/Gauging Station

Gauging Station No.	River or Catchment	Location	Type of Installation
1*	Pedieos	Old railway bridge north of Nicosia	Water-level and flow-velocity measurement
2*	Yialias	Road bridge on Nicosia-Limassol road	-do-
3*	Ovgos	Road bridge on Morphou-Kyrenia road	-do-
4*	Serakhis	About 1 mile north-west of Morphou	-do-
5*	Xeros (Lefka area)	Road bridge at Karavostasi	-do-
6*	Marathasa	Road bridge on Lefka-Skouriotissa road	-do-
7≠	Harangas (Famagusta)	About 1 mile west of Varosha-Dherinia road	Water-level recorder on existing 70-foot weir
8≠	Catchment near Avgorou	Near Avgorou turn-off on Nicosia-Famagusta road.	40-foot measuring weir with 2'0" x 6" notch
9	Paralimni Lake	At exit of outfall tunnel	2-foot standing-wave weir
10	Pyrgos	Near Phlevas saw-mill	30-foot measuring weir with 2'0" x 6" notch
11	Limnitis	At Limnitis saw-mill	-do-
12	Ovgos	Near Syrianokhori	6'7" sharp-edged weir with 2'0" x 6" notch (This weir is for measuring summer flows only and is removable)
13A	Kouris	Under road bridge on Limassol-Troodos road near Trimiklini	18-foot measuring weir with 2'0" x 6" notch
13B	Kouris	On irrigation channel by-passing weir 13A	1'6" standing-wave weir
14	Peristerona	At Panayia Bridge Forest Station	25-foot measuring weir with 2'0" x 6" notch
15*	Tremithios	At Kiti village	Water-level recorder on existing 70-foot irrigation weir

Gauging Station No.	River or Catchment	Location	Type of Installation
16*	Yermasoyia	Road bridge on Nicosia-Limassol road	Water-level and flow-velocity measurement
17*	Kouris	About 1 mile north-east of Kandou	Water-level recorder on 300-foot irrigation weir
18	Main drain on north side of old Akhyritou reservoir area	About 1 mile east of Kalopsidha (at Kolopannes)	25-foot measuring weir with 2'0" x 6" notch
19≠	Catchment near Akhna	Near Ayios Yeorgios Church about 2 miles north-east of Akhna	40-foot measuring weir with 2'0" x 6" notch
20≠	Catchment west of Phrenaros	About 1 mile north-west of Phrenaros-West pumping station	40-feet measuring weir with 2'0" x 6" notch.

* These stations are primarily intended to estimate river spates but enable approximate figures for annual flows to be calculated at the end of the year.

≠ For the Phrenaros Area Hydrological Survey.

During the year 1955-56 the discharges measured at the gauging stations listed in the previous table were as follows:-

Gauging Station No.	River or Catchment	Total Rainfall on Catchment ($x10^6$ c.ft)	Total Run-off ($x10^6$ c.ft)	Maximum peak flow (Cusecs)	Maximum run-off in 24-hours period ($x10^6$ c.ft)	Percentage Run-off
1	Pedieos	2170	65	250	16	3.0
2	Yialias	1520	60	175	8	3.9
3	Ovgos	3460	230	900	10	3.7
4	Serakhis	7840	149	900	61	1.9
5	Xeros	2020	35	100	9	1.7
6	Marathasa	1690	151	200	15	8.9
7	Harangas	340	9	70	3.3	2.6
8	Avgorou	585	0.1	1	0.04	negligible
9	Paralimni Lake	See "Recharge Activities" below				
10	Pyrgos	1030	238	325	17	23.4
11	Limnitis	1406	277	520	22	19.7
12	Ovgos (Syrianokhori)	Summer discharges only; see next paragraph				
13A) 13B)	Kouris (Trimiklini)	1600	496	200	10	31.0
14	Peristerona	1746	616	570	41	35.5
15	Tremithios	2150	60	470	25	2.8
16	Yermasoyia	3630	244	600	26	6.7
17	Kouris (Kandou)	8320	532	300	23	6.4
18	Kolopannes	not applic	12	12	0.9	not applic.
19	Akhna	490	0.2	17	0.1	negligible
20	Phrenaros West	186	6	124	4.2	3.2

/Details of

Details of all summer discharges at present being measured are given below for those gauging stations which recorded an appreciable flow between the 1st June and the 30th September 1956. The quantities involved for the Pyrgos, Limnitis, Kouris and Peristerona rivers have already been included in the annual totals given in the previous table but are given here in separate form to record minimum flows.

River	Gauging Station No.	Average Discharge (cusecs)			
		June	July	August	September
Pyrgos	10	0.75	0.16	0.08	0.14
Limnitis	11	1.58	0.23	0.05	0.10
Ovgos	12	0.76	0.18	0.08	0.08
Kouris	13A & 13B	6.2	3.3	2.3	2.0
Peristero -na	14	1.40	0.04	nil	nil

Spring Discharges

During the hydrological year 1,765 spring discharges were measured giving an average of 147 measurements each month. 320 springs are now measured regularly, 70 at monthly intervals, 139 bi-monthly, 108 every three months and 3 every six months.

The above-normal overall rainfall for the second year in succession resulted in spring discharges being generally up to average although certain areas continued to report low spring yields owing mainly to the uneven rainfall-pattern. Thus both in 1955-56 and in 1954-55 the rainfall on the southern slopes of the central massif was sub-normal and the springs in this area were adversely affected as a result. The highest portions of the central massif, its northern slopes and the central plains, have all experienced one dry and one wet winter and spring flows in these areas were back to normal during the summer of 1956. The Kyrenia range, however, reported above-normal rainfall during both years and springs at the foot of the hills discharged, in some instances, record dry-weather quantities during the last months of the year. The even distribution of the rainfall over the winter months of 1955-56 meant that the recovery of spring flows after the preceding summer was normal but the completely dry months at the end of the hydrological year resulted in all springs being down to minimum yields at the end of September and showing no signs of

/the usual

the usual seasonal recovery.

In the Nicosia area rainfalls during the year tended to be a little below average and spring flows by the end of the summer tailed off to lower figures than last year. Thus the Arab Ahmed chain-of-wells (upper) was discharging, in September, about 13,000 gallons per day less than last year's gauging of 173,000 gallons per day at the same time. At higher altitudes in the south of the Nicosia District area, however, spring flows were up during the year as a result of the heavy 1955-56 rainfall in this part of the central massif.

On Mt. Olympus the heavy snowfalls and up-to-average aggregate precipitations during the wet months of 1955-56 resulted in all higher altitude spring-discharges being back to normal in the summer of 1956 after the usually low discharges of the year before. The Troodos springs themselves were discharging 38,000 gallons per day in September compared with 17,000 gallons per day last year, and the Loumata-tou-Aetou group of springs also were yielding 27,000 gallons per day more than the 84,000 gallons per day minimum discharge recorded last year - an increase of over 30%. The Hardji and Kannoures springs showed an even greater increase and, although records are not available to prove the point, have almost certainly given above-average discharges this summer.

The Limassol district has been badly hit by two years of sub-normal rainfall. By September the aggregate flow from the three springs feeding Limassol Town - Kephalovrysos, Kria Pighadhia and Mavrommata - had dropped to 527,000 gallons per day, lower by about 20% than the minimum flow during the summer of 1955 and very nearly the lowest discharge on record. The Kissousa spring was also down, by the end of September, to a low figure (210,000 gallons per day) but was still well above the 1955 minimum flow of 165,000 gallons per day. Although all these springs were discharging sub-normal quantities during the summer, the maximum flows recorded at the beginning of 1956 were well above average and at that time satisfactory summer-yields were expected. The decline in discharges, however, was abrupt during the spring months and it would appear that the deeper strata feeding the springs had not been replenished. Further north on the upper slopes of the central massif, the heavy snowfalls in February caused a deeper penetration of surface water into the sub-

/strata and

strata and spring discharges remained above average throughout the summer.

All springs in the Kyrenia Range area flowed at an abnormally high rate throughout the year and the largest springs discharged very steadily. The Kythrea Kephalovrysos yield was near to 3,200,000 gallons per day during the entire twelve months and has struck a very even period. The Lapithos Kephalovrysos similarly discharged steadily at 1,100,000gallons per day during the year and the Karavas Kephalovrysos, after starting off last autumn at about 500,000 gallons per day, rose to 750,000 gallons per day in February and kept to this figure for the remainder of the year.

Springs in the Famagusta area generally behaved normally during the year although increases were not as high as the excessive winter rainfall would have seemed to warrant. The largest in this area - Panayia Spring owned by the Famagusta Water Board - started off the year at 61,000 gallons per day, rose to 308,000 gallons per day in March, and dropped to 98,000 gallons per day by the end of September.

A normal year was reported at Larnaca. The Bekir Pasha chain-of-wells was discharging just over one million gallons per day in October 1955 and ended the year with 1,200,-000 gallons per day in September 1956. The lowest flow recorded during the summer was 1,082,000 gallons per day in July. Similarly the Athanassi chain-of-wells commenced the year with 194,000 gallons per day and, after a normal increase during the winter, dropped to 230,000 gallons per day by the end of September.

In Paphos District, as in the Limassol area, springs in the south suffered from the low rainfall of 1955-56. The fall-off, compared with last year's minimum flows in the summer, amounted to about 10% but rarely more. The aggregate minimum discharge of the five springs supplying Ktima town showed a much greater decrease than this but the fall-off in these instances was probably mainly due to increased pumping from boreholes in their vicinity.

Pumped Discharges from Wells and Boreholes

Irrigation requirements of pumped water from wells

/and boreholes

and boreholes during the summer months of 1956 were generally not affected by abnormal climatic conditions although the almost complete lack of rain in September meant that at the end of the hydrological year all pumps over the Island were operating to full capacity and the water requirements had shown no signs of tailing off - a usual trend in September.

Ground-water used for Town Water Supplies

In contrast to the seasonal requirements of water for irrigation purposes, towns and villages require a regular water supply all the year round and most of these obtain their requirements wholly or in part from wells and boreholes equipped with pumping installations. The remainder derive their supplies from perennial springs which themselves form a natural means of tapping sub-soil water resources. Details of the water extracted from underground reserves by the major towns of Cyprus are given below:-

	Cubic feet (millions)	Gallons (millions)
Nicosia Water Supply:-		
Total extraction during 1955-56 (including gravity flow from springs and wells)	62.21 (100%)	388
Total from Kokkini Trimithia and Ayii Trimithias boreholes	28.21 (45.3%)	176
Total from Athalassa boreholes	2.85 (4.6%)	18
Total from Laxia boreholes	9.47 (15.2%)	59
Remainder	21.68 (34.9%)	135
Famagusta Water Supply:-		
Total extraction during 1955-56	39.47 (100%)	246
Total from Phrenaros West boreholes	14.38 (36.4%)	90
Total from Phrenaros North boreholes	23.08 (58.4%)	144
Remainder	2.01 (5.2%)	12
Limassol Water Supply:-		
Total quantity drawn from Kephalovrysos, Kria Pighadia and Mavrommata springs (gravity flow)	71.36	446
Total of above used for Limassol Town Water Supply (remainder was recharged into "Recharge Activities" below)	42.95 (89.2%	268

Limassol Water Supply: (Cntd)	Cubic feet (millions)	Gallons (millions)
Total quantity extracted from Chiftlikoudhia chain-of-wells	5.22 (10.8%)	33
Total consumption by Limassol Town Water Supply	48.17 (100%)	301

Ground-Water Levels

Seven new observation boreholes were brought into use during the year 1955-56, the total now being 45. By the end of September most of the underground water-tables had already fallen below the lowest levels recorded last autumn. Usually the groundwater levels are at a minimum in October but this year this date may be pushed back due to the dry summer and the late commencement of the 1956-57 seasonal rains. During 1955-56 the greatest declines in the underground water-levels of large aquifers were, ... once more, recorded in the Kokkini Trimithia and Phrenaros areas while the steadiest was in the Xylophagou area where the water-table shows no signs of dropping lower than last autumn's minimum levels.

