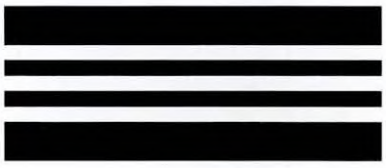

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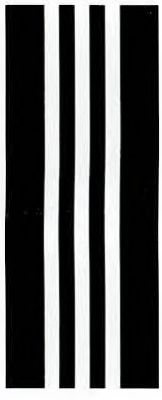

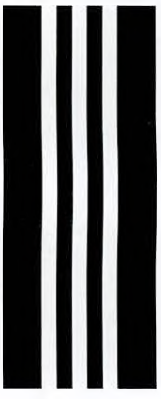

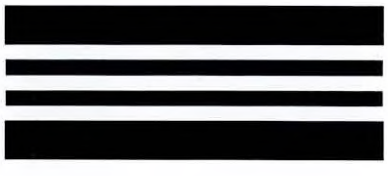

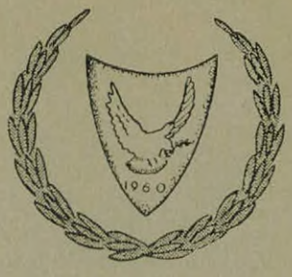

REPUBLIC OF CYPRUS

ANNUAL REPORT

OF THE

DEPARTMENT OF WATER DEVELOPMENT

FOR THE YEAR

1965

REPUBLIC OF CYPRUS

ANNUAL REPORT

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WATER DEVELOPMENT

FOR THE YEAR

1965

Prepared by

Mr. V. J. Kregar

Director,
Department of Water Development.

Contents

1. INTRODUCTION.

The Department of Water Development comes under the jurisdiction of the Ministry of Agriculture and Natural Resources. It is the responsible governmental body for the overall planning, design and execution of all waterworks on the island. It also advises the District Officers for the operation of the minor domestic water supply and irrigation projects technically and particularly in enforcing the water laws. Advices are given also to the Chairmen of the Town Water Boards and to the Government Water Committees for the operation of the Town Water Supplies and the major irrigation projects.

In its endeavours to adopt a proper water development and a water allocation policy the Water Development Department encounters difficulties of various kinds. The long process of getting water from scarce resources in a semi arid country as Cyprus, from collecting hydrological data for water inventory and balance, through planning, design, construction, distribution and maintenance of water works, organization and coordination of this process as a whole, and particularly in its construction stages, evaluation of unit prices, institutional constraints, unfavourable existing water rights, inadequate water law and its inefficient implementation and not at last social aspects form a rather complicated task for a young Republic. If this task has to be carried out by a very limited number of experienced staff it is as much more difficult.

Aware of all these facts and in view of increasing demands for water on the island, with, on the other hand, extremely favourable soil and climatic conditions the Government has shown, since its Independence, great interest in development of water resources. The contribution for 1965 in the field of water development has reached an amount of £1,665,500.

In spite of good will, great endeavours, and of amounts of money spent already in Water Development, as well as of results attained particularly in the field of domestic water supply where almost the last village enjoys

piped water supply, an integrated national water plan does not yet exist and all waterworks constructed until now are more or less piecemeal solutions. Fortunately the most expensive ones, i.e. the dams already constructed will not obstruct broader aspects of further development of water resources in the country when the national water plan comes to existence and performance what is, on the other hand, not the case with the overdeveloped aquifers, of which certain are already ruined. We hope in the nearest future to start in formulating the national water plan with the help of a U.N. Special Fund Project for which the request was submitted at the end of 1965.

By giving out the annual report for 1965 on the activities of the Water Development Department we try to present in short our work in 1965 with all the difficulties and problems involved and connected with the tasks we had to carry out. Going through the items of this report many of the problems can be seen straightforward, many of them guessed if read by somebody familiar with the construction problems, some are described at length, many concealed behind the conditions prevailing on the island particularly the shortage of experienced staff.

For the full support and understanding we were enjoying from the Government and especially from the Minister of Agriculture and Natural Resources and his staff members, I extend my sincere thanks, I feel it my duty also to express my thanks and deep appreciation to all the members of the staff and to foreign experts for their hard work and determination. In giving this account we are with great hopes looking also forward to the new tasks and expecting a fair and benevolent appraisal from the public for the work done as well as the difficulties we had to face in this countrywide enterprise.

2. STAFF ORGANIZATION

By Mr. Chr. P. Loucaides, Chief Clerk.

(a) Staff.

Mr. Vinko Kregar was appointed on contract jointly by the United Nations and the Government of the Republic of Cyprus as Director of the Department. Mr. Kregar resumed his duties on 5th July, 1965. Mr. Chr. Konteatis who was acting as Assistant Director was appointed as Assistant Director on 5th July, 1965, and Mr. Y. Hji Stavrinou, Assistant Director, who was seconded to the post of Director of Geological Department was appointed to the post of Director of that Department on 1st August, 1965.

Mr. Hsing Sieh Hu, accepted appointment on contract to the post of Executive Engineer in the Department and resumed duties on 29th September, 1965.

Mr. C. Lytras, previously serving in the Geological Department, was appointed as geologist of the Water Development Department since 15th October, 1965. Two more geologists, one Mechanical Engineer and a number of Technical Assistants are loaned to the Geological Department for the purposes of the U.N. Special Fund Project. 3 Executive Engineers resigned from the service during the year.

All Turks employees of this Department continued their absence from work in this Department since the date of the Turkish rebellion.

A number of vacant posts of Executive Engineers, Inspector of Works, Foremen and Technical Assistants exist in the Department, which will be filled early in 1966.

(b) Scholarships.

Mr. George Zafiris, Geologist, was offered a 1 year fellowship in Hydrogeology at Arizona University sponsored by the United Nations. Mr. Zafiris returned and resumed his duties with the Department. Mr. Zafiris left Cyprus on 16th September, 1964.

Mr. Nicos Ioannides, Executive Engineer, went on a 1 year scholarship sponsored by the United Nations for a post graduate course in Dam Foundation Engineering, in Denver, Colorado, U.S.A. Mr. Ioannides left on 23rd September, 1965.

Mr. Christos Phanardjis, Inspector of Works, was awarded a 3-years scholarship sponsored by the U.S. AID Mission to study Hydrology in Arizona University. Mr. Phanardjis left Cyprus on 1st January, 1965.

Mr. Andreas Evripidou, Inspector of Works, was awarded a 1 year scholarship sponsored by the U.S. AID Mission to study Surveying in Denver, Bureau of Reclamation, U.S.A. and left Cyprus on 15th September, 1965.

(c) Labour.

The average number of labourers employed in the Department during 1965 was 1586 as compared with 2096 in 1964. 17% were classed as regulars while about 32.7% were skilled employees. 1.6% of the labourers employed were Turks.

