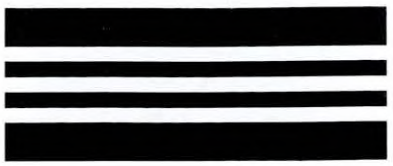

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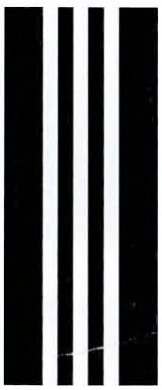

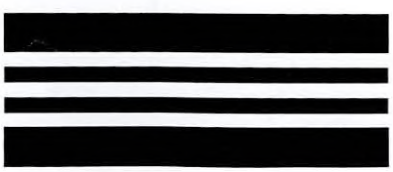

REPUBLIC OF CYPRUS

ANNUAL REPORT

OF THE

DEPARTMENT OF WATER DEVELOPMENT

FOR THE YEAR

1963

PREPARED BY

ir. PAUL DE GRUYTER

Director of the Department of Water Development

NICOSIA

PRINTED AT THE PRINTING OFFICE OF THE REPUBLIC OF CYPRUS.

1964

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DEPARTMENT OF WATER DEVELOPMENT

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DIRECTOR OF THE DEPARTMENT

OF WATER DEVELOPMENT

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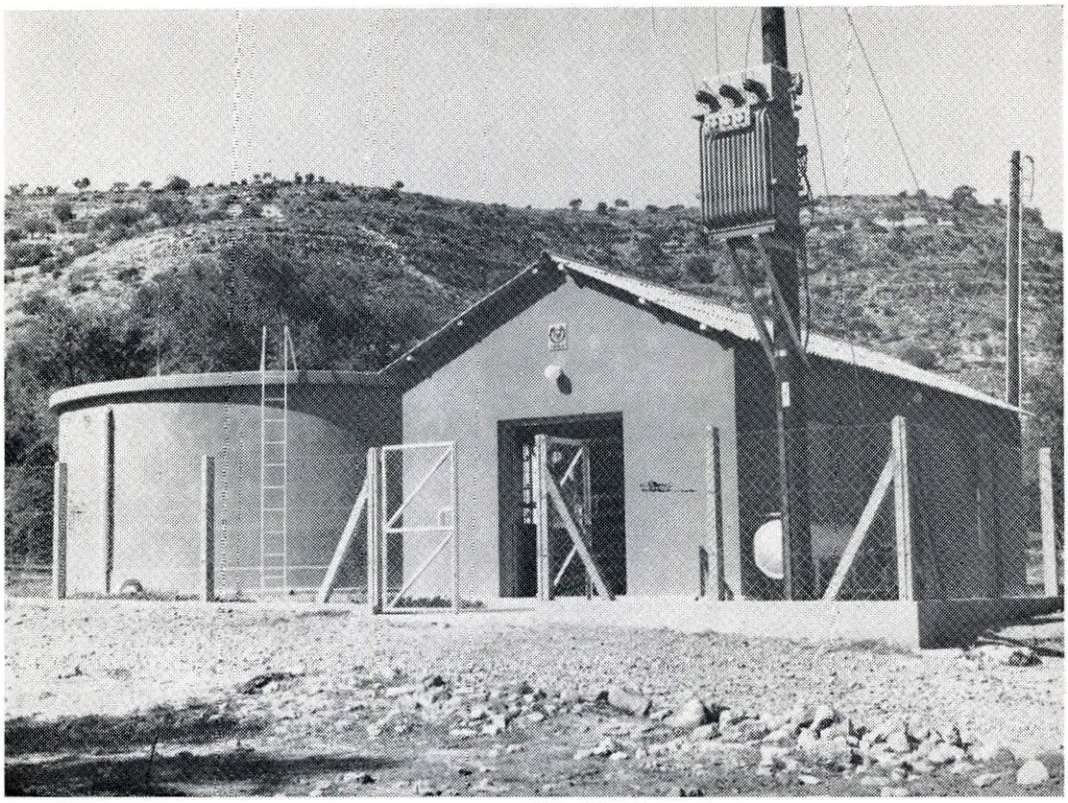
The President of the Republic, Archbishop Makarios, accompanied by the Director of the Department of Water Development visited the Kiti Dam and saw the works in progress.

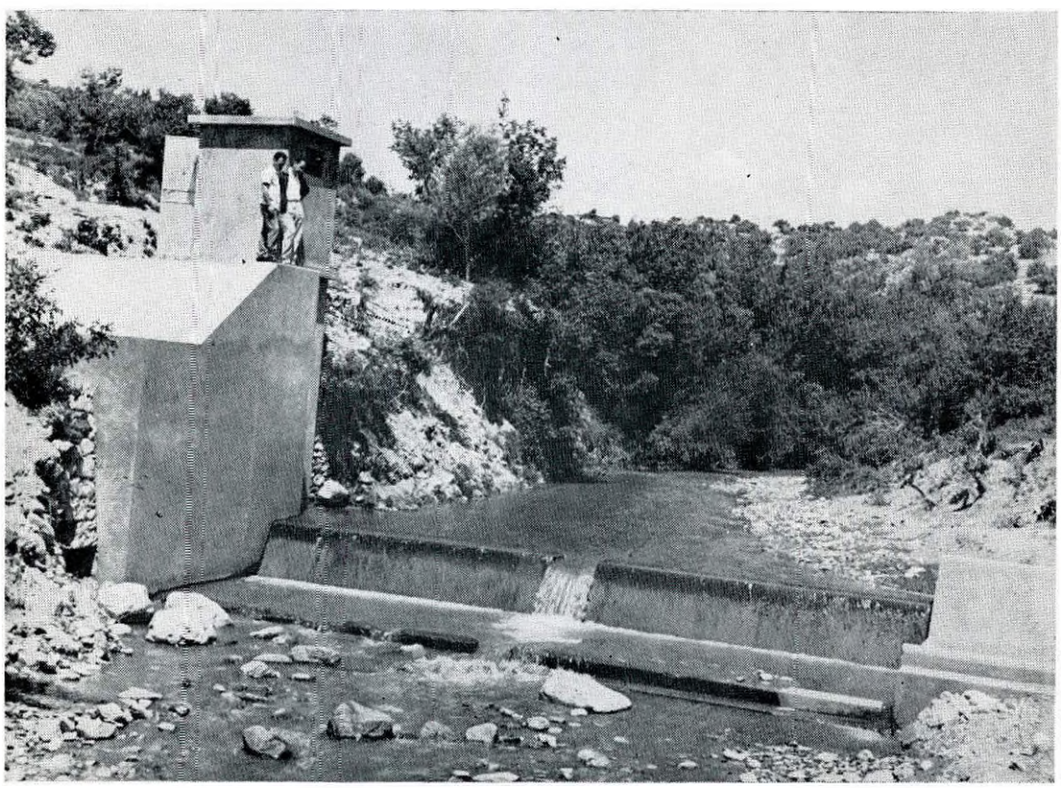
ARGAKA–MAGOUNDA DAM

(*Taken from helicopter on 28th February*, 1964)

Constructed on the 2nd half of 1963, it has impounded 60 feet of water amounting to 120 million gallons out of a total capacity of 270 million gallons.



Pump-House of the Yermasoyia Regional Domestic Supply Scheme.



Measuring Weir equipped with Automatic Water Level Recorder on Khirokitia River.

MIA MILEA DAM

Through the sporadic rains *beginning of February* this reservoir constructed in the 2nd half of 1963 impounded some 20 million gallons of water out of 74 million gallons capacity.

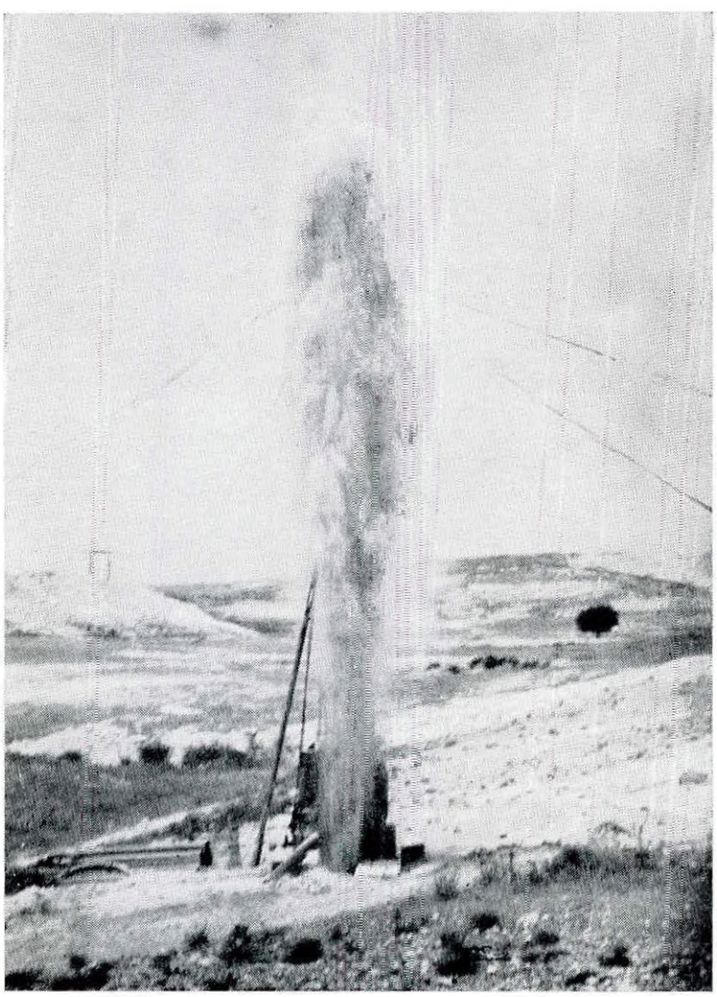
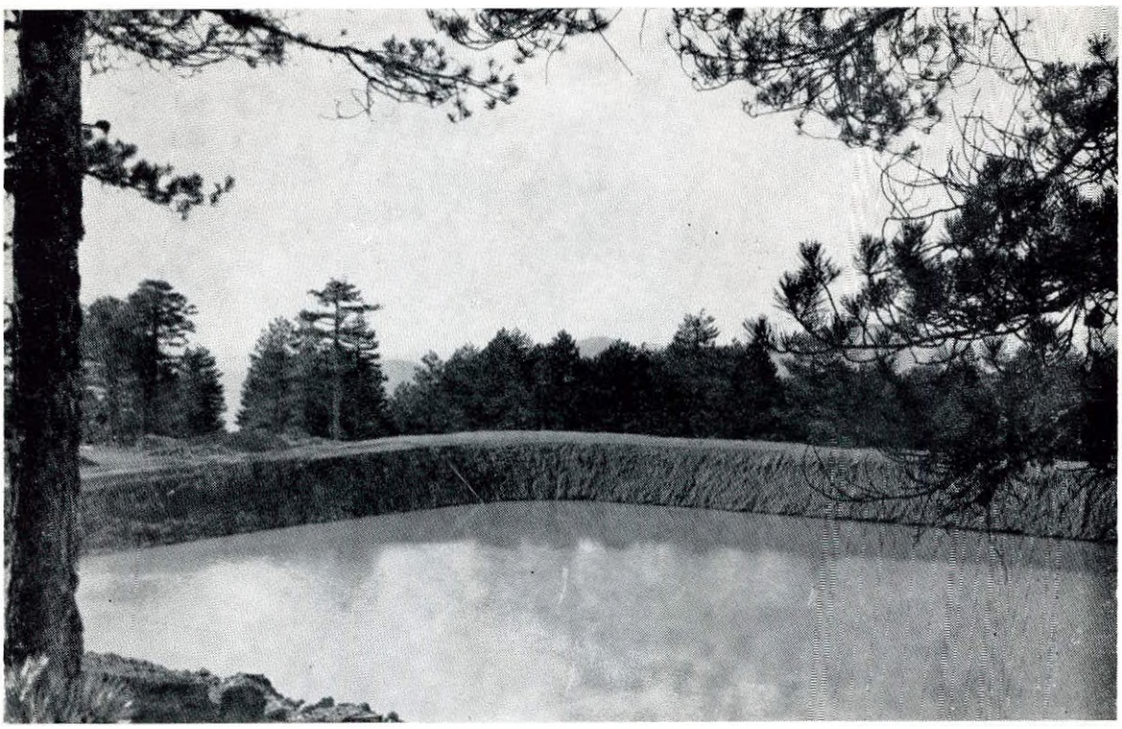


Plate showing stimulation of borehole by explosives.



PRODROMOS RESERVOIR at an altitude of about 5000 feet, is the largest of its kind ever built in Cyprus. It cost £72,000 and was completed in 1963.

MORPHOU DAM is of a capacity of about 450 million gallons and was built to recharge the Morphou acquifers. It cost £101,000 including acquisition of land.

1. INTRODUCTION

The engineering and geological side of all Government Water Development Work has been, as in former years, in the hands of the Department of Water Development whose duties include the overall planning and the design and construction of works for the development of water resources for irrigation purposes and for town and village domestic water supplies. Furthermore the Department deals with river training, flood protection and drainage works. The administration of Irrigation Divisions and Associations and Domestic Water Commissions was - as in former years - in the hands of the District Officers. Disputes over water rights were handled chiefly by the District Officer in consultation with the Law Officers and the Departments of Land Registration and Water Development. Soil Conservation and the Agricultural problems involved in the economic use of water for irrigation are the responsibilities of the Department of Agriculture.

The year 1963 was a record year for the execution of water development schemes. As it is seen from the table of capital invested in water development projects on page 5 a total expenditure of £1,744,680 was incurred on schemes during the past year (£1,390,233 in 1962).

After several years of low rainfall, the precipitation in winter 1962/63 was - as it was in 1961/62 - slightly above normal and this had a favourable effect on agricultural production in the rainfed areas and, in general, on the declining of the watertables in the overpumped aquifers (see Appendix VIII para. 15).

Mention must be made of the tragic events that started in the night of 20 December, 1963, when the first shots were fired between Greek and Turkish Cypriots. Since then all construction work in the field came to a standstill till the end of the year. During January and February 1964 there was a slight improvement now and again but no execution on a big scale has yet taken place.

2. STAFF AND LABOUR

The staff of the Department on 1 January, 1964 and 31 December, 1962, was as follows:

	31.12.62	1.1.64
Director	1	1
Assistant Director	1	1
Senior Water Engineers	2	2
Engineer - Hydrologist	1	1
Executive Engineers	9	18
Geologists	3	3
Superintendents of Works	2	2
Senior Inspectors of Works	4	4
Inspectors of Works	14	18
Chief Foremen	3	4
Assistant Chief Foremen	3	7
Technical Assistants	29	66
Foremen	49	47
Storekeeper	1	1
Administration, Accounts & Clerical Staff	36	42
Total	158	217

(For more details of the technical staff see Appendix 17.)

Mr. P. de Gruyter who was appointed jointly by the United Nations and the Government of Cyprus, as Director of the Water Development Department (under the OPEX programme) and took up his duties on 17 April, 1962, continued his assignment during 1963.

Mr. Y. Hji Stavrinou, Assistant Director of the Water Development Department, was appointed Co-Manager of the U.N. Special Fund Project for groundwater and mineral investigations in July 1963 (see para. 3).

Mr. C. Y. Hoplaros was appointed Administrative Secretary to the Department on the 3rd December, 1963.

The average number of labourers employed by the Department during 1963 was 1963, as compared with 1716 in 1962. About 19% were classed as regulars while about 39% were skilled employees.

The approximate monthly averages were as follows:

January	1298
February	1442
March	1663
April	1670
May	2083
June	2011
July	2236
August	2245
September	2232
October	2397
November	2373
December	1907
Average	1963

There were no labour disputes or strikes during the year. There were no appreciable variations in the wages structure during the year except the normal annual increases granted to regular employees.

3. ORGANIZATION AND COORDINATION

As in former years the department consisted of six technical sections:

(a) Irrigation and Drainage,
(b) Town Water Supplies,
(c) Village domestic water supplies,
(d) Hydro-geology and drilling,
(e) Hydrology,
(f) Workshops;

and furthermore a Registry and an Accounts Section to deal with all administrative and financial matters.

There is a close cooperation between all Sections, so that their work is well coordinated. The organization of the Water Development Department, whereby all Government responsibilities connected with the development and use of all water resources, together with a good coordination of the separate sections, guarantees the best possibilities for development. This organization had to undergo some changes as the result of a U.N.

Special Fund Project (S.F.P.). This project, designed for groundwater and mineral investigations, brings together activities which were dealt with by two Ministries, the Water Development Department of the Ministry of Agriculture and Natural Resources for the groundwater activities and the Geological Department of the Ministry of Commerce and Industry for the mineral exploration. In accordance with the Plan of Operations of said S.F.P. our Department was required to put the greater part of the staff working in the Drilling Section at the disposal of the S.F.P. It was not possible to meet in full the obligations of the S.F.P. as this would have been detrimental to the work of our Drilling Section. The demand for trained counterparts for the Special Fund Project experts coincides with the need for experienced officials for the control of borehole irrigation and for assisting the German geological mission (see para. 7). Furthermore the Assistant Director of the Water Development Department and chief of the Drilling Section Mr. Y. Hji Stavrinou was appointed Co-manager of the S.F.P. and terminated his work in the W.D.D. in July 1963. Yet he still occupied the post of Assistant Director, so a new Assistant Director could not be appointed.

The departure of the Chief and 2 geologists of the Drilling Section, the split responsibility and the shortage of experienced staff have weakened the organization of the W.D.D. considerably. The U.N. S.F.P. for groundwater is undoubtedly a very useful project. Whether the technical advantage of strengthening the Geological Department, resulting from the chosen set up, can compensate for the organizational disadvantage of weakening the W.D.D. and split responsibility seems doubtful. In any case a very close understanding, cooperation and coordination between W.D.D. and S.F.P. will be necessary.

If the Government would decide to pool workshops and machinery under the responsibility of the P.W.D., an issue which appears to be now under consideration and which we oppose very strongly, this would be another serious blow to the organization of the W.D.D. What the Department needs most of all is the strengthening of the authority and responsibility of the Director.

On the other hand a decentralized organization is required for the operation and maintenance of major irrigation projects which cannot be left in the hands of Irrigation Divisions (whose Committees lack the technical knowledge) and cannot be managed efficiently from Nicosia either. Our Department should establish branch offices, in Limassol and Paphos in any case, and District Waterboards should be set up. (See para. 10.)

A third attempt was made to establish in 1964 a branch office in Limassol (or Paphos) - to begin with - but only a crippled version of the proposal was approved by the Council of Ministers.

---

4. NOTES ON WORK DONE IN 1963

Much work has been done in 1963 by all Sections of the Department, but especially considerable progress was made in the development of water for irrigation purpose. (See para. 8.)

Mention must be made of the large number of separate works, scattered over the whole island, which are undertaken more or less simultaneously. As all these works are carried out solely by the (only) Office in Nicosia, this makes coordination and supervision difficult. A certain decentralization is highly desirable. This would improve the quality of development planning and construction, provide for better contact with the District Administration and the local people and above all it would enable control to be established. Branch offices would be the best start for decentralization. (See paras. 2 and 8.)

Leaving out all maintenance, observation and survey operations, the number of separate new (or improvement) works carried out in 1963, was as follows:

Major irrigation works	11
Minor irrigation works	99
Town Water Supply works	2
Village Water Supply works	97
Drilling operations for 115 boreholes for 55 villages	
Construction of new measuring weirs	8
	272

A more detailed account of the works undertaken in 1963 is given in the paras. 12 to 18.

5. FINANCE

The following is a summarized statement of the expenditure of the Department of Water Development in 1963.

	Government Funds	Contribution by Beneficiaries	Total
1. Administration (a breakdown is given below)	£151,580	-	£151,580
2. Irrigation, Drainage & Dams	542,000	248,000	790,000
3. Town Water Supplies (Including Morphou Bay Scheme and upon repayment)	58,400	12,500	70,900
4. Village Water Supplies	223,000	263,000	486,000
5. Drilling & Prospecting	63,700	-	63,700
6. Hydrological Research	40,500	-	40,500
7. Workshops (Maintenance)	14,000	-	14,000
8. Purchase of Machinery & Equipment (Deptl. & Block vote)	120,000	-	120,000
9. Government Water Supplies	8,000	-	8,000
+	£1,221,180	£523,500	£1,744,680

+ Note above breakdown includes expenditure charged to Ordinary Estimates amounting to £110,500.

A breakdown of the Administration charges is given hereunder:

Personal Emoluments	£ 76,580
Casual Assistance	8,000
Technical Assistance	18,000
Travelling	21,500
Maintenance & Operation of Motor Transport	15,000
Rents	1,000
Leave pay	11,500
	£151,580

The Government does not carry the whole financial burden of water development works. Beneficiaries contribute a certain, varying, percentage towards the initial cost of the works. Towards the cost of gravity irrigation works the village contribution varies from 20% to 60% according to the type of work (value of the water) and the nature of the ownership of the water. When the water is owned collectively as by the members of an Irrigation Division, the usual contribution is 20% for spate irrigation and 33.3% for perennial irrigation. For schemes whose purpose is to recharge aquifers from which irrigation water for perennial or summer crops is extracted, the customary rate is 33.3%, except in cases where recharge is doubtful and the water most likely will have to be used in early spring by means of canals; here the village share is 25%. 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 45%. The village share of the cost of scheme is usually raised by a loan from the Government Loan Commissioners at a low rate of interest but occasionally it is paid partly or wholly in cash or in free labour. In respect of drilling, private individuals are charged the actual cost including 20% departmental charges on works and 25% on the cost of casing pipes. Municipal Corporations, companies, etc., also usually pay the full cost and departmental charges at the rate of 20% on labour and 25% on materials.

Town water supply works are paid for in full by the respective authorities including departmental charges at the rate of 6% on labour and 10% on materials. The new Greater Nicosia Scheme and the Morphou Bay Scheme are, for the time being, financed wholly by Government. Domestic water schemes for rural municipalities and villages are paid for half by Government and half by the village if no house connections are wanted. If there are house connections the extra cost is borne entirely by the village.

Several meetings were organized by the Planning Bureau to discuss the suggestion of constructing, operating and maintaining dams by and at full cost of the Government and selling the water to the farmers, and it was decided to consider each case separately. Experience will have to be the main guide. The Argaka-Magounda Dam in the Polis area is the first project to be undertaken at full cost of the Government. (Appendix 18, Nos. 42 & 46.)

---

6. THE 1964 PROGRAMME

A very large programme for 1964 was approved. The total (regular and development) budget for 1964 for water development amounts to £2,670,601.

The programme for the Irrigation Section was increased the most. To realize that programme an amount of £1,310,615 would have to be spent on planning and construction of irrigation works.

To prepare the designs for such a large programme more staff was required and also more and better accommodation, furniture, transport, telephones, etc. We repeat more urgently what was said in the Annual Report of 1962, that, although we encountered goodwill and cooperation from all sides, yet many difficulties and obstacles had to be overcome before the men and the tools became available. If the Director would be given more authority and the Department would be less dependent on other Departments and Services, then development could proceed quicker, easier and cheaper. (Appendix 18, No. 15.)

As it was designs were not all prepared in time or with sufficient accuracy and this might delay the execution (in 1964).

---

7. FOREIGN ASSISTANCE.

In 1963 Cyprus received technical assistance in the field of water resources development from the United Nations and from the French, U.S., West German and Dutch Governments.

The French Government continued their offer of bilateral technical assistance to Cyprus by providing, through the SCET (Société Centrale pour L'équipement du Territoire) for a team of experts, one hydrogeologist, one hydrologist and one assistant hydrologist and one geophysician + one consulting engineer part-time. The team arrived in Cyprus on 15 March, 1962, and the agreement terminated on 15 March, 1963.

Under the Agreement France provided for 85% of the salaries of the experts, the full cost of their transport to Cyprus and back and for some equipment. The Government of Cyprus pays for all Cypriot counter-personnel, for transport in Cyprus and contributes a maximum of ± £7,400 for salaries of experts and equipment.

This French Mission carried out an investigation of the important Morphou aquifer, from which much more water is extracted for the irrigation of the citrus orchards than the natural replenishment.

Due to insufficient preparation of the assistance beforehand actual work only could start in June 1962, although the experts arrived in March 1962. For this reason and because the study was too extensive to be undertaken by three experts in one year, the work was not completed on 15 March, 1963. The experts were, however, kept in Cyprus six months longer at the expense of the Government of Cyprus. The hydrologist and assistant hydrologist left in August, whilst the team leader Mr. P. Coudert stayed on till November to complete his report. The final report will be printed in Paris.

F.A.O. provided, at the request of the Government of Cyprus, for the services of a Senior Irrigation Engineer, Mr. B. Milinusic, who arrived in Cyprus on 8 January, 1963. The Netherlands Government provided, through F.A.O., for the services of an Associate Expert, Mr. E. Dahmen, who started work on 16 February, 1963. Furthermore on 10 March Mr. S. Hsu, a U.N. Dam design Expert arrived in Nicosia. The four senior engineers, put at the disposal of the Government of Cyprus by the U.S. Aid Mission and their dates of arrival were: 1) Mr. B. Griffin, team leader, 18 July, 1963; 2) Mr. J. Maier, 2 July, 1963; 3) Mr. D. Wilson, 16 August, 1963, and 4) Mr. S. Nestingen, 9 December, 1963.

The above mentioned 6 foreign experts and 1 associate expert, who all worked directly under the supervision of the Director of Water Development Department, were all assigned to the Irrigation Section and were advisers to the Chief of Section, Mr. C. Konteatis for the following branches:

B. Griffin & E. Dahmen:	Watershed & Masterplanning.
S. Hsu & D. Wilson:	Short range planning (preliminary investigations).
S. Hsu:	Dam design.
B. Milinusic:	Dam Construction.
J. Maier & E. Dahmen:	Distribution Systems.
J. Maier:	Topography.
D. Wilson:	Soil Laboratory.
E. Dahmen:	Borehole pumping Schemes.
S. Nestingen:	Maintenance & operation of dams; Contracts & Agreements.