In the Kokkini Trimithia area, which provided Nicosia with nearly one-half of its 1955-56 domestic water supply, the average water-level dropped by nearly 2'6" during the year. The decrease in level over the last five years has been 9'0", giving an annual average of a little under 2'0". The year 1955-56 therefore recorded a fall in excess of the average and this area is now being subjected to an intensive hydrological survey with a view to co-ordinating control of ground-water extraction in the future. (See "Special Investigations" below). The average seasonal variation in water level in this area is about 4'0".

At Phrenaros West, Famagusta, the observation boreholes are in the vicinity of the pumps which supplied Famagusta Town with 90 million gallons of water during 1955-56. The year's records showed that the minimum level of the water-table had dropped about 2'3" and the average level by a little less than 2'0". This was more than the 1'0" drop of the year before but less than the average decrease of 2'0"

/over the

over the last five years. The area has experienced two successive years of above-average rainfall and this, together with the ban on the sinking of new boreholes, has helped in slowing down the rate of the water-table recession.

At Phrenaros North the average level of the water-table in this area continued to drop by about 3'0" during the year. It is in this locality that the new observation boreholes were sunk, the old ones being too near the boreholes and pumps which provided Famagusta with nearly 150 million gallons during the year. It is hoped that the new boreholes will give a more accurate picture of the fluctuations of the average water-table in the area and will show that the 3-feet-a-year decline does not apply to the aquifer as a whole. The intensive pumping in this area commenced only three years ago and it is possible that the local water-table has not yet stabilized its behaviour under the new conditions. An intensive hydrological survey of all this area is under way (see "Special Investigations" below).

In the coastal area south and south-west of Famagusta, where the ground-water level has been depressed by over-pumping to as much as 20 feet below sea level, the conditions appear to have been reasonably stable since 1953. Here also, two successive years of well-above average rainfall have taken effect and by the end of September the water levels in the two coastal observation boreholes were over 1'6" higher than at the same time in 1954 and about the same as in October 1953.

The water-table levels in the Ormidhia-Xylophagou coastal zone continued to indicate the most stable aquifer under observation on the Island during the year although, again, the above-average rainfall in the Cape Greco area at the beginning of the year was a most important contributory factor. The average ground-water level showed a rise of nearly 3" compared with 1954-55 but the improvement in the year's minimum level was even more satisfactory: 15.2' above M.S.L. against 14.7' in the previous year. In this area the water-table level is determined by taking the average of observations at five

/boreholes well

boreholes well spread out between Ormidhia and Cape Pyla. Since 1950-51, when records commenced in this locality, the average water-table level has been depressed by 1'3" or about 3" each year. This is very little for an area in which pumping installations for irrigation purposes have increased considerably over the last five years but the behaviour of the aquifer under conditions of sub-normal rainfall has yet to be studied.

In the Syrianokhori coastal area six observation boreholes are in use for recording fluctuations in the water-table level, four being located along the shore line and the other two about one mile inland. Since these were sunk at the beginning of 1954-55 the average water-table in the four coastal boreholes has declined only one inch but the minimum water lever recorded in 1955-56 showed a decrease of 4". It is apparent that increased demands for pumped irrigation-water during the year caused this serious drop in the level but it is possible that the recovery during the winter months of 1956-57 will be just as marked and that the overall stability will continue. The two inland boreholes recorded a drop in the average level of over 1'6" during the year, the minimum level falling by nearly 3'0". The future development of the underground water-resources in this area will be under strict control.

The five observation boreholes in the Morphou inland area, including Pendayia, are located 2 miles north of Morphou (168/50), at Morphou (92/50), at Prastio (93/50), at Ghaziveran (94/50) and at Pendayia (95/50) respectively. All these boreholes recorded a falling water-table during the year although two of them - 168/50 near the Ovgos river north of Morphou and 95/50 at Pendayia - have shown very little overall change in the five years since 1950-51. Of the remaining three, the Morphou Government Farm observation borehole (92/50) recorded the greatest drop in the water-table while the average level at the others - at Prastio and Ghaziveran - also declined by one to two feet. These latter three boreholes are heavily influenced by nearby privately owned irrigation pumping-installations and the actual decline of the water-table over the area as a whole is likely to be less than that indicated by the records.

/Appendix 5

Appendix 5 gives the water levels recorded at all observation wells and boreholes during the years 1950-51, 1954-55 and 1955-56.

Recharge Activities

Three recharge schemes for the artificial replenishment of underground water-tables are at present in operation. The first of these is at Ayios Loucas in the Famagusta area where a recharge basin has been formed and into which surplus water from nearby catchments is fed during the winter months. The second is nearby at Ayios Memnon where surplus water from The Paralimni Lake is normally drawn off during periods of excessive rains and fed into a recharge tunnel driven immediately above the surface of the depleted water-table. Owing to a dispute regarding the ownership of the water in the lake, no recharge was possible in this area during 1955-56. The third recharge scheme is operated in the Limassol area where, in winter, surplus water from the town domestic water supply is fed into the Chiftlikoudhia chain-of-wells to replenish the aquifer in the low-lying coastal area west of Limassol. During the summer, when the normal sources of the town supply are inadequate, water from the Chiftlikoudhia chain-of-wells is then pumped out to meet the additional demands. The Chiftlikoudhia aquifer is therefore used in much the same way as a normal supply reservoir, filling taking place mainly artificially during winter and these reserves being drawn off in summer. The recharge activities at Chiftlikoudhia over the past two years have not only increased the quantity of water available during the summer months but have also greatly diminished the salinity of the water which previously rose sharply whenever the source was intensively pumped. During 1955-56 the quantities of water involved in the above operations were:-

Total recharged into aquifer ... 28.41 million cub.feet
Total extracted from aquifer ... 5.22 million cub.feet

During the summer, the Chiftlikoudhia water was used for the Limassol town water supply at rates up to 450,000 gallons per day. The salinity of this water

/in 1948

in 1948 amounted to 990 parts of NaCl per million. Chiefly as a result of the discharge operations this reduced to 222 p.p.m. in 1955 and 111 p.p.m. in 1956.

Chemical Analyses

During the year 1,473 samples of water were sent to the Government Analyst for chemical analysis. Of these 400 were taken from wells, springs or boreholes supplying towns and the larger villages or from distribution systems in the main towns. All these were submitted to full analysis. 600 samples were taken from springs and wells used for village water supplies and were given partial analysis. The remaining 473 samples, derived from springs, observation boreholes, irrigation schemes, new boreholes, pumping-tests and from other miscellaneous sources, were also subjected to partial analysis.

Bacteriological Analyses

1955-56 was the first full year during which responsibility for the collection of samples for bacteriological analysis devolved on the Hydrological Section. The number of samples taken was necessarily restricted by the limited output of the Government pathological laboratory due to other urgent commitments. Nevertheless 395 samples were taken and analysed during the year October 1955 to September 1956. This works out at nearly 33 samples each month, the average distribution being 17 from Nicosia town, 10 from Famagusta, 4 from Limassol and 2 from Larnaca. The summary of the year's activities are as follows:-

Water supply	No. of samples taken	No. "unsatisfactory" or "suspicious"
Nicosia	197	20
Famagusta	123	9
Limassol	51	14
Larnaca	24	6
Totals	395	49

/At Nicosia

At Nicosia most of the unsatisfactory samples came from the smaller sources of supply in intermittent use as the wells at Ayii Omoloyitadhes. Chains-of-wells such as the Arab Ahmet and Bernera also yielded a few doubtful samples. All samples taken from the Kokkini Trimithia area boreholes or from Laxia and Athalassa boreholes were satisfactory throughout the year.

At Famagusta all the unsatisfactory samples taken came from the Panayia spring conduit at the Famagusta service reservoir end. This source discharges pure water - all samples taken at the spring have invariably been highly satisfactory - but the flow is polluted on its way to Famagusta owing to the bad condition of the conduit. This conduit is now being replaced by a pipe line and meanwhile very little of the Panayia spring water is being used for domestic purposes, particularly during the summer months.

Of the 14 unsatisfactory samples taken at Limassol one half of these were collected in the winter months when the springs supplying the Town were affected by surface run-off. The point of sampling of the polluted samples under these conditions was the raw-water main at the inlet to the reservoir and upstream of the chlorination plant. The other unsatisfactory samples were derived from the Chiftlikoudhia chain-of-wells pumping station during the late summer months when this supply was used to augment the depleted spring-flow. In this case, also, the samples were taken from the raw water prior to chlorination.

Four of the six unsatisfactory samples at Larnaca were taken from the Bekir Pasha chain-of-wells in winter time when the discharge was affected by direct surface inflow. The other two were collected from the same source in the summer at a time when the surrounds to the chain-of-wells were badly in need of cleaning.

Special Investigations

A number of special hydrological investigations were conducted during 1955-56, of which the two principal

/were at

were at Phrenaros and at Kokkini Trimithia.

(1) Phrenaros area hydrological survey: The Phrenaros survey covers an area of 23.7 square miles south-west of Famagusta, chosen because it is in this locality that the boreholes supplying Famagusta Town are situated and because the underground water-table is declining rapidly enough to make careful study and control imperative. During 1954-55 a complete topographical survey had been completed and every well and borehole in the area numbered, levelled and accurately located on large scale maps. In all 976 were found spread over the 23.7 square miles. Three separate sets of plans were prepared, one showing the positions of all wells and boreholes, one giving ground contours and the third the underground water-table contours. The ground-water levels change seasonally and new sets of contoured plans will be prepared every year to show the variation and decline in the water-table levels. During 1955-56 two sets showing these ground-water levels were prepared, one giving the levels during the 1955 dry season, the other giving the levels at the beginning of the 1956 summer season and just after the seasonal pumping of irrigation water from the wells had commenced. The aquifer levels will be taken again during the first months of 1956-57 as soon as the requirements of sub-soil water for irrigation cease. Estimates of the water extracted from the aquifer during each of the three years 1953-54, 1954-55 and 1955-56 are given in the Table below together with the total annual rainfall deposited on the area in each case:-

Year Year	Famagusta domestic supply (M galls)	Other domestic supplies (M galls)	Irrigation (M galls)	Total (M galls)	Total Rainfall on area (M galls)	Ratio: Total extraction to Rainfall
1953-54	306* (20.4%)	26 (1.7%)	1,168 (77.9%)	1,500 (100%)	4,000	37.5%
1954-55	214 (14.7%)	39 (2.7%)	1,204 (82.6%)	1,457 (100%)	6,250	23,3%
1955-56	234 (14.5%)	50 (3.1%)	1,332 (82.4%)	1,616 (100%)	6,970	23.2%

* Includes pumping tests at Phrenaros North group of boreholes.