During the year 10 casual plant Operators field workers went on 2 days' strike claiming subsistence allowance. Their claim was approved by the Joint Labour Committee.

The approximate monthly average were as follows:-

January	2311
February	2208
March	1691
April	1594
May	1562
June	1445
July	1549
August	1522
September	1515
October	1345
November	1222
December	1069
Average	1586

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.

Departmental Staff Consultations.

(i) Staff Committees.

Regular monthly staff consultations continued throughout the year under the chairmanship of the Director with elected representatives from all grades of the staff both technical and interchangeable. A great number of subjects were brought up by the staff and discussed at this Committee.

An atmosphere of informality and cordiality prevailed during these meetings. The staff showed their confidence towards this Committee by putting subjects above personal claims or complaints and directed their attention to the general interests of the service and their country.

(ii) Heads of Sections Meetings.

This Committee set up by the Director consisting of all Heads of Sections, Engineers and Foreign Experts attached to the Department continued functioning during the year under review. Various suggestions made by members for the purpose of improving existing services, proposals for the Department's estimates and works, difficulties encountered by the staff during the performance of their work, were discussed with a view to achieving more efficiency and co-ordination in the Department.

3. FOREIGN ASSISTANCE.

(a) United Nations.

1. Mr. V. J. Kregar was appointed as Director of the Water Development Department on 5 July, 1965, jointly by U.N. (OPEX Programme) and Government of Cyprus.

2. Throughout the year we kept Mr. B. Milinusic of FAO, Mr. S. W. Hsu of the UN and Mr. E. Dahmen, Associate expert of FAO, whose keenness, interest and hard work have contributed largely towards the success of last year. At the end of the year Mr. Eresund, Associate Expert of UN TAO joined this Department.

(b) U.S. AID Experts.

Mr. B. Griffin was cooperating with throughout the last year, while Mr. J. Maier left in June 1965. This help is very appreciated.

(c) United Nations Special Fund Project.

A request was submitted at the end of the year 1965 to the UN for a pre-investment Survey on Water Planning and Utilization in Cyprus, its aim being the formulation of a National Water Plan, feasibility study for the development of the water resources in the Paphos area and to assist the Government in setting up the most appropriate institutional and administrative arrangements for continuous overall planning for water development, water allocation and water management in general.

(d) West German Mission.

West German Mission has submitted its report on Water Resources investigation in the Kyrenia range where the works in the field were carried out in previous years and finished in 1964. This report represents a very valuable contribution towards assessment of water resources on the island.

(e) U.S. A.I.D. Training Aid.

Throughout the year a training programme in surveying was carried out by the U.S. A.I.D. Mission for training Water Development Department Surveyors. Mr. F. Grammaticas of Amman & Whitney, Athens, was employed as the Tutor. On 24th December, 9 certificates to the participants were given by the Director of U.S. A.I.D. Mission, Mr. F. Sligh, 2 of them to members of Agricultural Department.

4. INTER-DEPARTMENTAL CO-ORDINATION AND CO-OPERATION.

Being involved into more and larger projects and for which cooperation and services are needed for a successful planning we had close contacts with the following Government institutions:

(i) The Special Fund Project which is expected to supply a considerable volume of information regarding the underground water resources during the course of their work.

(ii) The Geological Department is the Department expected to supply the geological information required for the construction of major projects and also to carry out the geological mapping for such projects.

(iii) The Agricultural Department contributes the soil surveys, soil conservation, water requirements, the agricultural need of the island and a study on the benefits for the proposed projects.

(iv) The Agricultural Research Institute is expected in time to supply more and more data regarding the water requirements of crops, costs of agricultural production and benefits derived therefrom.

(v) The District Officers are always closely connected with us and their co-operation is always necessary in selecting projects in operating projects, in permits for wells, water rights and many other problems.

(vi) The Land Registry Department helps us in our mapping programme and in land acquisition and requisition.

(vii) The Planning Bureau plays an important role in co-ordinating the various works and in finally going through the economics, analysing and approving the various projects.

Our Minister, Mr. T. Papadopoullos, whose interest in co-ordinating the various services is well known, has re-established the old Inter-Departmental Committee in which all the Heads of Departments of the Ministry of Agriculture and Natural Resources under the chairmanship of the Minister have monthly meetings to discuss and co-ordinate the various activities of the Ministry.

5. WATER LEGISLATION.

A new legislation was enacted on the 9th July "for the conservation and protection of water resources in certain areas within which there exist or could be observed a serious insufficiency of water supplies". The aim of the law is to control extraction and to stop the wastage of water.

All steps are taken to enable the application of this law in 1966 when the regulation of it will be ready. It is a most important law and without its introduction there exist grave risks for the depletion of the ground water resources and subsequent economic disasters in the areas concerned with far reaching effects on the economy of the island.

6. HYDROLOGICAL SITUATION.

The rainfall in 1965 was 20.54 inches i.e. about 103.63% of a normal year. As a result of this, the rainfall run-off also was higher. The detailed figures are given in the report on the hydrological section.

In spite of a relatively good rainy year the situation with the groundwater table has worsened anew because of overpumping, and salinity content has increased in coastal areas where sea intrusion is becoming alarming.

The following measures are therefore imperatively necessary:-

(i) The ruthless prosecution of illegal drilling.

(ii) The control of extraction and the enforcement of existing and new legislation. This measure will also indirectly control the unauthorized extension of plantations and other cultivations.

(iii) The efficient utilization of water by eliminating all losses through the lining of canals, the use of pipelines, land levelling, weed killing and the application of the correct quantity of water to the crops.

This can become possible by the application of the new law and the provision of a water meter on each borehole.

(iv) Carrying out recharge works where technically and economically feasible.

(v) The supplying of more water where it exists either from surface or groundwater resources.

(vi) Saving domestic water for irrigation by replacing it by desalting if and where it can be proved feasible.

The International Hydrological Decade.

This decade was initiated by UNESCO and all member countries were asked to participate.

The Cyprus National Committee for the International Hydrological Decade is composed as follows:-

Chairman: Director, Water Development Department.

Secretary: Nicos Chr. Toufexis, Head of Hydrology Section, Water Development Department.

Members: Director, Department of Agriculture;
Director, Agricultural Research Institute;
Director, Department of Geological Survey;
Director, Department of Forests;
Government Meteorologist.

The objective of the International programme in the field of hydrology is to accelerate the study of Water Resources and the regimen of waters with a view to the rational management in the interest of mankind, to make known the need for hydrological research and education in all countries, and to improve their ability to evaluate their resources and use them to the best advantage.

7. FINANCE.

The expenditure incurred by the Department during the year is summarized in Appendix No. 1.