As a request of the Government of Cyprus the U.S. A.I.D. Mission in Cyprus (Director J. S. Toner) provided advice and technical assistance concerning the supply of water to Famagusta town. Bechtel Corporation was selected to render the required assistance and in February 1963 Bechtel engineers conducted on site investigations in Cyprus. The first report was submitted in April 1963.

A U.N. Special Fund Project for groundwater and mineral investigations started work in April 1963, when the Project Manager Dr. D. E. Thomas arrived in Cyprus.

A West German Mission also commenced work in April 1963 with the arrival of its team leader Dr. F. K. Mixius. See para. 9.

A combined report on the U.N. Special Fund Project and on the work of the Drilling Section of the Water Development Department has been prepared by Y. Hji Stavrinou who also drafted a report on the work of the West German Mission. Both reports are included in this report as paras. 17 and 18.

---

8. THE IRRIGATION SECTION.

The large scale development of water resources for irrigation purposes which was envisaged, called for planning, design and construction of works as had not yet been undertaken before in Cyprus.

For this reason foreign consulting engineers were called upon to prepare designs and contract documents for rock-fill dams and a couple of contractors undertook the construction of three dams.

Many difficulties were encountered in connection with the choosing and engaging of Consultants; with the forms of agreement and Contract Documents; with the awarding of Contracts; with differences in opinion between Resident Engineer and Contractor, etc. Most difficulties were due to lack of experience on both sides and insufficient time. Now that more experience is gained the administrative problem must be solved as to how to assign the designs for next years dams to Consultants in August of the year before, that is to say at a moment when the Development Budget has not yet been approved by the Council of Ministers.

Ten dams were under construction in 1963. Their total storage capacity reaches 1574 million gallons which exceeds the total storage capacity (1334 m.g.) of all 24 existing dams by 18%. (See para. 12, I.)

The design and construction of distribution systems - which are as important as the works to impound the water - did not keep pace with the construction of dams, firstly due to lack of staff and secondly due to lack of maps (with contour intervals every 3 ft.). Topographical Surveys proved to be too timely and not sufficiently accurate. Finally the Government decided upon an aerial survey, which was carried out by Fairey Air Surveys Ltd. (scale 1:10,000).

Afterwards negotiations took place in order to get the maps produced from the air photographs.

An important development in the branch of distribution systems was the establishment in January 1964 of the Inter Departmental Land Water Committee on the initiative of the new Director-General of the Ministry of Agriculture and Natural Resources. This Committee consists of 3 members: the Directors of the Departments of Water Development, Agriculture and Forests with Mr. Hoplaros as permanent Secretary and will cover and coordinate the planning and operation of all aspects of agricultural land and water use.

Much preparatory work was also done in a new field of work: the planning of Watersheds as an indispensable step towards an Island wide Masterplan. Specifications were prepared and sent to a great number of foreign Consultants which had shown interest in such kind of work. (Appendix 18, Nos. 9 and 30.) More than 20 offers were received and studied. A final decision has not yet been taken. The Kouris-Garyllis and the Xeros-Marathasa-Karyiotis-Atsas Watersheds are being given top priority. The mapping of all existing irrigation developments in the first Watershed has been completed by our own staff and is being carried out for the second watershed.

The organization of the Irrigation Section proceeded well. The Section was divided into 12 branches (see Appendix 17). The duties of these branches are being defined. There is not yet sufficient trained staff to man and to lead the different branches.

9. THE WESTERN AND EASTERN MESAORIA AQUIFERS

Observations in August 1963 by the French hydrological Mission (para. 7) revealed that the western part of the so-called Morphou aquifer was in a very bad condition: the water table in this part has fallen 10 ft. below sea level and sea intrusion has started to take place.

The Western Mesaoria aquifers are of paramount importance to Cyprus. 873 boreholes extracted 13,000 million gallons in 1963 for the domestic water supply of 25 villages and the greater part of Nicosia town and for 50,000 donums of citrus and other summer crops.

Many facts and proposals to remedy the grave situation were brought together in our Report dated 13 October, 1963. And more measures to be taken and policy decisions recommended by our letters of 28 November and 1 December, 1963, (see Appendix 18, Nos. 26, 33, 38 and 39). Due to the intercommunal troubles no decisions have yet been taken, except that the Government decided for 1964 not to operate the Morphou Bay Scheme for water supply to Nicosia town and not to construct any dams in the upper regions of the Serakhis Watershed.

Most urgent steps to be taken are: a) enact a new law, b) establish effective control with watermeters, etc., c) line the canals and d) design and construct more recharge works than have already been executed (Morphou and Ovgos dams). Plans for large scale artificial recharge are now being completed. But we have advised the Government not to spend any more money on the aquifer if the farmers do not cooperate by installing watermeters, increasing the efficiency of the water use and halting the expansion of citrus orchards.

We are, of course, anxiously awaiting the final report of the French Mission and also looking forward to the results of investigations by the hydrogeological team of the U.N. Special Fund Project. These will produce facts on which to base a long term policy, for instance whether or not a desalting plant for Nicosia town will be required.

But the facts we know now are sufficient to convince us, that Government action (new law and policy decisions) and a well staffed and well equipped control service (jointly administered by District Administration and Departments of Water Development and Agriculture) are most urgently needed. Then - with the cooperation of the farmers - the canals can be lined and recharge works carried out and the aquifer can be saved for long term use.

The Eastern Mesaoria aquifers are also of very great importance to Cyprus. Here approximately 6000 boreholes and wells extract about 7000 m.g. of water for the domestic water supply of Famagusta town, a large number of villages and about 36000 donums of perennial and summer crops. Here the natural replenishment of the aquifers is much less and artificial recharge far more difficult.

Here also as in the Western part of the Mesaoria plain the extraction from the underground water resources by far exceeds the natural replenishment and the watertable is dropping rapidly in near all villages. And as the water for irrigation is used here more economically than in Morphou and artificial recharge is limited and difficult there are less possibilities for improvement. In our letter of 29 June, 1962, several measures to improve the situation were mentioned: control of pumping and halting of illegal drilling; hydrogeological investigations, study of artificial recharge from other watersheds (recharge works from local surface water sources have already been carried out) and a desalting plant for Famagusta town.

This plant was considered an urgent matter as the results of water saving and recharge measures would not be obtainable in time and could be beneficially used anyhow for expansion of citrus and summer crops. Besides, many other advantages would be derived from this solution, which was only meant to solve the problem of the domestic water supply of Famagusta town and surroundings.

As a result of discussions the U.S. Aid Mission selected the Bechtel Corporation to prepare a feasibility study on an added water supply for Famagusta town (see para. 7). The first report was submitted in April 196[illegible]

The report contains 110 pages and as many appendices. Conversion plants at 4 different sites and a dam in the Dhiarizos River with a 100 mile pipeline were studied as alternate sources of water supply for Famagusta town. The capital cost of a conversion plant was estimated to be ± £1,225,000 and of the dam and pipeline £4,680,000. The cost of the water (excluding distribution in the town) was estimated to be 72 to 74 mils per ton for the conversion plants and 58 mils per ton for the dam project.

In our comments (28 May, 1963) we pointed out that the disadvantages against the dam scheme are of such a magnitude that this project should not be considered. The construction of a desalting plant at Kala or, if a cheaper steam price could be agreed with the Electricity Authority, at Dhekelia (combined with the existing power station) is recommended. With a Government subsidy of £38,200 per year the consumer's water would cost 66 mils per m^3 on an average which is not considered to be too high.

The Government subsidy would amount to subsidizing the farmers so that citrus could be produced from the water otherwise consumed domestically to an extent of 13.6 mils per ton. This does not compare too infavourably with the Government contribution to large dams (our letter of 24 October, 1963).

Due to differences in opinion no decision has yet been taken and, taking the present political situation in account, we feel that Government will at present not undertake to carry out a desalting plant and we are looking for some temporary solution.

Finally we wish to point out that several works were carried out in 1963 to recharge both aquifers (see para. 12, I).

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10. WATER LEGISLATION

The report on proposed new water legislation by Dr. N. G. Krausz and Dr. D. Caponera (F.A.O. technical assistance) was submitted in February 1963.

Our two reports of 18 March, 1963, commented on the proposed water legislation and dealt with the closely connected subject of financing and management of dams (appendix 18, Nos. 2, 3, 43 and 46).

Many interesting discussions took place but no final decision was reached.

In the meantime a new law on drilling of boreholes and the use of groundwater was prepared, but the draft law was not yet enacted in 1963.

As the new water legislation is not to be expected soon, a revision of the wells law is very urgent so as to enable efficient control of borehole irrigation.

It would be a good thing for Cyprus if - as a general policy - no more permits for drilling boreholes and using underground water individually would be issued and new developments would be realized only by means of Government designed and executed so called controlled pumping irrigation schemes, to be administered by Irrigation Divisions, whose Committees and guards should receive some training in the efficient use of water. In this way every extension of borehole irrigation will be established on a proper communal basis.

When new good aquifers will be discovered by the U.N. Special Fund Project for groundwater survey it is recommended that no permits be issued by the District Administration.

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11. ACKNOWLEDGMENTS

We are happy and thankful for the fine cooperation offered to us by all Sides of the Government and by the officers of our Department in particular.

With great pleasure we pay tribute to our officials who at all levels performed their duty satisfactorily, often under difficult circumstances and notwithstanding some disappointments. They showed eagerness to learn, devotion to study and enthusiasm in their work, which is greatly appreciated.

We also express our thanks to the Institutions and Governments which provided us with technical assistance and to the Experts for their valuable work and advice.

Mention is made of the closer understanding and cooperation growing between the Departments of Agriculture and Water Development. The necessity to coordinate the development of water resources with the means and ways to use water more efficiently (research and extension) and agricultural development as closely as possible is realized and encouraged by the Ministry of Agriculture and Natural Resources and the Planning Commission.

We hope and trust that a very close understanding and cooperation will develop between the Water Development Department and the U.N. Special Fund Project for ground-water investigations.

Finally we trust that the cooperation between the Water Development Department and the Agricultural Research Institute will also lead to better planning and more efficient use of Cyprus' precious water.

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12. REPORT ON IRRIGATION

By C. A. C. Konteatis, B.Sc.(Eng.), A.M.I.C.E., A.M.I.W.E., Senior Water Engineer.

1963 has again been a record year for construction and planning of irrigation works. The total expenditure on works reached £790,000 which represents 53.6% of the total Departmental expenditure on works. The table appendix 1 gives an idea of the increasing emphasis on irrigation works especially after independence.

It is estimated that as a result of the construction of these projects 8900 donums of perennial crops, 5190 donums of spring crops and 22,900 donums of winter crops will be benefited. In addition there will be the benefit to the underground water due to the carrying out of the recharge works.

This year was the first time we have employed Consultants and Contractors for our works.

Energoprojekt of Beograd, Yugoslavia, was employed for the design of the Pomos and Ayia Marina rockfill Dams, Howard Humphreys of London, England, were employed for the design of the rockfill dam for Argaka-Magounda and Il Nuovo Castoro of Florence, Italy, prepared the designs of the Kiti-Tremithios earth dam.

For the construction works, the successful tenderer for Ayia Marina and Pomos rockfill dams were the Mediterranean Constructors of Athens, Greece, together with Zachariades & Co. of Limassol. For the construction of the Argaka-Magounda dam a bilateral agreement was signed involving a loan with Mowlem and Ridgways of London, England. All the other projects were designed and constructed directly by the Water Development Department. It must be mentioned that the Irrigation Section was considerably strengthened in 1963 by both local staff and foreign experts. The local engineers employed totalled 15 whilst there were still three vacancies to be filled. The other office technical staff totalled 46 with 10 more vacancies.

The foreign experts whose valuable services we were fortunate to have were:-

Mr. S. Hsu,	United Nations Dam Expert.
Mr. B. Milinusic,	F.A.O. Irrigation Works Expert.
Mr. E. Dahmen,	F.A.O. Irrigation Works Associate Expert.
Mr. B. Griffin,	United States Aid Mission Water Works Expert.
Mr. J. Maier,	U.S. A.I.D. Mission Water Works Expert.
Mr. S. Nestingen,	U.S. A.I.D. Mission Water Works Expert.
Mr. D. Wilson,	U.S. A.I.D. Mission Engineer Geologist.

Three of our engineers are now on scholarship.

Mr. T. Mirata in the Imperial College, London, specializing in Soil Mechanics.

Mr. K. Hassabis in Canada specializing in Concrete Technology.

Mr. N. Ioannides in Paris specializing in Aerial Surveying.

I. Construction Works.

The following tables Appendices 2, 3, 4 and 5 give an outline of the works undertaken in 1963, but herebelow some more information is given about the most important of them.

(a) Impounding Schemes.

1. Argaka-Magounda Dam.

This is one of the three rockfill dams built in 1963. The site was selected by the Water Development Department and preliminary investigations were carried out to determine the feasibility of the dam. The project having been considered feasible, Howard & Humphreys, Consulting Engineers of London, were asked to prepare the detailed designs for the dam. The dam was designed as a rockfill dam of a maximum height above river bed of 100 ft. The upstream slope of the dam is 1 to 1.5 and the downstream slope is 1 to 1.75. The embankment is made up of rockfill on either side and clay core in the middle with transition zones of a filter material between the rockfill and the clay. The total quantity of fill material is 180,000 cu. yds. A tunnel has been provided through the left abutment lined in concrete in a circular slope of 7 ft. diameter. The purpose of the tunnel is for desilting, for conveying the 15" dia. steel outlet pipe and to help as diversion during construction. The penstock of the tunnel is fitted at the upstream entry but operates from downstream. The 15" pipe is controlled from a valve downstream.

A 120 ft. wide spillway has been provided mainly unlined throughout its 500 ft. length on a rock base. There is a broadcrested weir at the entry to the spillway capable of discharging 6,000 cusecs considering 7 ft. of water head and allowing 3 ft. of freeboard to the dam crest. A foot bridge has also been included to connect the dam crest to the other side of the spillway. A small house has been built next to the dam at a commanding spot which during construction served as the office of the Resident Engineer and his staff and after construction will serve as a control and guard house for the proper operation and maintenance of the project.

The construction of the dam was undertaken by Mowlem and Ridgways of London through a bilateral agreement involving finance facilities. The contractors undertook to construct the dam at a cost of ± £280,000.

The storage capacity of the dam is 270 million gallons and it is intended to irrigate 1500 donums of perennial and spring crops for the Argaka and Magounda villages. Objections were raised by Limni Mines for the construction of this dam as it was claimed that it might affect their boreholes near the coast downstream of the dam. To satisfy the Mines a recharge scheme in the form of a small spreading ground upstream of the boreholes is being constructed.

It has been decided that this scheme be controlled by Government and therefore no contribution has been paid by villagers, who will instead be asked to pay water rates according to the consumption they make. It is the first scheme that will be wholly financed and controlled by Government except the old case of the Eastern Mesaoria Irrigation Works, and it will serve as an example for formulating the future Government policy for the financing and Management of dams.

2. Pomos Dam.

This is also one of the three first rockfill dams constructed in Cyprus. It is the highest of all dams until now constructed being 110 ft. from the river bed to the crest.

The site was selected by the Water Development Department which carried out the preliminary investigations and decided on the scheme.

The Energoprojekt Consulting Engineers of Beograd, Yugoslavia, were then requested to prepare the detailed designs and contract documents for public tender.

The embankment is made up of rockfill on either side, the upstream slope being 1:1.5 and the downstream 1:2. The clay core in the middle is protected on both sides by filter zones and random fill. The total quantity of fill material is about 200,000 cu. yds. On both the upstream and downstream faces a hand placed rip-rap has been built.

A tunnel has been constructed on the left hand side of the dam of a total length of 400 ft. and of a concrete lined horse shoe section 8 ft. wide, 6 ft. high with an access circular shaft lined in concrete 7 ft. in diameter.

The penstock operates from the top of the shaft by a hand operated gear system. The purpose of the tunnel is for desilting and to divert river flow during construction. An outlet irrigation steel pipe 16" dia. has been embedded into the base of the tunnel operating by a valve downstream.

The overflow from the dam can be discharged through a 140 ft. long side channel ogee shaped spillway, the crest of which is at 11.5 ft. below the crest of the embankment. Allowing for 4 ft. freeboard the maximum discharge can reach 11,000 cusecs.

The total length of the spillway chute is 310 ft. partly lined in concrete. A steel foot bridge over the spillway has also been provided.

A small house has been built by the Water Development Department at a commanding spot next to the dam which during construction served as the office of the Resident Engineer and his staff and as a laboratory and its main purpose after construction being a control and guard house for the proper operation and maintenance of the project.

The construction of the dam was undertaken by the Mediterranean Constructors of Athens and Zachariades, Contractors of Limassol, after published tenders in which they were the lowest bidders having got the contract for both Ayia Marina and Pomos Dams at a cost of £160,000. However, the actual cost is expected to be of the order of £200,000 when completed.

The storage capacity of the dam is 270 million gallons which is the same as that of the Argaka-Magounda project and is also expected to provide for the irrigation of 1500 donums of perennial and spring crops. The land that will be commanded by the canal system belongs to Paliambela, Pomos and Nea Dhimmata villages.

3. Ayia Marina Dam.

This is the third and smallest of the series of the first three rockfill dams built in Cyprus all of them in the Tylliria region on the northwest of the Island. The site was also selected by the Water Development Department which carried out the necessary investigations for the determination of the project feasibility.

The Energoprojekt Consulting Engineers of Beograd were asked under the same agreement as for Pomos Dam to prepare the designs and contract documents for this dam.

The dam is at its maximum height 100 ft. above river bed and the embankment is made up of rockfill on either side with a clay core in the middle and transition zones of filter material on either side of the core. The total embankment fill amounts to 80,000 cu. yds. On both the upstream and downstream faces a handplaced rip-rap has been built.

In this dam a cut and cover concrete culvert was provided on the left abutment instead of a tunnel as in the case of the Pomos and Argaka-Magounda dams. The reasons for employing this outlet was that the rock was not very deep on the left abutment and formed a good foundation and in addition the rock was considered to be too hard and the tunnel would have been too expensive.

The total length of this gallery is 300 ft., the upstream 126 ft. of which is of a horse shoe shape 5 ft. wide and 3'-3" high. The downstream 174 ft. is of a two storey section the lowest part being of a rectangular non pressure section 5 ft. wide by 5'-3" ft. high through which the water can flow, whilst the upper section is of oval shape 5 ft. wide and 7'-0" high which serves as an access gallery from the downstream side to the penstock chamber. This penstock will be operated mechanically by hand through a gear system. Under the base of the lower gallery a 12" dia. steel pipeline for irrigation has been embedded in the concrete.

The tunnel is to be used for desilting, as an access for operating the penstock and has been used during construction for the diversion of river water.

The spillway of the dam has been excavated on the right hand side and at its entry it is 55 ft. wide in the form of an ogee shape weir. The chute channel spillway is 150 ft. long and is partly lined in concrete. The crest of the spillway weir is 11.5 ft. below the crest of the dam and allowing for 3.5 ft. freeboard; this spillway is capable of discharging 4,500 cusecs.

A small house similar to those at Pomos and Argaka-Magounda has also been built by the Water Development Department for the same purposes.

The construction of this dam was undertaken by the Mediterranean Constructors of Athens and Zachariades, Contractors of Limassol, under the same contract as for Pomos, the combined cost being estimated to reach £200,000.

The storage capacity of the dam is 70 million gallons and is to provide water for the irrigation of some 500 donums of perennial and spring crops for the Ayia Marina (Kato Yialia) village. The area between Polis and Limnitis and in particular in the region of Ayia Marina is famous for its early spring crops such as tomatoes and cucumbers which are sold at high prices in the market.

4. Kiti-Tremithios Dam.

This has been the largest dam constructed in 1963 as regards the quantity of fill involved being 230,000 cu. yds. It is of earthfill construction and was built near Tersephanou on the Tremithios river. The site was selected by the Water Development Department after carrying out the necessary investigations which proved that the scheme was feasible. Il Nuovo Castoro, an Italian firm of Consulting Engineers from Florence, was then asked to complete the detailed plans for this project. The embankment is 3500 ft. long and at its maximum height above river bed it is 52 ft.

It is formed of a gravel embankment sloping upstream 1:2.5 and downstream 1:2. In the middle a clay core forms the impermeable part of the embankment. The upstream face is protected with handplaced rip-rap from half the height upwards.

A pressure gallery at the lowest part of the river through the embankment has been constructed which is 240 ft. long and its diameter 6'6" of a concrete lined section. This tunnel is to be used for desilting purposes and during construction it served for the diversion of river flow.

At the base of the tunnel a 15" dia. steel irrigation pipeline has been embedded in the concrete. The penstock for operating the tunnel is installed at the upstream side but operates from the downstream by a hydraulic system. The valve operating the pipeline operates at the downstream part. Another high level irrigation outlet pipe 12" dia. has been fixed for the irrigation of Tersephanou lands. The spillway is the most expensive we have ever built in Cyprus. It is made up of 10,000 cu. yds. of concrete including the big retaining walls. A mass concrete ogee shaped weir 210 ft. wide is the inlet of the spillway from where the water will discharge to the river through a concrete lined chute 600 ft. long. At its end a stilling basin is provided to avoid erosion. The crest of the spillway is 13 ft. below the crest of the dam and is capable of discharging 20,000 cusecs allowing 4 ft. of freeboard.

The construction of this dam was undertaken by the Water Development Department and heavy earth moving machinery such as two new D.8 bulldozers and 2 60 ton heavy tyred pneumatic rollers was used. A lot of other earth moving and concrete machinery were also at the site. The cost of this dam is expected to be about £130,000.

Its storage capacity is 400 million gallons and the water is to be used for the irrigation of some 2500 donums of land belonging to Kiti, Tersephanou and Sophtadhes mainly for spring and some perennial crops.

Some water may be used for recharge downstream at Kiti and Pervolia where a lot of underground water is being pumped and some sea intrusion has been observed at Pervolia. The main crops in this area are artichokes, cauliflowers, water melons and other vegetables.

5. Ovgos Dam (Morphou).

This dam is the second dam built for Morphou (the first one being the Serrachis dam in 1962). This dam was built on the Ovgos tributary of the Serrachis near Chrysilliou.

Both preliminary works, detailed designs and construction were undertaken by the Water Development Department. Its type is of earth construction formed of

silty gravel zones on either side of a clay core. The upstream slope is 1:2.5 and the downstream 1:2. The maximum height of the dam above river bed is 46 ft. and the embankment is 2,400 ft. long. The total fill material amounts to 170,600 cu. yds. The upstream face has been provided with handplaced rip-rap for half its height upwards. The spillway entry is a side channel 290 ft. long of ogee shape and its crest is 9 ft. below the crest of the dam. Allowing for 3 ft. of freeboard the maximum discharge can be 14,000 cusecs. The chute is 1050 ft. long and is lined throughout its length in concrete provided with three stilling basins starting at 250' from the end of the weir. A non pressure gallery of concrete oval section 4'-3" wide and 4'-3" high was built through the embankment of the dam in the lowest point of the river bed. This gallery is used to convey a 24" dia. steel pipe to serve for desilting, and branching off a 12" dia. steel pipe for conveying irrigation water to the canals. It also conveys an 8" dia. steel pipe for diverting any saline water from upstream of the reservoir to the downstream side beyond the embankment. The total length of this gallery is 160 ft. The diversion pipeline for the saline water comes from a diversion weir built in concrete upstream of the reservoir. The total length of this pipeline is 6200 ft. of which 1200 ft. is of steel and 5000 ft. of asbestos. The reason for the existence of saline water is that some parts of the upstream catchment especially at Skylloura are made up of saline soils. Usually when the run off is large and water comes from the whole catchment the salinity of the water is low, but during small flows, the salt that has been deposited on the river channel dissolves and a high concentration is noticed. From the measurements of flow and salinity it has been calculated that above 1.2 cusecs the water is of good quality (below 200 p.p. in NaCl). Thus the diversion weir upstream is designed to divert flows below 1.2 cusecs.

The entry to the gallery is sealed off in concrete whilst the irrigation pipeline, and the desilting pipelines are controlled by valves from the downstream.

The dam with the necessary acquisition of land will cost £80,000.

The capacity of this dam is 200 million gallons and is to be used for the direct irrigation of existing citrus plantations in the Ovgos region. The purpose is to relieve the pumping from the boreholes in the area as the underground watertable has dropped considerably and the salinity exceeds 1000 p.p.m. NaCl. The original idea was to recharge through spreading grounds but investigations have shown that permeable and impermeable beds overlied each other from the surface to the water table and that recharge was not practicable.

6. Kanli Koyü Dam.

This dam was built to replace the small Kanli Koyü earth dam built in 1949 which had substantially filled with silt. The capacity of the small dam was 40 million gallons. The new dam has a capacity of 240 million gallons.

Preliminary investigations, detailed designs and construction were undertaken by the Water Development Department. Its cost will reach £30,000.

The embankment which at its highest is 35 ft. is formed of 62,000 cu. yds. of uniform fill of cohesive material, its upstream slope being 1:3 and its downstream slope 1:2. A filter downstream blanket and toe have been provided. The upstream face is protected by a handplaced rip-rap from half the height upwards.

A non pressure oval shape gallery of concrete lining 4'-3" wide by 4'-3" high was built through the embankment of the dam at the lowest part of the river bed which is used for the conveyance of a 12" dia. steel irrigation pipeline controlled by a valve on the downstream side. The total length of this gallery is 200 ft.

The spillway entrance is in the form of a broad-crested concrete weir 100 ft. long the crest of which is 7 ft. below the crest of the dam. Allowing for 3 ft. freeboard the maximum discharge can reach 5,500 cusecs. Another anti-erosion weir is provided along the 100 ft. long spillway channel and a concrete protection wall at the embankment side.

The original Kanli Koyü Dam was the second dam built on the southern flanks of the Kyrenia range, the first one being the Syngrassis reservoir.

The water from this dam will be used mainly for the supplementing of irrigation water to cereals such as wheat and barley and also for some irrigation in spring crops. The reservoir basin itself can be used for the growing of summer crops after the reservoir is emptied because the soil is argillaceous and retains moisture for quite a long time. The total extent of land that can be benefited is about 1500 donums.