/Another activity

Another activity at Phrenaros during the year in connection with the hydrological survey has been the fixing of meters on typical well or borehole pumping-installations in order to improve the future accuracy of estimates of irrigation water extractions. Four installations were chosen, each typical of the main categories of pumps in use in the area. These were:-

a) A large pumping-plant in a well used for an extensive orange-grove and pumping about 16,000 gallons/hour.

b) A small shaft-driven turbine pump in a borehole used for general irrigation purposes; capacity about 2,000 gallons/hour.

c) A wind-driven reciprecating pump in a borehole with a maximum capacity of about 1,200 gallons/hour.

d) An "Alakati" or Persian Wheel in a well with a top output of 900 gallons/hour.

At the end of the 1956 irrigation season the total extraction of water by each type of pump will be calculated and related to the area irrigated and the type of crop produced.

Surface run-off calculations will be facilitated by the measurements obtained from five measuring weirs built on catchments draining the area. Four of these had been completed by the end of 1954-55 and run-off figures for these during 1955-56 are given in the table under "River and Stream Discharges" above. The fifth weir, near Liopetri, was completed during the summer of 1955-56 and the measurement of discharges at this point will commence in 1956-57.

(2) Kokkini-Trimithia area hydrological survey: This survey is similar in nature to that in progress near Phrenaros. The area involved is triangular, centred about Kokkini-Trimithia village and bounded on the south-west by the Meriki river and on the north by the Dhenia-Mammari escarpment. In all about 18.6 square miles has been included. It is in this area that are situated the Nicosia Water Board boreholes which provide nearly one half of the present supply to the city. As at Phrenaros the underground water-table is declining at the rate

/of about

of about 2 feet each year and a hydrological survey was therefore commenced in 1955-56 in order to study the general trend of the fluctuations in underground water reserves. During the year a complete topographical survey of the area was made with the help of the Lands and Surveys Department and all the wells and boreholes - a total of 600 - were located, numbered and ground-levels at the head works taken.

A preliminary estimate of the water extracted from the aquifer under the hydrological survey area during 1954-55 has been prepared and amounts to 875 M gallons. This corresponds to 47 M gallons per square mile compared with 62 M gallons per square mile for the same year in the Phrenaros area. Of the 875 M gallons extracted in the Kokkini-Trimithia area about 85% was used for irrigation purposes.

New Works and Costs

By the end of the hydrological year (30th September 1956) 31 permanent gauging stations had been established on rivers, streams or drainage channels and were fitted with water-level recorders for the continuous measurement of discharges. This total compares with 19 at the end of 1954-55 and 6 in September 1954. Details of the 12 new gauging stations built and equipped during 1955-56 are as follows:-

(1) Near Kokkini-Trimithia on a catchment draining into the Meriki river:- 40-feet weir with 2'0" x 6" notch for low flows. This weir has been installed to provide data for the Kokkini-Trimithia area hydrological survey now in progress (see above). Total cost £820 including purchase of land.

(2) Near Liopetri on a catchment draining south-westwards to the sea near Cape Pyla:- 40-foot weir with 2'0" x 6" notch for low flows. This weir has been built in connection with the Phrenaros area hydrological survey now in progress (see above). Cost £600.

(3) Yialias river near Kotchati:- 30-foot weir with 2'0" x 6" notch for low flows. Cost £1,170. Additional cost of this weir due mainly to access difficulties.

(4) Akaki river near Malounda:- 40-foot weir with 2'0" x 6" notch for low flows. Cost £860.

/(5) Skylloura

(5) Skylloura river near Ayios Vassilios:- 60-foot weir with 2'0" x 1'0" notch for low flows. Cost £1,575. The high cost of this weir was due to the above-average overall length of the weir and abutments and to excessive ground-water met with during the construction of the foundations.

(6) Ak-Sou river near Petra-tou-Dhigeni:- 30-foot weir with 2'0" x 6" notch for low flows. Cost £1,000.

(7) Almiros river near Geunyeli:- 40-foot weir with 2'0" x 6" notch for low flows and with a standing-wave weir (equipped with its own water-level recorder) on a by-pass irrigation channel east of the main weir. Total cost £1,260. Increased cost due to additional installation required on irrigation channel and to access difficulties.

(8) Khrysokhou river near Skoulli:- 40-foot weir with 2'0" x 6" notch for low flows. Cost £1,600. High cost due to continuous pumping required during excavation and concreting of foundations.

(9) Evretou river near Trimithousa:- 25-foot weir with 2'0" x 6" notch for low flows. Cost £950.

(10) Syrgatis river near Skarinou:- Stabilization of water-way between abutments of old Nicosia-Limassol road bridge. Work consisted of construction of concrete sill at ground level between abutments and installation of water-level recorder. Discharges will be determined by float measurements across the stabilized section. Cost £260.

(11) Dhiarizos river at the Limassol-Ktima road bridge:- Water-level recorder installation at bridge to be used in conjunction with float measurements. Cost £230.

(12) Xeros river at the Limassol-Ktima road bridge:- Water-level recorder installation at bridge to be used in conjunction with float measurements. Cost £200.

APPENDIX 5

WATER LEVELS IN CONTROL BOREHOLES

FEET ABOVE SEA LEVEL

	Borehole No.	Maximum Water Level			Minimum Water Level		
		50-51	54-55	55-56	50-51	54-55	55-56
1.Kokkini Trimithia (Police Station)	90/50	685.8	678.8	675.9	681.2	675.2	672.6
2.Kokkini Trimithia (North Side)	160/50	682.7	675.9	674.7	679.8	672.8	671.8
3.Kokkini Trimithia (East Side)	161/50	686.0	678.7	675.8	680.2	673.7	670.1
4.Astromeritis (Katokopia road)	91/50	370.4	359.8	357.7	365.1	332.3	330.3
5.Morphou (North of Ovgos River)	168.50	89.2	89.7	89.7	84.1	83.5	81.6
6.Morphou (Government Experimental Farm)	92/50	83.7	78.3	71.6	69.9	64.7	57.3
7.Prastion (27 M.P.)	93/50	27.1	25.6	23.4	22.1	20.8	18.6
8.Ghaziveran (between 29-30 M.P.)	94/50	18.5	17.6	15.7	16.2	15.5	14.2
9.Pendayia (on road to Peristeronari)	95/50	10.6	11.5	11.8	8.0	8.9	7.2
10.Xylophagou (West of village)	70/51	24.4	23.3	20.9	23.4	20.1	20.1
11.Xylophagou (West of village)	71/51	18.8	15.6	14.4	17.7	13.2	13.0
12.Xylophagou (West of village)	72/51	23.2	24.4	26.0	22.6	20.9	22.9
13.Xylophagou (East of village)	73/51	11.3	10.5	11.3	10.3	9.0	9.5
14.Xylophagou (East of village)	74/51	11.1	11.9	11.6	11.1	10.1	10.8
15.Pergamos	86/51	256.6	254.2	251.3	254.7	250.2	248.0
16.Phrenaros (Famagusta W.S.B.Hs)	51/51	87.0	75.5	74.8	86.6	73.6	71.8
17.Phrenaros (Famagusta W.S.B.Hs)	52/51	85.8	77.0	74.5	85.4	73.3	71.1
18.Phrenaros (Famagusta W.S.B.Hs)	53/51	85.2	78.0	77.1	84.9	76.6	74.0
19.Phrenaros (Famagusta W.S.B.Hs)	67/53	-	78.5	76.3	-	76.5	74.4
20.Phrenaros (North Famagusta W.S.B.Hs)	108/52	-	67.3	63.8	-	63.7	60.4
21.Phrenaros (North Famagusta W.S.B.Hs)	109/52	-	66.7	63.6	-	63.5	59.6
22.Phrenaros (North Famagusta W.S.B.Hs)	110/52	-	66.3	63.2	-	63.5	59.9
23.Phrenaros (North Famagusta W.S.B.Hs)	76/56	-	-	-	-	-	-

Location	Borehole No.	Maximum Water Level 50-51	54-55	55-56	Minimum Water Level 50-51	54-55	55-56
25. Phrenaros (North Famagusta W.S.B.Hs)	78/56	-	-	-	-	-	-
26. Phrenaros (north Famagusta W.S.B.Hs)	79/56	-	-	-	-	-	-
27. Ayios Nikolaos Camp Famagusta	89/56	-	-	-	-	-	-
28. Ayios Memnon (South)	69/38	-	(-)12.3	(-)13.6	-	(-)19.4	(-)17.9
29. Ayios Memnon (South)	50/53	-	(-) 7.9	(-) 9.9	-	(-)14.9	(-)12.3
30. Makrasyka (South of village)	48/54	-	117.0	114.9	-	110.7	110.4
31. Makrasyka (South of village)	49/54	-	120.1	118.0	-	117.4	115.9
32. Kalopsidha (S.W. of village)	54/54	-	68.6	64.7	-	60.3	60.5
33. Kalopsidha (S.W. of village)	55/54	-	73.9	72.4	-	65.4	70.9
34. Kalopsidha (S.W. of village)	56/54	-	75.3	74.1	-	74.2	73.1
35. Kolossi	88/54	-	16.0	13.5	-	12.0	9.5
36. Syrianokhori	150/54	-	9.7	10.2	-	8.2	8.0
37. Syrianokhori	151/54	-	9.3	9.6	-	8.1	7.8
38. Syrianokhori	152/54	-	7.2	7.0	-	5.0	4.5
39. Syrianokhori	153/54	-	4.3	4.6	-	3.3	3.0
40. Syrianokhori	1/55	-	23.1	23.0	-	17.7	14.1
41. Syrianokhori	23/55	-	20.9	20.4	-	17.4	15.2
42. Laxia	208/55	-	-	672.2	-	-	666.3
43. Ephtakomi	163/55	-	-	683.2	-	-	677.0
44. Syrianokhori	201/56	-	-	-	-	-	-
45. Syrianokhori	209/56	-	-	-	-	-	-

APPENDIX 6.

DESCRIPTION OF CERTAIN IRRIGATION SCHEMES

By A.H.P. McLaughlan, A.M.I.C.E., Senior Engineer,
and J. Karapetian, B.E.M., Superintendent of Works.

(A) AYIOS LOUCAS RECHARGE SCHEME:-

For some years the wells and boreholes along the sea shore in the Famagusta town area and environs have been pumped heavily for irrigation purposes with the result that the level of the underground water has fallen below sea level. This has caused sea water to advance inland, and hitherto sweet underground water to become slightly saline in certain areas.

With a view to raising the level of the underground water and arresting the advance of the sea inland an experimental scheme was prepared to recharge the underground aquifers at Ayios Memnon for the Dherinia Famagusta Irrigation Division by leading the surface water impounded in Paralimni lake into a tunnel or ex-filtration gallery which was driven through the Ayios Memnon aquifers as part of the scheme.