In the reports of the various sections the expenditure on the various projects is given separately. The projects were financed in the standard way as follows:

(a) Routine Irrigation Projects
Perennial Crop Irrigation 66.7% Contribution by Govt.

(b) Drainage schemes full cost to Government except where irrigation works are also included in which case the irrigation part is financed according to the irrigation season.

(c) Flood protection schemes full cost to the Government except where irrigation is also incorporated in which case the irrigation part is financed according to the season of irrigation.

(d) Village domestic water supplies Government contribution 50%.

(e) Town water supplies no Government contribution.

(f) The Government contribution for Irrigation Association depends on the ownership of shares of water between the shareholders.

(g) For Major Irrigation Projects the financing is now full cost to the Government which then charges water rates per unit volume of water sold.

The village shares are made available by the Government in the form of a long term low interest loan.

In the case of private drilling, test pumping, and works for Water Boards and other non Government authorities, Departmental charges to cover overheads are also charged in addition to the actual cost.

On the subject of the Departmental overheads a study was made which indicates that the indirect costs and overheads including the amortization of machinery exceeds 20%. A recommendation has been passed to the Government for adding a fixed sum to the estimated cost of each project which will depend upon the previous year's overheads and indirect costs. In addition the machinery will have to be hired to the works according to rates which have already been calculated and submitted to Government by the Department. The recommendation is to base this fixed sum on the overheads and indirect costs of the Development budget only.

Adding the overhead costs on our projects will:

(i) Give a more clear picture of the cost of our projects.

(ii) Save some money for the Government.

(iii) A more correct cost-benefit ratio for the economic justification of the projects will be achieved.

Appendix No. 1.

1965 Expenditure - Water Development Department.

Details	Government Funds	Contribution by beneficiaries	Total
	£	£	£
1. Administration	135,410	-	135,410
2. Irrigation, Drainage and Dams	697,217	89,133	786,350
3. Town Water Supplies	32,470	107,780	140,250
4. Village Water Supplies	182,600	222,000	404,600
5. Drilling and Prospecting	40,200	-	40,200
6. Hydrological Research & Weirs	28,200	-	28,200
7. Workshops (Maintenance)	15,500	-	15,500
8. Purchase of Machinery, tools & equipment	16,875	-	16,875
9. Government Water Supplies	2,700	-	2,700
10. Consultants' fees	45,065	-	45,065
11. Major Projects Investigations	15,290	-	15,290
12. Greater Nicosia Scheme	35,060	-	35,060
Includes Ordinary and Development Expenditure	£1,246,587	£418,913	£1,665,500

Breakdown of Administration

1. Personal Emoluments	£ 77,000	-	£ 77,000
2. Casual Assistance	7,400	-	7,400
3. Technical Assistance	14,800	-	14,800
4. Travelling	15,700	-	15,700
5. Maintenance & Operation of M.T.	13,000	-	13,000
6. Rents	150	-	150
7. Leave pay to Regular Employees	7,360	-	7,360
	£ 135,410	-	£ 135,410

8. DESIGN SECTION

By K. Hassabis, Executive Engineer.

This section of the Department deals with the design of Dams and Distribution Systems - other than those designed by Consulting Engineers, and any other design work that may be required.

The staff of the Section is composed at present of three local Civil Engineers and one Rural and Topographer Engineer who are working in close co-operation and under the technical supervision of two Senior United Nations Experts. At the end of 1965 two Associate United Nations Experts joined the staff of the Design Section.

In 1965 the work of the section was mainly concentrated on the Distribution Systems of Dams already built or under construction. As the design of these systems depends largely on information, data and work done by specialized services of the Department of Agriculture a close working co-operation has been established with them and many meetings and joint consultations were held during the year.

It may be pointed out that various other non-technical factors, which however have to be taken into consideration in the final form of a distribution network, affect the design and often cause considerable delay.

One of the crucial points directly affecting the design is the manner of eventual operation of these projects. This has yet to be clearly and finally settled.

It is to be regretted that several Engineers who have been engaged in design work have either left the Department during the year or have been assigned to construction work; as a result progress of the work has been considerably affected.

During 1965 design work has been done on the following projects:-

(a) Distribution Systems:-

Ayia Marina, Pomos, Argaka-Magounda, Polemidhia, Kalopanayiotis, Kiti.

(b) Dams:-

Syngrassi, Sklidros, Lefkara, Karavas.

(c) Town Water Supply:-

Mesa Yitonia Service Reservoir for Limassol Water Board.

DRAWING OFFICE.

The members of the Drawing Office during 1965 averaged 10 of whom half were male and half female, including the officer in charge of the Drawing Office.

Towards the end of the year the number of female members exceeded that of male with the ultimate aim of having an all female drafting staff. About 50% of the staff were engaged in 1965 and had no previous experience in drawing.

At the end of the year the Drawing Office after some training was in a position to undertake more drafting work.

Most of the drawing work in the Department is done in the Drawing Office. In particular all routine irrigation works, Major Projects and Major Projects investigations, and watershed planning consisting of records of existing distribution systems, water sources and land irrigated.

TOPOGRAPHY SECTION.

This section performed its usual task of carrying out topographical surveys and producing maps and drawings for major projects i.e. impounding and distribution schemes.

The staff at the end of the year comprised:-

1 Inspector of Works (in charge of the section)
4 monthly paid Technical Assistants
1 Surveyor on daily wages
4 Technical Assistants on daily wages.

During the year three monthly paid Technical Assistants of the section left the Department after securing better paid posts outside the Government Service and one Inspector of Works left Cyprus for U.S.A. on scholarship for one year's course in surveying, granted by the U.S. A.I.D. Mission.

The training scheme on topography for members of the section, which was initiated in December 1964 by the U.S.A. A.I.D. Mission by employing the services of an expert from Greece, continued throughout the year. Three officers from the Department of Agriculture participated in the training for a period of four months. In a special ceremony held on the 24th December, 1965, Mr. Sligh, the Director of the A.I.D. Mission, Cyprus Branch, handed certificates of achievement to all participants who have successfully completed the course.

The schemes which the Topography Section has dealt with during the year were:-

Village	Type of work	Remarks
Ayia Trias	Dam site & Reservoir	Field work & plans. Location of test pits.
Yermasoyia	Dam site	Setting out of tunnel & spillway. Location of test pits. Location of high water level. Acquisition & requisition plans.
Kiti	Distribution System	Field work - Plans, long sections & design of pipes & channels - Acquisition plans.
Argaka-Magounda	Distribution System	Field work. Plans, long section of pipes & channels.