7. Mia Milea Dam.

This is the 6th dam, all of earth type construction, built on the southern flanks of the Kyrenia range and is the second built for Mia Milea. The first one was built in 1960. The new dam is much bigger and is on the "Symeas" Stream a much bigger stream than the Argaki tou Konnou stream on which the smaller dam was built.

The preliminary investigations, detailed designs and construction were undertaken by the Water Development Department. The embankment is 50 ft. at its highest above the river bed and the total fill amounts to 70,000 cu. yds.

It is of a zoned embankment made up of a clay core in the middle and gravel zones on either side. The upstream slope is 1:2.5 and the downstream slope 1:2. The upstream face has been protected by a handplaced rip-rap for half the height upwards. A 12" dia. steel irrigation outlet pipe has been embedded in concrete at the lowest part of the river bed through the embankment. This irrigation pipe which is 265 ft. long can be controlled by a valve on the downstream side.

The spillway entrance is made up of a broadcrested concrete spillway 80 ft. wide whose crest is at 6 ft. below the crest of the dam. Allowing for 3 ft. freeboard the maximum discharge over the spillway can reach 4,500 cusecs. An anti-erosion weir is provided along the 80 ft. long spillway and a concrete protection wall on the embankment side.

The capacity of this dam which will cost £28,000 is 74 million gallons. The water will be used for supplementing the necessary water for the irrigation of cereals which mostly rely on the rainfall. Some spring crops are also to be irrigated. The total extent of land that may be benefited can be 700 donums. As in the case of Kanli Koyü it will be possible to grow summer crops in the reservoir basin.

8. Famagusta Recharge reservoir and Pumping scheme.

This scheme which will cost £25,000 is a continuation of the Famagusta-Dherynia recharge scheme which started in 1954.

The main works included in the scheme carried out in 1963 are:-

(i) An earth reservoir 930 ft. x 350 ft. of maximum height of 16 ft. of total fill 30,000 cu. yds. of mainly havara soil. This reservoir with a capacity of 12 million gallons will be used to recharge water through the bed of the reservoir which is a continuation to the surface of the sandstone aquifer of Famagusta. The water will be pumped from the recharge gallery coming from Ayios Lucas reservoir at a point 1500 ft. away from the reservoir and involving a total head of 100 ft. The capacity of the delivery pipeline is 2.5 cusecs.

(ii) A big pumping unit at Ayios Lucas reservoir for the purpose of pumping water from the fresh water Lake to Ayios Lucas reservoir, for recharge purposes.

Two pumping units each 45 h.p. have been installed and are capable of delivering 250,000 g.p.h.

(iii) A seaward drain 8000 ft. long from the Fresh water Lake to the sea to enable the draining of the lake when the salinity of the water becomes unacceptable.

9. Famagusta Antiflood and Recharge Dam.

This scheme involves the construction of an embankment 5760 ft. long being 23 ft. at its maximum height and 98,000 cu. yds total fill and whose cost is £33,000. The embankment is homogeneous of havara soil. A spillway channel 1300 ft. long to discharge any surplus water into the Pharangas stream has also been provided. The spillway

entry is in the form of a concrete broadcrested weir whose crest is 5 ft. below the crest of the dam. Allowing for 2 ft. freeboard, the maximum spillway discharge can be 2000 cusecs.

The main purpose for this dam was flood protection for Famagusta town and the embankment intercepts 5 small streams which used to flood downstream houses. The holding capacity of the basin is 40 million gallons and the water can partly percolate through the exposed sandstone aquifer or can be allowed through three outlet pipes to flow downstream for spreading purposes.

10. Ayia Napa recharge Dams.

This scheme involves the construction of 7 small earth dams with appropriate spillways and small diameter outlet pipes at a cost of £7,000

The highest of these dams is 15 ft. of homogeneous embankment material. The total fill of all seven dams amounts to 23,000 cu. yds. and the total holding capacity is 12 million gallons. The purpose of these small dams is to recharge directly through the exposed sandstone bed of the reservoirs, the overpumped coastal aquifer. This scheme is very similar to that carried out in Paralimni in 1962.

(b) Flood Protection Schemes.

1. Yermasoyia Antiflood scheme.

This scheme which is estimated to cost £35,000 involves the following.

Stage I.

River training upstream of the Yermasoyia bridge on the Nicosia-Limassol road including widening of the river bed and protection of the embankments.

Reconstruction of a measuring weir which was destructing the river flow.

Protection of a medieval foot bridge.

Stage II.

To be constructed in 1964 involves the alignment of the river downstream of the bridge as far as the sea.

2. Karavostassi Antiflood Scheme.

This is also a river training scheme of a small stream which often used to flood a few houses at Karavostassi. Here the stream disappeared near the houses which it used to flood before reaching the sea. Therefore a new river course had to be opened to the sea.

The cost involved which includes quite a lot for compensation amounts to £7,800.

3. Voroklini Antiflood Scheme.

This scheme is in the form of a peripheral canal around the village of Voroklini which serves in catching up the flood water which used to flood the village from the surrounding hills, before it reaches the village. The water is drained into a nearby small stream and thence into the sea.

The cost of the scheme was £4,600.

(c) Pumping Schemes.

1. Loutros.

The scheme consists of a borehole with a pumping unit capable of pumping 15,000 gallons per hour through a 2,000 ft. composite 6" and 8" steel rising main delivering the water into a concrete lined channel 7000 ft. long which commands 120 donums of land to be irrigated by the Loutros people in perennial crops.

The scheme's cost is £10,800.

2. Avlona.

This pumping scheme at a cost of £20,000 involves the construction of a borehole with the necessary pumping installations for delivering at a rate of 20,000 gallons per hour and the lining in concrete of 26,000 ft. of channels to command an area of 2000 donums for the irrigation of perennial crops. A lot of this land is also irrigated in cereals by river water during the winter months.

3. Athienou.

The scheme consists of a borehole with the necessary pumping unit to pump at a rate of 15,000 gallons per hour, 900 ft. of 6" steel rising main and 12,800 ft. of Class B 6" dia. Asbestos pipes at a cost of £9,600. The scheme will irrigate 100 donums with perennial crops.

(d) Other Irrigation Works.

1. Kellia.

This scheme on which £10,000 have been spent, involves the construction of 4 concrete intake weirs and a total length of 16,000 ft. of earth channels.

The source is winter stream flow and the crops to be irrigated will be cereals.

2. Anayia.

This scheme is for the lining in concrete of 19,000 ft. of channels for the benefit of the Anayia Irrigation Division, the Anayia "Kourtoudji" Irrigation Association and the Argates "Koutouji" Irrigation Association.

The cost of the scheme was £11,500.

3. Pedhoulas.

This scheme whose cost was £9,900 involved:-

The construction of 3 concrete intake weirs on the Marathassa Catchment.

The construction of a concrete circular storage tank 20,000 gallons capacity and the laying of 6000 ft. of steel irrigation pipes varying from $1\frac{1}{2}$" to 4" dia.

The scheme is for the irrigation of deciduous trees such as apples and cherries.

4. Pelendria.

This scheme which cost £4,690 involved the improvement of springs by excavation and protection works, the construction of concrete storage tanks, the construction of intake weirs on small streams, the laying of steel irrigation pipes of up to 4" dia. and the construction of concrete channels.

The construction works are independent units in the following localities:

Pano Koutlos, Froudhi, Pano Potamoulia, Kato Englisis Amiantou and Kato Englisis Pelendrion.

5. Kalopanayiotis.

The scheme constructed at "Xerarkaka" locality consists of a small subsurface dam layed into the bed rock of the river to enable the underground flow to rise to the surface and from there to be distributed by pipes and channels for the irrigation of some 20 donums with perennial crops. The flow is estimated to exceed 2000 gallons per hour in summer.

The cost amounted to £2,200.

6. Tris Elies.

The scheme constructed at the locality "Drakontas" consist of the construction of 4 concrete intake weirs on small streams, 12,100 ft. of concrete channels, 400 ft. of 6" dia. and 450 ft. of 4" dia. steel pipes for irrigation.

The expenditure on the scheme is £8,000 and will irrigate 80 donums with perennial crops and 120 donums with spring crops.

7. Polis.

This scheme is for the lining in concrete of 12,500 ft. of channels of the "Gastrappi" Irrigation Division which takes water from the "Gastrappi" chain-of-wells as far as Prodromi village.

The scheme is estimated to cost £9,000 and will irrigate about 120 donums in summer crops, 190 donums in spring crops and 600 donums of winter crops.

8. Akaki.

This scheme at a cost of £11,300 was constructed for the "Riatikon" Irrigation Association.

It involves the lining in concrete of 7700 ft. of channels and the improvement of another 5700 ft. of earth channels.

The source of water is a chain-of-wells and river flow when available.

9. Agros.

This scheme consists of 8 small independent irrigation works at the localities "Anastassia", "Vourni", "Kakopoullia", "Pano Kamara", "Kato Kamara", "Pano Lambada", "Loura" and "Kaouros" at a total cost of £6,230.

The works involve, excavation and improvement of springs, building concrete diversion weirs on small streams, building of concrete reservoirs, the building of irrigation pipes and laying of small diameter steel irrigation pipes.

II. Short Range Planning.

The major projects scheduled for construction in 1964 are given in outline in the table Appendix 6. The work carried out in 1963 to enable the construction of these works in 1964 is the following:-

(i) Site investigations such as

Surveying work
Test pits, boreholes
Geological work
Hydrological work, measurements of flow, rainfall etc.

The expenditure on the test pits and boreholes was as follows:-

Palechori	£426
Agros	£ 77
Mavrokolymbos	£125
Polemidhia	£126
Lefkara	£ 20
Kalopanayiotis	£450

But more expenditure is expected in the beginning of 1964 on the above projects. The total expenditure on major projects investigations spent in 1963 including the investigations on the 1963 Dams was £14,000.

(ii) Laboratory work for the above projects for the testing of materials for the construction. £100 were spent for this purpose.

(iii) Design work for these projects was more or less completed by the end of 1963.

For the 1964 projects the designs are carried out by:-

Agros	by the Water Development Dept.
Lefkara	" " " " "
Kalopanayiotis	" Howard Humphreys
Mavrokolymbos, Polemidhia	" Energoprojekt
Ayios Theodoros	" Tahal of Israel.

The total expenditure on Consultant's fees incurred in 1963 was £26,869.

III. Long Range Planning.

This planning has been a more or less new introduction.

The aim is to produce a master plan for the whole island water development but still a lot has to be done to achieve this aim as it is by no means an easy job having to deal with an island which although small in size yet it has so many complicated water rights, traditions, variable topography, geology and hydrology. As a start it has already being decided to grant the two main watersheds of the island to one or more consultants experienced in master planning. These watersheds are the Kourris-Garyllis including the Akrotiri in the south and the Xeros-Marathassa-Karyotis-Atsas on the north. No decision has yet been taken as to who the Consultants will be. The Water Development Department itself has completed a preliminary or skeleton masterplan for the water development of the Pendaskynos, of the Tremithios and of the Elea rivers. In addition a certain programme has been put forward for more detailed investigation for the construction of dams in 1965 and 1966.

With the masterplanning being introduced and with more details now required for planning the distribution systems for the dams, the need for topographic maps has become evident. And as a field survey on a large scale is a timely and expensive job, an aerial survey was decided upon. The whole island has already been flown and aerial photographs to a scale of 1/10,000 taken by the Fairey Air Surveys Ltd. of London.

The Government now is negotiating for the preparation of 4-colour topographic maps from these photographs on a scale of 1/5,000 in the plains with contours at an interval of 2 to 4 ft.

A difficulty is the ground control marking which takes a long time to perform. A line of 1st order levelling is also necessary from the Famagusta bench mark to establish other benchmarks in a circuit around the island.

IV. Operation & Maintenance of Dams.

A new section has been created for the operation and maintenance of dams which as time goes on will become more important. The management is now in the hands of the Irrigation Divisions. Although the Irrigation Divisions are in need of more technical assistance, especially in the field of efficient water use, yet the system works satisfactorily, except when a large dam forms part of the project. For such projects and especially for the management of watersheds with several dams more appropriate bodies, including technicians are required. During the interim period, until the proper organization is established, the Government must take responsibility in some cases for the complete management, in other cases for the assisting of the Irrigation Divisions.

With regard to the maintenance of dams for which a vote of £5,000 had been approved by Government the following works were carried out in 1963.

1.	Athalassa dam extension of spillway and repairs on embankment	£ 670
2.	Gypsos dam repairs on embankment	1,100
3.	Perapedhi dam repairs on gates	50
4.	Lefka Kafizes dam desilting	40
5.	Trimiklini dam desilting and repairs on gates	160
6.	Petra dam repairs on gates	300
7.	Kouklia reservoir repairs on embankment	350
		£2,670

Of this £2,100 were Government contribution and £570 deposits from the beneficiaries concerned.

Appendix 1.

Year	Expenditure on Irrigation Works £	Total expenditure on all water works in W.D.D. £	Expenditure on irrigation % of total expenditure on general works in W.D.D.
1950	102,620	307,162	33
1951	163,493	522,847	31
1952	171,493	585,141	29
1953	169,500	771,800	22
1954	132,500	821,900	16
1955	180,850	661,400	27
1956	125,276	852,172	14.5
1957	179,600	1,064,000	17
1958	95,275	1,049,125	10
1959	85,147	500,872	17
1960	90,686	345,491	26
1961	285,000	1,024,793	28
1962	400,000	1,089,152	36.5
1963	790,000	1,473,100	53.6

Appendix 2.

CONSTRUCTION OF DAMS IN 1963.

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums Winter	Spring	Perennial	Remarks
1	Morphou (Serrakhis)	Construction of an earth dam	95,000	3,980	-	-	-	For recharge purposes. Scheme continued from 1962.
2	Prodhromos	Construction of an intake weir, laying of pipes and construction of a big earth reservoir	72,000	26,041	-	-	200	Improved and new irrigation. Scheme continued from 1962.
3	Kanli Koyü	Construction of an earth dam	30,000	21,800	500	200	-	Improved and new irrigation. Scheme to be completed in 1964.
4	Morphou (Ovgos)	Construction of an earth dam and distribution channels	120,000	58,000	-	-	-	For recharge purposes. Scheme to be completed in 1964.
5	Mia Milia (Symeas)	Construction of an earth dam and distribution system	28,000	21,200	600	200	-	Improved and new irrigation. Scheme to be completed in 1964.
6	Famagusta Recharge	Construction of an earth reservoir for recharge and pumping installations	25,000	20,600	-	-	-	For recharge purposes. Scheme to be completed in 1964.
7	Famagusta Antiflood	Construction of an earth dam for recharge	33,000	30,600	-	-	-	For antiflood and recharge purposes. Scheme to be completed in 1964.
		C.F.	403,000	182,221	1,100	400	200	

Ser. No.	Village	Nature of work	Estimated cost £	Expend-iture in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Per-ennial	
		B.F.	403,000	182,221	1,100	400	200	
8	Kiti (Tremithios)	Construction of an earth dam	115,000	80,300	-	-	1,400	Scheme to be completed in 1964.
9	Pomos	Construction of a rockfill dam and distribution	130,000	97,500	-	400	400	Scheme to be completed in 1964.
10	Ay. Marina	Construction of a rockfill dam and distribution	110,000	48,700	-	450	50	Scheme to be completed in 1964.
11	Argaka-Nagounda	Construction of a rockfill dam	280,000	209,000	-	800	350	Scheme to be completed in 1964.
		Totals	1,038,000	617,721	1,100	2,050	2,400	

Appendix 3.

MINOR IRRIGATION SCHEMES COMPLETED IN 1963.

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Perennial	
(a)	Kyrenia District							
1	Kalogrea	Repairs to the existing storage tank and laying of pipes	440	400	8	2	2	Improved and new irrigation.
2	Lapithos (Sphinarkotikon)	Lining of channels	7,000	6,750	-	-	63	Additional irrigation.
3	Larnaca tis Lapithou	Excavation and building of springs, laying of pipes, lining of channels and repairs	2,000	1,890	-	50	30	Improved and new irrigation.
4	Karavas	Lining of channels	3,350	801	-	-	800	Improved and new irrigation. Continued from 1962.
5	Thermia (Boghaz)	Laying of pipes	1,300	470	10	10	3	Improved and new irrigation. Continued from 1962.
		Totals	14,090	10,311	18	62	898	

Ser. No.	Village	Nature of Work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Perennial	
(b)	Nicosia District							
1	Anayia	Lining of channels	12,000	11,820	527	200	-	Improved and new irrigation.
2	Tembria-Sinaoros	Lining of channels	2,190	1,890	-	-	32	- do -
3	Kalopanayiotis	Construction of a weir, lining of channels and laying of pipes	2,200	2,030	-	-	20	- do -
4	Elea	Laying of pipes	1,800	1,800	-	100	150	- do -
5	Apliki	Construction of a storage tank, lining of channels and laying of pipes	1,700	1,620	-	25	6	- do -
6	Spilia	Construction of a weir and storage tank and laying of pipes	840	780	-	15	5	- do -
7	Alona	Repairs	170	170	-	-	-	Improvement work.
8	Pharmakas	Lining of channels and laying of pipes	280	260	-	10	4	Improved and new irrigation.
9	Milikouri (Potamos)	Construction of weirs and laying of pipes	2,000	2,000	-	-	48	- do -
10	Milikouri (Pano Pateritsa)	Excavation and building of springs, construction of storage tank and laying of pipes	700	700	-	18	5	- do -
		C.F.	23,880	23,070	527	368	270	

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums Winter	Spring	Perennial	Remarks
		B.F.	23,880	23,070	527	368	270	
11	Orounda	Pumping unit	4,800	1,815	-	500	-	Improved and new irrigation. Continued from 1962.
12	Avlona	Pumping unit	5,500	1,670	-	-	200	- do -
13	Gourri	Lining of channels	3,600	1,427	300	20	-	- do -
14	Nisou	Lining of channels	1,800	252	-	100	50	- do -
15	Kambi	(i) Construction of storage tank and lining of channels	530	92	20	19	2	- do -
		(ii) Construction of storage tank and laying of pipes	550	235	-	-	10	- do -
16	Kythrea	Lining of channels	11,700	11,520	-	200	100	Improved and new irrigation.
		Totals	52,360	40,081	847	1,207	632	
(c)	Famagusta District							
1	Livadhi	Excavation and lining of tunnel, pumping unit	2,000	1,970	-	-	50	Improved and new irrigation.
2	Paralimni	(i) Construction of earth dams	9,200	3,050	-	-	-	For recharge purposes.
		(ii) Construction of canals	18,000		-	-	-	- do - Continued from 1962.
		C.F.	29,200	5,020	-	-	50	

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums Winter	Spring	Perennial	Remarks
		B.F.	29,200	5,020	-	-	50	
3	Chattos	Improvements to the existing spate irrigation system	1,950	1,350	-	-	-	Improvement work. Continued from 1962.
4	Engomi	Desilting and regrading of earth channels	3,200	1,425	2,000	-	-	Improved and new irrigation. Continued from 1962.
5	Prastio	Desilting and regrading of earth channels	11,800	172	1,100	-	-	- do -
6	Asha	Desilting and regrading of earth channels	2,300	560	5,000	-	-	- do -
7	Ay. Napa	Construction of earth dams	9,000	8,850	-	-	-	For recharge purposes.
		Totals	57,450	17,377	8,100	-	50	
(d)	Larnaca District							
1	Psevdhas	Lining of channels	400	370	-	23	18	Improved and new irrigation.
2	Kellia	Construction of weirs, excavation of earth channels	10,000	9,200	656	-	-	- do -
3	Maroni	Construction of a protective wall	140	140	-	-	-	Improvement work.
4	Aradhippou	Construction of weirs, excavation of earth channels, repairs	2,350	2,260	400	-	-	Improved and new irrigation.
		C.F.	12,890	11,970	1,056	23	18	

Ser. No.	Village	Nature of work	Estimated cost £	Expend-iture in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Per-ennial	
		B.F.	12,890	11,970	1,056	23	18	
5	Odhou	Lining of channels, laying of pipes, construction of storage tank	1,500	1,370	-	60	3	Improved and new Irrigation.
6	Ay. Theodhoros	Construction of a diversion weir and earth channels	8,500	7,700	2,563	-	-	- do -
7	Arsos	Pumping unit, laying of pipes	9,000	7,500	-	-	150	- do -
		Totals	31,890	28,740	3,619	83	171	
(e)	Limassol District							
1	Agros (Pano Vrysia)	Construction of a storage tank and laying of pipes	270	250	-	-	8	Improved and new irrigation.
2	Agros (Yeratjia-Pertikoudhia)	Construction of a storage tank, laying of pipes	560	540	-	10	8	- do -
3	Agros (Anastasia)	Lining of channels, laying of pipes	1,450	1,430	-	-	55	- do -
4	Agros (Vourni)	Excavation and building of spring, laying of pipes	1,400	1,400	-	20	18	- do -
5	Agros (Kamara)	Excavation and building of springs, laying of pipes	1,310	1,300	-	20	15	- do -
		C.F.	4,990	4,920	-	50	104	

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Perennial	
		B.F.	4,990	4,920	-	50	104	
6	Agros (P. Lambadha)	Construction of a storage tank, laying of pipes and lining of channels	470	462	-	15	10	Improved and new irrigation
7	Agros (Loura)	Laying of pipes, lining of channels	300	300	-	15	9	- do -
8	Agros (Kaouros)	Construction of storage tank, laying of pipes, lining of channels	900	890	-	-	13	- do -
9	Tris Elies (Gatania)	Construction of a weir, storage tank, laying of pipes	1,030	1,000	-	15	2	- do -
10	Pelendria (Mesi Koutlos)	Laying of pipes	200	200	-	-	3	- do -
11	Pelendria (Skamioratos)	Construction of a weir, storage tank and laying of pipes	700	700	-	-	9	- do -
12	Pelendria (Kato Englisis Pelendrion)	Construction of a storage tank, lining of channels, laying of pipes	1,240	1,230	-	-	15	- do -
13	Pelendria (Kato Englisis Amiandou)	Construction of a storage tank, lining of channels	1,000	900	-	-	18	- do -
		C.F.	10,830	10,602	-	95	183	

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Perennial	
		B.F.	10,830	10,602	-	95	183	
14	Ay. Ioannis (Makheras)	Laying of pipes, lining of channels	1,030	900	-	-	70	Improved and new irrigation.
15	Dhierona (Kamaroudhia)	Lining of channels	2,600	2,500	-	-	220	- do -
16	Yermasoyia (1st stage)	Pumping units, lining of channels	16,000	16,000	-	-	800	- do -
17	Pelendria (Kolokasi)	Lining of channels	1,280	1,080	-	10	8	- do -
18	Pelendria (Hji Phisouni)	Construction of weir, storage tank, lining of channels	1,700	1,580	-	15	17	- do -
19	Anoyira	Repairs, laying of pipes	460	57	-	10	4	- do -
20	Kato Amiandos	Construction of intake, lining of channels, laying of pipes	16,000	2,100	-	-	500	- do - Continued from 1962.
21	Ay. Demetrios (Kaminia)	Construction of weir, storage tank, lining of channels	1,300	313	-	-	180	- do -
22	Ay. Demetrios (Kryo Nero)	Construction of a protective wall	420	510	-	-	-	Improvement work.
23	Agridhia (Pano Yeradjia)	Construction of storage tank, lining of channels, laying of pipes	600	600	-	20	10	Improved and new irrigation.
		Totals	52,220	36,242	-	150	1,992	

Ser. No.	Village	Nature of work	Estimated cost £	Expend-iture in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Per-ennial	
(f)	Paphos District							
1	Kilinia	Construction of a small weir, laying of pipes	170	125	-	-	8	Improved and new irrigation.
2	Polis (Kastrapi)	Construction of a weir, lining of channels	11,200	11,200	600	190	120	- do -
3	Polis (Chiftlik)	Construction of pro-tection works	2,000	1,960	-	-	-	Improvement work.
4	Polis (Djerepia)	Lining of channels	3,800	3,800	5,000	-	-	Improved and new irrigation.
5	Armou	Excavation and building of springs, laying of pipes	1,550	980	-	25	20	- do - Continued from 1962.
6	Panayia (Monadhia)	Spring, construction of storage tank	1,500	1,480	-	16	8	Improved and new irrigation.
7	Kritou Terra	Construction of weir, lining of channels, laying of pipes	1,000	1,000	-	-	15	- do -
8	Phinikas	Lining of channels	7,400	7,000	-	-	250	- do -
9	Kithasi	Pumping unit, laying of pipes	4,000	980	-	50	70	- do - Continued from 1962.
10	Souskiou	Lining of channels	5,900	1,494	-	-	150	- do -
11	Peyia	Spring, construction of storage tank, pumping unit, laying of pipes	4,000	1,930	-	20	30	- do -
		C.F.	42,520	31,949	5,600	301	671	

Ser. No.	Village	Nature of work	Estimated cost £	Expend-iture in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Per-ennial	
		B.F.	42,520	31,949	5,600	301	671	
12	Amargeti	Repairs, laying of pipes	850	870	-	-	200	Improved and new irrigation.
13	Kholi	Excavation and lining of tunnel	450	380	-	15	10	- do -
14	Trimithousa (Khrys)	Repairs, laying of pipes	460	456	-	5	10	- do -
15	Mamonia	Construction of a protective wall	1,300	1,276	-	-	-	Antiflood scheme.
16	Akhelia	Relaying of a pipe-crossing	600	600	-	-	-	Maintenance work.
17	Episkopi	Laying of pipes	1,600	1,438	-	-	100	Improved and new irrigation.
		Totals	47,780	36,969	5,600	321	991	
		Grand totals for all Districts	255,790	169,720	18,184	1,823	4,734	

IRRIGATION SCHEMES UNDER CONSTRUCTION IN 1963 TO CONTINUE IN 1964.