The experimental scheme was completed in 1952 and as far as can be judged was successful in that in 1954-55, 136 million gallons of water from Paralimni lake was run into the ex-filtration gallery and the water level of the wells in the vicinity of the gallery rose by 14".

The encouraging results of the Ayios Memnon Scheme caused the orange growers in the Famagusta area to demand further recharge works, and a scheme was prepared to recharge the aquifers of the Irrigation Division at Ayios Loucas.

The Ayios Loucas Recharge Scheme was designed to impound the surface flow of the river Harangas, and to divert part of the flow of the Akhyritou Drainage Basin and surplus water from Kouklia Reservoir to a new Ayios Loucas Reservoir and to lead the water so impounded into ex-filtration galleries located in the Ayios Loucas acquifers for recharge

/purposes.

purposes. The scheme is being carried out in three stages. The execution of each successive stage has depended on the success of the previous stage, and each is a major undertaking involving long tunnels and other works requiring about a year to complete.

Stage I was carried out in 1954 and consisted of reconstructing the Ayios Loucas dam and reservoir and excavating the ex-filtration gallery as described in Appendix 6 of the Annual Report for 1954.

Stage II was carried out during the period under review and is designed to divert part of the surface run-off of the Akhyritou drainage basin and part of the surplus flow of Kouklia reservoir to the Ayios Loucas Reservoir. The work included:

(a) the construction of a diversion gate on the Akhyritou main drain,

(b) the excavation of 14,200 feet of earth canal, 4 feet wide at the bottom, 3 to 4 feet deep, with 2 on 1 side slopes,

(c) the formation of earth roads on the side of the canal,

(d) the construction of 7 road bridges over the canal in masonry and reinforced concrete,

(e) the construction of 25 pipe culverts under the road discharging into the earth canal,

(f) the construction of one relief spillway 25 feet wide,

(g) the construction of one level crossing 50 feet wide,

(h) the construction of one head gate on the canal to regulate the water entering Ayios Loucas Reservoir,

/(j) the

(j) the re-excavation of 1800 feet of abandoned Eastern Mesaoria Irrigation works diversion tunnel and lining 1000 feet in reinforced concrete,

(k) the driving and lining in reinforced concrete of a new tunnel 3700 feet long through the spur separating the Akhyritou basin from the Ayios Loucas Reservoir.

The work of Stage II was completed in 1956 at a cost of £13,750.

In March 1956 the work done under stages I and II was tested by allowing a small quantity of water from Kouklia Reservoir to flow through the new canal and tunnels to the Ayios Loucas Reservoir when it was impounded and later conducted to the Ayios Loucas ex-filtration gallery for recharging purposes.

The work under stage III was put in hand in November this year and will be completed next year in the early summer. The work consists of extending the Ayios Loucas ex-filtration gallery by 19,600 feet in the direction of Paralimni and connecting it to the Ayios Memnon gallery. The estimated cost is £21,000.

(B) AKHYRITOU DRAINAGE:-

The object of the Scheme is to reclaim and improve the Government land in the bed of the Akhyritou Reservoir and the saline marsh-lands known as the Ayios Kendeas and Ayios Mammas marshes by permanent main drainage and at a later stage by land reclamation works to be carried out by the Department of Agriculture in the form of secondary drainage to enable the salt to be washed out of the land.

Work on the main drainage scheme was put in hand by this Department in October 1955 and was completed nine months later. The Ayios Kendeas marsh and the reservoir bed was drained by means of a main channel about 3½ miles long with its outfall at the main sluice gate of the reservoir. The Ayios Georghios and Ayios Mammas marshes were drained by a ditch 1¼ miles long discharging into the above main

/channel.

channel.

The drains on the average are 4 feet wide at the bottom, 20 feet wide at the top, 4 feet deep and the side slopes 2 on 1. Earth roads have been provided alongside the drains including 10 bridges and 64 pipe crossings under the road for drainage purposes. It was essential to provide bridges for crossing the drains and inlets to allow the surface water to enter the drain, as the lack of these facilities has caused the failure of early attempts to drain these marshes.

Considerable difficulty was experienced in excavating the drains due to lack of suitable plant, and the breaking down of the small amount of plant that was available. Towards the later stages of the work three draglines were used and very good progress was made. It was found that draglines are more suitable than traxcavators for excavating and particularly shaping the drain. The total excavation carried out was 45,000 cubic yards and the cost of the whole scheme including bridges, etc. was £8,766.

After the reclamation works which are to be carried out by the Department of Agriculture, 1600 donums of land, some of which has never been cultivated, will be benefited.

(C) KALOCHORIO (LEFKAS) SUB-SURFACE WEIR:-

These works were carried out for an Irrigation Association known as the "Koskinas" Water Irrigation Association of Kalokhorio (Lefkas) which has over 100 shareholders mainly village farmers.

The scheme consists of a subsurface weir which is the largest of its kind so far constructed in Cyprus and channels lined in reinforced concrete.

The weir has been constructed on the Karkotis river near the Skouriotissa mines at the site where a number of perennial springs and seepages were issuing

/from the

from the banks of the river, but where the water could not be properly utilized as it was lost in the river gravels. The object of the weir was to intercept and bring to the surface the underground flow of water at times when the river surface is dry and to improve and consolidate the old system of brushwood intake. The weir has a total length of 320 feet and a maximum depth of 23 feet from crest level to bed-rock, and has been built in mass cement concrete mainly in the proportion of 1:3:6 using river aggregate. The weir has a total volume in concrete of 1150 cub. yards. It was constructed in sections of 25 feet long with vertical joints between sections rendered in bitumen.

Work on the scheme started in 1955 and was carried out in two stages. The excavation was carried out by hand in the first stage of the work but excavating machinery was used in the second stage, when a trench of over 40 feet in depth was cut into the left bank of the river, where there was an old railway embankment.

In the first stage only about half the total length of the weir was completed together with the lining of 7000 feet of channels in reinforced concrete, when work was stopped for the winter. The construction of the weir was resumed in late spring 1956, and completed in early August 1956.

The flow of water in the intake channel soon after the completion of the weir was at the rate of about 400,000 gallons per day, whereas only a small fraction of the flow was normally available to the association at the same period before the works were undertaken.

Further measurements of the flow will be taken in 1957, to ascertain the full benefit of the scheme in time of summer irrigation crops, but it is expected that out of the total area of 3000 donums benefiting from winter and spring irrigation enough water will be available for the irrigation of summer

/crops of

crops of an area ranging from 300 to 400 donums. The cost of the scheme was £15,525.

(D) KAPILIO RIVER TRAINING AND IRRIGATION:-

Two separate schemes, one for irrigation and the other for river training works were carried out in 1956.

The works now completed form part only of a larger project for river training works at Kapilio. The works are of a type that is new to Cyprus and they have been carried out partly for experimental purposes.

The object is mainly to protect good agricultural land on the flanks of the river which are being washed away year after year by a meandering torrent and secondly to render possible the reclamation of land which has been washed away or is badly eroded. Following a survey the river channel was defined within a 160-foot strip more or less in the centre of the flood plain and wired concrete staking was then fixed on either side with a view to confining most of the flow to this central channel and thus including silting in the outer zone, beyond the staking.

The staking consists of reinforced concrete posts 9 feet long and of 4" x 4" section, buried in the gravels to a depth of 6 feet at 3 feet intervals with an average of 3 feet in height above ground level. Four lines of wire are fixed on the stakes at about 9 inches vertical intervals above ground level and special straining posts of reinforced concrete are provided at the beginning and end of each line of staking.

All the excavation work for placing the stakes was done by machinery and the total length of staking completed was 1625 feet. At a later stage this length may be increased to 3325 feet.

Another feature of the scheme is the construction of gabion walls for the protection of land on the banks of the river. One such wall has been constructed of a length of about 10 meters by 3 meters in height, and consists of imported containers made of wire mesh which

/are filled

are filled at the site with large river boulders. The containers are then bound together with wire.

The total estimated cost of the scheme was £2000. The cost of the experimental part of the works which has been completed this year was £1060 towards which the villagers made a token contribution of £59 in the form of free labour.

An independent irrigation scheme was carried out at the same time and commands the lands under protection by the river training works. This consists of a subsurface weir which has been formed by underpinning in cement-concrete the foundation of an old dam which was constructed in about 1930 for irrigation storage. The underpinning was carried down to the bed-rock which was found at a depth of 25 feet from river-bed level. The width of the structure across the river at the surface is about 30 feet. A pipeline of 6" diameter conveys water from the weir to the intake of the irrigation channel some 1000 feet downstream.

The scheme provides for the lining of channels in reinforced concrete where necessary together with a small groyne intake at river-bed level at the outlet of the conveyor 6" diameter pipeline. Only the weir and the channels have been completed this year and the rest of the work will be put in hand in the Spring of 1957.

The cost of the works is estimated at £3,300 and will provide perennial irrigation for about 70 donums of land planted with fruit-trees.

The irrigation scheme was carried out partly as a drought relief work because intensive irrigation from the upper reaches had caused the river at Kapilio to become dry. In previous years there had usually been sufficient water for the fruit-trees which include some of the best peach trees in the island. The new sub-surface weir brought about 250,000 gallons per day to the surface in September, at a place where the river bed was dry and enabled the year's crop to be harvested

/and the

and the trees to be saved, much to the relief of the villagers.

(E) ATHALASSA IRRIGATION:-

This concerns irrigation works at the Athalassa Experimental Farm carried out for the Department of Agriculture.

The scheme consists of two boreholes and pumping units near Tseri delivering through two separate rising pipelines of 4" diameter steel pipes to a collecting reinforced concrete tank of 2,000 gallons capacity on high ground overlooking the pumps. Each pump delivers at the rate of about 5000 gallons per hour. A pipeline of 8000 feet of 6" diameter asbestos cement pipes starting from the collecting tank delivers to a new masonry storage tank of 100,000 gallons capacity constructed on high ground commanding the lands within the farm. A second pipeline of 3500 feet of 6" diameter asbestos cement leads from the new storage tank to an old tank near the residential area of the farm. On the latter pipeline a minor branch of 4" pipes has been constructed to provide irrigation to the experimental fodder farm section. From the new storage tank 2000 feet of 10" diameter asbestos cement pipeline has been laid supplying the main plots earmarked for experimental fodder irrigation.

The scheme was carried out in two stages. Work started in September 1955 and completed in Summer 1956 at a total cost of £12,000.

A separate scheme for the supply of water to the Forest Department Nursery in the Athalassa area has been completed in 1956, and it is an extension of the main Athalassa project.

This consists of a 2½" pipeline starting from the new storage tank and delivering to the Forest nursery, a distance of about 2½ miles. An electric booster pump is fixed at approximately half the distance

/from the

from the supply tank. The delivery to the nursery is at the rate of 27 gallons per minute and the cost of the works is £2,050.

(F) DHIERONA CHANNELS:-

Two gravity Irrigation Schemes which were completed in Dhierona in recent years, were improved by lining the earth channels in reinforced concrete.

A total length of 11,000 feet of channels has been lined at a cost of £5,000.

The work was carried out for the Irrigation Division of "Kamaroudhia" and benefits about 160 donums with summer irrigation. One-third of the cost has been contributed by the villagers, partly in the form of free labour and partly with a loan from Government.