Village	Type of work	Remarks
Ayia Marina	Distribution System Stage II	Plans, long sections & design of pipes.
Pomos	Distribution System Stage II	Field work, plans, long sections & design of distribution pipes.
Polemidhia-Zakaki	Distribution System	Field work for a piped system.
Syngrassis	Dam site & Reservoir	Field work & plans.
Palekhori	Dam site	Field work & plans.
	Distribution System	Long Section of existing canal to define its capacity.
Kalopanayiotis	Distribution System	Field work & long section of the main pipeline for a preliminary estimate.
Koma tou Yialou	Dam site & reservoir	Field work.
Vasilikos River	Dam site reservoir - Preliminary survey	Field work, plans & sections for capacity & earth volume.

9. REPORT ON THE HYDROLOGICAL SECTION

By Nicos Chr. Toufexis, Superintendent of works.

(This report covers the period from 1st October, 1964, to 30th September, 1965.)

I. Meteorological data.

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

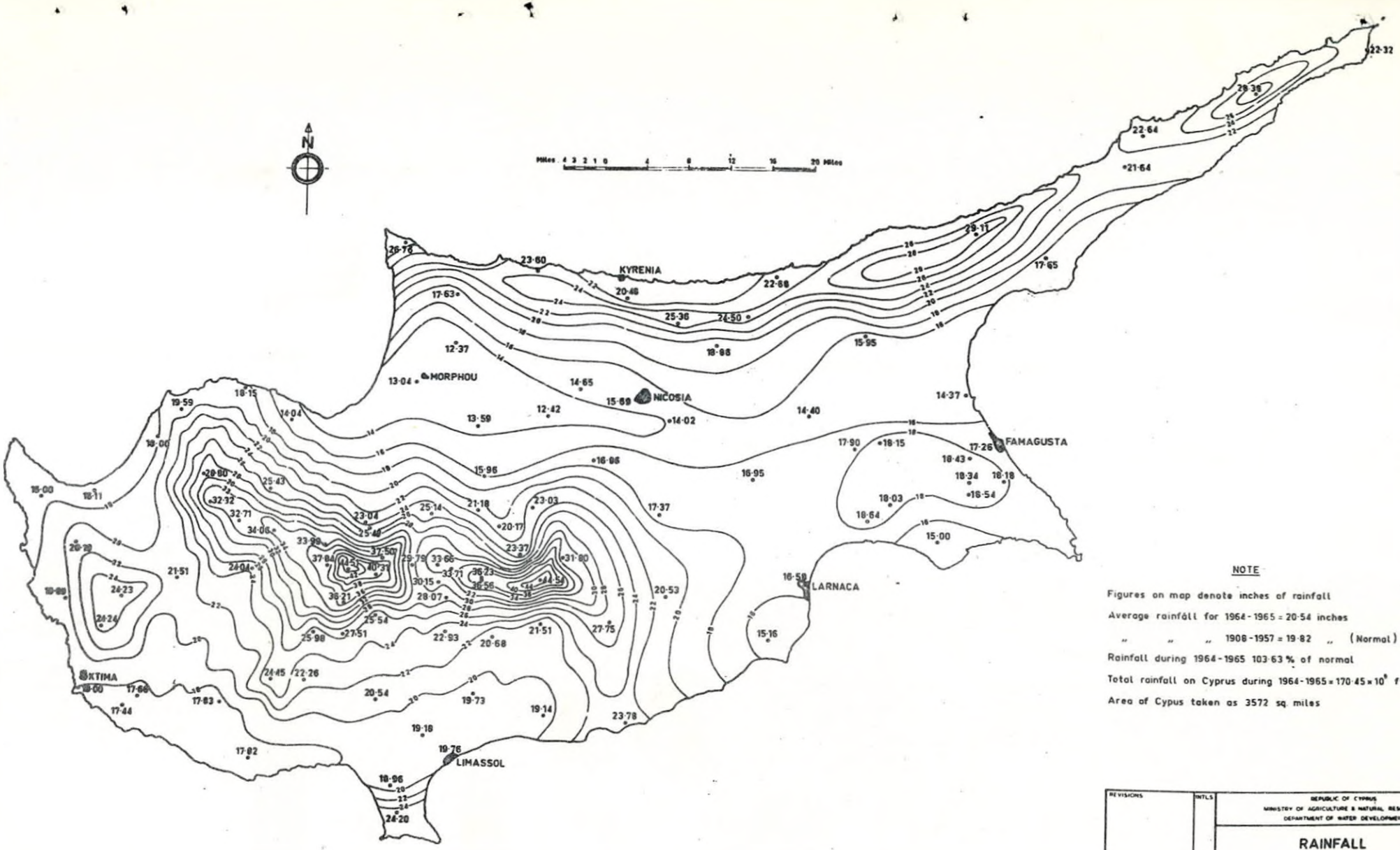
(a) The average rainfall over the whole island was 20.54 inches which is 103.63% of normal as compared with the average since 1908 which is 19.82 inches. See Appendix No. 2 & No. 3.

(b) October, March, August and September were the months with below average rainfall. Precipitation during the other months was above normal.

(c) The highest daily fall in the year was 5.10 inches as recorded at Kionia Forest Station on the 19th January, 1965.

(d) Snow fall at high altitudes of Troodos mountains started in the middle of November, 1964, and continued in the subsequent months of January, February and March. Snow cover persisted till the end of April.

(e) Temperatures during the year were generally below normal. The highest temperature recorded at Nicosia was 105° F on the 6th and 28th July, 1965, and the lowest 29° F on the 10th January, 1965.



NOTE

Figures on map denote inches of rainfall

Average rainfall for 1964-1965 = 20·54 inches

" " " 1908-1957 = 19·82 " (Normal)

Rainfall during 1964-1965 103·63 % of normal

Total rainfall on Cyprus during 1964-1965 = $170·45 \times 10^6$ ft^3

Area of Cypus taken as 3572 sq. miles

REVISIONS	INITLS	REPUBLIC OF CYPRUS MINISTRY OF AGRICULTURE & NATURAL RESOURCES DEPARTMENT OF WATER DEVELOPMENT
		RAINFALL
		ISOHYETAL MAP OF CYPRUS BASED ON RAINFALL FROM 1st OCT. 1964-30th SEPT 1965
		DECEMBER 1966 · DG · DDG No 1/9/37
		SURVEYED BY · TRACED BY · CHECKED BY · DESIGNED BY · APPROVED BY · DRAWN BY