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums			Remarks
					Winter	Spring	Perennial	
(a)	Nicosia District							
1	Xerovounos-Loutros	Pumping unit, lining of channels, laying of pipes	10,800	5,500	-	-	120	Improved and new irrigation.
2	Avlona	Pumping unit, lining of channels	20,000	19,400	1,000	800	200	- do -
3	Argaki	Pumping unit, lining of channels	5,000	1,260	120	250	135	- do -
4	Karavostasi	Antiflood scheme	9,550	7,300	-	-	-	
5	Pedhoulas	Construction of intake weirs, lining of channels and laying of pipes	9,900	8,900	-	-	103	Improved and new irrigation.
6	Akaki	Lining of channels	11,300	11,085	2,500	-	-	- do -
7	Geunyeli	Lining of channels	6,200	4,200	-	-	-	
		Totals	72,750	57,645	3,620	1,050	558	
(b)	Famagusta District							
1	Ay. Iacovos	Spring, lining of channels, laying of pipes	1,800	1,100	-	-	25	- do -
		Totals	1,800	1,100	-	-	25	

Ser. No.	Village	Nature of work	Estimated cost £	Expend-iture in 1963 £	Land to be irrigated in a normal year of run-off Donums Winter	Spring	Per-ennial	Remarks
(c)	Larnaca District							
1	Voroklini	Construction of antiflood weirs, excavation of canals	4,600	2,700	-	-	-	Antiflood scheme.
2	Louvaras (P. Monastirka)	Construction of weir, storage tank, laying of pipes	1,370	803	-	25	9	Improved and new irrigation.
3	Louvaras (Koutoutsou)	Construction of a storage tank, lining of channels	490	250	-	20	10	- do -
4	Louvaras (Paskalis)	Spring, construction of storage tank, lining of channels	1,360	260	-	20	14	- do -
5	Louvaras (P. Pervolia)	Repairs, laying of pipes	380	330	-	10	6	- do -
6	Louvaras	Spring, laying of pipes	230	130	-	-	7	
		Totals	8,430	4,473	-	75	46	
(d)	Limassol District							
1	Potamitissa (Yeradjia)	Laying of pipes	1,400	580	-	20	16	- do -
2	Potamitissa (Angelina)	Construction of storage tank, lining of channels, laying of pipes	1,640	1,300	-	-	20	- do -
		C.F.	3,040	1,880	-	20	36	

Ser. No.	Village	Nature of work	Estimated cost £	Expenditure in 1963 £	Land to be irrigated in a normal year of run-off Donums Winter	Spring	Perennial	Remarks
		B.F.	3,040	1,880	-	20	36	
3	Tris Elies (Dhrakontas)	Construction of weirs, lining of channels, laying of pipes	8,000	3,000	-	120	80	Improved and new irrigation.
4	Yermasoyia (stage II)	Pumping units and lining of channels	26,000	9,600	-	-	800	- do -
5	Agridhia (Kaloyiros)	Spring, lining of channels	590	330	-	-	10	- do -
6	Yermasoyia	Construction of a weir and river training works	14,000	9,600	-	-	-	Antiflood scheme.
7	Potamitissa (Vlou)	Laying of pipes	1,150	1,100	-	-	12	Improved and new irrigation.
8	Sykopetra	Lining of channels, repairs	780	430	-	30	20	- do -
9	Agridhia (Pano and Kato Leftina)	Spring, construction of weir, laying of pipes, lining of channels	1,260	1,150	-	20	30	- do -
		Totals	54,820	27,090	-	190	988	
(e)	Paphos District							
1	Souskiou	Pumping unit	4,000	2,700	-	-	150	- do -
		Totals	4,000	2,700	-	-	150	
		Grand totals for all Districts	141,800	93,008	3,620	1,315	1,767	

Appendix 5.

IRRIGATION SCHEMES APPROVED FOR EXECUTION 1963 BUT NOT UNDERTAKEN.

Ser. No.	Village	Nature of work	Estimated cost £	Land to be irrigated in a normal year of run-off Donums			Remarks
				Winter	Spring	Per-ennial	
(a)	Kyrenia District						
1	Dhikomo	Improvements on the spring, lining of channels	3,150	7,000	-	-	Arrears and Administration difficulties.
		Totals	3,150	7,000	-	-	
(b)	Nicosia District						
1	Ayii Trimithias	Construction of a retaining wall, repairs	3,100	1,030	-	-	- do -
2	Lythrodhontas	Repairs	380	-	-	-	- do -
3	Kalokhorio (Klirou)	Raising of the existing R.C. channels	4,800	-	550	100	- do -
4	Sarandi	Spring, construction of a storage tank, lining of channels	660	-	8	8	- do -
5	Lagoudhera	Construction of a storage tank, laying of pipes	950	-	32	8	- do -
6	Palekhori (Maroullena)	Construction of a storage tank, laying of pipes	1,100	-	10	20	Scheme rejected.
		C.F.	10,990	1,030	600	136	

Ser. No.	Village	Nature of work	Estimated cost £	Land to be irrigated in a normal year of run-off Donums			Remarks
				Winter	Spring	Per-ennial	
		B.F.	10,990	1,030	600	136	
7	Palekhori (Angoulous)	Construction of a retaining wall, lining of channels	270	-	-	14	Scheme rejected.
8	Elia	Pumping unit, laying of pipes	5,500	-	-	110	Admin. difficulties.
		Totals	16,760	1,030	600	260	
(c)	Famagusta District						
1	Liopetri	Construction of an earth dam	33,000	-	-	-	Administration difficulties.
		Totals	33,000	-	-	-	
(d)	Larnaca District						
1	Layia	Laying of pipes	240	10	2	2	Scheme abandoned.
2	Athienou	Pumping unit, laying of pipes	9,600	-	-	100	Administration difficulties.
		Totals	9,840	10	2	102	
(e)	Limassol District						
1	Omodhos (Ayiasma)	Construction of storage tank, laying of pipes	1,780	-	10	6	Administration difficulties.
2	Agros (Karkopoulia)	Repairs, lining of channels, laying of pipes	400	-	-	10	Scheme abandoned due to the construction of a big reservoir.
		C.F.	2,180	-	10	16	

Ser. No.	Village	Nature of work	Estimated cost £	Land to be irrigated in a normal year of run-off Donums			Remarks
				Winter	Spring	Per-ennial	
		B.F.	2,180	-	10	16	
3	Silikou (Fidolar)	Lining of channels, laying of pipes	650	-	-	10	Administration difficulties.
4	Pyrgos (Dhimmatis Regaenas)	Construction of weir, repairs, lining of channels	3,500	150	150	-	- do -
5	Pelendria (P. Koutlos)	Spring, laying of pipes	220	-	-	8	- do -
6	Pelendria (Froudhi)	Excavation and building of spring	330	-	-	2	- do -
7	Pelendria (P. Potamoulia)	Construction of storage tank, lining of channels	780	-	20	14	- do -
8	Potamitissa (Skouri)	Construction of storage tank, lining of channels, laying of pipes	500	-	10	3	- do -
9	Ay. Theodhoros (Perdikousa)	Construction of storage tank, weir, lining of channels, laying of pipes	1,610	-	-	24	- do -
10	Ay. Therapon	Repairs, laying of pipes, lining of channels	1,060	-	-	100	- do -
11	K. Amiandos-Pelendria (Phournia)	Laying of pipes	260	-	13	14	- do -
		C.F.	11,090	150	203	191	

Ser. No.	Village	Nature of work	Estimated cost £	Land to be irrigated in a normal year of run-off Donums			Remarks
				Winter	Spring	Per-ennial	
		B.F.	11,090	150	203	191	
12	Limnatis (Alakati)	Laying of pipes	400	-	3	4	Administration difficulties.
13	Akrotiri	Desilting and regrading of earth channels	6,000	-	-	-	Scheme to be executed in 1964. For recharge purposes.
		Totals	17,490	150	206	195	
(f)	Paphos District						
1	Statos	Excavation and building of spring	200	-	-	5	Scheme not wanted.
2	Terra	Lining of channels, laying of pipes	2,600	-	-	64	Arrears and administration difficulties.
		Totals	2,800	-	-	69	
		Grand totals for all Districts	83,040	8,190	808	626	

Appendix 6.

MAJOR IRRIGATION PROJECTS

DAM - PROGRAMME FOR 1964

Dam	Type of dam	Capacity in million gallons	Quantity of Fill			Total Excavations cu. yds.	Total Concrete cu. yds.	Estimated cost including distribution system £
			Main fill cu. yds.	Core cu. yds.	Filter cu. yds.			
1. Agros	Earth	22	90,000	30,000	-	45,000	500	50,000
2. Ay. Theodhoros Tyllirias	Gravity	100	-	-	-	3,650	19,500	100,000
3. Kalopanayiotis	Rockfill	100	190,000	46,000	20,000	200,000	10,000	220,000
4. Lefkara	Concrete Gravity	200	-	-	-	6,000	20,000	200,000
5. Liopetri	Earth	80	38,000	17,000	2,000	30,000	1,000	33,000
6. Mavrokolymbos	Earth	350	240,000	25,000	46,000	250,000	7,000	300,000
7. Polemidhia	Earth	750	180,000	29,000	40,000	270,000	10,000	170,000

13. REPORT ON VILLAGE WATER SUPPLIES

By H. P. Karakannas, M.ASCE., M.I.P.H.E., M.R.S.H.,
Engineer-Hydrologist.

The work of the Village Domestic Water Supply Section is confined to the domestic supplies for the villages, but it also includes the Towns of Paphos and Kyrenia, all representing a population of 392,000 persons, or 66% of the total population of the island. The Section deals with all aspects of waterworks: the investigation and development of springs, the laying of supply and distribution water mains, the construction of storage reservoirs, pumping stations and public fountains. Practically in every village whereto nowadays water is provided, a house-to-house service is implemented. The cost of the scheme is shared between Government and the village on the fifty-fifty basis as a practice, while the extra cost for a house-to-house service is borne entirely by the village. The supply to the consumers is controlled by means of water meters or break-pressure and distribution boxes. The daily satisfactory supply per capita is now considered at 20 gallons, but it will have to be raised to 25 gallons or even 30 as the standard of living is rising steadily and rapidly.

The sources of village domestic supplies may be springs, boreholes, infiltration galleries or dams. Practically all the schemes executed during the year in Nicosia, Famagusta and Larnaca Districts have as sources of supply successful boreholes. The stability or deterioration of the aquifers in these districts has a direct influence on the domestic supplies, which should be maintained to a satisfactory degree. In the case of the hilly areas, such as Pitsillia dry villages, it may be found necessary to use water of the springs and compensate any irrigation losses by the construction of dams or other irrigation works that will be designed under the development programme of the watershed areas.

In the case of pumped supplies, turbine pumps are installed, driven by a diesel engine or motor where electricity is available. Water is pumped into a ground level or elevated re-inforced concrete tank, the function of which is to provide at least one day's and over storage,

and in other cases to act as a reservoir from where a steady continuous quantity of water can be withdrawn.

Most of the remaining villages without piped or satisfactory water are in the area Northwest of Salamis and Boghaz, Famagusta, and on the Northern side of Kyrenia range. A Team of German Experts is now carrying out exploratory investigations and drilling for the purpose of tapping new aquifers from where water may be withdrawn for domestic purposes.

An amount of £640,000 was allocated for village domestic supplies during 1963, and the approved programme of schemes was completed during the year. Eighty five (85) village water supply schemes serving a population of 58,684 persons were completed. It is worth mentioning that 293.74 miles of pipes varying from ½-10 inch diameter have been laid. Moreover 76 reinforced concrete tanks, 12 pumping stations and 16 public fountains were constructed. A house-to-house service was provided in 67 villages and 11,600 house connections were made. It is estimated that an area of about 1,000 donums of land within the village areas has been brought under irrigation by the use of the surplus water over their domestic requirements. This brings a very high return to the villagers.

At the end of 1963, of the total of 627 villages of the island, the number with piped supplies was 580 or 92.50%. 432 or 68.90% are considered satisfactory and 148 or 23.60% need fundamental repairs, replacements or supplementary supply. 204 villages with a population of 226,000 persons or 61.41% of the rural population of the island have a house-to-house service, conforming with the Universal standards. Because of the increase of population, rise in the standard of living, the subnormal rainfall, and the overpumping of the aquifers, water supplies that were formerly considered satisfactory are now in need of improvements or additional supply. The 47 villages without piped supply are on the whole situated far from suitable and reliable sources of water supply, but every effort is being made to solve their water problems, even if the cost of supplying them from distant sources is made higher than in past schemes.

In addition to the 84 schemes completed in 1963, a further 13 schemes were under construction in their final stage at the end of the year. Plans were prepared for 161 schemes, all estimated to cost £1,156,523.

The following table gives an outline of the work executed during the year.

LENGTH OF PIPES LAID IN 1963

(Galvanized mild steel pipes)

Size (Nominal Diameter)	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	Victaulic 6"	Total miles
Length in miles	0.835	2.875	46.390	40.613	54.113	36.007	10.840	11.970	20.337	0.831	224.801

(Asbestos-cement pressure pipes)

Size (Nominal Diameter)	2"	3"	4"	6"	8"	10"	Total miles
Length in miles	17.568	16.770	19.347	12.300	2.080	0.874	68.939

Reinforced concrete tanks:-

Elevated tanks	10 (300,000 gallons capacity)
Ground tanks	66 (2,000,000 " ")
School tanks	37
Pumping stations	12
Fountains	16
House connections	67 villages (15,000 consumers)
Area of land brought under perennial irrigation	1000 donums approximately.

The schemes completed may be classified as shown below:-

"Village standard" means that the distribution of the water is effected by street fountains only, and not by house connections. A public fountain with trough and proper drainage system serves 6-10 houses.

"House-to-house" means that the distribution of the water is effected by individual house connections. Distribution mains are laid in all inhabited areas, and the consumer

bears the cost of the service connections. The supply is controlled by means of water meters, or break-pressure regulators securing an equal quantity of water to all houses, in those cases where the supply is fixed and limited. Practically in all the new schemes in Nicosia, Famagusta and Larnaca Districts water meters are installed.

Lists showing the number of villages with piped water supply, schemes completed during the year, schemes in hand at the end of the year and schemes prepared for execution are given in Appendices 7, 8, 9 and 10.

Successful drilling carried out during the year made it possible to provide many villages in Nicosia, Famagusta, Larnaca and Limassol Districts with domestic water.

(a) An important pumping scheme providing Yerolakkos, Ayios Vasilios and Skylloura with adequate water has been completed during the year. It may be worth mentioning that these three villages were supplied with water by tankers before the pumping scheme. The new source of supply is a successful borehole near Avlona village from where water is pumped by means of an electrically driven pumping unit at the rate of 12,000 gallons per hour into a 100,000 gallons capacity reinforced concrete balancing tank. From this balancing tank a 6 inch in diameter asbestos cement pipeline 7.5 miles in length conveys the water by gravity to Yerolakkos. Another 4 inch in diameter asbestos cement pipeline conveys the water by gravity to the other two villages. A house-to-house service has been provided for all the villages and 900 house connections controlled by water meters have been installed.

(b) A major pumping scheme executed during the year in Famagusta District is the Rizokarpasso scheme. The source of supply are two successful boreholes from where water is pumped at the rate of 5,000 gallons per hour from each into a 100,000 gallons capacity reinforced concrete reservoir. The water is distributed throughout Rizokarpasso by means of 37 miles in length distribution mains varying from 10 inch to 2 in diameter. Nine hundred house-connections controlled by water meters have been installed.

(c) Another major pumping scheme executed in the Famagusta District is the Lefkoniko scheme. The source of supply is a borehole in the Kyrenia Range from where water is pumped into a 100,000 gallons capacity reinforced concrete reservoir through a 4 inch diameter asbestos cement pipeline. A house-to-house service consisting of 700 house connections has been installed.

(d) A pumping scheme for Kiti village was completed in the Larnaca District. The source of supply is an infiltration gallery in the Trimithos river, from where water is pumped at the rate of 6,000 gallons per hour into a 30,000 gallons capacity reinforced concrete elevated tank. A house-to-house service including the installation of 300 water meters has been completed. This village had no piped water before the implementation of this scheme.

(e) A big regional gravity supply scheme was completed in the Limassol District. This scheme serves 5 villages, namely: Mandria, Kato Platres, Arsos, Omodhos and Potamiou having in all a population of over 4,000 persons. The source of supply is part of the water of the big "Arko-lakhania" spring situated in the Mesapotamos river. About 15 miles of galvanized mild steel mains varying from 4 to 2 inch-diameter have been laid from the spring to the five villages. In all the villages a house-to-house service with break-pressure regulators has been installed.

(f) Another scheme executed during the year in the Limassol District is the new distribution system of Pano Platres, which is the biggest Summer Resort of the island. The water consumed is controlled by meters.

(g) A mass concrete weir 15 feet high was constructed in the Stavros-tis-Psokas river, whereby the river water is filtered and used as a supplementary source of supply during the late summer, at which time the yield of Xeropiyi spring is low, and by this arrangement the supply to the eight Paphos villages (Lyso, Istinjo, Melandra, Meladhia, Pelathousa, Philousa, Zakharia, Peristerona) is kept at a very satisfactory standard all through the year.

Appendix 7.

NUMBER AND PERCENTAGE OF VILLAGES WITH PIPED DOMESTIC SUPPLY

31ST DECEMBER, 1963

District	Villages with piped water			Villages with no piped supply		Total Villages
	Satisfactory	Unsatisfactory	Total			
	No.	No.	No.	No.	%	No.
Nicosia	112	52	164	14	7.87%	178
Larnaca	39	16	55	4	6.78%	59
Limassol	78	30	108	5	4.42%	113
Famagusta	56	27	83	15	15.31%	98
Paphos	124	4	128	4	3.03%	132
Kyrenia	23	19	42	5	10.63%	47
TOTALS	432	148	580	47	7.50%	627
PERCENTAGE	68.90%	23.60%	92.50%	7.50%	7.50%	100.00%

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

Appendix 8.

VILLAGE DOMESTIC WATER SUPPLY SCHEMES COMPLETED IN 1963

Serial No.	Village	District	Nature of work	Date of completion	Population
1	Pano Koutraphas	Nicosia	/	28. 1.63	50
2	Spilia	"	X	31. 1.63	555
3	Ay. Thomas	Limassol	* X	4. 2.63	214
4	Kyra	Nicosia	* X	15. 2.63	580
5	Dhoros	Limassol	* X	2. 3.63	207
6	Monagri	"	* X	2. 3.63	282
7	Ay. Georghios (Sylikou)	"	/ X	28. 3.63	185
8	Ay. Theodhoros	Famagusta	/ X	31. 3.63	828
9	Syngrasis	"	* X	1. 4.63	277
10	Khoulou	Paphos	* X	7. 4.63	806
11	Kallepia	"	* X	15. 4.63	557
12	Letymbou	"	* X	15. 4.63	741
13	Pitargou	"	* X	15. 4.63	192
14	Kritou Marottou	"	* X	15. 4.63	197
15	Psomolophou	Nicosia	X	18. 4.63	537
16	Argaki	"	/	3. 5.63	1,291
17	Ay. Varvara	"	/	9. 5.63	829
18	Pera	"	* X	20. 5.63	648
19	Trypimeni	Famagusta	/ X	25. 5.63	456
20	Kannavia	Nicosia	/	15. 6.63	223
X 21	Katokopia	"	/ X	20. 6.63	1,198
22	Ay. Theodhoros (Agrou)	Limassol	/ X	20. 6.63	604
23	Lania	"	* X	22. 6.63	282
24	Plataniskia	"	* X	29. 6.63	330
25	Xylophagou	Larnaca	/	30. 6.63	1,911
26	Phiti	Paphos	X	30. 6.63	342
27	Ay. Dhimitrianos	"	X	30. 6.63	234
28	Ayii Vavatsinia	Larnaca	* X	30. 6.63	397
29	Lasa	Paphos	X	6. 7.63	279
30	Oekos	Nicosia	/	25. 7.63	218
31	Limnatis	Limassol	/	31. 7.63	561
32	Steni	Paphos	X	31. 7.63	205
				C.F.	16,236

Serial No.	Village	District	Nature of work	Date of completion	Population
				B.F.	16,230
33	Trapeza	Kyrenia	/	31. 7.63	79
34	Potamiou	Limassol	* X	31. 7.63	247
35	Pano Platres	"	* X	4. 8.63	413
36	Phterikoudhi	Nicosia	/	29. 8.63	294
37	Astromeritis	"	/	31. 8.63	1,005
38	Kapilio	Limassol	* X	15. 9.63	111
39	Anargeti	Paphos	X	15. 9.63	551
40	Knodhara	Famagusta	X	30. 9.63	623
41	Agrokypia	Nicosia	* X	30. 9.63	273
42	Pano Zodhia	"	/	18.10.63	1,346
43	Ypsonas - Pano & Kato Polemidhia	Limassol	* X	28.10.63	4,088
44	Kato Platres	"	* X	28.10.63	309
45	Lefkoniko	Famagusta	/ X	28.10.63	2,350
46	Askas	Nicosia	* X	28.10.63	363
47	Dherinia	Famagusta	/ X	30.10.63	2,741
48	Mandria	Limassol	* X	24.11.63	272
49	Pomos-Paleambela	Paphos	* X	30.11.63	675
50	Prastio	Famagusta	/	30.11.63	977
51	Gaidhouras	"	/	30.11.63	366
52	Kilanemos	"	* X	30.11.63	99
53	Kato Akourdhalia	Paphos	/	30.11.63	90
54	Polystypos	Nicosia	/	31.12.63	430
55	Omodhos	Limassol	* X	31.12.63	942
56	Arsos	"	* X	31.12.63	1,018
57	Rizokarpaso	Famagusta	* X	31.12.63	3,154
58	Korphi	Limassol	* X	31.12.63	171
59	Ayia Marina	Paphos	* X	31.12.63	545
60	Nea Dhimmata	"	* X	31.12.63	109
61	Mosphiloti	Larnaca	* X	31.12.63	353
62	Kiti	"	* X	31.12.63	1,080
63	Peristerona	Nicosia	* X	31.12.63	1,166
64	Yerolakkos	"	* X	31.12.63	1,868
65	Ayios Vasilios	"	* X	31.12.63	609
66	Skylloura	"	* X	31.12.63	793
67	Kondemenos	Kyrenia	X	31.12.63	831
68	Kathikas	Paphos	X	31.12.63	763
				C.F.	47,354

Serial No.	Village	District	Nature of work	Date of completion	Population
				B.F.	47,354
69	Larnaca tis Lapithou	Kyrenia	* ¥	31.12.63	797
70	Apostolos Andreas	Famagusta	*	"	-
71	Avgorou	"	* ¥	"	1,867
72	Mandria	Paphos	* ¥	"	414
73	Kholetria	"	* ¥	"	356
74	Pano Akourdhalia	"	¥	"	102
75	Platani	Famagusta	/ ¥	"	378
76	Psillatos	"	/	"	455
77	Vitsadha	"	/	"	402
78	Dhali	Nicosia	/ ¥	"	2,609
79	Kambos	"	¥	"	1,070
80	Kakopetria	"	/	"	1,200
81	Milikouri	"	¥	"	418
82	Prastio (Morphou)	"	¥	"	545
83	Pano Arkhimandrita	Paphos	/	"	317
84	Vavatsinia	Larnaca	¥	"	229
85	Zyyi	"	/	"	171
					58,684

/ Improvements to an existing supply.

* New schemes.

¥ House-to-house service.

Appendix 9.

VILLAGE WATER SUPPLY SCHEMES IN HAND AT THE END OF 1963

Serial No.	Village
1	Katydhata
2	Ayios Ioannis (Maloundas)
3	Moutoullas
4	Akaki
5	Livadhia (Pitsilias)
6	Paleosophos
7	Chakistra
8	Pergamos
9	Lefka
10	Ay. Theodhoros (Soleas)
11	Ay. Georghios (Soleas)
12	Ardhana
13	Kantara
14	Nikitas

Appendix 10.

VILLAGE DOMESTIC SUPPLY SCHEMES PREPARED AND SUBMITTED FOR CONSIDERATION AND APPROVAL.

NICOSIA & KYRENIA DISTRICTS.