The Irrigation Division Committee has applied for the lining of further channels in reinforced concrete. This matter is now under consideration.

(G) KALOKHORIO (KLIROU) CHANNELS:-

The old scheme, which was carried out in 1947 and consisted of a masonry dam and storage reservoir with earth channels, has now been improved by lining the channels in reinforced concrete and by adding supplementary works to the distribution system.

A total length of 12,500 feet of channels has been completed at a total cost of £10,500.

The work was carried out in two phases. About one-quarter of the length of channels was completed in 1955 and the other three-quarters in 1956.

(H) PERGAMOS IRRIGATION:-

This is a pumping scheme providing irrigation water and distribution facilities to the farm of the Rural School at Pergamos.

/The scheme

The scheme consists of two boreholes with pumping units, each delivering at the rate of about 6,000 gallons per hour. Water is pumped direct into a 4" diameter steel pipeline with valve outlets at points commanding the area under irrigation. The total length of the pipeline is 1700 feet.

The pumps are of the vertical turbine type driven by diesel engines installed in masonry engine houses. The area of the farm lands commanded by the works is about 80 donums and the total cost of the scheme was £4,000 provided by the Department of Education.

APPENDIX 7.

IRRIGATION SCHEMES COMPLETED IN 1956.

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
1	Lapithos	Excavation of spring	-	3	3
2	Episkopi (P)	Repairs to channels	-	-	-
3	Katokopia (Vathys)	Groyne intake, channels and retaining walls	2,000	-	2,000
4	Trikomo	Repairs	100	-	100
5	Ora	Lining of channels in R.C.	-	30	30
6	Orounda (Maoutchos)	Tunnelling	-	288	288
7	Neokhorion (Tengeli)	Intake and irrigation ports	90	-	90
8	Agridhia (Kambia)	Tank and channels	-	9	9
9	Stavrokonnou	Irrigation tank and piping	-	11	11
10	Nea Dhimmata	Weir and piping	-	8	8
11	Melini (Kannoura)	Weir, piping and irrigation	-	14	14
12	Ay. Dhimitrianos	Springs, R.C. Channels	-	160	160
13	Vitsadha (Ftirkes)	Irrigation ports etc.	200	-	200
14	Vyzakia (Hji Vassili)	Irrigation ports and channels	100	-	100
15	Prastion (Morphou)	R.C. Channels, Irrigation	-	50	50
16	Agridhia (Mersinarkaka)	Irrigation tank and channel	-	8	8
17	Sinda (Kara Hasan)	Repairs	80	-	80
18	Exo-Metokhi	Irrigation ports	100	-	100
19	Mamonia	Lining of channels in R.C.C.	-	220	220
20	Sina-Oros-Galata	Construction of No. 2, Water Divisions	-	-	-
21	Agridhia (Yerakies)	Irrigation tank	-	4	4
22	Pano-Koutraphas	Irrigation tank and piping	14	14	28
23	Phinikaria	Groyne intake, R.C. Channels	100	50	150
24	Athienou	Lining of tunnels in pre-cast cement Pipes, and R.C. Channels	500	400	900
25	Alethrico	R.C.C. Circular Irrigation Tank	25	5	30
26	Akaki (Merika Water)	Construction of Cutting, R.C. Channels	-	170	170
27	Peristeronopiyi	Construction of a weir	100	-	100
28	Lefkoniko	Masonry spillway and earth banks	150	-	150
29	Kalopanayiotis (Ay. Kyriacos)	Excavation of springs	-	12	12
		Carried forward ...	3,559	1,456	5,015

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Tota
		Brought Forward	3,559	1,456	5,015
30	Pharmakas (Mangoun)	Excavation of spring	-	6	6
31	Nata-Kholetria	Repairs to channel	-	-	-
32	Nicosia (Nursery Garden)	Repairs to well	-	-	-
33	Pharmakas (Koskinas)	R.C. Channels and piping	130	-	130
34	Kyra (Serakhis)	Groyne intake, channels and ports	2,029	-	2,029
35	Katokopia (Vathys)	Culvert	-	-	-
36	Kouklia (E.M.I.W.)	Screw-gates etc.	-	-	-
37	Argaka (Ay. Varvara) Lands	R.C. Irrigation Tank	-	-	-
38	Athalassa (Farm)	Piping etc.	-	60	60
39	Akhyritou (Ayios Kendeas)	Drainage Works	-	-	-
40	Ay, Amvrosios (Vrysi-Platania)	Repairs to channels, laying of pipes	-	-	-
41	Perapedhi (Mylos)	Lining of channels in R.C.	-	56	56
42	Pergamos (Rural School)	Pumping Scheme and piping	-	80	80
43	Athalassa (Forest Nursery)	Pump and piping	8	-	8
44	Ay. Isidhoros	Piping and outlets	-	4	4
45	Voroklini	Drainage Works	-	-	-
46	Kritou Marottou	Repairs	-	2	2
47	Kapilio	River training, staking	-	-	-
48	Kalokhorio (Lefka)	Subsurface weir and R.C.C. Channels	3,000	250	3,250
49	Sinda (Kuchuk Dere)	Repairs	-	-	-
50	Dhierona (Kamaroudhia)	R.C. Channels	-	80	80
51	Evretou (Kerodja)	Spring, cutting Head works	-	70	70
52	Kalopanayiotis (Pararoupi)	Spring and piping	-	12	12
53	Pelendria	Weir, irrigation tank and pipes	-	17	17
54	Kouklia (E.M.I.W.)	Resr. embarkment repairs	-	-	-
55	Akhelia (Chiftlik)	Pumping scheme	-	30	30
56	Prastion (Katarraktis)	Repairs to channels	-	-	-
57	Pyrgos (L1) (Moulos)	Retaining wall	-	-	-
58	Kato-Mylos (Angoulos-Dhipotamia	R.C. Channels	-	18	18
59	Yerolakkos (Ovgos River)	Springs and R.C. channels	-	55	55
60	Gypsos (Vathys)	Irrigation ports, overflow spillway	100	-	100
61	Potamia (Chiftlik)	Repairs to apron & channels	-	-	-
		C/F	8,826	2,196	11,022

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
		Brought forward	8,826	2,196	11,022
62	Chakkistra	Piping	40	14	54
63	Ayios Ioannis (L1) (Spilia)	Spring R.C. Channels	-	10	10
		TOTALS	8,866	2,220	11,086

APPENDIX 8.

IRRIGATION SCHEMES IN HAND AT THE END OF 1956

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
1.	Ayios Loucas	Re-Charge Scheme	-	-	-
2.	Aplanda	Spring and irrigation tank	25	25	50
3.	Trimiklini	Construction of a dam and R.C. Channels	700	100	800
4.	Karavas (Ayios Andreas)	Spring and R.C. Channels	-	30	30
5.	Agridhia (Pano (Platanoudhia)	Irrigation tank and piping	-	8	8
6.	Mesoyi (Mana-tou-Nerou)	Spring, R.C. Channels and Irrigation Tank	200	40	240
7.	Chatos	Irrigation ports etc.	-	-	-
		TOTALS	1,005	203	1,208

APPENDIX 9.

IRRIGATION SCHEMES READY FOR CONSTRUCTION AT THE END OF 1956 BUT NOT YET STARTED

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
1	Aredhiou (Dhimma-Kholetria)	Lining of channels in R.C.	800	-	800
2	Pyrgos (N) (Katouris River)	Concrete dam and R.C. Channels	1,000	600	1,600
3	Peristerona (Trehaton Neron Eterias)	Cleaning and repairs to tunnels, lining of channels in R.C.	1,500	-	1,500
4	Kaliana (Aplikí-Anefani)	R.C. Channels and irrigation ports	190	95	285
5	Kythrea (Kephalovrysos (Topou etc.)	Lining of channels in R.C. irrigation ports	-	1,000	1,000
6	Meniko (Trakhonas, Mesi)	R.C. Channels	200	50	250
7	Ay.Varvara-Kotchati (Asproyi-Mustafades)	R.C. Channels	180	-	180
8	Tseri (Almyros)	Repairs to tunnels and channels	600	-	600
9	Ay. Ioannis (Malou-(nda) (Neron-tou-Khoriou)	Tunnelling and lining of channels in R.C.	800	50	850
10	Argaka-MagoundaIII	Construction of a dam and piping channels	1,200	200	1,400
11	Askas (Pano-Ambelia)	Irrigation tank & piping	-	12	12
12	Ayios Epiphanios Orinis (Parisi)	Irrigation tank and channels	20	14	34
13	Vouni (Klokkaris)	Irrigation tank and piping	-	12	12
14	" (Palea-Vrysi)	R.C. Channels	-	10	10
15	Syngrassi	Construction of weirs-gate etc.	2,000	-	2,000
16	Phini (Kambi-tou Stavrou)	Weir tank and channels	-	68	68
17	Vikla	Weir, pipes and irrigation tank	135	32	167
18	Lasa	Lining of channels in R.C.	-	20	20
19	Gouphes	Channels and irrigation ports	100	-	100
20	Yenagra	Repairs to channel and irrigation port	-	-	-
21	Sotira	Weir, R.C. Channels and irrigation tank	300	150	450
22	Marathounda	Weir, irrigation tank and piping	-	100	100
23	Potami (Poliati)	Weir, channels and tank	70	22	92
		Carried forward	9,095	2,435	11,530

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
		Brought Forward	9,095	2,435	11,530
24	Kholetria-Nata	River-training, staking	-	-	-
25	Palekhori (No.2)	Lining of channels in R.C.	-	3	3
26	Psevdhas	Irrigation ports, culverts	200	-	200
27	Ora	Lining of channels in R.C.	16	4	20
28	Kalokhorion (Ll)	Repairs & Lining of channels) Weir, piping and	10	5	15
29	Kyperounda (Khalospities)	irrigation tank	-	12	12
30	Kyperounda (Piyi)	Spring and piping	-	5	5
31	Episkopion (N)	Construction of intake and channels	300	-	300
32	Krini	Lining of channels in R.C.	200	100	300
33	Lymbia	Irrigation tank & piping	-	32	32
34	Tembria-Korakou (Kaliana Station)	R.C. Channels	-	8	8
35	Louroudjina (Armyrkos)	Cleaning and lining of chain-of-wells Construction of Irr. Tank and channells	-	26	26
36	Kalopanayiotis-Oekos (Pano-Gnoudhias)	Irrigation tank	-	26	26
37	Kato-Zodhia (Koutraphas-Water)	Small aqueducts, channel crossings	100	-	100
38	Pera (Phaseron)	Tunnels, cutting, R.C. Channels	720	-	720
39	Athalassa Farm (Kaloyiros)	Construction of a weir	120	-	120
40	Kyperounda (Appia)	Repairs to channel and wing walls	-	5	5
41	Prodhromos (Kyparisin)	Irrigation tanks	-	14	14
42	Ay. Therapon Platania Pezoules Skotini	Lining of channels in R.C.		130	130
43	Khalassa (Ypsonas)	Groyne intake and channels	1,000	-	1,000
44	Ay. Yeorghios (Ll) (Kato-Piyenia)	Piping	-	18	18
45	Plataniskia	Lining of channels in R.C.	-	10	10
46	Kaminaria (Hlios)	Spring and irrigation tank	-	10	10
47	Agridhia (Pano Lahania)	" " " "	-	22	22
48	Prodhromos (Hardji)	Small weir and R.C.C. Channels	-	24	24
49	Tris Elies (Lakkotis)	Lining of channels in R.C.	-	6	6
50	Agros (Vrysia)	Repairs to irrigation tank	-	3	3
51	Arsos (Pesous-Ay. Yeorghios)	Lining of channels in R.C.	-	20	20
52	Athrakos (Halourakas	Weir channels and piping	-	24	24
53	Agros (Pano-Vrysia)	Construction of irrigation tank	-	4	4
54	" (Kato-Netikon)	Irrigation tank & channel	-	6	6
		Carried forward	11,761	2,952	14,713