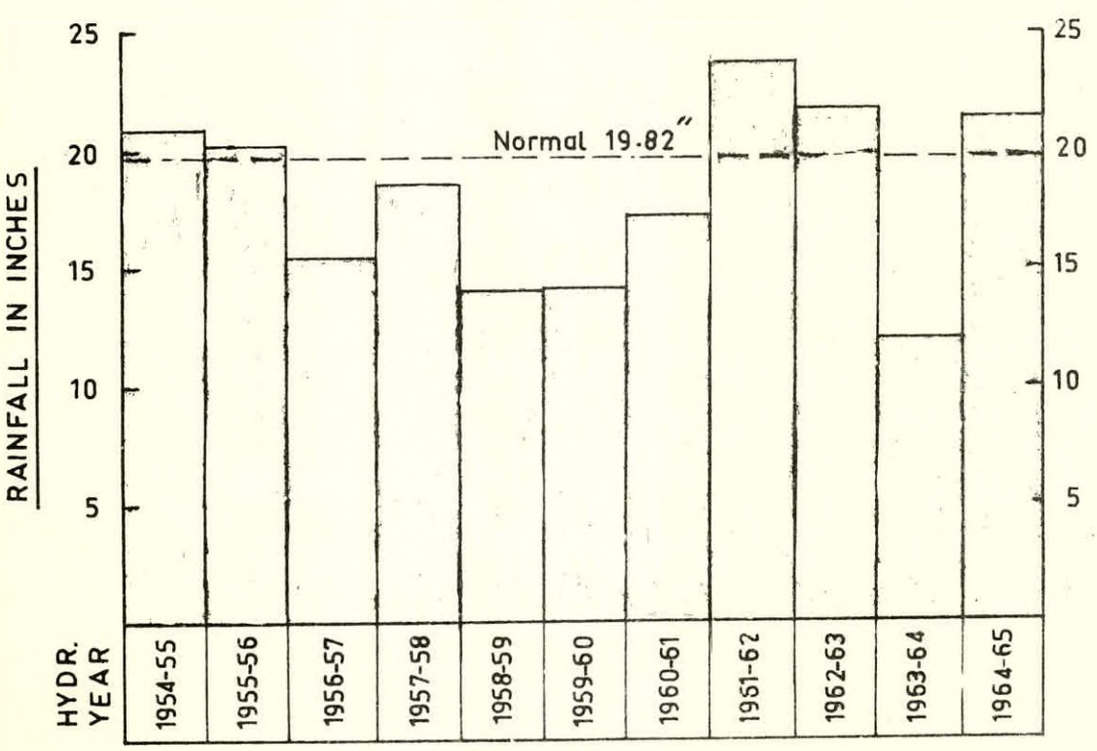
AVERAGE ANNUAL RAINFALL

OF CYPRUS

NORMAL (Determined from 50 years records 1908-57)	INCHES	PERCENTAGE	RAINFALL ON ISLAND IN MILLION FT^3
	19·82	100	164,476
Year			
1954-55	21·00	105·95	174,800
1955-56	20·30	102·42	167,700
1956-57	15·50	78·20	128,787
1957-58	18·66	94·15	154,850
1958-59	14·05	70·90	116,820
1959-60	14·09	71·09	116,900
1960-61	17·20	86·80	142,700
1961-62	23·96	120·88	198,832
1962-63	21·93	110·65	181,100
1963-64	12·06	60·85	100,080
1964-65	20·54	103·63	170,450

GRAPHICAL PRESENTATION

OF ANNUAL RAINFALL



II. Flood discharges.

Quite a number of floods were reported during the hydrological year 1964-65 mainly in December, January and February in the valleys of rivers flowing from the central massif. The highest flood-flows were 2580 cusecs in Serakhis river recorded near Massari on 19th January, 1965, and 1383 cusecs in Vathis river recorded at Athalassa on 31st March, 1965. The rainfall on 18th January, 1965, was 3.27 inches at Panayia Forest Station and 0.85 inches at Athalassa on 31st March, 1965.

Summary of some of the larger floods and of the rainfalls measured in the catchment or in adjacent catchment on the day of the flood or on the previous days is given in the following table. Floods of less importance have been ignored.

River	Location	Peak flow		Rainfall		
		Cusecs	Date	Inches	Place	Date
Peristerona (Nicosia)	Panayia F.S.	1076.2	7/ 2/65	2.27	Alona	6/ 2/65
Yermasoyia	New Police Station	456.0	7/ 2/65	1.88	Kalokhorio (Ll)	6/2/65
Kouris (Erimi)	Erimi bridge	863.0	8/ 2/65	2.65	P. Amiandos	6/ 2/65
Kolopannes	Near Kalo-psidha	258.0	15/12/64	2.07	Akhna	14/12/64
Akhna	New Akhna Police Stat.	455.4	15/12/64	2.07	Akhna	14/12/65
Akaki	Malounda	692.9	7/ 2/65	2.92	Palekhori	6/ 2/65
Skylloura	Ay. Vasilios	920.1	11/12/64	3.50	Sisklipos	11/12/64
Stavros tis Psokas	Evretou	402.0	8/ 2/65	1.13	Stavros tis Psokas	8/ 2/65
Syrgatis	Skarinou St.	609.0	26/ 1/65	1.59	Lefkara P.	24/ 1/65
Tremithios	Ay. Anna	636.4	26/ 3/65	1.17	Perakhorio	26/ 3/65
Elea	Ghaziveran	260.0	19/ 1/65	2.00	Kapoura	18/ 1/65
Serakhis	Massari	2580.0	19/ 1/65	3.27	Panayia F.S.	18/ 1/65
Ezuza	Akhelia	353.0	7/ 2/65	1.40	P. Panayia Paphos	7/ 2/65
Vasilikos	Kalavasos	237.0	4/ 2/65	2.50	Ora	3/ 2/65
Khapotami	Kouklia	205.0	8/ 2/65	1.47	Platres	8/ 2/65
Pouzis	Mazotos	627.9	12/12/64	1.60	Kornos	11/12/64

River	Location	Peak flow		Rainfall		
		Cusecs	Date	Inches	Place	Date
Kouris	Khalassa	251.0	8/ 2/65	2.65	Amiandos	6/ 2/65
Kryos	Khalassa	368.0	7/ 2/65	2.65	Amiandos	6/ 2/65
Zygos	Mia-Kremmos	285	7/ 2/65	2.50	Kyperounda	7/ 2/65
Vathis	Athalassa	1382.9	31/ 3/65	0.85	Athalassa	31/ 3/65
Elea	Vizakia	464.0	19/ 1/65	2.00	Kapoura	18/ 1/65
Aloupos	Morphou	269.5	11/12/65	1.34	Kapouti	10/12/64
Syrgatis	Kornos	382.0	9/12/64	1.50	Kornos	9/12/64
Ezuza	Kannaviou	255	8/ 2/65	1.40	Pano Panayia	7/ 2/65

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
3	Ovgos	Morphou-Pnasi Monastery bridge	Water level recorder on 35 ft. bridge.
5	Xeros (Nicosia)	Nicosia-Xeros bridge	Water level recorder on 71 ft. bridge.
6A	Marathasa	Nicosia-Xeros main road	Water level recorder on 50 ft. measuring weir.
6B	"	Upstream of Lefka dam	Water level recorder using natural section of the river.
8	Avgorou	Near Avgorou	Water level recorder on 40 ft. measuring weir.
9	Paralimni	Near Paralimni lake outfall	Water level recorder on the recharge channel.
13A	Kourris (Trimiklini)	Limassol-Troodos bridge	Water level recorder on 18 ft. bridge.
13B	"	Near 13A	Water level recorder on 1'.6" flume.