Serial No.	Village	Amount £	Remarks
1	Mia Milia	20,000	
2	Ayios Georghios (S.)	1,000	
3	Vroishia	6,700	
4	Laxia	27,600	
5	Yeri		
6	Episkopio	3,700	
7	Deftera Pano	34,000	
8	" Kato		
9	Alambra	15,000	
10	Kapedhes	14,000	
11	Orounda	12,000	
12	Ayia Kebir	16,150	
13	Xyliatos	5,000	
14	Ayia Marina		
15	Sarandi	2,800	
16	Karavostassi	17,000	
17	Kalokhorio (Kapouti)	350	
18	Ayios Yeorghios (Kafkalou)	650	
19	Dhiorios	53,800	
20	Ayia Irini		
21	Kormakitis		
22	Asomatos	10,500	
23	Vasilia	8,400	
24	Ayios Amvrosios	5,600	
25	Krini	6,000	
26	Meniko	16,000	
27	Ayia Marina (Skyl.)	3,000	
28	Morphou	86,000	
29	Aredhiou	8,460	
30	Gourri	1,900	
	C.F.	£375,610	

Serial No.	Village	Amount £	Remarks
	B.F.	£375,610	
31	Argates	11,400	
32	Kythrea	23,500	
33	Kythrea Lower 7 villages	30,000	
34	Lythrodontas	5,000	
35	Pyroi	2,000	
36	Lymbia	6,500	
	Total	£454,010	
	FAMAGUSTA DISTRICT.		
1	Akanthou	16,800	
2	Ayios Andronikos	17,500	
3	Komi-Kebir	10,500	
4	Korovia	1,600	
5	Ovgoros	2,500	
6	Ayios Georghios		
7	Arnadhi		
8	Spathariko	71.500	
9	Limnia		
10	Ayios Serghios		
11	Gypsos		
12	Milea		
13	Piyi	65,000	
14	Peristerona		
15	Prastio	3,700	
16	Gaidhouras	1,450	
17	Leonarisso etc.	2,500	
		£193,050	
	LIMASSOL DISTRICT.		
1	Limnatis	1,150	
2	Ay. Costantinos	180	
3	Lophos	5,932	
4	Ay. Therapon	7,534	
5	Pakhna	16,174	
6	Dhora	16,628	
	C.F.	£ 47,598	

Serial No.	Village	Amount £	Remarks
	B.F.	£ 47,598	
7	Sotira	4,000	
8	Zakaki	13,000	
9	Vasa (Kilani)	15,100	
10	Asgata	14,100	
11	Kalokhorio	3,000	
12	P. Platres	8,500	
13	Prodromos	3,400	
14	Kato Mylos	4,100	
15	Akrounda	3,534	
16	Mathikoloni	5,966	
17	Kaminaria	20,700	
18	Tris Elies	8,200	
19	Yermasoyia	4,000	
20	Asomatos	6,700	
21	Ay. Ioannis (Agrou)	5,600	
22	Arakapas	5,100	
23	Apsiou	2,900	
24	Vasa (Kellaki)	4,000	
25	Apeshia	8,200	
26	Alassa	2,600	
27	Kilani	2,300	
28	Sykopetra	2,800	
29	Pendakomo	11,900	
30	Pareklishia	2,400	
31	Ay. Phyla	5,600	
32	Louvaras	1,900	
33	Pissouri	3,600	
34	Prastio Avdhimou	3,300	
35	Yerasa	900	
36	Agros	3,600	
37	Souni-Zanadjia	600	
38	Vouni	2,300	
39	Erimi	1,400	
40	P. Kividhes	4,150	
41	Kandou	700	
42	Ay. Dhemetrios	3,900	
	C.F.	£241,648	

Serial No.	Village	Amount £	Remarks
	B.F.	£241,648	
43	Phini	5,000	
44	Paleomylos	1,700	
45	Anoyira	4,000	
46	Trimiklini	2,400	
47	Kouka	1,132	
48	Pyrgos	800	
49	Evdhimou	900	
50	Moni	1,100	
51	Akapnou	2,600	
	Total	£261,280	
	LARNACA DISTRICT.		
1	Menoyia	18,350	
2	Anglissides		
3	Anaphotia		
4	Aplanda		
5	Kivisil	8,653	
6	Alethriko		
7	Pyla	8,800	
8	Arsos	4,850	
9	Khirokitia	4,300	
10	Troulli	44,900	
11	Avdellero		
12	Ayia		
13	Goshi	570	
14	Petrophani	1,340	
15	Tremetoushia	10,500	
16	Tokhni	2,200	
	Total	£103,463	
	PAPHOS DISTRICT.		
1	Kouklia	11,900	
2	Konia	26,200	
3	Anavargos		
4	Trimithousa		
5	Ktima		
	C.F.	£ 38,100	

Serial No.	Village	Amount £	Remarks
	B.F.	£ 38,100	
6	Peyia	25,000	
7	Polis-Prodromi	19,000	
8	Kritou-Terra	1,900	
9	Salamiou	4,300	
10	Stroumbi	3,400	
11	Emba	6,500	
12	Peristerona	2,000	
13	Ay. Nicolaos	3,200	
14	Argaka	1,100	
15	Kelokedhara	1,750	
16	Episkopi	5,600	
17	Mesana	2,150	
18	Ay. Ioannis	2,900	
19	Lemona	1,400	
20	Magounda	700	
21	Akoursos	2,200	
22	Arnadhiou	1,500	
23	Kilinia	500	
24	Kedhares	1,800	
25	Loukrounou	350	
26	Neokhorio	2,000	
27	Polemi	8,400	
28	Pretori	720	
29	Stavrokonnou	1,000	
30	Tsadha	5,100	
31	Yiolou	2,150	
	Total	£144,720	

S U M M A R Y

Nicosia & Kyrenia	£	454,010
Famagusta		193,050
Limassol		261,280
Larnaca		103,463
Paphos		144,720
Total		£1,156,523

14. REPORT ON TOWN WATER SUPPLIES

By G. Charalambous, Senior Inspector of Works.

General: The activities of the Town Water Supplies Section of the Water Development Department were substantially the same as in previous year. It administered the Greater Nicosia Scheme and gave technical advice to all Water Boards (Nicosia, Limassol, Famagusta), including the Evcaf Office on the administration of the Larnaca water supply.

Nicosia & Suburbs: Although the operation of the Morphou Bay Scheme, which was completed early in April and which will produce 2.0 m.g.d., could not be materialized, yet the demand in both Greater Nicosia Scheme and Nicosia Water Board areas was met satisfactorily. It should be noted, however, that all available sources were put into commission for the maximum yield.

2. The highest daily consumption was 6,400 c.m. for Greater Nicosia Scheme and 13,000 c.m. for the Nicosia Water Board (including Nicosia Water Commission) making a total of 19,400 c.m. In one or two cases during this peak consumption period, shortage could only be avoided because of the close co-operation which existed between this Department and the Nicosia Water Board.

3. Other than routine maintenance over installations and pipelines, at Dhali source, electricity was made available and the existing mechanically driven arrangements were replaced. 3 No. electrosubmersible pumps on equal number of boreholes were installed, and the water from the collecting tank is now pumped by means of centrifugal pumps coupled to electric motors upto the elevated tank for gravitation to service reservoirs.

4. During 1963, the distribution system of the Greater Nicosia Scheme was extended by approximately 26,000 ft. or 5.0 miles of asbestos-cement pipes. Most of the extensions were carried out in newly developed areas at the expense of the respective private developers. The number of consumers was increased by 590 and this brings the total number to 6,848.

5. A statement of expenditure and revenue of the Greater Nicosia Scheme is given in Appendix 11.

6. Limassol: The demand on water supply for this town was met successfully from the existing sources. The maximum daily consumption was 10,347 c.m. (9.8.63.)

7. Nevertheless, the so called "Yermasoyia River Scheme" commenced late in the year soon after Limassol Water Board secured part of necessary funds. This scheme will supplement the town's future requirements by 1.5 m.g.d. and will serve mainly the high level areas. A trunk main of 10" Ø asbestos-cement pipes 8,000 ft. in length was laid, from the proposed reservoir site to supply five areas including Mesayitonia village.

8. Apart from the new scheme, a length of 31,660 ft. of water mains was laid. The total number of consumers reached the figure of 11,266.

9. Famagusta: Water supply position of this town is in a dangerous state. Contrary to increase in population, water level of the sources is declining rapidly.

10. By putting, however, some new boreholes into commission and with the erection of a more powerful Boosting Station at Frenaros "North", a regular supply to the town could be maintained. The summer daily consumption of water rose to 5,257 c.m. The total number of consumers reached 8,487.

11. The question of desalting sea water for Famagusta is being considered.

12. Larnaca: The Water Supply system of this town is administered by Evcaf Office. The yield of the existing sources - an old chain-of-wells and two boreholes - can only suffice the town's requirements in years with normal rainfall. Due, however, to present administrative difficulties neither improvements nor implementation of a scheme for supplementary supply seems feasible. The establishment of a Water Board, in the first instance, would enable a solution to be found.

Appendix 11.

Revenue and expenditure account of the Greater Nicosia Scheme for the year 1963.

Expenditure			Revenue	
(a) Pumping charges	£15,200		(a) Sale of water and meter rent	£77,804
(b) Purchase of water	3,654		(b) Connection fees	1,160
(c) Maintenance charges	2,890		(c) Usage of pipes by Water Board	3,952
(d) Collection fees	11,845			
(e) Supervision	850			
Total		£34,429	Total	£82,916
Administration	£ 3,000			
Amortization (£650,000 in 30 years at 4%)	37,590			
		40,590		
Grand Total		£75,019	Profit for the year	£ 7,897

Appendix 12.

FACTS ABOUT NICOSIA WATER BOARD.

1.	Total quantity of water supplied from all sources .. .. .. (including Nicosia Water Commission's sources)	3,676,870 M3
2.	Total quantity of water consumed, registered by area meters .. (including consumption within Nicosia Water Commission's Area)	3,494,508 M3
3.	Total maximum summer consumption per day (including Nicosia Water Commission)	13,000 M3
4.	Total number of consumers ..	9,454
5.	Extension of Distribution System ..	21,700 ft. of 4" ∅

Appendix 13.

FACTS ABOUT LIMASSOL WATER BOARD.

1.	Total quantity of water supplied from all sources	2,825,173 M3
2.	Total quantity of water registered by area meters	2,547,705 M3
3.	Maximum consumption on any summer day	
	12.7.63	10,325 M3
	9.8.63	10,347
4.	Number of consumers as at 31.12.63	11,266
5.	(a) Extension of distribution system during 1963 = ...	31,660 ft.
	(b) Total length of distribution system as at 31.12.63	532,800 ft.
6.	(a) Hydrants installed in 1963 ..	30
	(b) Hydrants installed as at 31.12.63	489

Appendix 14.

FACTS ABOUT FAMAGUSTA WATER BOARD.

1.	Total quantity of water supplied from all sources	1,619,936 M3
2.	Total quantity of water consumed registered by area meters ..	1,485,096 M3
3.	Total maximum summer consumption per day	5,257 M3
4.	Total number of consumers ..	8,487
5.	(a) Extension of distribution system in ft. run and size of pipes ..	8,448 ft. Ø 4"
	(b) Total length of distribution system (including extensions for last year)	77.8 miles
6.	(a) Number of hydrants installed in 1963	16
	(b) Total number of hydrants installed within water supply area ..	476

15. REPORT ON THE HYDROLOGICAL SECTION

By Nicos Chr. Toufexis, Senior Inspector of Works.

(This report covers the period from 1st October, 1962, to 30th September, 1963.)

I. Meteorological data.

The principal features of the rainfall during the year were:-

(a) The average rainfall over the whole island was 21.63 inches which is 109.13% of normal as compared with the average since 1908 which is 19.82 inches.

(b) November, January and February were the months with below average rainfall. Precipitation during the other months was above normal.

(c) The highest daily fall in the year was 3.58 inches and it occurred in Pano Amiandos on the 29th December, 1962.

(d) Some snow fell at the high altitudes of the Troodos mountains during December 1962 and January, February and March, 1963. The snow-cover persisted until beginning of May.

(e) The South-Eastern Mesaoria was the only area that experienced sub-normal rainfall.

(f) Temperatures were generally above normal. The highest temperature recorded at Nicosia was 107° F on the 18th August and the lowest 31° F on the 7th March.

II. Flood Discharges.

The most remarkable flash flows during the year occurred in the valleys of rivers flowing west and north of the central massif. The highest flood flows were estimated to be 10,600 cusecs in Stavros-tis-Psokas river at Evretou on the 28th October, 1962, and 12,000 cusecs in Meriki river at Paleometokho on the 25th July, 1963.

The table below summarizes some of the larger floods and gives an idea of the maximum rainfalls measured in the catchment on the day of the flood or on the previous days. Floods of less importance have been ignored.

River	Location	Peak flow		Rainfall		
		Cusecs	Date	Inches	Place	Date
Pedhieos	Nicosia Ex-Railway Bridge	2,500	28. 5.63	0.71	Nicosia	28. 5.63
Serakhis	Massari Bridge	1,795	23.12.62	2.20) 2.62)	Alona	(22.12.62 (23.12.62
		2,545	9. 5.63	1.27	- do -	4. 5.63
		3,600	25. 7.63	1.82	Kokkini-Trimithia	25. 7.63
Yermasoyia	Yermasoyia Police Station	895	23.12.62	1.95) 1.85)	Ayios Theodhoros	(22.12.62 (23.12.62
		759	30. 4.63	0.36	- do -	30. 4.63
		645	4. 5.63	0.72	- do -	4. 5.63
		760	16. 5.63	1.36	Kalokhorio (Limassol)	15. 5.63
Ak-Sou	Petra-tou-Dhigheni	611	23. 9.63	1.72	Halevga	23. 9.63
Stavros-tis-Psokas	Evretou	10,600	28.10.62	3.50	Ayios Merkourios	28.10.62
		1,618	23.12.62	1.85	Stavros-tis-Psokas	23.12.62
		1,950	16. 5.63	1.42	- do -	15. 5.63
Khrysokhou	Skoulli	3,100	28.10.62	2.50	Stroumbi	27.10.62
		2,086	23.12.62	1.91	- do -	23.12.62
		620	4. 5.63	0.92	Asproyia	4. 5.63
		1,440	16. 5.63	1.45) 0.76)	Polis Stroumbi	15. 5.63
Syrgatis	Skarinou	626	27. 2.63	0.32	Pano Lefkara	27. 2.63
Dhiarizos	Kouklia (P.)	790	24.10.62	0.78	Ayios Nicolaos	24.10.62
		1,632	13.12.62	2.30	- do -	23.12.62
Xeros	Phinikas	3,322	23.12.62	1.50	Kelokedhara	23.12.62
		1,234	23. 1.63	1.00	- do -	23. 1.63
		830	11. 2.63	1.15	Kykko Monastery	11. 2.63
		660	4. 3.63	0.83	- do -	4. 3.63
		885	30. 4.63	1.55	- do -	30. 4.63
		1,415	9. 5.63	1.55	Ayios Nicolaos	9. 5.63
		1,644	16. 5.63	1.70	Kykko Monastery	16. 5.63
		1,720	6. 7.63	0.85	Ayios Nicolaos	6. 7.63
		2,836	22. 9.63	1.25	- do -	22. 9.63
Ezusa	Akhelia	1,150	26.10.62	0.64	Anatoliko	26.10.62
		3,228	23.12.62	2.53	Asproyia	23.12.62
Pelathousa	Near Polis	1,260	28.10.62	3.50	Ayios Merkourios	28.10.62
Kurminkoph	- do -	2,390	28.10.62	3.50	- do -	28.10.62

River	Location	Peak flow		Rainfall		
		Cusecs	Date	Inches	Place	Date
Yialia	Kato Yialia	1,150	28.10.62	2.15	Yialia Police Station	27.10.62
Lavro-kollymbos	Potima	650	28.10.62	2.50	Stroumbi	27.10.62
		1,098	23.12.62	1.91	- do -	23.12.62
Vasilikos	Kalavasos	750	24. 4.63	1.20	Ora	24. 4.63
		618	5. 7.63	3.00	- do -	6. 7.63
		3,800	20. 9.63	3.86	- do -	20. 9.63
Trimithios	Ayia Anna	650	27. 5.63	0.43) 0.38)	Perakhorio (Nissou) Kornos	27. 5.63
	- do -	2,414	2. 6.63	Due to local rains		
	Kiti	775	2. 6.63			
Phileri	Kythrea	3,000	10. 5.63	2.25	Kythrea	10. 5.63
Peiki	Paleometokho	12,000	25. 7.63	1.82	Kokkini Trimithia	25. 7.63

III. River Discharges.

As a result of the high rainfall intensities experienced over the island during the year, the total discharges from most of the mountain rivers were well above normal.

IV. Water level recorders.

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

Recorder No.	Catchment	Location	Type of installation
1	Pedhieos	Nicosia Ex-Railway Bridge	Water level recorder on 40 ft. measuring weir.
2	Yialias	Near Kochatis	Water level recorder on 60 ft. measuring weir.
3	Ovgos	Morphou-Pnasi Monastery bridge	Water level recorder on bridge.
4	Serakhis	Near Morphou	Water level recorder.
5	Xeros (Nicosia)	Xeros bridge	Water level recorder on bridge.
6	Marathasa	Lefka-Skouriotissa bridge	Water level recorder on bridge.

Recorder No.	Catchment	Location	Type of installation
8	Avgorou	Near Avgorou	Water level recorder on 40 ft. measuring weir.
9	Paralimni	Near Paralimni Lake	Water level recorder on recharge channel.
10	Pyrgos (Tyllirias)	Near Phileyia	Water level recorder on 30 ft. measuring weir.
11	Limnitis	Near Limnitis Saw-Mill	- do -
13 A	Kouris (Trimiklini)	Limassol - Troodos bridge	Water level recorder on 18 ft. measuring weir.
13 B	- do -	Near 13 A	Water level recorder on 1'-6" flume.
14	Peristerona (Nicosia)	Near Panayia Forest Station	Water level recorder on 20 ft. measuring weir.
15	Tremithios	Kiti	Water level recorder on 75 ft. irrigation weir.
16	Yermasoyia	Near Police Station	Water level recorder on 54 ft. measuring weir.
17	Kouris	Erimi bridge	Water level recorder on bridge.
18	Kolopannes	Near Kalopsidha	Water level recorder on 25 ft. measuring weir.
19	Akhna	Near Akhna Police Station	Water level recorder on 40 ft. measuring weir.
20	Phrenaros	Near Asprovouniotissa Church	Water level recorder on 40 ft. measuring weir.
21	Kokkini-Trimithia	Near Kokkini-Trimithia	Water level recorder on 55 ft. measuring weir.
22	Liopetri	Near Liopetri	Water level recorder on 40 ft. measuring weir.
23	Akaki	Malounda	- do -
24	Skylloura	Ayios Vasilios	Water level recorder on 60 ft. measuring weir.
25	Ak-Sou	Petra-tou-Dhigheni	Water level recorder on 30 ft. measuring weir.
27	Khrysokhou	Skoulli	Water level recorder on 40 ft. measuring weir.
28	Stavros-tis-Psokas	Evretou	Water level recorder on 25 ft. measuring weir.
29	Syrgatis	Skarinou	Water level recorder.
30	Dhiarizos	Kouklia (Paphos)	Water level recorder on 40 ft. measuring weir.
31	Xeros (Paphos)	Phinikas	Water level recorder on 120 ft. measuring weir.

Recorder No.	Catchment	Location	Type of installation
32	Alakati	Platimatis near Ay. Amvrosios (Kyrenia)	Water level recorder on 22 ft. measuring weir.
33	Karyiotis	Pendayia	Water level recorder on 60 ft. measuring weir.
34	Tremithios	Ayia Anna	Water level recorder on 40 ft. measuring weir.
35	Elea	Elea bridge near Ghazivera	Water level recorder on bridge.
36 A	Ayios Loucas (Famagusta)	Near Ayios Loucas (Famagusta)	Water level recorder on Ayios Loucas Lake.
36 B	Ay. Loucas (Famagusta)	Near Ay. Loucas (Famagusta)	Water level recorder on conveyor channel.
37	Atsas	Evrykhou	Water level recorder on 25 ft. measuring weir.
38 A	Serakhis	Massari	Water level recorder on bridge.
38 B	- do -	- do -	- do -
39	Livadhi	Paleambela	Water level recorder on 70 ft. measuring weir.
40	Xeros (Polis)	Ayia Marina	Water level recorder on bridge.
41	Yialia (Polis)	Kato Yialia	Water level recorder on 14'-10" measuring weir.
42	Magounda	Kato Argaka	Water level recorder on bridge.
43	Mavrokolymbos	Potima	Water level recorder on 40 ft. measuring weir.
44	Ezusa	Akhelia	Water level recorder on 85 ft. measuring weir.
45	Khapotami	Kouklia (Paphos)	Water level recorder on 50 ft. measuring weir.
46	Garyllis	Kato Polemidhia	Water level recorder on 66 ft. measuring weir.
47	Vasilikos	Kalavasos	Water level recorder on 75 ft. measuring weir.
48	Maroni	Khirokitia Station	Water level recorder on 40 ft. measuring weir.

All water level recorders in use are float operated instruments. As their intake pipes are frequently blocked with the river-mud, pneumatic recorders have been installed on three rivers for test, so as to see whether this new type of instrument is better fitted to our local conditions.

V. Measured discharges 1962-63.

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

Recorder No.	Catchment	Rainfall during 1962-63 10^6 c. ft.	Runoff during 1962-63 10^6 c. ft.	Maximum discharge in a day 10^6 c. ft.	Maximum flow cusecs	Runoff in % Rainfall 1962-63
1	Pedhieos	1918.69	57.315	15.0	2500	2.99
2	Yialias	1510.04	174.00	9.2	436	11.50
3	Ovgos	3234.86	Nil	-	-	-
4	Serakhis (Morphou)	7708.59	46.00	-	-	0.59
5	Xeros (Nicosia)	1858.06	67.12	6.3	81	3.61
6	Marathasa	1776.53	222.16	7.3	94	12.5
8	Avgorou	199.80	Nil	-	-	-
9	Paralimni	-	4.195	0.4	13.5	-
10	Pyrgos	1201.30	321.61	10.1	175	26.77
11	Limnitis	1604.50	361.63	12.9	382	22.55
13	Kouris (Trimiklini)	2216.40	931.11	16.8	292	42.00
14	Peristerona	2299.70	424.90	38.5	488	18.48
15	Tremithios (Kiti)	2543.85	14.14	11	775	0.55
16	Yermasoyia	4600.60	626.72	28.6	895	13.62
17	Kouris (Erimi)	11824.03	1428.19	125.00	595	12.10
18	Kolopannes	-	0.49	0.02	2.7	-
19	Akhna	232.28	0.07	0.07	16	0.03
20	Phrenaros	82.93	0.61	0.03	12.6	0.73
21	Kokkini Trimithia	368.50	4.88	2.4	400	1.32
22	Liopetri	89.60	0.51	0.22	36.2	0.56
23	Akaki	2212.60	531.41	27.04	506	24.00
24	Skylloura	1019.33	1.29	0.55	39	0.13
25	Ak-Sou	180.14	24.3	5.3	611	13.5
27	Khrysokhou	2064.50	563.07	38	2086	27.27
28	Stavros-tis-Psokas	2919.10	575.34	50.3	1953	19.71
29	Syrgatis	3333.26	201.54	9.1	626	6.04
30	Dhiarizos	8586.20	977.73	58.1	1632	11.38
31	Xeros (Paphos)	6891.86	1496.22	145.9	3322	21.71
32	Alakati	263.75	7.89	2.75	402	2.99

Recor-der No.	Catchment	Rainfall during 1962-63 10^6 c. ft.	Runoff during 1962-63 10^6 c. ft.	Maximum discharge in a day 10^6 c. ft.	Maximum flow cusecs	Runoff in % Rainfall 1962-63
33	Karyiotis	2493.64	186.27	8.55	164	7.46
34	Tremithios (Ay. Anna)	1432.10	65.82	9.1	2417	4.59
35	Elea	2976.40	9.32	4.75	200	0.31
36	Ay. Loucas	-	0.04	0.04	-	-
37	Atsas	735.93	21.13	0.75	28	2.87
38	Serakhis (Massari)	7579.47	667.12	86.2	3600	8.93
39	Livadhi	1002.70	137.98	9.1	1900	13.76
40	Xeros (Ay. Marina)	225.47	0.316	-	-	0.14
41	Yialia (Polis)	497.88	1.31	-	-	0.26
42	Magounda	1740.25	112.46	10.8	166	0.64
43	Mavrokolymbos	1116.02	97.46	16.2	78	8.73
44	Ezusa	9037.96	994.98	112.0	3222	11.00
45	Khapotami	3683.34	413.06	12.9	420	11.21
46	Garyllis	2197.47	111.94	7.9	315	5.09
47	Vasilikos	3307.27	416.84	22.0	3800	12.60
48	Maroni	1512.31	48.43	1.15	60	3.20

VI. Spring discharges.

During the Hydrological year, 1704 spring discharges were measured averaging to 142 measurements every month. The output of 264 springs is now being measured regularly; 104 of these at monthly intervals, 30 every 2 months, 24 every 3 months, 7 every 4 months, 49 every 6 months, 44 every year, and 6 every fortnight.

In most parts of the island especially on the mountains the above normal rainfall led to an increase of the flow of most springs.

The heavy rainfall and snow during the wet season on the Troodos mountains affected the flow of most springs and caused the above normal rate of flow to be maintained also during Summer. Thus the flow of the springs used for Troodos Water Supply was 54,000 g.p.d. during September 1963, compared with 30,400 g.p.d. which is the September average since 1955.

Similarly the flow of the three springs Kephalovrysos, Mavrommata and Krya Pighadhia supplying Limassol reached 1,649,000 g.p.d. during September 1963, this being the maximum September discharge ever recorded. These springs are in the Kouris river basin, and their flow depends on the precipitation on the Southern flank of the Troodos mountains.

On the contrary, the flow of the main springs on the Kyrenia range was below normal, the steadiest flow being that of the Kephalovrysos Karavas. The rainfall on this range was about normal.

The flow of the chain of wells in Pedhieos and Yialias river basins was below normal.

VII. Ground water used for town water supplies.

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

Nicosia	Quantity		Percentage
	Million cubic meters	Million cubic feet	
Kokkini Trimithia, Akaki & Paleometokho	2.3	80.7	44.6
Morphou	0.6	22.7	12.6
Arab Ahmet at Strovolos	0.3	11.6	6.4
Laxia	0.2	5.5	3.0
Dhikomo	0.3	11.8	6.5
Dhali	0.3	11.8	6.5
Sykhari	0.2	5.5	3.0
Athalassa	0.1	2.6	1.5
Makedhonitissa	0.4	15.1	8.4
Others (Approx.)	0.4	13.5	7.5
Total extraction during 1962-63 =	5.1	180.8	100.0
Famagusta			
Phrenaros West	0.6	20.0	34.7
Phrenaros North	1.0	35.8	62.2
Others	0.1	1.8	3.1
Total extraction during 1962-63 =	1.7	57.6	100.0

Limassol	Quantity		Percentage
	Million cubic meters	Million cubic feet	
Kephalovrysos, Mavrommata & Kria Pighadhia springs	2.3	80.0	86.6
Chiftlikoudhia Chain of Wells	0.2	7.0	7.6
Others	0.2	5.4	5.8
Total extraction during 1962-63 =	2.7	92.4	100.0

VIII. Ground Water Levels.

Twenty two new observation boreholes were brought into use during the year 1962-63, the total now being 146. Of these only 76 may be considered as permanent observation boreholes.

The decline in the underground water levels has been observed in all aquifers, in spite of the above normal rainfall which has been recorded in most areas this year. It is obvious that the extraction of the ground water continues to be in excess of the replenishment.

Thus in the Morphou Bay area, about 1½ miles inland, the average water table has been depressed as low as five feet below sea level, while measurements taken at individual boreholes during the year's dry season indicated that the water table there was 11 feet below sea level. Controlled pumping and more economical practice in irrigation, resulted in partial recovery of the water table later in the year.

In the Kokkini Trimithia area, which supplied Nicosia with 44.6% of the year's domestic water requirements, the water table towards the end of the year had declined by 7.05 feet compared with the early year's recovery of 4.5 feet. Thus, the fall during the year was 2.55 feet compared with 3.7 feet last year, when Nicosia drew 59.1% of its Domestic Water requirements from this area.

In the Phrenaros North area, the rate of decline of the water table is increasing. Thus, the rise after the wet season of the year was only 0.23 feet while the summer fall was 4.91 feet, leaving a deficiency of

4.68 feet in the water table. The rainfall in most parts of the south-eastern Mesaoria was below normal.