Ser. No.	Location	Nature of Construction	Donums Commanded New Irrigation		
			Winter or Spring	Summer	Total
		Brought Forward	11,761	2,952	14,713
55	Kyperounda (Kardhama-Paranga)	Excavation of spring	-	5	5
56	Ayios Pavlos (Styrakas)	Irrigation tank & channels	-	24	24
57	Kato Amiandos, Pelendria (Chrysovrysi)	Springs, piping, irrigation tank	-	21	21
58	Pelendria (Filagra)	Weir and irrigation tank	-	8	8
59	Agridhia (Kato Netikon)	Irrigation tank, piping and R.C. Channels	-	14	14
60	Phini	Repairs	-	-	-
61	Pelendria (Raftis)	Irrigation tank and piping	-	8	8
62	Koma-tou-Yialou	Construction of anti-erosion weirs etc.	500	-	500
63	Vitsadha	Construction of anti-erosion weirs etc.	-	-	-
64	Ayios Andronicos (F) (Vrysi)	Lining of channels in R.C.	10	60	70
65	Ayia Marina	Construction of a dam and piping	700	300	1,000
66	Polis (Chiftlik)	Lining of channels in R.C.	-	330	330
67	Ay. Nicolaos (Meletzes)	Piping distribution system	-	19	19
68	Ay. Nicolaos (Kamishlik)	Lining of channels in R.C.	-	20	20
69	Kithasi (Dhiarizos)	Irrigation tank & piping	12	12	24
70	Pano Archimandrita	Spring and R.C. channels	-	5	5
71	Polis (Prodhromi) Gastrappi	Repairs to channels	-	-	-
72	Istinjo (Vrysi-tou-Khoriou)	Building and repairs to spring	-	10	10
73	Nea-Dhimmata	Piping	-	2	2
74	Ora	Irrigation tank & channels	180	10	190
75	Aradhippou	Channels and drains	80	-	80
76	Melini (Pervoles)	Weir, R.C. channels and irrigation tank	-	30	30
77	Meneou (new Mental Hospital)	Tunnels, pumphouse, Irrigation tank, piping	-	40	40
78	Odhou	Lining of channels in R.C.	-	10	10
79	Anglisidhes (Stavroti)	Piping	40	20	60
80	Pelathousa (Blissez)	Excavation & building of spring	-	5	5
81	Mousoulita-Marathovounos (Pedhieos river)	Reformation of banks, cleaning and regrading of canal	1,000	-	1,000
82	Phini (Chrysomilies)	Small weirs, irrigation tanks and piping	-	20	20
83	Koutraphas-Kato	R.C.C. Circular irrigation tank and piping	5	6	11
		TOTALS	14,288	3,931	18,219

APPENDIX 10.

TOWN WATER SUPPLIES

by R.S. Wood B.Sc., A.M.I.C.E., M.I.W.E., Senior Engineer.

In 1956 the work of the Town Water Supplies branch consisted chiefly of (a) planning new schemes for Nicosia and Famagusta (b) designing in detail and starting the construction of the Greater Nicosia Scheme (c) advising and assisting the Water Boards and other water authorities and (d) operating the Government water supply systems in Nicosia.

Planning. The Greater Nicosia Water Supply Scheme was prepared in 1954 and modified and extended in 1953. The scheme was approved by Government in May 1956 and undertaken as a Government scheme. The detailed plans of the reservoirs and pipelines were completed in the first few months of the year and the materials were ordered as soon as Government approval was given.

Outline plans were also prepared for proposed additional water supply schemes for Nicosia and Famagusta, The Nicosia (Morphou Bay) Scheme is to pump water from boreholes at Syrianokhori to Engomi Reservoir a distance of 23 miles. The Famagusta Scheme is to supply water from boreholes at Xylophagou and Liopetri through an 11 mile pipeline to a new reservoir near mile-post 2 on the Famagusta-Nicosia road. The proposed reservoir site has been located and levels taken. Most of this site is on Government land.

Greater Nicosia Scheme: This scheme will provide an additional one million gallons per day for Nicosia for the purpose of (a) relieving the shortage of water within the present area of supply of the Water Board and (b) providing piped water for the suburban villages of Nicosia.

New pipelines are being laid to Nicosia from Dhikomo, Kokkini Trimithia and Dhali, service reservoirs

/are being

are being constructed at the lower end of each of these pipelines, and a distribution system will thereafter be provided for the suburban villages.

The three service reservoirs at Engomi, Lakatamia and Mandres are being constructed with mass concrete walls and reinforced concrete columns, beams and roof. They are all of similar design so that the same movable shuttering can be used for each reservoir. The capacity of the Lakatamia and Mandres reservoir, is 850,000 gallons each. The design of the Engomi reservoir was amended to double its capacity to 1.7 million gallons so as to be used in conjuction with the future Morphou Bay Scheme. It is expected that the Engomi reservoir in its present form, or after enlargement, will deal with a flow of $5\frac{1}{2}$ million gallons per day which is the total finally expected from the Morphou Bay and Kokkini Trimithia boreholes.

The following paragraphs describe the progress made on the Greater Nicosia Scheme by the end of the year:-

(a) Kokkini Trimithia - A masonry and reinforced concrete collecting tank of 100,000 gallons capacity has been constructed with pumphouse and storehouse attached. Five recently drilled boreholes have been cleaned out and 4" and 6" steel pumping mains laid from the boreholes to the collecting tank. The electric submersible pumps to be installed in these boreholes are to be controlled from the central pumphouse at the collecting tank and the electricity supply is already available. Three electric centrifugal pumps will pump the water from the collecting tank to an elevated tank at Paleometokho.

(b) Paleometokho - A reinforced concrete water tower has been constructed with a tank of 3,000 gallons capacity at 20 ft. above ground level. The 6" steel rising main has been laid from the Kokkini Trimithia tank to the elevated tank. A pumphouse has been constructed adjacent to the elevated tank over a borehole and a turbine pump

/driven by

driven by a diesel engine has been installed in the borehole with a 6" rising main.

(c) Paleometokho to Engomi Pipeline - The whole of the trench for the pipeline from Paleometokho elevated tank to Engomi reservoir has been excavated, which included excavating with compressors 5,000 feet of trench in rock. The remaining length of 33,000 feet was excavated chiefly by mechanical trencher. The pipeline is to include 14,000 ft. of 10" asbestos cement pipes and 24,000 ft. of 12" pipes.

(d) Engomi Reservoir - The excavation of the site and wall foundations of the reservoir was done by contract. The foundations have been concreted and the pouring of the walls in mass concrete has nearly completed. The walls were constructed in alternate sections 45 ft. long with a bitumen expansion joint between each section. An economical method of construction was worked out using three sets of movable shuttering, two large concretemixers, and two mechanical hoists. The concrete is poured direct from the hoist through chutes into the moulds and mechanical vibrators are used to consolidate the concrete. A pumphouse and a house containing meters, reception tank and chlorinator are being built attached to the reservoir. A separate storehouse and office building has already been completed.

(e) Engomi to Ring Main Connection - The excavation of the trench for the pipeline from Engomi reservoir to the existing Water Board ring main at Ayii Omoloyitadhes has been started and the excavation of the rocky portion of the river Pedias in 12" steel pipes has been laid near the Secretariat ready for the connection to the existing rising main.

(f) Dhali - The foundations of a collecting tank

/have been

have been excavated and concreted. The tank is similar to that at Kokkini Trimithia but the walls are to be constructed in mass concrete, which although perhaps not so pleasing in appearance as masonry, has proved to be cheaper. It moreover obviates the difficulty of awaiting stone supplies. A set of movable shuttering for one side has been constructed and pouring the concrete walls will now be started. The three boreholes near the collecting tank have been cleaned out and a pumphouse is being built over each borehole. A turbine pump driven by a diesel engine is to be installed in each borehole which will pump to the collecting tank. A 6" steel rising main has been laid from the collecting tank across the river Yialias to the elevated tank, which is being constructed on the hill top above the boreholes. The foundations of the elevated tank have been excavated and concreted. The tank is similar to the elevated tank at Palcometokho and from it the water will gravitate 8 miles through an 8" asbestos cement pipeline to Lakatamia reservoir.

(g) Lakatamia Reservoir - The excavation of the site and wall foundations of the Lakatamia reservoir has been finished. Some difficulty was experienced with this site as the top crust is of hard havara, which had to be completely excavated under the foundations, as a cavity was found over most of the site between the havara and the soft ground underneath. Concreting of the foundations has now started. A separate storehouse and office building adjacement to the reservoir is being constructed.

(h) Mandres Reservoir - An approach road to the reservoir 2,000 ft. long has been made. The reservoir site and wall foundations have been excavated using a traxcavator and no difficulties have been encountered. A separate storehouse and office is being built.

/Water Boards

Water Boards and Authorities:- Advice has been given when required to the Water Boards of the three main towns of Nicosia, Famagusta and Limassol on the layout of new water mains, and on the running, renewal and repair of plant; the Famagusta Board was also advised upon its new offices and workshop. Similar advice has been given to the Evcaf Department for the water supply of Larnaca, where in addition this Department carried out the laying of 3 miles of water mains and the installation of 21 hydrants. A foreman of this Department supervises all work carried out for the water supply of Larnaca including the installation of water meters, repair of mains and maintenance of the chain of wells.

Meter testing for the Water Boards has been carried out regularly on request and 36 large meters have been tested and adjusted and 98 small meters, including meters tested for Government supplies.

Government Water Supplies:- The three Government water supplies at Nicosia have been operated and maintained throughout the year. The water is supplied to domestic residences and Government institutions in Nicosia. This summer a maximum of 90,000 gallons per day was produced. Hydrants are maintained in Government compounds and all water meters on Government supplies in Nicosia are read and checked regularly.

APPENDIX 11.

TOWN WATER CONSUMPTION, SUMMER, 1956.

QUANTITY SUPPLIED AT SOURCE IN GALLONS PER HEAD PER DAY.

Town	Estimated population	June g.h.d.	July g.h.d.	August g.h.d.	September g.h.d.
Nicosia (Water Board Area)	59,000	33½	31	29½	28
Limassol	29,900	36	41	40	36
Famagusta	26,300	33	36	37½	35
Larnaca	17,200	-	51#	56#	56#

Approximate only, unmetered.

Notes:-

1) The population figures are interpolated from a report on "Distribution of Population and Growth of Towns" by Mr. Windyer Morris, dated 30/12/1952. The Nicosia figure has been brought up to date by subsequent correspondence with Mr. Morris.