Recorder No.	Catchment	Location	Type of installation
14	Peristerona (Nicosia)	Near Panayia Forest station	Water level recorder on 20 ft. measuring weir.
15	Tremithios	On the spillway of Kiti dam	Water level recorder on 212 ft. dam's spillway.
16	Yermasoyia	Near Yermasoyia Police Station	Water level recorder on 80 ft. measuring weir.
17A	Kouris (Erimi)	Erimi bridge	Water level recorder on 66 ft. bridge.
17B	" "	" "	Water level recorder on 55'.6" 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	Near Malounda	Water level recorder on 40 ft. measuring weir.
24	Skylloura	Near Ay. Vasilios	Water level recorder on 60 ft. measuring weir.
27	Khrysokhou	Skoulli	Water level recorder on 40 ft. measuring weir.
28	Stavros-tis-Psokas	Near Evretou	Water level recorder on 25 ft. measuring weir.
29	Syrgatis	Skarinou station	Water level recorder on 71'.6" measuring weir.
30	Dhiarizos	Kouklia (Paphos) main bridge	Water level recorder on 40 ft. bridge.
32	Alakati	Platimatis locality near Ay. Amvrosios (Kyrenia)	Water level recorder on 22 ft. measuring weir.
33A	Karyiotis	Near Pendayia-Xeros main road bridge	Water level recorder on 60 ft. measuring weir.
33B	"	Near Evrykhou	Water level recorder using natural section of river.
34	Tremithios	Ayia Anna	Water level recorder on 40 ft. measuring weir.
35	Elea	Ghaziveran-Pendayia main road bridge	Water level recorder on bridge.

Recorder No.	Catchment	Location	Type of installation
36A	Ay. Loucas (Akhyritou outlet tunnel)	Near Ay. Loucas, Famagusta	Water level recorder on Ayios Loucas lake.
36B	Ay. Loucas lake	"	Water level recorder on Ay. Loucas lake at outlet.
37	Atsas	Upstream of Petra dam	Water level recorder on 25 ft. measuring weir.
38A	Serakhis	Massari main bridge	Water level recorder on 58'.6" bridge.
38B	"	"	Water level recorder on 39'.6" bridge.
39	Livadhi	Paleambela loc., Pomos	Water level recorder on 70 ft. measuring weir.
40	Xeros (Polis)	Ayia Marina main road bridge	Water level recorder on 35 ft. bridge.
41	Yialia (Polis)	Kato Yialia main road bridge	Water level recorder on 14'.10" bridge
42	Magounda	Kato Arghaka main road bridge	Water level recorder on 39'.6" measuring weir.
43	Mavrokolymbos	Potima Chiftlik	Water level recorder on 40 ft. measuring weir.
44	Ezuza	Akhelia	Water level recorder on 85 ft. measuring weir.
45	Khapotami	Near Kouklia (Paphos)	Water level recorder on 50 ft. measuring weir.
46	Garyllis	Near the Armenian Cemetery at 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.
49	Kambos	Potamos-tou-Kambou	Water level recorder on 45 ft. measuring weir.
50	Pouzis	Near Mazotos	Water level recorder on 45 ft. measuring weir.
52	Kouris-Khalassa	Khalassa-Lophos road bridge	Water level recorder on 23 ft. bridge.
53	Kouris & Kryos	At Khalassa	Water level recorder on 101 ft. measuring weir.
54	Kouris-Zyghos	Mia-Kremmos locality	Water level recorder on 75 ft. measuring weir.
55	Elea-Asinou	Nikitari	Water level recorder on 25 ft. measuring weir.
56	Vathis	Athalassa	Water level recorder on 33'.6" measuring weir.

Recorder No.	Catchment	Location	Type of installation
57	Elea-Vizakia	Vizakia	Water level recorder on 29'.6" measuring weir.
58	Aloupos	Aloupos Chiftlik	Water level recorder on 55 ft. measuring weir.
59	Khapotami-Kissousa	Kissousa	Water level recorder on 20 ft. measuring weir.
60	Syrgatis-Mylou	Near Kornos	Water level recorder on 30 ft. measuring weir.
61	Ezuza-Kannaviou	Near Kannaviou	Water level recorder on 45 ft. measuring weir.
62	Xeros-Peyia	Near Peyia	Water level recorder on 40 ft. measuring weir.
63	Melini-Ayia Trias (Yialousa)	Near Ayia Trias, Yialousa	Water level recorder on 22 ft. measuring weir.
64	Karyiotis-Ayios Nicolaos	Near Ayios Nicolaos Monastery, Kakopetria	Water level recorder on 20 ft. measuring weir.
65	Karyiotis-Platania	Near Kakopetria	Water level recorder on 20 ft. measuring weir.
67	Dhiarizos-Philousa	Near Philousa	Water level recorder on 60 ft. measuring weir.

All water level recorders used on the above stations are of the float operated type, except on stations No. 6B, 14, 33B, 53, 54 on which Pneumatic recorders have been installed.

V. Measured discharges 1964-1965.

The discharges which could be measured during the year at the Gauging Stations of the previous paragraph are as follows:-

No.	Catchment	Rainfall during 1964-65 10^6 cub.ft.	Runoff during 1964-65 10^6 cub.ft.	Maximum discharge in a day 10^6 cub.ft.	Maximum flow cusecs	Runoff in % rainfall 1964-65
3	Ovgos	3251.9	5.9	0.1	1.6	0.2
5	Xeros (Nicosia)	1754.1	4.1	0.3	5.0	0.2
6A	Marathasa (at the coast)	1852.7	93.3	8.5	156.0	5.0
6B	Marathasa (up-stream of Lefka dam)	1421.2	174.8	12.7	147.6	12.3