In the Phrenaros West the fall during the year was about the same as last year's, i.e. 4.04 feet. The total decline since 1954 amounts to 29.44 feet.

In the Xylophagou reef limestone aquifer the average water table was lowered as far as 1.26 feet below sea level. In one particular borehole, the minimum water level recorded during the year was 8 feet below sea level.

The situation in the Pergamos confined aquifer is a serious one. The rate of decline of the water table is continuously increasing. A fall of 7 feet was recorded this year, compared with a fall of 4.25 feet last year. A total fall of 35.48 feet has been recorded since 1952.

In Macrasyka area, the number of private irrigation boreholes in use has considerably increased, and the water table is declining at a high rate. Thus, a fall of 10.84 feet in the average water table was recorded during the year. The total fall since 1955 is 37.84 feet.

The average minimum water level in the two observation boreholes at Ayios Memnon, was 5.40 feet below sea level, and the fall during the year was only 0.17 feet. The total fall since 1953 is 2.25 feet.

The fall of the water table in the two observation boreholes at Ayios Andronikos was 2.78 feet, compared with 1.28 feet last year. The total fall since 1959 is 6.74 feet, and the rainfall for the year is below normal.

Again this year Kolossi observation borehole has recorded the most interesting results. Thus, a rise of 2.8 feet was recorded in the water table compared with a rise of 2.6 feet last year. The average annual fall since 1955 has dropped to 0.33 feet. Kouris river has also discharged an above average runoff. This and the above normal rainfall on the area have contributed to the replenishment of the aquifer.

Appendix 15 gives the water levels recorded at all observation boreholes after drilling and during the years 1961-62 and 1962-63.

IX. Recharge Activities.

Artificial recharge was practiced in various parts of Cyprus, where use was made of runoff from rainfall or surplus water from domestic water supplies, to recharge depleted aquifers. During 1962-63 this form of activity was in operation in the following areas.

	Total Recharge into the aquifer
Paralimni	
From rainwater flowing into Paralimni Lake from local catchments. This water is diverted in a canal and thence distributed to a number of small dams	4.2 Million cubic feet.
Limassol	
Surplus water from the town's Domestic Supply into Chiftlikoudhia chain of wells	6.5 Million cubic feet.
Morphou	
Serakhis river flood-water stored by dam and recharged into aquifer	202 Million cubic feet.

X. Chemical Analyses.

During the year 4839 samples of water were sent to the Medical Department's Analyst for partial chemical analysis. Of these 1491 samples were taken from springs, wells or boreholes which are used or proposed as water supply sources. The remaining 3348 samples derived from springs, observation boreholes and from other miscellaneous sources. In addition 59 samples of water were taken from boreholes used for irrigation purposes and were sent to the Agricultural Department's Analyst.

XI. Bacteriological Analyses.

During the year, 1,001 samples of water taken mainly from town water supplies were analysed by the Government Pathologist.

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

Water Supply	Number of Samples	Number of unsatisfactory samples
Nicosia	592	102
Famagusta	170	38
Limassol	42	3
Larnaca	49	16
Paphos	82	18
Kyrenia	66	3
	1,001	180

At Nicosia most of the unsatisfactory samples came from private boreholes at Kokkini Trimithia and Paleometokho area which supply water to Nicosia Water Board. All chlorinated samples at all reservoirs were satisfactory.

The unsatisfactory samples at Limassol, Famagusta, Larnaca, Ktima and Kyrenia were usually of unchlorinated water. All chlorinated samples at the main reservoirs were satisfactory.

XII. New Measuring Sites.

By the end of the Hydrological year 1962-63 the following new measuring weirs were completed, and automatic water level recorders were installed.

1. Weir on Potamos-tou-Kambou river near Nicosia-Polis main road bridge.

   A 45'-0" broad-crested measuring weir (with 2'-0" x 6" notch for low flows).

2. Weir on Marathasa river near Nicosia-Polis main road bridge.

   A 50'-0" broad-crested measuring weir (with 2'-0" x 6" notch for low flows).

3. Weir on Pouzis river near Mazotos.

   A 45'-0" broad-crested measuring weir (with 2'-0" x 6" notch for low flows).

4. Weir on Mavravis river near Alaminos.

   A 41'-0" broad-crested measuring weir (with 2'-0" x 6" notch for low flows).

5. Measuring site on Kouris river near Erimi.

   Stabilization of river bed under Limassol-Paphos main road bridge.

6. Weir on Kryos river near Khalassa.

   A 100'-0" broad-crested measuring weir on which an iron foot-bridge was installed for flow measurements with a current-meter.

7. Weir on Zygos river near Khalassa.

   A 75'-0" broad-crested measuring weir on which an iron foot-bridge was installed for flow measurements with a current-meter.

8. Measuring site on Kouris river near Khalassa.

   Stabilization of river bed under Limassol-Lophou road bridge.

XIII. Repairs and Improvements to the existing measuring sites:-

Besides the construction of new measuring weirs, repairs or improvements have been carried out to the following existing measuring weirs during the year:-

1. Yermasoyia river measuring site:-

   Weir on Yermasoyia river near Yermasoyia Police Station was widened and improved.

2. Xeros river (Phinikas) measuring site:-

   The apron which has been undermined by big floods was repaired and improved.

3. Ezusa river measuring site:-

   The sill and apron of the measuring weir were raised by 1 ft.

4. Kouris river (Trimiklini) measuring site:-

   The sill and apron of the measuring weir which have been damaged by floods were repaired.

5. Also minor repairs were carried out to the weirs on Peristerona river near Panayia bridge Forest Station, and to Kalavasos weir on Vasilikos river.

Appendix 15.

WATER LEVEL IN CONTROL BOREHOLES.

(Feet above sea level)

Ser. No.	Place	Bore-hole Number & Year	Maximum Water Level			Minimum Water Level		
			Year after drill-ing	61-62	62-63	Year after drill-ing	61-62	62-63
1	Astromeritis	91/50	372.14	336.66	332.16	336.54	325.41	328.24
2	Ayios Andronikos	249/55	391.30	387.00	384.56	389.89	384.77	382.56
3	"	322/55	386.25	383.99	383.97	385.38	383.47	383.05
4	Ayios Memnon	69/38	- 1.20	- 1.71	- 1.49	- 5.60	- 8.19	- 6.49
5	"	50/53	3.21	- 2.33	0.28	- 0.69	- 5.58	- 4.12
6	"	18/62	-	-	- 4.89	-	-	- 9.64
7	"	30/62	-	-	- 3.80	-	-	- 7.05
8	Ayios Nicolaos Famagusta	89/56	29.50	27.21	26.92	28.80	26.23	25.75
9	Dherinia	2/62	-	-	29.93	-	-	15.49
10	"	12/62	-	-	24.13	-	-	1.97
11	Ephtakomi	163/55	496.39	461.22	461.89	489.22	460.41	459.30
12	Famagusta	15/62	-	-	-17.65	-	-	-20.97
13	"	16/62	-	-	-10.98	-	-	-19.52
14	"	17/62	-	-	-14.03	-	-	-17.73
15	"	19/62	-	-	- 7.09	-	-	-12.45
16	"	20/62	-	-	-12.57	-	-	-19.67
17	"	27/62	-	-	-10.32	-	-	-14.70
18	"	29/62	-	-	- 4.03	-	-	- 7.27
19	Ghaziveran	94/50	22.52	8.81	9.44	18.22	4.62	5.77
20	Kalopsidha	54/54	68.55	41.13	41.05	60.30	35.30	33.97
21	"	55/54	73.86	56.45	52.20	71.87	51.37	48.48
22	"	56/54	75.31	60.56	58.02	73.85	57.73	55.27
23	Khalassa	23/58	547.58	548.59	549.59	544.21	545.96	546.38
24	Kokkini-Trimithia	90/50	686.60	-	652.75	682.40	-	650.50
25	"	160/50	682.70	656.67	654.67	679.40	653.00	649.75
26	"	161/50	686.00	638.46	630.58	679.40	621.50	617.33
27	Kolossi	88/54	12.29	7.71	11.04	5.79	- 2.21	4.15
28	Laxia	208/55	672.23	645.31	640.98	666.31	639.31	638.81
29	Makrasyka	48/54	117.00	96.25	90.50	110.70	77.63	75.92
30	"	49/54	120.10	103.69	98.32	116.90	99.52	92.07

Ser. No.	Place	Borehole Number & Year	Maximum Water Level			Minimum Water Level		
			Year after drilling	61-62	62-63	Year after drilling	61-62	62-63
31	Lorphou	168/50	89.27	67.95	71.99	83.57	62.49	67.24
32	"	92/50	86.43	49.98	45.31	76.13	14.36	16.15
33	Ormidhia	189/57	- 1.50	- 1.02	- 1.40	- 2.27	- 2.15	- 2.3[illegible]
34	"	227/57	0.70	0.05	- 0.05	0.20	- 0.51	- 1.[illegible]
35	"	246/57	0.22	- 0.19	0.68	- 0.32	- 0.65	- 0.[illegible]
36	Pendayia	95/50	10.60	10.50	11.75	8.00	2.48	6.[illegible]
37	Pergamos	86/51	259.00	236.82	232.48	254.30	228.65	221.4[illegible]
38	Phrenaros North	108/52	72.20	44.49	40.53	70.60	41.62	36.44
39	" "	109/52	70.60	43.68	39.18	66.08	39.56	34.66
40	" "	110/52	70.20	44.12	39.74	66.16	40.12	35.00
41	" "	76/56	58.13	42.68	39.38	56.47	38.72	34.97
42	" "	77/56	64.13	58.30	57.88	62.80	57.63	56.84
43	" "	78/56	65.63	52.03	49.88	63.80	49.88	46.72
44	" "	79/56	72.77	56.77	49.68	71.27	49.98	42.52
45	" West	51/51	87.10	61.00	58.83	86.50	58.58	55.5[illegible]
46	" "	52/51	86.00	57.63	53.40	85.30	52.94	49.73
47	" "	53/51	85.20	43.47	34.80	84.80	34.97	29.3[illegible]
48	" "	67/53	81.10	60.27	56.92	78.70	57.29	54.0[illegible]
49	Prastio	93/50	31.49	4.52	3.40	24.29	- 1.14	- 3.3[illegible]
50	"	11/57	26.31	-	5.69	14.73	-	- 0.14
51	Syrianokhori	150/54	10.51	4.30	3.34	9.01	2.22	0.9[illegible]
52	"	151/54	10.12	1.70	1.16	8.83	1.00	0.[illegible]
53	"	152/54	8.32	2.15	1.34	6.07	0.99	0.0[illegible]
54	"	153/54	5.79	1.92	1.54	4.71	1.25	0.[illegible]
55	"	1/55	24.09	3.43	0.97	17.80	- 3.24	- 6.2[illegible]
56	"	23/55	21.89	1.81	- 0.03	17.64	- 3.36	- 7.20
57	"	201/56	18.45	1.97	- 0.11	13.02	- 3.61	- 7.11
58	"	209/56	17.24	3.49	1.41	12.49	- 2.67	- 6.21
59	"	195/57	7.07	2.40	1.59	5.19	0.69	- 0.51
60	"	209/57	4.56	2.33	1.12	2.96	0.87	0.62
61	"	212/57	3.69	2.02	1.98	2.36	0.36	0.58
62	"	248/57	10.58	1.69	0.61	6.44	- 0.31	- 1.98
63	"	253/57	10.76	1.88	0.75	6.72	0.05	- 1.7[illegible]
64	Xylophagou	70/51	19.10	9.80	7.63	17.50	7.43	5.8[illegible]
65	"	71/51	13.10	- 0.05	- 1.75	11.20	- 4.47	- 6.5[illegible]

Ser. No.	Place	Bore-hole Number & Year	Maximum Water Level			Minimum Water Level		
			Year after drill-ing	61-62	62-63	Year after drill-ing	61-62	62-63
66	Xylophagou	72/51	17.15	19.23	19.48	14.65	11.32	15.40
67	"	73/51	6.03	5.28	6.03	4.03	3.93	4.53
68	"	74/51	6.85	2.97	2.51	4.45	1.63	0.51
69	Yermasoyia	133/59	-	38.66	43.12	8.91	15.70	6.37
70	"	134/59	-	50.16	45.91	10.41	18.91	12.41
71	"	180/59	-	117.61	114.61	38.03	54.82	50.86
72	"	191/59	-	50.02	48.52	9.77	18.60	12.27
73	"	7/60	-	30.07	30.37	-	13.54	9.70
74	"	107/61	-	59.88	62.38	16.71	21.38	13.71
75	"	113/61	-	56.81	55.35	10.39	19.97	13.10
76	"	177/61	-	190.40	187.73	136.40	133.98	135.40

16. REPORT ON WORKSHOPS

by A. Karoglanian, Superintendent of Works.

The Workshop Section of the Department attends to the maintenance of all departmental plant and in addition serves all the other sections in respect of Development Schemes such as building of forms for concrete works, carpentry, the supply of precast concrete products, the installation of pumping plant, repairs and maintenance of town and village water supply plant, the fabricating of special pipe connections and steel sluice gates, the cutting and bending of steel reinforcement, the slotting and perforation of pipes and drilling casing, forging and electrowelding drilling bits for boreholes, construction of sheep foot rollers etc.

The Workshop and Stores accommodation include Workshop's office, garage, filters shop plant maintenance bay, precast concrete yard, welders shop, smithy, a small moulding shop, a water meter testing room and three store buildings.

80% of the employees of the workshop and stores are employed for development projects, such as irrigation schemes, village water supplies, hydrological works and drilling. 20% are employed for the maintenance of plant and tools. The amount spent by the workshop in 1963 is £130,000.

In 1963 machinery to the value of £151,000 was bought for the needs of the department such as concrete mixers, tractors, vibrating rollers etc.

A list of the chief items of plant now on charge is given in Appendix 16. Other plant is hired from contractors or borrowed from other Departments as required. A lot of earth moving machinery was hired for the construction of the Ovgos, Kiti, Mia Milea, Kanli Keuy, Prodromos dams, and Famagusta Recharge Works. Heavy lorry transport is all hired from contractors, but some departmental Land Rovers and light "countryman" vans were used for the transport of personnel, light tools etc.

Pumping plants were installed by the workshop for 38 village water supplies and 12 irrigation schemes.

Appendix 16.

MECHANICAL PLANT
(as on 31/12/63)

MOBILE PLANT:-	No.
Ruston Bucyrus Drilling rigs 22W ..	11
Ruston Bucyrus Drilling rigs 60RL ..	1
Water Dev. Department (1959) drilling rigs	1
Edeco Drilling Rigs	2
Cheshire earth boring machine	1
Allen Trencher 12"-21'	2
Avelling-Barford Trencher	1
Caterpillar D8	2
Caterpillar Traxcavators 955	4
Caterpillar Traxcavator HT4	1
Caterpillar Bulldozer	1
International Bulldozer	1
Ruston Bucyrus Excavator RB10	1
Ruston Bucyrus Excavator RB19	1
Compressors	20
Morrison diesel alternator on trailer ..	3
Electrosubmersible test pumps	10
Turbine deep-well test pumping units ..	2
Plunger deep-well test pumping units ..	2
Centrifugal pumping units	4
Portable works pumps	18
Sheepfoots roller	26
Cranes	2
Hoists	3
Concrete mixers	53
Vibrators	40
Low loader	1
Austin Countryman Vans	6
Land Rovers	22
Fordson Lorry 3 ton	1
Humber Utility Vans	2
Thornycroft Tractive Unit for Low Loader ..	1
Dumpers	3
Bray Loader	1
Vibrating Rollers	4
5 ton diesel lorry	1
Soil compactors	6

	No.
Allis Chalmers Shovel 150D	1
Allis Chalmers Bulldozer	2
Excavator S' 3/4 Cu. Yd.	2
Rubber Tyred Compaction Rollers ..	2
Core Drill 200 ft. Depth	1
Concrete Grouting machine	1
Grouting drill Pneumatic 150 ft. ..	1
Sludge Pump Pneumatic	6

WORKSHOP PLANT:-

Lathes	4
Shaping machine	1
Screwing machine	1
Drilling machine	3
Planning Timber Machine	1
Bandsaw timber	1
Bar Bender	1
Bar Cutter	1
Electric Welders	5
Forges	3
Pipe slotting machine oxy-acetylene ..	1
Vibrating table	1
Water Meter Testing Plant	1
Concrete block making machine	2
Compressor air (Tecalemit)	1
Milling machine	1
Grinding machine	2
Hack-saw Electrical	1
Concrete testing machine	1
Slotting Machine	2
Electrowelding machine	1
Steel cutting machine (high speed) ..	1

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TECHNICAL STAFF OF W.D.D. ON 1-1-1964

APPENDIX 17

SER. No.	MONTHLY AND DAILY PAID TECHNICAL STAFF		D	A.D.	SWE	EH	EE	ME	Geo	SW	SIW	IW	CF	ACF	TA	F	S	Exp.	TS	TOTAL Nos
1	Permanent staff		1	1	2	1	4	–	1	2	4	14	3	3	21	39	1	–	–	97
2	Temporary staff						14	1	2	1	2	5	1	9	57	14	–	–	4	110
3	Foreign Experts	i U.N. (OPEX)	1*																	
		ii U.N. (B.T.A.O.)																		
		iii U.N. (FAO)																		
4	Foreign Missions	i U.S.A. Aid Mission																1		231
		ii West German Mission																2		24
																		4		
	SECTION	BRANCH	DISTRIBUTION OF STAFF BY SECTIONS															17		
5	Irrigation				1															
	(The distribution of engineers is given as planned during 1st half year and between brackets for 2nd half year.)	i Watershed Planning					2											6		
		ii Short range Planning					4(2)											1		
		iii Dam Design					1											1		
		iv Dam Construction					-(4)											1		
		v Distribution Systems					3				1	2			6	9		1		
		vi Topography																1		
		vii Soil Laboratory										2			9			1		
		viii Drawing Office													4					
		ix Pumping Schemes										1			6					
		x B/H Irrigation Control																		
		xi Management of Dams																		
		xii Minor Irrigation Works					1											1	1	
6	Town Water Supplies				1					1		2	2		5	10			2	
7	Village Water Supplies					1					1	1			2	4				
8	Drilling											7		5	8	17				
9	Hydrology								3		1	2		2	9	3		12	1	
10	Workshops										1	1			17	2				
11	Branch Offices									1			2			2	1			
12	On Scholarship						4(2)													
13	Vacancies						3	1												
	TOTAL NUMBERS		1	1	2	1	18	1	3	3	6	19	4	12	78	53	1	24	4	231
14	Ordinary budget 1964		1	1	2	1	4		1	2	4	14	3	3	21	39	1			
15	Development budget 1964						14	1	2	1	2	5	1	9	57	14			4	
16	Experts																			
	TOTAL NUMBERS		1	1	2	1	18	1	3	3	6	19	4	12	78	53	1		4	

REFERENCE

D	Director
AD	Assistant Director
SWE	Senior Water Engineer
EH	Engineer Hydrologist
EE	Executive Engineer
ME	Mechanical Engineer
Geo	Geologist
SW	Superintendent of Works
SIW	Senior Inspector of Works
IW	Inspector of Works
CF	Chief Foreman
ACF	Asst Chief Foreman
TA	Technical Assistant, monthly and daily paid.
F	Foreman
S	Storekeeper
Exp.	Foreign Experts
TS	Temporary Staff; includes four pensioners reemployed and paid on daily wages.

NOTE * The Director has been provided by U.N. OPEX and is paid partly by Government and partly by U.N. The Assistant Director has been seconded to and served during 1963 as Co-Manager of the United Nations Project Special Fund.

Appendix 18.

LIST OF IMPORTANT LETTERS AND REPORTS, 1963.

	Date	No.	T i t l e
1	6 March	22/42/C	Consulting Engineers for 1963 projects British Consortium proposals for the construction of the Argaka-Magounda Dam.
2	18 March		Comments on proposed new Water Legislation.
3	18 March	43/39	Financing and Management of dams.
4	1 April		Some notes concerning the proposed Argaka-Magounda Dam.
5	11 April	72/53/IV	Desalinization of Sea Water.
6	12 April	117/39/A/2	Major Irrigation Works - Progress Report.
7	April		Notes on the Mediterranean Karst Hydrogeologic Meeting held in Greece in March 1963.
8	2 May	69/61/III	Watershed Planning. (Letter to Director-General, Ministry of Agriculture & Natural Resources)
9	2 May	69/61/III	Watershed Planning. (Specifications for Engineering Services required)
10	4 May		Some aspects of new irrigation schemes.
11	21 May		Utilization of Water from the Geunyeli Dam.
12	28 May	72/53/V	Comments on Bechtel Report. (Feasibility study, Part I. Added Water Supply Famagusta.)
13	5 June	13/62/D	De-daggering of funds. Staff of Water Development Department.
14	11 June	72/53/V	Some notes relating to the Bechtel Report.
15	20 June	13/63/D	1964 Development Budget and detailed development plan for 1964, 1965 and 1966. Proposals concerning bottlenecks.
16	27 June	72/53/V	Concerning Feasibility Study, Part I - Added Water Supply for Famagusta.
17	28 June	13/63/D	1964 Development Estimates.
18	June		The Water Resources of Cyprus. (Report)
19	5 July	62/39/II	Authorization of Heads of Section to sign letters.

	Date	No.	T i t l e
20	22 July	56/49	Accommodation (new arcon).
21	22 July	45/43/III	Concerning delay in awarding of tenders.
22	23 July	65/48/II	Aerial Survey and Mapping.
23	23 July	65/48/II	Aerial Survey & Mapping.
24	July		The Morphou Earth Dam. (Report)
25	4 August	13/63/D	Rough Development Estimates for 1965 and 1966.
26	10 August	125/58/II	Situation of West Mesaoria Aquifer Morphou Bay Scheme.
27	17 August	13/63/D	Consulting Engineers for 1964 dams.
28	14 September	65/48/II	Aerial Survey of Cyprus.
29	18 September	86/40	Controlled pumping Irrigation Scheme Pergamos.
30	22 September	69/61/IV	Watershed and island-wide masterplans.
31	25 September	72/62/II	Hydrological Section (Mr. Babau).
32	26 September	139/57/II	Staff - Appointment of Engineers.
33	13 October		The Morphou Aquifer. (Report)
34	24 October	72/53/V	Feasibility Study. Famagusta Water Supply.
35	24 October	81/63	Nicosia Water Supply.
36	1 November	101/59	Agreement between Director, Water Development Department and Co-Manager, U.N. Special Fund Project for ground-water and Mineral Survey.
37	25 November	65/54/II	Pergamos Complaints.
38	28 November	125/58/II	Morphou Project - Measures to be taken.
39	1 December	125/58/II	Morphou Project - Policy decisions.
40	7 December	101/51/X	Panayia Spring hydrological area.
41	18 December	56/63	Permits for boreholes - Committee.
42	19 December		Agreement between Min. of Agriculture & Natural Resources and Cyprus Sulphur and Copper Co. for Water Supply.
43	22 December	64/63	Operation and Maintenance of Major Irrigation Works.
44	23 December	51/63	Water Resources problems. (Reply to Mr. Toumazis speech in the House.)
45	December		Plan for development of the Tremithios River. (Report)
46	6 January, 1964	75/63	Financing and Management of dams - Argaka-Magounda Dam, Water rate.
47			Several reports of the French Mission on the West Mesaoria aquifer.

17 REPORT ON THE UNITED NATIONS SPECIAL FUND PROJECT FOR GROUND-WATER AND MINERAL SURVEY OF CYPRUS

BY Y. HJI STAVRINOU

I. Purpose and Description

The purpose of the Project is to assess mineral and groundwater resources in promising areas by means of Geological and Geophysical exploration and drilling, while strengthening the Geological Survey Department and the Drilling Section of the Water Development Department by training local staff in the use of modern investigation techniques. The duration of the Project will be five years.

Mineral exploration will be undertaken in an area of 250 square miles mainly in the Upper and Lower Pillow Lavas. The programme for the groundwater investigations however, was revised towards the end of the year in order to enable an assessment of the total water resources of the Island to be made. The aim of the original programme was merely to cover a number of selected areas where the prospects of discovering new aquifers were thought to be promising. The modification to the hydrogeological part of the scheme was suggested in order to study the complete groundwater inventory of the Island by combining the previously selected and closely related areas. The alarming decline of the water table in the existing groundwater areas, like the Western Mesaoria, the Southeastern Cyprus and the Akrotiri Peninsula also needs special study and investigation.

II. Participation and Contribution of the Government

In accordance with the original Plan of Operation the Government of Cyprus was obliged to contribute professional, administrative, and clerical personnel as well as skilled and unskilled labour for a total period of 4,380 man-months. The original contribution of the Special Fund in experts, equipment and supplies would have been £ 436,000 but with the modifications that have taken place this contribution will be greatly increased. Consequently, the Government's contribution in personnel, office accomodation, equipment, supplies etc. would have been £ 622,000 but this amount will be increased because of the revision to the Plan of Operation. Appendix 1 shows the Government contribution in personnel.

III. Commencement of the Project

The agreement between the Government of the Republic and the United Nations Special Fund was signed on 21st November, 196[illegible]

Although the survey was scheduled to commence on 1st December, 1962, it did not begin until 19th April, 1963, when the Project Manager, Dr. D. E. Thomas, arrived on the Island. Mr. Y. Hji Stavrinou, was seconded from his post as Assistant Director of the Water Development Department to the post of Project Co-Manager on the 1st June, 1963.

During the early stages of the Project there were a number of unforseen delays, nevertheless, towards the second half of the year rapid progress was made in both the supply of counterpart personnel and the arrival of the U.N. experts.

By the end of the year almost all the counterpart personnel had been made available with the exception of a few posts (one geologist, one civil engineer, one mechanical engineer and one geophysicist). Applications for the post of the geologist and the mechanical engineer have already been invited.

When the drilling rigs arrive (they are under requisition by the United Nations) the requisite number of drilling foremen and assistants will be seconded to the Project from the Water Development Department. Other vacant posts, particularly those of clerks and typists, will be filled as the need arises.