2) The water supplied by Nicosia Water Board and Government is measured by meter at source. The Lower Arab Ahmet and Sykhari water are measured by gauging. The quantity of water from other sources for Nicosia has been estimated following enquiry with regard to pumping hours and times. Within the walls water was supplied from the beginning of the year for 6 hours per day, from Jan. 16th 8 hours per day, from June 18th to the end of the year 6 hours per day.

3) Limassol - The water supplied is measured by meter at the outlet from the reservoir and an allowance of 3% has been added for losses in the main pipelines from the springs.

4) Famagusta - Water sold to ships was 34,000 gallons per day on the average or 1.3 gallons per head per day.

5) Larnaca - The water supplied is measured by gauging at source and 9% is deducted for water supplied by saccoraphi for irrigation. The drop in consumption per head compared with last year is probably due to the same quantity of water being used by an increased number of consumers.

/Appendix 12

APPENDIX 12.

DATA CONCERNING TOWN WATER SUPPLY

	Nicosia ¤	Limassol	Famagusta	Larnaca
(a) Sources in regular use Nos.	13/	3	9	1
(b) Sources for emergency use Nos.	3	1	3	0
(c) Capacity of sources in an average summer, m.g.d.	1.30	1.00	0.90	1.00
(d) Main reservoir capacity, m.g.	0.80	0.80	0.70	0
(e) Supply mains, miles	31	18	13	3.5
(f) Distribution mains, miles	107	57	62	23
(g),Pumps in regular use on wells or boreholes-Nos.	19	0	8	0
(h) Consumer meters - Nos.	5,789	6,400	5,750	561
(i) Saccoraphia connections (domestic)	-	-	-	1,417
(j) Hydrants - Nos	622	349	404	21

¤ Excludes old water supplies still in operation.

/ Includes water pumped from two boreholes at Kokkini Trimithia owned by Mr. Charalambous. An agreement was concluded by the Water Board on 14/5/56 by which Mr. Charalambous undertook to supply the Board with minimum 315,000 g.p.d., maximum 1,580,000 g.p.d.

m.g.d. = million gallons per day.

m.g. = million gallons.

APPENDIX 13.

DESCRIPTION OF CERTAIN VILLAGE WATER SUPPLIES

(A) AGROS.

This is a hill village which is also a summer resort for visitors from the plains. The present winter population is about 2,000, usually increasing in summer to about 2,500. The villagers are anxious to encourage summer visitors but in the past the shortage of water has caused difficulties.

The village water was formerly drawn from three small springs which in late summer produced about 20,000 gallons per day, or only about 8 gallons per person. The new source is one of the Loumata-tou-Aetou group of springs, near Troodos, at an elevation of about, 5,000 feet and at a distance of 12 miles from Agros. This is a large group of springs with a summer flow of about 100,000 gallons per day, of which 30,000 were piped to the village under the scheme. The village now has about 50,000 gallons per day, or 20 gallons per person, which is considered satisfactory for a village of this type.

The new works consist chiefly of 11½ miles of 2" gravity pipeline, one 10,000 gallon storage tank, and two 6,000 gallon tanks. No new distribution system was included as the old one is reasonably satisfactory for the present. Street fountains and some distribution boxes for house connections exist, but it is expected that more house connections will be wanted in the not distant future. The work was started in March 1956 and completed in August at a total cost of £15,600, or £7.8 per winter inhabitant. Half the cost was paid by Government and half by the village.

(B) LYMBIA.

The problem of a water supply for Lymbia was difficult because there are no suitable springs near the village, and underground water in sufficient quantity does not exist. After much preliminary study it was decided to

/purchase two

purchase two springs at Mathiatis village about 9 miles away, at a cost of approximately £7,500. These springs together yielded about 12,500 gallons per day in summer, sufficient for a supply of about 8.5 gallons per person per day for the present population of Lymbia, which numbered 1,200 at the time of the 1946 census and which is thought to have now reached about 1,500. The water available from this scheme is not as much as may be desired, but it represents a great improvement on past conditions when the inhabitants of the village were forced to fetch their summer water several miles, mostly in tins carried on the backs of animals.

The works consist of spring headworks, 8.7 miles of 4" and 3" gravity main pipeline, one 10,000 gallon storage tank, and a distribution system of 38 street fountains. The cost amounted to £21,000 or £17.5 per person, half of which was paid by Government and half by the village. This very high cost was unavoidable and arose from the necessity to purchase the water from private irrigators and from the need for a long main pipe. Construction started in October 1955 and was completed in April 1956.

(c) TRIKOMO.

Although many shallow wells and a few boreholes exist in and around this large village, it was not possible to obtain a nearby source or group of sources that were capable of providing a sufficiently reliable yield of suitable water for a public supply. A number of prospecting boreholes proved unsuccessful either because of little water or because of the poor chemical quality. No suitable springs exist in the neighbourhood either on the plains or in the Kyrenia range to the north. It was eventually decided to purchase two privately owned wells at Lapathos village, four miles away, and to pump the water to Trikomo.

The scheme consisted of improvements to the two wells, the installation of two turbine pumps, the construction of two 10,000 gallon collecting tanks near

/the wells

the wells, a pumping main 6" diameter and 20,400 feet long to the village, two 20,000 gallon storage tanks at the village, and a distribution system of 43 street fountains. The pumping main was in two parts. The first part consisted of 6,200 feet of 6" steel pipe rising to the top of a low ridge 60 feet in height above the collecting tank. At the top of the ridge an air vent was fixed and from that point the second part of the pipe, of 6" asbestos cement, continued for 14,200 feet on a falling gradient to the storage tanks at the outskirts of the village. In the village itself the cost of excavating trenches for the distribution pipes was high owing to the unusually hard kafkalla rock on the surface of the ground.

Construction started in August 1955 and was completed in May 1956. The cost was £30,600 or £12.2 per person.

(D) LEFKA.

An improvement scheme for this rural municipality was carried out in 1950 when some of the old sources were repaired and when a new storage tank and a number of distribution boxes were built for house connections as described in the Annual Report of 1950. No new sources were then provided and by 1955 the total summer supply for a population of about 4,000 was only about 20,000 gallons per day, or 5 gallons per person.

Proposals to acquire springs in the adjacent Marathasa valley met with considerable opposition and it became necessary to pipe water drom distant springs in the forests of the upper catchment of the Xeros river above the Kafizes dam. The new sources consist of five small springs, of which the total summer flow amounts to about 100,000 gallons, or sufficient to provide about 30 gallons per person per day when added to the old sources. The distance of the new springs from the town is about 12 miles, and the intervening forest country is steep and mostly accessible only on foot. The pipes were carried in to the forest mostly

/by mule

by mule or donkey.

The works consisted of excavations and building at the springs, 11½ miles of 4" and 3" main pipeline, one 20,000 and one 10,000 gallon storage tanks, and some minor pipelines. The cost amounted to £38,000 or £9.5 per person, and all the money was, in the first instance, advanced by Government. The share of the Municipality was eventually fixed at £16,775.

Construction started in April 1956 and in spite of the difficult terrain and of frequent interruptions by the Security Forces who were operating in the area, the work was completed in November. The scheme was officially opened by His Excellency the Governor on 15th November, 1956.

(E) DRY VILLAGES, EASTERN MESAORIA.

These thirteen waterless villages have presented a problem to the Department for many years. They are Petra-tou-Dhigeni, Chatos, Knodhara, Kourou Monastir, Mora, Angastina, Marathovouno, Mousoulita, Yenagra, Pyrga, Ornithi, Aphania and Asha.

The villages are all situated in the Mesaoria, which is an almost waterless plain overlooked by the Kyrenia Hills. Although the plain is dry there is one large spring in the hills, the Kythrea spring, which is the largest in the island. The water flows towards the plain but does not reach the dry villages as it is all used for irrigation or is lost by wastage. If the channels were lined in concrete most of the wastage would be prevented. The water is privately owned and efforts to acquire part of it for the use of other villages have always met the fierce resistance from the owners. Because of this resistance Government has been unwilling to take the water compulsorily and for the same reason no effort has been spared to find other sources. All the smaller springs in the area have been thoroughly investigated, adits have been driven into the hills, and no less than 13 expensive prospecting boreholes have been

/drilled in

drilled in the hills and foothills. None of these investigations has met with success and the cost, which is not known exactly, must have amounted to several thousand pounds.

It has been clear for some years that the best technical solution to the problem would be to acquire a small percentage of the Kythrea spring for the domestic use of the villages and to compensate the owners of the spring by lining some of their irrigation channels in concrete to prevent unnecessary waste. This is now accepted as Government policy and following an order issued on 1st June 1956, 5% of the water was acquired compulsorily under the Water (Development and Distribution) Law and an offer was made to line 18 miles of channels in reinforced concrete in compensation, at an estimated cost of £60,000. The owners have not yet decided whether to accept compensation in the form proposed or to seek it in cash. The aquired water has, however, been piped to the dry villages of the plain.

The water is conveyed to the various villages by 43 miles of main pipeline and distributed within the villages by a further 20 miles of pipe. The intake is at the Kythrea spring, from which a single 4" pipe runs to the first distribution box near Petra-tou-Dhigeni. At this box a division is made into five branches which serve the villages singly or in groups. Each village has its own storage tank, system of distribution pipes, and street fountains. House connections are not at present provided. Because of the flat nature of the ground, elevated tanks were necessary to provide sufficient distribution pressure in four of the villages and in these cases standard circular concrete tanks are being built on reinforced concrete trestles 20 feet high. The principal works consist of the following:-

(a) 41 miles galvanised steel piping $\frac{3}{4}$" to 4" diameter
(b) 22 miles asbestos cement piping $1\frac{1}{2}$" to 4" diameter
(c) Eight reinforced concrete storage tanks at ground

/level

level, 2,000 gallons to 20,000 gallons.

(d) Four reinforced concrete storage tanks, elevated, 3,000 to 20,000 gallons.

(e) 170 street fountains.

The population of the 13 villages covered by this scheme, was 8,961 at the time of the 1946 census and is now probably about 10,500. The quantity of water, which is 5% of the total discharge of the Kythrea spring, will vary slowly from year to year according to the usual fluctuations in discharge of the spring. The villages will receive from 110,000 to 250,000 gallons per day, which represents 10½ to 24 gallons per person of the assumed present population, or say, 17 gallons per person on the average.

The work was started in June 1956 and at the end of the year was complete except for the elevated tanks at Marathovouno, Knodhara, Pyrga and Asha, and ground level tanks at Aphania and Ornithi. At the commencement of the work the possibility of sabotage of the head pipe at Kythrea was considered and, as a precautionary measure, the Royal Engineers were asked to lay the first 2½ miles of pipe through Kythrea village. This they kindly agreed to do and the work was carried out without incident. The estimated cost of this domestic water scheme is £90,000 or £8.6 per person. Half was paid by Government and half by the villagers by means of a loan from Government.

APPENDIX 14.