No.	Catchment	Rainfall during 1964-65 10^6 cub.ft.	Runoff during 1964-65 10^6 cub.ft.	Maximum discharge in a day 10^6 cub.ft.	Maximum flow cusecs	Runoff in % rainfall 1964-65
8	Avgorou	341.6	2.7	1.6	92.5	0.8
9	Paralimni	-	83.4	1.6	29.8	-
13	Kouris (Trimiklini)	1607.7	349.6	8.6	156.0	21.7
14	Peristerona (Nicosia)	2073.7	896.0	75.1	1076.2	43.2
15	Tremithios (Dam's over-flow)	2622.8	-	-	-	-
16	Yermasoyia (Police Station)	3543.9	268.3	22.5	456.0	7.6
17A & 17B	Kouris (Erimi)	8375.4	567.6	41.2	863.0	6.8
18	Kolopannes	-	100.0	14.5	258.0	-
19	Akhna	378.4	8.5	3.3	455.4	2.2
20	Phrenaros	152.1	2.7	1.2	42.6	1.8
21	Kokkini Trimithia	364.2	NIL	NIL	NIL	-
22	Liopetri	166.9	9.7	2.4	72.7	5.8
23	Akaki (Malounda)	2306.5	553.6	37.0	692.9	24.0
24	Skylloura (at Ay. Vasilios)	1254.7	109.0	34.3	920.1	8.7
27	Khrysokhou (at Skoulli)	1399.1	80.4	5.3	107	5.7
28	Stavros tis Psokas (at Evretou)	1837.4	227.9	18.0	402	12.4
29	Syrgatis (at Skarinou)	3076.3	532.9	26.3	609.0	17.3
30	Dhiarizos (at Kouklia)	6206.2	213.6	5.8	115	3.4
32	Alakati (at Ay. Amvrosios Kyrenia)	271.0	1.4	1.0	71.0	0.5
33A	Karyiotis (at Pendayia)	2287.3	106.9	7.9	142.3	4.7
33B	Karyiotis at Evrykhou)	1740.4	465.3	10.9	129.1	26.7
34	Tremithios (at Ay. Anna)	1591.4	226.7	12.8	636.4	14.2
35	Elea (at Ghaziveran)	3367.5	54.1	9.1	260.0	1.6

No.	Catchment	Rainfall during 1964-65 10^6 cub.ft.	Runoff during 1964-65 10^6 cub.ft.	Maximum discharge in a day 10^6 cub.ft.	Maximum flow cusecs	Runoff in % rainfall 1964-65
36	Ayios Loucas lake (Intake)	-	21.9	0.8	17.6	-
37	Atsas	728.9	97.0	6.2	94.4	13.3
38A & 38B	Serakhis (at Massari bridge)	8263.3	1213.4	127.6	2580.0	14.7
39	Livadhi (at Pomos)	880.5	63.6	3.7	60	7.2
40	Xeros (Polis) (Ay. Marina)	198.7	0.02	0.02	8	0.01
41	Yialia (Polis)	398.6	19.9	1.8	130	5.0
42	Magounda	1231.2	9.5	0.8	14	0.8
43	Mavrokolymbos	846.2	31.5	1.1	33	3.8
44	Ezuza (at Akhelia)	4327.6	257.8	18.4	353	6.0
45	Khapotami (at Kouklia)	2513.2	153.6	7.1	205	6.1
46	Garyllis	1697.7	66.4	4.8	123.0	3.9
47	Vasilikos	2881.5	315.0	11.0	237.0	10.9
48	Maroni	1297.0	126.6	6.2	112.1	9.8
49	Kambos	938.1	71.0	8.0	111.7	7.6
50	Pouzis (at Mazotos)	983.4	82.1	9.7	627.9	8.4
52	Kouris Khalassa	2706.0	585.9	16.3	251.0	21.7
53	Kouris-Kryos	4350.7	611.2	23.7	368.0	14.0
54	Kouris-Zyghos	2972.2	525.7	20.5	285.0	17.7
55	Elea (at Asinou)	354.9	35.3	2.3	122.6	9.9
56	Vathis (at Athalassa)	449.0	23.9	8.0	1382.9	5.3
57	Elea (at Vizakia)	1865.7	453.1	29.6	463.9	24.3
58	Aloupos	1316.8	24.0	5.9	269.5	1.8
59	Khapotami (at Kissousa)	931.2	150.9	7.7	154.0	16.2
60	Syrgatis-Mylou (at Kornos)	680.9	252.8	17.9	382.0	37.1
61	Ezuza (at Kannaviou)	1786.5	247.9	13.6	255	13.9
62	Xeros (at Peyia)	302.7	29.0	3.3	74	9.6

No.	Catchment	Rainfall during 1964-65 10^6 cub.ft.	Runoff during 1964-65 10^6 cub.ft.	Maximum discharge in a day 10^6 cub.ft.	Maximum flow cusecs	Runoff in % rainfall 1964-65
63	Melini (at Ayia Trias, Yialousa)	83.3	3.4	0.3	14.5	4.1
67	Dhiarizos (at Philousa)	3793.8	436.2	7.9	120	11.5

VI. Spring discharges.

During the Hydrological year 1902 spring discharges were measured, averaging to 162 measurements every month. The output of 335 springs is now being measured regularly; 142 of these at monthly intervals, 44 every 2 months, 33 every 3 months, 18 every 4 months, 49 every 6 months and 49 every year.

Because of the above normal rainfall in most parts of the island, spring discharges were generally above average. The increase in the flow of springs commenced after the heavy rains in December. Their yield was considerably higher than last year and in certain cases the highest for the last five years.

On the Troodos mountains the combined flow of springs used for the water supply of Troodos was 36,000 gallons per day in September compared with 22,000 gallons per day last year. The average flow for September since regular measurements commenced in 1954 is 30,000 gallons per day.

On the northern slope of the Kyrenia range, the rate of flow of Kephalovrysos Lapithos during the first four months of the year was less than 231,000 gallons per day and it was the lowest yield recorded in the last decade. As a result of the heavy rains fell in December and January, the discharge increased to 720,000 gallons per day during February and it remained nearly at this level throughout the year.

The Kephalovrysos Karavas was yielding 827,000 gallons per day from February to May, while during the other months it was between 543,000 gallons per day and 575,000 gallons per day. It is worth mentioning that it is the only spring in Cyprus which has shown a relatively constant flow with little variations during the last decade.

Both, Kephalovrysos Lapithos and Karavas had their discharge above average from February till the end of the hydrological year.

On the southern slope of the Kyrenia range, the Kephalovrysos Kythrea was flowing at the rate of 1,894,000 gallons per day during the period March to September and it was the highest yield since the year 1960. Concerning the flow during the other months, it was below normal, the rate being between the limits of 1,549,000 gallons per day and 1,776,000 gallons per day.

In the central Mesaoria plain the flow of the chain of wells was above normal and has followed the same behaviour which was observed in most springs of the Kyrenia and Troodos mountains.