IV. Field Work

By the end of the year good progress in field work had been achieved. A total area of about 120 square miles was mapped by the counterpart personnel under the supervision of the United Nations experts. Further details of their field work are given in the annual report of the Geological Survey Department.

V. Geochemical Work

Geochemical section analysed approximately 5,000 soil samples for copper and zinc, mainly from the Vretcha area north of Paphos and the Lefkara - Lythrodonda - Vavatsinia southwest of Nicosia. A pilot scheme for collecting samples from sediments shallowly overlying the pillow lavas was started in the Arsos - Troulli area north of Larnaca and by the end of the year about 500 samples had been collected. Details of the geochemical work carried out are included in the annual report of the Geological Survey Department.

VI. Drilling and Prospecting

Towards the end of 1962 three geologists were recruited by the Water Development Department. These were Messrs. D.

G. Zafiris and Z. Koutrafali. Mr. Kypris was put in charge of the siting of boreholes, the supervision of drilling operations and other hydrogeological works in the Nicosia and Kyrenia districts. Mr. Zafiris undertook similar responsibilities in the Famagusta and Larnaca districts, and Mr. Koutrafali in the Limassol and Paphos districts.

The year 1963 was a record year for prospecting drilling for groundwater. During the year the drilling plant engaged in drilling operations consisted of 14 rigs and another two were on loan from the Limni Mines. These comprise one Ruston-Bucyrus, 60 R. L. and thirteen Ruston-Bucyrus, 22 Ws. The rigs on loan from the Limni Mines consisted of one Ruston-Bucyrus 22 and one Mangold, which after being in continual use were returned towards the end of the year. A privately owned rig was on contract drilling for a period of two months during summer.

All of the rigs are of the percussion type, but one of the 22-W is fitted with a rotary attachment, enabling it to be used for either percussion or rotary (shot crown or tungsten carbine crown) core drilling. The normal capacity range of the rigs is 8" to 10" diameter boreholes to depths of up to 500 feet but the 60 R. L. is of a much heavier duty. Under normal conditions it can drill an 8" diameter borehole to a depth of over 1,000 feet or alternatively it can be used fo drill 18" diameter holes to over 250 feet depth.

A number of deep well pumping units for long continuous test pumpings of wells and boreholes are available. In addition to several old reciprocating pumping units there are ten diesel-driven turbine pumps with a capacity of 5,000 to 20,000 g.p.h. and three 25 and one 30 K.V.A. mobile diesel-electric generating sets which are used in conjunction with $7\frac{1}{2}$" diameter electrosubmersible pumps. With these units borehole test pumping may be carried out in the capacity head range of 18,000 g.p.h. from 100 feet, to 15,000 gallons from 450 feet. A total of 40 lengthy test pumpings, from 48 hours to 302 hours continuous duration were carried out, involving a total pumping time of 7,168 hours and a total volume of 92.8 million gallons of water. Experience has shown that exhaustive test pumping are essential for showing the reliability of the aquifers.

The number of boreholes drilled during 1963 was 213 an aggregate footage of 40,301 and an average depth of 189 feet. One hundred and fifteen boreholes with a total footage of 29,3

were drilled for water. The average drilling depth for water was 259 feet. The average time taken to complete a borehole including laying the casing and an eight hour test pumping of a successful borehole was 19.7 days. The average footage drilled per day was 9.6 feet. The total yield of boreholes sunk for water in 1963 was 8,768,000 gallons per day. In addition to new drillings, 18 old boreholes were cleaned and renovated. This involved 212 drilling days, equivalent to the average time taken to drill 11 new boreholes. Only 7 boreholes were sunk solely for irrigation.

The number of successful irrigation boreholes drilled by Government since 1946 is now 1,307 with a tested output of 270 million gallons per day, sufficient to irrigate 135,500 donums of summer crops.

The area now being irrigated, as a result of these drillings is conservatively estimated to be 108,800 donums. The 1946 census estimated that in that year some 53,000 donums were being irrigated perennially by pumped water. By the end of 1963, as a result of Government drilling alone this had been increased by 206 per cent to 161,800 donums.

Drilling for water was fairly evenly distributed throughout Cyprus in 1963. By districts, the borehole distribution was as follows:-

Nicosia	40
Famagusta	12
Larnaca	25
Limassol	12
Paphos	26

A total of 115 prospecting boreholes were sunk in 1963.

In fact, the 1963 prospecting drilling programme was so arranged as to secure a source of water supply to a great number of villages which are at the moment in dire need of a satisfactory supply. It is considered that a total of about 40 villages will be supplied with a satisfactory domestic water supply from the successful boreholes put down in 1963. The prospecting drilling of 1963 produced very interesting discoveries.

A. <u>Drilling and prospecting in the Nicosia and Kyrenia districts.</u>

Drilling was carried out this year in various geological formations and useful information about new aquifers was obtained. Drilling in Pliocene marls (deep boreholes at Pera, Episkopio and

Meniko) proved that within these marls some coarse facies do exist forming good aquifers with water either of very good quality such as at Pera and Episkopio or sometimes highly mineralised as at Meniko.

Drilling on Pliocene beds, near Potami proved that the Koronia reef limestone may extend below the Pliocene marls, resulting in artesian conditions and that the reef limestone is always a very good aquifer under favourable conditions. Boreholes drilled in the Lapithos Group at Kambia and Alambra were unsuccessful and the possibilities of obtaining much water from this group of rocks in these areas are small. A little water was struck only in the bedding and fault planes. Massive chalk with solution channels were not intersected here.

Drilling in the igneous rocks where village water supplies could not otherwise be obtained as at Mathiatis, Klirou, Kalo-Khorio (Klirou) proved that little water could be obtained from the pillow lavas and diabase. The water was sought in fault zones, near dykes in pillow lavas, in jointed diabase or in deeply weathered igneous rocks. The yield of most of these boreholes was between 500 and 1,000 g.p.h. Two, one at Mathiatis and the other at Klirou are to be developed into wells.

During 1963 the hydrogeological work of the French Team of S.C.E.T. (Societe Centrale pour l'Equipment du Territoire), mentioned in the Water Development Department's Annual Report of 1962 in the Western Mesaoria, continued. The team was composed of Mr. P. Coudert, hydrogeologist, head of the mission, Mr. M. C. Babau, hydrologist, and Mr. M. Gineard geologist. Special problems in the Western Mesaoria were dealt with by Mr. Tixeront and Mr. J. M. Daniel, experts of S.C.E.T. who visited Cyprus for a short period for this purpose.

The French team worked in Cyprus from the beginning of 1962 until the autumn of 1963 and submitted 11 reports and 14 notes on the various problems studied. These reports and notes can be found in the libraries of the Water Development and Geological Departments. The Government contributed to the work of the team as four boreholes were drilled within Morphou village during 1963 and a number of test pumpings were carried out by the S.C.E.T. experts to compile figures about the hydrogeological characteristics of the Morphou aquifers. These boreholes are, 49/63, 54/63, 77/63, 93/63. Also nine observation boreholes were drilled in the We[illegible]

Mesaoria at sites selected by the S.C.E.T. Special attention was paid to separate the various aquifers, where possible, in order to observe the variation of the S.W.L. of each aquifer separately. These boreholes are the following:-

8/63, 9/63, 32/63, 33/63, 34/63, 39/63, 52/63, 60/63 and 142/63.

Borehole 142/63 was also drilled to verify the results of an electrical geophysical investigation carried out in the Morphou Bay coastal zone in order to detect salt water encroachment.

The most interesting boreholes drilled in the Nicosia district during 1963 are the following:-

Meniko serial No. 114/63 (Grid Ref: N. 61,720 E. 84,360)*.

The drilling of this bordhole was started in October 1962 and was completed in May 1963. The borehole, located near Meniko on the bank of the Akaki river, was sited on recent river deposits resting directly on marls, mapped as Myrtou Marls, rising gently to the south towards the Troodos massif.

The borehole reached a depth of 1,875 feet passing through 6 feet of gravels (representing the river deposits), 1,540 feet of a continuous blue-grey marls series with occasional sandstone layers, and finally 330 feet of brownish light grey and white chalks and chalky marls. At the bottom of the hole some hard chert layers were intercalated within the varie-coloured chalky marls, and at the lose there was a stiff brown clay.

Little water was found in the upper deposits but it was of good quality. The water of the lower coarse facies of the marl series was brackish and artesian, the salinity of the artesian flow increasing with depth. From the depth of 695 feet, when the first artesian aquifer was struck, to 1,390 feet when the artesian flow was at its maximum, the discharge increased from 60 g.p.h. to 2,030 g.p.h. and the salinity from 2,223 p.p.m. NaCl increased to 8,484 p.p.m.

The last test pumping was carried out at the rate of 4,400 g.p.h. with a maximum drawdown of 153 feet and the water which had a NaCl content of 6,728 p.p.m. unfortunately could not be used for drinking or irrigation purposes. It is interesting to note that a sample taken from a depth of 1,790 feet contained 15,387

* military maps at scale 1:50,000

p.p.m. NaCl.

The temperature of the artesian flow (taken everyday) between depths of 1,830 feet and 1,875 feet was steady at 27°C. The temperature of the mud bailed out between 1,846 feet to 1,875 feet was around 35° C.

Borehole near Pera, serial No. 167/63 (Grid Ref: N.53,620 E.94,760)

This borehole was sited directly on Myrtou Marls. It went down to a depth of 910 feet through blue grey marls, grey sands and fine gravels the latter representing a coarse facies in the marls. The bottom of the hole was in whitish chalks. It is interesting to note that the total thickness of the coarse facies is about 400 feet, but because of the silty character of the formation the specific capacity of the borehole was only about .85 g.p.m. per foot of drawdown.

Efforts to improve the specific capacity by surging the borehole failed. The borehole was then treated with calgon (30 tins of 8 lbs each) diluted in water. After this treatment the specific capacity was increased to .94 g.p.m. per foot of drawdown. Extensive test pumping was carried out for 7 days at the rate of 16,360 g.p.h. with a maximum drawdown of 320 feet. This borehole is considered to be very successful as it lies in a comparatively virgin area.

Borehole near Kazivera, serial No.142/63 (Grid Ref: N.70,320 E.62,550)

This borehole was drilled about 300 feet from the coast to verify the results of an electrical resistivity survey for salt water encroachment and for use as an observation borehole.

During drilling, samples were taken regularly to test the salinity of the various aquifers. This was possible because the casing was plain except for a few feet at the bottom which was of perforated casing. Chemical analyses revealed an increased salinity in the third aquifer. This proved that the fresh and sea water interface had been inverted inland in reality a salt water encroachment along the deep horizons had already started in these areas. The maximum sodium chloride content in the third aquifer was 5,558 p.p.m. at 357 feet below ground level. It is interesting to note that the S.W.L. of the third aquifer was considerably lower than that of the first and second aquifers. The details were as follows:- First water 6 feet 11 inches; second water 6 feet 7 inches; third water 9 feet 4 inches; below ground surface. The maximum sodium

chloride content of the first aquifer is 1,094 p.p.m.; second aquifer 2,047 p.p.m. and third aquifer 5,558 p.p.m.

The drilling of this borehole proved to be extremely difficult because of the lose sand flowing in the borehole and creating a number of problems which were solved by the experienced driller. The borehole eventually penetrated the third aquifer at a depth of 380 feet with 10" casing. In this borehole three pipes of 4" diameter were placed for each aquifer, the aquifer being again separated with clay and conctrete. Piezometers in this borehole are with 4" pipes as follows:-

First aquifer 35 feet of casing with the bottom 5 feet perforated.

Second aquifer 95 feet of casing with the bottom 10 feet perforated and the third 315 feet casing with the bottom 10 feet perforated.

Potami borehole, serial No. 187/63 (Grid Ref: N.61,060 E. 74,260)

This borehole was drilled at Potami village in a small stream traversing Myrtou marls, near the Koronia Limestone. It penetrated 340 feet of blue grey marls with a few layers of water-bearing coarse material and intersected the reef limestone underlying the marls. The limestone proved to be in this case an artesian aquifer. The confined water coming from this limestone had been sealed off from the other aquifers by means of plain casing of 10" and clay forced around it. The artesian yield was 3,200 g.p.h. but a small scale test proved it to be very free yielding and large quantities of water can be pumped. Another borehole was drilled (Serial No.111/62) in 1962 directly on an outcrop of reef limestone in the same area at a distance of about 4,000 feet from the other but it appears that the two boreholes draw their water from different aquifers. Borehole number 111/62 has a lower water table than the new one and an NaCl content of 819 p.p.m. while the new borehole contains only 480 p.p.m. NaCl.

B. <u>Prospecting drilling in the Famagusta and Larnaca districts.</u>

In the above two districts, like in previous years, good results were achieved in the drilling of boreholes in river gravels. Particularly useful finds were discovered in the Pakhna gypsum and in other Pakhna rocks around Khirokitia and Ayios Theodoros (Skarinou) where a coarse facies occurs. Large yields from boreholes intersecting gypsum were obtained after borehole development was carried out by using dynamite.

Smaller successes in these districts were achieved by drilling in the Lapithos Group as well as in deeply weathered pillow lavas. In these rocks the water is a product of the secondary porosity of the rocks i.e. groundwater occurs in fissures, faults planes and in the case of the Lapithos chalks occasionally in small solution channels.

The most important boreholes drilled in the above two districts in 1963 are the following:-

Gastria borehole, serial No. 3/63 (Grid Ref: N.87,600 E. 60.500)

The boring was located on a big outcrop of gypsum. It penetrated 115 feet of gypsum and then entered the Kythrea marls. The S.W.L. was at 30 feet below ground level. The first test pumping was carried out with an output of 1,800 g.p.h. with complete drawdown. The bore was then exploded with 60 lbs of dynamite at two different levels where a little water was struck during drilling. The borehole was properly test pumped for a total of 192 hours with an output of 18,000 g.p.h. (this being the maximum output of the electrosubmersible pump used) with a small drawdown of only 5 feet.

Pergamos borehole, serial No. 70/63 (Grid Ref: N. 54,435 E.35,210)

This borehole went down to a depth of 370 feet. At first 148 feet of impervious marls were intersected followed by 160 feet of solid gypsum. The last 62 feet were in blue grey marls. The first test pumping gave a very small output, about 1,000 g.p.h. with complete drawdown. The borehole was then exploded with 70 lbs of dynamite at two different levels and a second test pumping followed. The pumping was of duration of 302 hours the yield being 22,000 g.p.h. (the maximum capacity of the electrosubmersible pump used) with a drawdown of 14 feet. The recovery of the water level at the completion of the pumping took only 30 minutes.

The water of gypsum aquifers is highly mineralised, especially its total hardness which lies within the region of 2,000 p.p.m. However, this water can be, and is in fact very usefully used for agricultural purposes, especially for the irrigation of resistant crops such as alpha-alpha, vines and certain vegetables.

Khirokitia borehole, serial No.27/63 (Grid Ref: N.27,700 E. 00.700)

This borehole was drilled north of the village and struck water in the fissures and solution channels of the Koronia Limestone. The boring intersected 200 feet of this limestone and then went down to a depth of 695 feet, the lowest strata belonging to the

Pakhna Formation. The borehole was tested for a total of 168 hours with a constant yield of 16,400 g.p.h. and a maximum drawdown of 97 feet. The quality of the water was excellent.

Ayios Theodoros (Skarinou) borehole, serial No.71/63 (Grid Ref: N. 23,280 E. 08,125).

The borehole was located on the bank of the Pendaskinos river. After 105 feet of free yielding river gravels were penetrated it then went through 850 feet of fragmental limestone of the Pakhna Formation. A number of coarse grained sediments were intersected which gave an artesian flow (the gravels were sealed off by means of 13" plain casing). The total depth of the borehole was 1,000 feet and the artesian flow at the end of the drilling was 2,400 g.p.h. The confined aquifers were tested by means of deepwell pumping. The output was 6,000 g.p.h. (the maximum capacity of the pump) with a small drawdown. Proper test pumping will soon be carried out and the yield is expected to be very high because a considerable thickness of coarse grained aquiferous material was intersected.

C. Drilling and prospecting in the Limassol and Paphos districts.

Most of the boreholes drilled in these districts were located in river valleys such as the Yermasoyia, Khapotami, Dhiarrizos, Xeropotamos and Ezuza. Practically all the boreholes located in these rivers were very successful. The results of the 1958 seismic survey by the Overseas Geological Survey in selected river valleys helped in the location of the sites. Yields from such boreholes were in the region of 20,000 g.p.h. with a small drawdown.

Other boreholes drilled in the districts under consideration were located in the Lapithos and Pakhna chalks. Small quantities of water in the region of 5,000 g.p.h. were struct in fissures and bedding planes.

The most interesting borehole drilled in the Paphos district was borehole serial No. 105/63 (Grid Ref: 53,100 E.18,700) situated on the banks of the Chrysochou river, south of Polis. This was one of the few deep boreholes to be put down by Government, and the intention was to find out whether Pakhna gypsum as well as Terra Limestone (Strata usually carrying considerable quantities of water) exist in this area. The boring reached a total depth of 1,100 feet but unfortunately missed the above two formations.

The borehole log is shown below:-

0' - 60' river Alluvium (Recent)
60' - 608' Buff and blue grey marls (Pliocene)
608' - 693' Buff and creamy marls and chalks (Pakhna)
693' - 1100' Clays, marls limestone and tuffs (Mamonia Complex)

A confined aquifer in the Mamonia limestones was struck at a depth of 1,010 feet. Unfortunately this lower water was very saline and as it could not be used for either domestic or irrigation purposes it was sealed off. The yield of this well was 2,500 g.p.h. with a drawdown of 150 feet.

The location of the boreholes described above are given in appendix 2.

VII. Drilling Costs

All drilling in 1963 was financed entirely from Government funds.

The average cost of departmental drillings in 1963 was £228 per borehole or 1205 mils per foot of drilling. These costs are inclusive of the expenses of laying casing pipes as well as an eight hour pumping test of the 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 maintainance of drilling tools and equipment. Depreciation of drilling plant and the salaries and expenses of the supervisory staff are not included.

No subsidized boreholes were drilled in 1963 owing to lack of funds.

VIII. Hydrogeological surveys.

The knowledge of the groundwater inventory of each water basin involves systematic research and study, not only of the geological and geophysical conditions of the basin but also of its hydrological data. A clear knowledge of the conditions of the surface and groundwater resources is absolutely essential for the discovery, development and replenishment of the aquifers of the water basins in the Island where continuous uncontrolled and irrational pumping has caused the decline of the water table to a dangerous level. This had had the unfortunate result that in a number of areas such as Famagusta, Zakaki, Morphou and Kiti, sea incursion has taken place.

Thus the Water Development Department started an early accumulation of the hydrological data of existing groundwater producing basins of the Western Mesaoria, Southeastern Cyprus, the Akrotiri Peninsula, Kyrenia Range, Ayia Marina-Polis and Kiti-Pervolia coastal belts. The purpose of these surveys is to keep under observation the behaviour of groundwater especially the S.W.L. the salinity and the seasonal and long term fluctuations of the water table in connection with the amount of the water extracted.

The survey of the Western Mesaoria and Akrotiri Peninsula has now been completed in the sense that all wells and boreholes have now been plotted on L.R.O. sheets of 1:5000 and maps have now been produced on a scale of 1:10,000 showing the topographical as well as the groundwater contours. Twice annually the water levels of the observation as well as a number of selected private wells are measured and maps are prepared of the groundwater table at its maximum in springs (before pumping starts) and at its minimum in autumn (when pumping stops.). Figures of the quantities of water extracted as well as the number of donums irrigated are taken once a year. Summaries of these surveys for 1963 are shown in appendices 3 and 4.

The southeastern Cyprus hydrological survey which has already covered a total area of 129 square miles is now in full swing. It is hoped that this survey will be completed in 1964.

The first phase of the Kyrenia survey, consisting of the plotting of all wells and boreholes on L.R.O. 1:5000 plans and the preparation of 1:10,000 maps, has now been completed. By the end of the year the levelling of all wells and boreholes was in hand. A summary of the total number of wells used, together with the amount of water extracted, as well as the types of crops irrigated, are shown on appendices 5 and 6.

During the year the Ayia Marina - Polis tis Chrysochous hydrological survey was started. At the time of writing practically all the wells and boreholes had been plotted on L.R.O. 1:5000 sheets. It is hoped that this survey will be completed in 1964.

In 1963 the hydrological survey of the Kiti-Pervolia coastal belt was also started and by the end of the year all wells and boreholes had been plotted on L.R.O. 1:5000 sheets; maps of 1:10,000 had also been prepared. It is expected that the survey will be completed in 1964. Summaries of the survey completed in 1963 are shown in appendices 7, 8 and 9.

IX. Private Drilling

There were 37 privately owned drilling rigs operating in Cyprus at the end of 1963. Altogether they drilled 34 new boreholes all for water with an aggregate footage of 22,913. Unfortunately, there were quite a number of illegal drillings of which no information is available. A number of these boreholes struck water but unfortunately the private drillers involved gave no definite figures of the output as not test pumpings were carried out. Twenty-five of these rigs are locally made, some of them quite well constructed, but they are of a rather light type, generally only suitable for drilling in favourable rock conditions. There has been a tendency towards the use of imported drilling rigs by private contractors, because in 1963 in addition to 25 locally made rigs, there were eight Ruston-Bucyrus 22W, one Ruston-Bucyrus 60 R.L. and 3 Swedish made rigs. As in previous years a considerable number of boreholes were sunk, cleaned and renovated in the Famagusta and Larnaca districts where drilling is comparatively easy and wells may be sunk without casing; there has however, been increased activity in the Nicosia district during 1963 where drilling rigs were operating near Nicosia and in the vicinity of Morphou. Two drilling rigs sunk several successful boreholes in the Limassol and Paphos districts.

By law, private drilling contractors are obliged to give notice of drilling, to keep records of depth of boreholes and S.W.L. and to retain borehole samples for inspection by an officer of the Water Development Department. Test pumpings are not normally carried out. As many of the boreholes were drilled in the bottom of existing wells or they were old boreholes and were renovated so the increase in yields is somewhat conjectural and no estimation of the additional quantity of water found can be given.

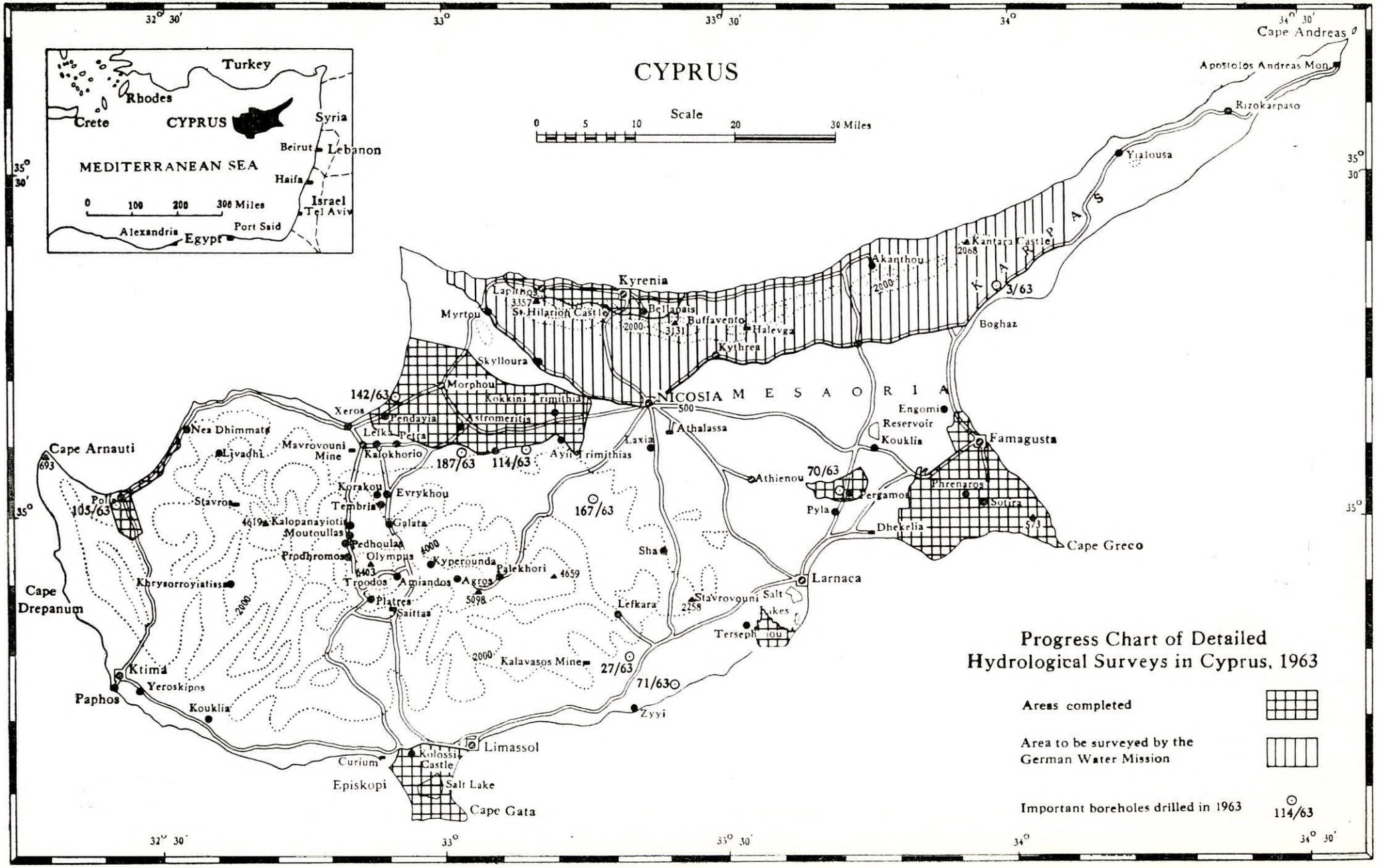
Appendix 10 shows boreholes drilled by government since 1946 and those drilled by government in 1963.

Appendix 11 shows summary of results of boreholes drilled by government in 1963.

SPECIAL FUND PROJECT FOR GROUNDWATER AND MINERALS
CONTRIBUTION OF PERSONNEL BY THE CYPRUS GOVT.

APPENDIX I.