NUMBER AND PERCENTAGE OF VILLAGES WITH PIPED DOMESTIC WATER

31st December, 1955

District No.	Villages with piped water			Villages with no piped water		Total Villages
	Satisfactory No.	Needing Improvement No.	Total No.	No.	%	No.
Nicosia	109	19	128	48	27	176
Larnaca	46	4	50	9	15	59
Limassol	86	16	102	11	10	113
Famagusta	48	13	61	37	38	98
Paphos	100	22	122	12	9	134
Kyrenia	26	12	39	8	17	47
Totals	415	87	502	125	20	627
Percentage	66	14	80	20	20	100

Note: The above figures were obtained from a new survey and they do not 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 15.

VILLAGE WATER SUPPLY SCHEMES COMPLETED IN 1956

No.	Village	District	Nature of work	Date of completic
1	Koutsovendis	Kyrenia	≠	24th January
2	Kalyvakia	Nicosia	≠	23rd February
3	Goshi	Larnaca	*	12th March
4	Zyyi	"	≠	15th "
5	Astromeritis	Nicosia	≠	17th "
6	Anarita	Paphos	≠	7th April
7	Lymbia	Nicosia	*	13th April
8	Yeroskipos	Paphos	≠	24th "
9	Pharmakas	Nicosia	≠	25th "
10	Alevga	"	≠	25th "
11	Thermia	Kyrenia	*	26th "
12	Ay. Napa	Famagusta	≠	30th "
13	Souskiou	Paphos	*	2nd May
14	Mia Milia	Nicosia	≠	3rd May
15	Nikitas	"	*	19th May
16	Trikomo	Famagusta	≠	22nd May
17	Peyia	Paphos	≠	26th May
18	Voni	Nicosia	≠	26th May
19	Margi	"	*	28th May
20	Panayia	Paphos	≠	6th June
21	Statos	"	≠	6th June
22	Alaminos	Larnaca	≠	16th June
23	Ay. Nicolaos	Paphos	≠	26th June
24	Ay. Georghios	Limassol	≠	6th July
25	Ay. Irini	Nicosia	≠	19th July
26	Ay. Marina Xyliatou	"	≠	31st July
27	Mallia	Limassol	≠	31st July
28	Neokhorio	Paphos	≠	8th August
29	Dhrousha (Pitokopos)	"	≠	8th "
30	Agros	Limassol	≠	12th "
31	Ay. Constantinos	"	≠	21st "
32	Dhromolaxia	Larnaca	*	25th "
33	Moniatis	Limassol	≠	29th "
34	Evdhimou	"	≠	28th September
35	Alona	Nicosia	≠	28th "
36	Kalavasos	Larnaca	≠	29th "
37	Syrianokhori	Nicosia	*	1st October
38	Xylophagou	Larnaca	≠	3rd "
39	Petra-tou-Dhigeni	Nicosia	*	5th "
40	P. Lefkara	Larnaca	≠	11th "
41	Kourou Monastir	Nicosia	≠	15th "
42	Phikardou	"	*	19th "
43	Ay. Elias	Famagusta	≠	24th "
44	Moni	Limassol	≠	25th "
45	Chatos	Famagusta	*	31st "
46	Ay. Epiphanios Orinis	Nicosia	≠	31st "

No.	Village	District	Nature of work	Date of completion
47	Akapnou	Limassol	≠	10th November
48	Aradhippou	Larnaca	≠	20th "
49	Lefka	Nicosia	≠	29th "
50	Evrykhou	"	≠	30th "
51	Ay. Georghios Soleas	"	≠	30th "
52	Angastina	Famagusta	*	10th December
53	Mousoulita	"	*	19th "
54	Mora	Nicosia	*	22nd "
55	Polemi	Paphos	≠	22nd "
56	Prastio Morphou	Nicosia	≠	29th "
57	Sinda	Famagusta	≠	29th "

* New scheme where previously there was no piped supply.

≠ Replacement or improvement of an old supply.

≠ Water supply to schools and Police Stations.

APPENDIX 16.

VILLAGE WATER SUPPLY IN HAND AT THE END OF 1956

Serial No.	Village	Serial No.	Village
1	Knodhara	9	Livadhia
2	Marathovounos	10	Khalassa
3	Yenagra	11	Yerovasa
4	Pyrga	12	Alekhtora
5	Aphania	13	Dhiorios
6	Ornithi	14	Vouno
7	Asha	15	Lyso
8	Karavas	16	Monarga

APPENDIX 17.

VILLAGE WATER SUPPLY SCHEMES READY FOR CONSTRUCTION AT THE END OF 1956

Serial No.	Village	Serial No.	Village
1	Episkopi (Limassol)	3	Korakou
2	Ayios Ermolaos	4	Mitsero
Nos. 1-4 have already provided their shares in the cost of the work.			
5	Sellain D' Appi	9	Sykhari
6	Mansoura	10	Meloucha
7	Ayios Theodoros (Tyllirias)	11	Kophinou
8	Mosphilleri	12	Skarinou
Nos. 5-12 have their loans approved, but not yet executed.			
13	Ammadhies	53	Eliophotes
14	Ayios Ioannis (Selemani)	54	Kythrea
		55	Lythrodondas
15	Limnitis	56	Kakopetria
16	Analiondas	57	Piyenia
17	Ambelikou	58	Spilia
18	Ayii Trimithias	59	Pano Pyrgos
19	Paleometokho	60	Kato Zodhia
20	Tymbou	61	Galini
21	Pyroi	62	Pakhyammos
22	Katokopia	63	Milikouri
23	Kambia	64	Moutoullas
24	Kokkinotrimithia	65	Kambos
25	Mathiatis	66	Mammari
26	Orounda	67	Skylloura
27	Psomolophou	68	Ayia Irini (Kyrenia)
28	Xeri	69	Ayios Epiktitos
29	Ghaziveran	70	Ayios Yeorghios (K'ni
30	Apliki	71	Karpasha
31	Aredhiou	72	Myrtou
32	Palekhori Orinis	73	Kazaphani
33	Ayios Sozomenos	74	Kormakitis
34	Kalokhorio (Kapouti)	75	Vasilia
35	Katydhata	76	Paleosophos
36	Lagoudhera	77	Kremmama Kamilou
37	Lazania	78	Sisklipos
38	Gourri	79	Trapeza
39	Loutros	80	Kato Dhikomo
40	Askas	81	Larnaca-tis-Lapitho
41	Mandres (Morphou)	82	Kalogrea
42	Masari	83	Aghirda
43	Petra	84	Ayia Trias
44	Ayia Marina (Skyllouras)	85	Vokolidha
		86	Livadhia (Famagusta)
45	Yerolakkos	87	Tavros

Serial No.	Village	Serial No.	Village
46	Pano Zodhia	88	Akhna
47	Alithinou	89	Styllos
48	Varisha	90	Engomi
49	Argaki	91	Ayios Theodhoros (F'sta)
50	Ayios Vasilios	92	Paralimni
51	Ayios Yeorghios (Kafkallou)	93	Lysi
		94	Koma-tou-Yialou
52	Dhali	95	Gastria

Serial No.	Village	Serial No.	Village
96	Patriki	150	Kato Amiandos
97	Dherinia	151	Ayios Yeorghios (Limassol)
98	Strongylos		
99	Ayios Khariton	152	Kolossi
100	Prastio (Famagusta)	153	Yermasoyia
101	Trypimeni	154	Ayios Therapon
102	Yerani	155	Kato Akourdalia
103	Yialousa	156	Kato Archimandrita
104	Ayios Efstathios	157	Khlorakas
105	Avdhellero	158	Ayia Marinoudha
106	Troulli	159	Tala
107	Tersephanou	160	Polis
108	Anaphotia	161	Prodhromi
109	Kivisil	162	Marathounda
110	Odhou	163	Sarama
111	Goshi	164	Trakhypedhoula
112	Zyyi	165	Peristerona (Paphos)
113	Alethriko	166	Kallepia
114	Maroni	167	Timi
115	Tokhni	168	Nata
116	Anglisidhes	169	Maronas
117	Voroklini	170	Argaka
118	Kato Dhrys	171	Magounda
119	Ayii Vavatsinias	172	Armou
120	Athienou	173	Anavargos
121	Kato Polemidhia	174	Mesakhorio
122	Pano Polemidhia	175	Khrysokhou
123	Ypsonas	176	Akoursos
124	Kaminaria	177	Skoulli
125	Dhymes	178	Kissonerga
126	Kalokhorio (Limassol)	179	Stroumbi
127	Mesayitonia	180	Vretcha
128	Moni	181	Lemona
129	Mandria	182	Lasa
130	Mouttayiaka	183	Inia
131	Lophos	184	Salamiou
132	Pakhna	185	Trimithousa
133	Phasoula	186	Emba
134	Plataniskia	187	Lemba
135	Potamiou	188	Amargeti
136	Sotira	189	Kili
137	Vasa (Kilani)	190	Pomos
138	Yerasa	191	Kilinia
139	Silikou	192	Kholetria
140	Apsiou	193	Kedhares
141	Pendakomo	194	Pano Arodhes
142	Vasa (Limassol)	195	Steni
143	Ayios Dhimitrios	196	Dhrymou
144	Dhora	197	Letymbou
145	Evdhimou	198	Tsadha
146	Ayios Ioannis (Agros)	199	Kathikas
147	Kyperounda	200	Miliou
148	Kilani		
149	Prodhromos		

Nos. 13-200 schemes submitted for approval.

APPENDIX 18.

MECHANICAL PLANT

		No.
(A) MOBILE PLANT:	Ruston Bucyrus drilling rigs 22W ...	11
	" " " 2 60RL ...	1
	Edeco drilling rigs ...	3
	Toronto drilling rigs, small, obsolete	1
	Cheshire earth boring machine ...	1
	Allen Trencher, 12/21 ...	1
	Aveling-Barford Trencher ...	1
	Caterpillar Traxcavators 955 ...	3
	" " HT4 ...	1
	Caterpillar Bulldozer, D2 ...	1
	Ruston Bucyrus Excavator, RB10 ...	1
	Compressors ...	7
	Morrison diesel alternator on trailer with submersible electric test pumping units	1
	Turbine test pumping units ...	2
	Plunger deep well test pumping units ...	2
	Centrifugal pumping units ...	4
	Portable works pumps ...	17
	Sheepsfoot roller ...	1
	Crane ...	1
	Hoists ...	3
	Concrete Mixers ...	19
	Vibrators ...	12
	Low Loader ...	1
	Austin Countryman Vans ...	6
	Land Rovers ...	4
	Light Lorry ...	1

On order but undelivered:-

Morrison diesel alternator on trailer with submersible test pumping units ...	1
Ruston Bucyrus drilling rigs, 22W ...	2
Allen Trencher 12/21 ...	1
Crane ...	1
Tractive Unit for Low Loader ...	1

/Compressors

	Compressors	...	4
	Concrete Mixers	...	8
(B) WORKSHOP PLANT:-			
	Lathes	...	2
	Shaping Machine	...	1
	Screwing Machine	...	1
	Drilling Machine	...	2
	Planing Machine (timber)	...	1
	Bandsaw	...	1
	Bar Bender	...	1
	Bar Cutter	...	1
	Electric welders	...	2
	Forges	...	2
	Pipe slotting machine, oxy-acetyline	...	1
	Vibrating table	...	1
	Water meter testing plant	...	1
	On order but undelivered:-		
	Concrete block making machines	...	2
	Concrete testing machine	...	1