POSTS	NO	FROM GEOLOGICAL DEPT.	FROM WATER DEVELOPMENT DEPT.
Senior Hydrogeologist	1		1
Senior Geologist	1	1	
Hydrogeologist	2		2
Civil Engineer	1		1
Geophysicists	2	1	1
Geologists	4	4	
Chemist	1	1	
Chief Driller Foreman	1		1
Driller Foremen	6		6
Drilling Assistants	12		12
Mechanical Engineer	1		1
Mechanics	2		2
Draughtsmen	2	1	1
Surveyor Draughtsmen	9	6	3
Technical Assistants	2		2
Field and Laboratory Assts.	9	7	2
Foremen	3	3	
Chief Clerk	1		
Clerks and Typists	12		
Secretary	1		


CYPRUS
Scale
0 5 10 20 30 Miles
Turkey
Rhodes
Crete
CYPRUS
Syria
Beirut
Lebanon
MEDITERRANEAN SEA
Haifa
Israel
Tel Aviv
0 100 200 300 Miles
Alexandria
Egypt
Port Said
Cape Andreas
Apostolos Andreas Mon.
Rizokarpaso
Yialousa
Kantara Castle
2068
Akanthou
2000
KYRENIA RANGE
3/63
Boghaz
Kyrenia
Lapithos
3357
St. Hilarion Castle
Bellapais
Buffavento
3131
Halevga
Kythrea
Myrtou
Skylloura
Morphou
142/63
Kokkina
Trimithias
Xeros
Pendayia
Astromeritis
Lefka
Peita
Nea Dhimmata
Cape Arnauti
693
Ljvadhi
Mavrovouni Mine
Kalokhorio
187/63
114/63
Ayia Trimithias
NICOSIA
500
Athalassa
Laxia
MESAORIA
Engomi
Reservoir
Kouklia
Famagusta
Athienou
70/63
Pergamos
Phrenaros
Sotira
573
Pyla
Dhekelia
Cape Greco
Korakou
Evrykhou
Tembria
Galata
167/63
Stavros
105/63
Pole
4619
Kalopanayiotis
Moutoullas
Pedhoulas
Prodhromos
6403
Olympus
4000
Kyperounda
Palekhori
4659
Troodos
Amiandos
Agros
5098
Platres
Saittas
Sha
Larnaca
Khrysorroyiatissa
2000
Cape Drepanum
Lefkara
2258
Stavrovouni
Salt Lakes
Terseph ou
Kalavasos Mine
27/63
71/63
Zyyi
Ktima
Paphos
Yeroskipos
Kouklia
Limassol
Curium
Kolossi Castle
Episkopi
Salt Lake
Cape Gata
Progress Chart of Detailed
Hydrological Surveys in Cyprus, 1963
Areas completed
Area to be surveyed by the
German Water Mission
Important boreholes drilled in 1963
114/63

WELLS AND BOREHOLES IN WESTERN MESAORIA - YEAR 1963 APPENDIX 3

Serial No.	Village Boundaries	Total No. of legal B.Hs with P.U*	Area Irrig. Dons	Quant. of water extract. M.G.Y.	Total No. of ill. B.Hs. with P.U.	Area Irrig. Dons	Quant. of water extract. M.G.Y.	Total No. of wells with P.U.	Area irr. Dons	Quant. of water extract. M.G.Y.	Total No. of springs & Ch. of wells in use	Area irr. Dons	Quant. of water extract. M.G.Y.
1	Morphou	236	14470	4488	15	1220	320	-	-	-	-	-	-
2	Syrianokhori	26	2094	546	2	140	40	-	-	-	-	-	-
3	Kapouti	3	70	19	-	-	-	2	10	3	-	-	-
4	Chysiliou	7	360	91	-	-	-	2	10	4	-	-	-
5	Prastio	26	2540	637	-	-	-	-	-	-	-	-	-
6	Nikitas	7	640	179	-	-	-	-	-	-	-	-	-
7	Pendayia	11	1200	242	-	-	-	-	-	-	2	550	320
8	Elea	8	820	141	-	-	-	-	-	-	-	-	-
9	Petra	1	15	2	-	-	-	-	-	-	-	-	-
10	Gazivera	13	780	205	4	90	29	7	180	44	-	-	-
11	Angolemi	2	15	3	-	-	-	-	-	-	-	-	-
12	K. Zodhia	29	4027	799	1	190	20	-	-	-	-	-	-
13	P. Zodhia	16	2180	326	1	60	12	-	-	-	-	-	-
14	Astromeritis	12	890	128	-	-	-	-	-	-	-	-	-
15	Katokopia	24	4430	740	-	-	-	-	-	-	4	525	200
16	Argaki	11	1630	283	2	60	12	-	-	-	-	-	-

* P. U. = Pumping Unit.

17	Masari	6	1500	328	-	-	-	-	-	-	1	1	2	
18	Kyra	4	660	121	-	-	-	1	10	2	-	-	-	
19	Philia	2	130	47	-	-	-	1	15	6	8	78	21	
20	Akaki	39	1560	285	1	10	3	6	65	13	7	129	269	
21	Avlona	11	545	95	-	-	-	3	80	11	3	220	290	
22	Peristerona	18	1550	222	1	30	4	1	10	2	5	250	440	
23	Meniko	2	10	2	-	-	-	11	50	12	-	-	-	
24	Orounda	3	20	5	-	-	-	2	10	3	2	600	140	
25	Paleometocho	41	770	135	9	190	34	42	135	33	1	1	1	
26	Dhenia	3	50	9	1	3	1	10	100	16	9	47	23	
27	K. Trimithia	62	700	172	15	250	47	2	15	3	1	-	1	
28	Mammari	1	4	2	1	7	1	34	220	50	5	9	10	
29.	Ayii Trimithias	5	100	23	6	230	36	-	-	-	-	-	-	
30	Yerolakkos	-	---	-	-	-	-	10	10	2	-	-	-	
31	Koutraphas	-	-	-	-	-	-	-	-	-	1	70	40	
	TOTAL	329	43860	10275	59	2480	559	134	920	204	51	2600	2017	

WELLS AND BOREHOLES IN AKROTIRI PENINSULA - YEAR 1963

APPENDIX 4

Village Boundaries	Total Number of legal B.Hs	Area Irrig. Don.	Est. Q. Extract. Mill.Gals.	Total No. of illegal B.Hs. on Private Land	Area Irrig. Don.	Est. Q. Extract. Mil. Gals.	Total Number of Wells	Area Irrig. Don.	Est.Q. Extract. Mil.Gals.	RE-MARKS
Limassol	5	5	3.89	-	-	-	21	115	35.70	
Chiftli-koudhia	2	14	3.77	-	-	-	126	674	206.16	
Zakaki	15	615	194.92	3	92	27.57	109	869	243.72	
Cherkes Chiftlik	22	1,250	374.23	-	-	-	16	227	61.63	
Asomatos	20	1,821	614.94	-	-	-	48	914	244.80	
Akrotiri	28	1,392	502.56	1	25	2.50	118	530	116.51	
Kolossi	18	1,750	493.97	-	-	-	13	-	-	
Ypsonas	1	-	- - -	-	-	-	14	161	39.35	
K.Pole-midhia	20	727	188.58	-	-	-	38	465	120.54	
Trakhoni	8	534	125.35	1	13	3.55	39	497	117.89	
Erimi	3	250	53.00	-	-	-	-	-	-	
Episkopi	4	154	36.87	3	167	41.25	-	-	-	
GRANT TOTALS	146	8,512	2,592.08	8	297	77.87	542	4,452	1,186.30	Figures for Phasouri Pl[illegible] tions [illegible] tlage of [illegible] 1223 fi[illegible] not avail[illegible]

WELLS, BOREHOLES AND SPRINGS IN KYRENIA HYDROLOGICAL AREA APPENDIX

Village Boundaries	Domestic and Industrial Uses										Shepherd's Wells		
	Total No.of B/Hs	With P.Plant	Without P.Plant	Est. Q. extract. M.Gls	Total No.of Wells	With P.Plant	Without P.Plant	Est.Q. extract. M.Gls	Total No.of Springs	Est.Q. estract. M.Gls	Total No.of Wells	Est.Q. extrad M.Gls	Re-marks
Vasilia	-	-	-	-	24	3	21	0.4	2	2.1	1	0.01	
Lapithos	-	-	-	-	103	27	76	2.6	3	6.6	5	0.1	
Karavas	1	1	-	0.9	23	14	9	2.9	1	13.6	9	0.2	
Elea	-	-	-	-	3	1	2	0.6	-	-	-	-	
Paleosophos	-	-	-	-	1	-	1	0.03	-	-	-	-	
Phterykha	-	-	-	-	-	-	-	-	-	-	-	-	
Ayios Georghios	-	-	-	-	60	44	16	1.6	1	0.02	4	0.1	
Trimithi	-	-	-	-	8	4	4	0.1	1	1.4	-	-	
Karmi	-	-	-	-	6	3	3	0.1	6	8.0	-	-	
Temblos	-	-	-	-	20	11	9	1.3	-	-	3	0.03	
Kyrenia	6	6	-	1.2	67	60	7	3.7	3	0.3	5	0.1	
Thermia	-	-	-	-	3	1	2	0.1	1	5.5	-	-	
Karakoumi	-	-	-	-	10	10	-	0.7	-	-	-	-	
Kazaphani	2	2	-	2.9	44	20	24	4.2	2	2.1	4	0.05	
Bellapais	4	4	-	81.9	3	1	2	0.02	3	5.9	5	0.2	
Ay.Epiktitos	-	-	-	-	145	42	103	3.3	6	0.3	8	0.1	
GRAND TOTALS	13	13	-	86.9	520	241	279	21.65	29	45.8	44	0.89	Total Q. extracted from the whole area 155.3 m.gls

WELLS, BOREHOLES AND SPRINGS IN KYRENIA HYDROLOGICAL AREA APPENDIX 6
YEAR 1963

Village Boundaries	Total No.of B/Hs with P.Plant	Area irr. Dons	Est.Q extract. M.Gls	Total No.of wells with P.Plant	Area irr. Dons	Est.Q. extract. M.Gls	Total No.of Springs in use	Area irr. Dons	Est.Q. Disch. M.Gls	Remarks
Vasilia	-	-	-	100	808	133.0	-	-	-	
Lapithos	12	120	56.2	212	1400	314.4	42	1336	258.8	An additional Q. of 6.6 mils gls used for W.S. from 1 spring
Karavas	26	381	103.2	126	1038	208.9	13	804	242.6	An additional Q.of 1.9 m.gls used for W.S.from 2 wells. An additional Q.of13.6 m.gls. used for W.S. from 1spring.
Elea	2	22	5.8	16	134	28.2	-	-	-	
Paleoscplos	-	-	-	2	5	0.6	7	80	8.2	
Phterykha	-	-	-	-	-	-	8	152	31.1	
Ay.Georghios	2	17	0.9	77	341	40.4	-	-	-	
Trimithi	2	20	3.3.	27	233	32.6	-	-	-	
Karmi	1	2	0.1	4	35	6.6	1	1	0.4	
Temblos	-	-	-	13	113	11.3	-	-	-	
Kyrenia	5	27	6.6	81	308	33.3	-	-	-	
Thermia	-	-	-	19	130	11.2	1	1	0.4	An additional Q.of 5.5 m.gls used for W.S. from 1 spring
Karakoumi	-	-	-	6	12	2.0	-	-	-	
Kazaphani	2	14	6.7	78	493	71.5	6	18	2.9	
Bellapais	4	15	10.0	5	37	1.1	11	508	38.4	An additional Q.of 5.8 m.gls used for W.S. from 2 springs
Ay.Epiktitos	-	-	-	58	225	23.2	6	27	2.2	
GRAND TOTALS	56	618	192.8	824	5312	918.3	95	2927	585.0	Total Q.extracted from the whole area 1696.1 m.gls An additional Q.of 20.9 m.gls from springs out to sea

WELLS AND BOREHOLES IN KITI - PERVOLIA AREA — APPENDIX - 7
YEAR 1963

Village Boundaries	Total No.of B.Hs	With pumping units	Without pumping units	AREA IRRIGATED TYPE OF CROP Permanent Crops		NON PERMANENT CROPS								Total Area Irr. (Don)	Estim. Q. of water extract. (M.G/Y)
				Citrus	Other Trees	Potatoes E.	Potatoes L.	Artichokes	Melons	Beans	Ladies Fingers	Cabbage	Other Crops (Meget)		
KITI	41	32	9	40	8	55	35	363	160	40	NIL	21	8	730	180.3
PERVOLIA	21	13	8	70	NIL	60	10	22	45	2	13	2	15	239	52.1
	Total No.of Wells														
KITI	103	35	68	54	10	54	25	113	110	25	10	9	12	422	90.0
PERVOLIA	159	69	90	8	2	143	100	303	103	29	167	30	181	1,066	228.0
TOTALS	324	149	175	172	20	312	170	801	418	96	190	62	216	2,457	550.4
				DOMESTIC USE											
KITI	2	2	NIL	One borehole and one well for Kiti water supply											6.0
PERVOLIA	127	105	12	All Wells with hand-pumps											1.2
TOTALS	129	107	12												7.2

VILLAGE	Total Area (Sq. miles)	Total Cultivalbe Area (Not Irrigated)	Total Irrigated Area	Percentage of total cultivable Area Irrigated by Boreholes and Wells
KITI	3.4 (6,600 Dons)	2.8 (5,450 Dons)	.6 (1,150 Dons)	17.4%
PERVOLIA	3.3 (6,400 Dons)	2.6 (5,100 Dons)	.7 (1,300 Dons)	20.3%
TOTALS	6.7 (13,000 Dons)	5.4 (10,550 Dons)	1.3 (2,450 Dons)	18.8%

WELLS AND BOREHOLES IN KITI-PERVOLIA AREA — APPENDIX 9
YEAR 1963

Village Boundaries	Type of Crop	Total No. of B/Hs and Wells	Total Area Irr. (Don)	Total Q of water extracted (M.G/Y)	Average Area Irrigated: Per B.H or well (Don)	Average Area Irrigated: Per M.G. (Don)	Average Annual Extraction: Per B.H. or well (M.G/Y)	Average Annual Extraction: Per Don (10^3 gall)	m.m.	Average Rainfall during crop growth (m.m.)	Average Annual Water used (m.m.)	Remarks
	Citrus		112	21	1.67-	5.33	.31	.187-	639.5	361.9	1.001.4	
	Potatoes(E)		109	11	1.62-	9.91	.16-	.101	345.4	127.8	473.2	
	Potatoes(L)		60	10	.89	6.00	.15	.166	567.7	60.9	628.6	
	Artichokes		476	147	7.10	3.23	2.19	.309	1.056.8	361.9	1.418.7	
KITI	Melons	67	270	54	4.02	5.00	.81	.200	684.0	35.3	719.3	
	TOTALS		1,152	270	17.16	4.26	4.02	.234	800.3	214.8	1,015.1	
	Citrus		80	23	.98	3.47	.28	.287	981.5	361.9	1,343.4	
	Potatoes(E)		203	21	2.48	9.66	.26	.103	352.2	127.8	480.0	
	Potatoes(L)		110	18	1.34	6.11	.22	.163	557.4	60.9	618.3	
	Artichokes	80	325	103	3.96	3.15	1.25	.316	1.080.7	361.9	1.442.6	
PERVOLIA	Melons		148	29	1.80	5.10	.35	.196	670.3	35.3	705.6	
	Other Crops		439	86	5.35	5.10	1.05	.195	666.9	60.9	727.8	
	TOTALS		1,305	280	15.91	4.66	3.41	.214	731.9	161.8	893.7	
TOTALS		149	2,457	550	16.5	4.46	3.55	.224	766.1	186.6	952.7	

APPENDIX 10

NUMBER AND FOOTAGE OF BOREHOLES
NUMBER OF BOREHOLES DRILLED
1956 - 1963

Purpose	1946-1956	1957	1958	1959	1960	1961	1962	1963
For Private Individuals and Companies	1,456	202	106	155	165	55	22	12
For Government	449	62	35	9	13	126	207	190
For W.D. and A.M.W.D.	236	29	16	27	10	18	18	11
Totals	2,141	293	157	191	188	199	247	213
Aggregate footage drilled	103,243	51,420	32,842	48,250	49,887	49,681	51,292	40,301
Average depth	387	175	209	253	265	245	208	189

BOREHOLES DRILLED
IN 1963

Purpose	No.	Existing Well Footage	Footage Drilled	% age successful	Total tested yield G.P.D.*
Irrigation	7	25	1,404	28.6	384,000
Domestic W.S.	7	-	1,366	57.1	411,600
Prospecting	101	119	27,066	40.6	7,972,800
Total for water	115	144	29,836	40.9	8,768,400
Observation	32	-	4,671	-	-
Technical & Geological	66	1,726	5,794	-	-
Total Drilled	213	1,870	40,301	-	-

Old Boreholes Renovated - 18

* Figures include 19 potential tests with an Electric Submersible Pump, and the remainder of boreholes preliminary tested with a Deep-well pump only, of limited capacity.

BOREHOLES DRILLED FOR WATER IN 1963 APPENDIX 11

SUMMARY OF RESULTS

District	Locality	No. Drilled	No.* Successful	% age Successful	Total Tested Output G.P.D.**	Average yield per Successful Borehole .G.P.D.
Nicosia	Western Mesaoria	22	11	50.0	1,951,200	177,380
	Episkopio-Kambia-Kalo-khorio	5	2	40.0	448,800	224,400
	Paleometocho-Strovolos	2	1	50.0	117,600	117,600
	Lythrodonda-Mathiati	6	-	-	-	-
	Alambra-Nisou	5	1	20.0	216,000	216,000
Fmagusta	Asha	5	-	-	-	-
	Kouklia-Makrasyka	2	1	50.0	216,000	216,000
	Gastria	3	3	100.0	592,800	197,600
	Kantara	1	1	100.0	540,000	540,000
	Ay. Napa	1	1	100.0	240,000	240,000
Larnaca	Aradhippou-Pergamos-Dhekelia	12	6	50.0	1,155,600	192,600
	Anglisides-Pevdas-Meneou	10	3	30.0	208,800	69,600
	Khirokitia-Ay.Theodoros	2	2	100.0	537,600	268,800
	Tremetousha	1	-	-	-	-
Limassol	Monagroulli-Pendakomo	7	1	14,3	127,200	127,200
	Khalassa	3	1	33.3	48,000	48,000
	Polemidhia	1	1	100.0	127,200	127,200
	Alektora	1	-	-	-	-

District	Locality	No. Drilled	No.* Successful	% age Successful	Total Tested Output G.P.D.**	Average yield per Successful borehole G.P.D.
Paphos	Trachypedhoula-Mamonia-Ay. Yeorghios	6	3	50.0	936,000	312,000
	Kambia-Yeroskipos	7	4	57.1	324,000	81,000
	Malia-Kapedhes	4	-	-	-	-
	Goudhi-Evretou	2	1	50.0	540,000	540,000
	Peyia	4	2	50.0	153,600	76,800
	Khoulou	2	2	100.0	288,000	144,000
	Polis	1	-	-	-	-
		115	47	40.9	8,768,400	186,500

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

** Figures include 19 potential tests with an Electric Submersible Pump, and the remainder of boreholes preliminary tested with a Deep-well pump, only, of limited capacity.

18 REPORT ON THE WORK OF THE WEST GERMAN WATER MISSION

BY Y. HJI STAVRINOU

I. Introduction

An agreement was signed on the 30th October 1961 between the Federal Republic of Germany and the Cyprus Republic for technical assistance for the execution of a water project in the northern range of the Island. The purpose of the project is to assess groundwater resources in the said region by means of geological and geophysical exploration as well as drilling of a number of boreholes. A utilization plan for the water reserves to be discovered is also to be made. A soil survey of the most suitable lands that may be brought under irrigation is also envisaged in this project. The areas to be surveyed are shown on appendix 2.

For the above purpose 17 experts arrived in the Island and work commenced on the 22nd April 1963. The team is headed by Dr. F. K. Mixius. The composition of the team is shown on appendix 1.

II. Field Work

By the end of 1963, reconnaisance survey of the Hilarion Limestone was carried out and a number of borehole sites have been selected by means of reconnaisance geological mapping and the use of aerial photographs. In addition the deleniation and structural details of the more or less incoherent units of the Hilarion Limestone have been completed.

III. Drilling

The team imported in the Island three rotary rigs. These are:- One ITAGH of a normal capacity range of 6" diameter boreholes to depths of 1,350 feet and two S.G. 750 rigs of a normal capacity range of 6" diameter boreholes to depths of 700 feet.

On the 21st October, 1963, drilling was started in the Kyrenia range and by the end of the year four boreholes were drilled with an aggregate footage of 2,680 feet. Out of these boreholes three of them were successful. A short description is shown below:-

Borehole Serial No. B.10 (Grid Ref: N.85,250 E. 26,250)*

This borehole was drilled $8\frac{5}{8}$" in diameter down to a depth of 670 feet. The water level is at a depth of 250 feet. No proper test pumping was carried out.

* Military maps at scale 1:50,000

Borehole Serial No. B.16 (Grid Ref: N. 85,150 E. 24,550).

This borehole was drilled 5" in diameter down to a depth of 705 feet. The water level is at a depth of 183 feet. A test pumping was carried out using an airlift pump. The output was about 6,000 g.p.h. with a small drawdown. A proper test pumping with a pump of much bigger output will be carried out in the near future.

Borehole Serial No.B.9 (Grid Ref: N. 83,875 E. 23,825).

This borehole was drilled 6¼" in diameter down to a depth of 472 feet. The water level is at a depth of 336 feet. No proper test pumping was carried out.

Borehole Serial No. B. 8 (Grid Ref: N. 83,420 E.23,030).

This borehole was drilled 6¼" in diameter down to a depth of 670 feet. The water level is at a depth of 446 feet. No proper test pumping was carried out.

Borehole Serial No. B.1 (Grid Ref: N.94,150 E. 54,130).

This borehole was drilled by a government percussion drilling rig to a depth of 253 feet and its diameter is 8". Water was found from 40 - 82 feet and the water level rose to 35' 8". A short test pumping was carried out and the output was 22,500 g.p.h. with a maximum drawdown of 47 feet. A proper test pumping will be carried out on this boring in the near future.

IV. Water Use Plan

The German Water Engineering Group in co-operation with the Geological team is working for the above project. By the end of the year a number of maps have been prepared as follows:-

a) A map showing the existing springs and boreholes used for domestic and irrigation purposes as well as the additional supply of water required by the villages in the area to be surveyed.
b) An isohyetal map of the area being surveyed by the German Water Mission.
c) A plan showing the watersheds and rivers of the northern range.

Another map showing possible dam sites for dams storing the winter floods of the range either for recharge or direct irrigation purposes is now under preparation.

V. Soil Survey

The above team arrived in the Island on the 25th November 1963, and they are now working on soil research in co-operation with the Soil Survey Section of the Agricultural Department.

The geophysical team is expected to arrive in the Island in the near future.

VI. Government Contribution

The Government of Cyprus is contributing to the above project and three percussion rigs have been provided that drill borings of 10" in diameter down to a depth of about 60 feet. In this way the work of the rotary drilling rigs is greatly facilitated. One of the government rigs is operating on the Hilarion Limestone full time putting down boreholes to great depths. These sites are again selected by the German Water Mission. A total of 10 drilling foremen and 7 drilling assistants are working with the German drilling crews the purpose being that these people acquire good experience in rotary drilling techniques. The Government is also providing local transport and is maintaining the vehicles belonging to the German Water Mission. In addition it constructs access roads to the sites selected, provides accomodation to the local personnel and water for the rotary rigs for use during the process of drilling. Appendix 3 shows local personnel attached to the project.

VII. Finance

The approximate cost of the contribution of the German Water Mission for a period of one year is estimated to be about £ 107,000 while that of the Government of Cyprus is estimated to be £ 31,000.

The work of the German Water Mission is co-ordinated by the U.N. Special Fund on the Groundwater and Mineral Survey now operating in Cyprus. All drilling results including borehole samples as well as geological maps are passed on to the Geological Survey Department.

COMPOSITION OF W. GERMAN TEAM — APPENDIX 1

NAME	POST	DATE OF ARRIVAL
1. Dr. F. K. Mixius	Geologist	22. 4. 1963
2. Dr. K. Kreysing	"	22. 4. 1963
3. K. Gottschalk	Mining Engineer	22. 4. 1963
4. Dipl.Eng.Staender	Water Engineer	20. 8. 1963
5. R. Bubner	Exec. Engineer	20. 8. 1963
6. P. Hansen	" "	20. 8. 1963
7. H. Sparenberg	Drilling Superintendent	6.10. 1963
8. K. Eggers	Drilling Engineer	13.10. 1963
9. M. Lautenschlaeger	Driller	13.10. 1963
10. W. Graba	"	13.10. 1963
11. H. Bauernfeind	"	13.10. 1963
12. H. Fischer	"	13.10. 1963
13. H. Rodler	"	13.10. 1963
14. A. Bosse	"	13.10. 1963
15. H. Berendsen	"	13.10. 1963
16. Dr. H. Lueken	Dipl. Agronomy	10.12. 1963
17. A. Nitsch	Mining Engineer	10.12. 1963

CYPRIOT PERSONNEL ATTACHED TO THE WEST GERMAN WATER MISSION

APPENDIX 2

NAME	POST	REMARKS
G. Zafiris	Geologist	Part-time
M. Andreou	Chief Driller	Part-time
M. Antoniades	Inspector of Works	Liaison Officer full time
G. Kamindjis	Driller	Full time
Chr. Theologou	"	" "
A. Zakheos	"	" "
H. Georghiou	"	" "
S. Avraam	"	" "
N. Nicolaou	"	" "
Chr. Chysanthou	"	" "
Chr. Sotiri	"	" "
M. Akathiotis	"	" "
G. Agathangelou	"	" "
Ch. Solomou	Drilling Assisant	" "
Har. Khrysou	" "	" "
A. Christou	" "	" "
I. Louca	" "	" "
L. Savva	" "	" "
A. Theodorou	" "	" "
E. Photi	" "	" "

With German crews on rotating rigs

Working on government percussion rigs.

With German crews on rotary rigs.

With government percussion rigs.