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		
	Million cubic meters	Million cubic feet	Percentage
Kokkini Trimithia Akaki & Paleometokho	2.3	81.2	34.6
Morphou	1.8	63.6	27.0
Arab Ahmet at Strovolos	0.3	10.6	4.5
Laxia	0.4	14.1	6.0
Dhikomo	0.3	10.6	4.5
Dhali	0.3	10.6	4.5
Sykhari	0.3	10.6	4.5
Athalassa	0.06	2.1	0.9
Makedhonitissa	0.5	17.7	7.5
Others (Approx.)	0.4	14.1	6.0
	6.66	235.2	100

Famagusta	Quantity		
	Million cubic meters	Million cubic feet	Percentage
Phrenaros West	0.7	24.7	37.3
Phrenaros North	1.1	38.8	58.5
Others	0.08	2.8	4.2
Total extraction during 1964-65	1.88	66.3	100

Limassol	Quantity		
	Million cubic meters	Million cubic feet	Percentage
Kephalovrysos Mavrommata & Kria Pighadhia springs	1.6	56.5	55.2
Chiftlikoudhia chain of wells	0.3	10.6	10.3
Garillis river boreholes	1.0	35.3	34.5
Total extraction during 1964-65	2.9	102.4	100

VIII. Groundwater Levels.

The total number of boreholes measured for observation purposes over the whole island was 141. All water-levels in the observation boreholes are read monthly and chemical analyses are also made of samples regularly. Appendix 3 gives the annual maximum and minimum water-level for certain observation boreholes which are considered representative of the prevailing conditions.

In the eastern Mesaoria at Ayios Memnon, Famagusta, where the water table last year has been depressed in places to 7'.6" below sea level by overpumping, a temporary halt in the depletion of the aquifer has been recorded this year. The water level of the coastal observation borehole No. 69/38 was 3'.6" below sea level. Similarly, the water level in the other coastal observation borehole No. 50/53 has been raised by nearly 3 feet. It is obvious that the improvement is due to the last winter's heavy rains and to the artificial recharge operations.

In Phrenaros area, from which water for the Famagusta domestic supply is obtained, the water level has been declining steadily with little or no seasonal recovery during the wet months, the average rate of fall being over 3 feet. This rapid decline may, in part be explained by the very heavy demands made in this area by the requirements for the Famagusta water supply, but the rate of exhaustion can obviously not to be allowed to continue at this level.

In the Xylophagou reef limestone aquifer the average water table showed a rise of 1 foot since last year.

In the Western Mesaoria, at Kokkini Trimithia area, which provided Nicosia most of the year's domestic water requirements, a depression of 42 feet of the water table has been recorded for the last 15 years. During the last twelve months the decrease in level has been 2'.6" and indicates a very disquieting trend.

At Morphou Bay, the water table as recorded by the observation boreholes about 2 miles inland show a total fall of 30 feet in the last nine years. The water table has so far been depressed to 12 feet below sea level. Continuing at the present rate would certainly cause a further general decline of the water table and sea intrusion along the coastal aquifers.

At Morphou inland the recovery was by 3 feet higher and the decline less than last year. The Morphou dam has beneficiously contributed to the replenishment of the depleted aquifer and to the reduction of the rate of decline of the water table.

A general outlook on the behaviour of the water table in the main groundwater producing areas of Cyprus is that the decline is nearly everywhere caused by overpumping. Had the year's rainfall not been above normal the rate of depression of the water table would be higher.

IX. Chemical Analyses.

During the year 5,317 samples of water were sent to the Medical Department's analyst for partial chemical analysis. Of these 1,112 samples were taken from springs,

wells or boreholes which are used or proposed as water supply sources. The remaining 4,205 samples derived from springs, observation boreholes and from other miscellaneous sources. In addition 1,100 samples of water were taken from boreholes used for irrigation purposes and were sent to the Geological Laboratory.

X. Bacteriological Analyses.

During the year, 996 samples of water were 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	625	46
Famagusta	136	5
Limassol	88	10
Larnaca	56	13
Paphos	66	8
Kyrenia	25	
	996	82

At Nicosia most of the unsatisfactory samples came from private boreholes 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, except Larnaca, due to the contamination caused to the source of supply (Bekir Pasha chain of wells) by the Tremithios river.

XI. New Measuring sites.

By the end of the hydrological year 1964-65 the following new measuring sites were completed and automatic water level recorders were installed.

1. Yermasoyia (at Akrounda) river:-

   A 25 ft. broad-crested measuring weir (with a 2'-0" x 6" notch for low flows).

2. Phinikaria (Yermasoyia) river:-

   Automatic water level recorder installation at the 92 ft. existing irrigation weir.

3. Serakhis river:-

   Automatic water level recorder installation at the 250 ft. spillway of Morphou dam.

4. Aradhippou river:-

   Stabilization of the river bed by constructing a 27' 9" measuring weir (with 2' x 6" notch for low flows) under the main road Nicosia - Larnaca old bridge.

5. Goshi river:-

   Stabilization of the river bed by constructing a 16 ft. measuring weir (with 2' x 6" notch for low flows) under bridge near Yematousa (at Aradhippou) church.

6. Panagra river:-

   Stabilization of the river bed by constructing a 27 ft. measuring weir (with 2' x 6" notch for low flows) under main road Panagra - Lapithos bridge.

7. Ovgos and Serakhis rivers:-

   A 40-ft. broad-crested measuring weir (with a 2' 0" x 6" notch for low flows) at Syrianokhori where Ovgos and Serakhis rivers are joined together.

XII. <u>Repairs and Improvements to the existing measuring sites</u>:-

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

1. Ovgos measuring site:-

   Raising the sill of the weir and the intake pipe system by 2 feet.

2. Syrkatis measuring site:-

   Raising the sill of the weir and the intake pipe system by 2 feet.

3. Ayios Vasilios measuring site:-

   Repairing the apron of the weir which has been undermined during recent floods.

4. Marathasa measuring site:-

   Stabilization of the river bed under the bridge near Xerarkaka Forest station, Kalopanayiotis.

5. Malounda measuring site:-

   Repairing the sill of the weir.

Hydrological Surveys and Construction of Measuring weirs costs.

During the year the following expenditure was incurred by the Hydrology Section:-

	Approved Estimate Cost	Actual Expenditure
	£	£
Hydrological Surveys & Research	18,000	
- do -	2,000	19,310
Construction & Maintenance of Measuring weirs	9,000	8,890
Totals =	£29,000	£28,200

Appendix 4.

OBSERVATION [illegible]

(Reduced Level of static ground water surface to M.S.L. in feet)

Ser. No.	Place	Bore-hole number & year	Maximum water level			Minimum water level		
			Year after drilling	63-64	64-65	Year after drilling	63-64	64-65
1	Astromeritis	91/50	372.14	332.90	328.24	336.54	327.66	326.91
2	Ay. Andronikos	249/55	391.30	382.39	379.47	389.89	379.56	377.47
3	" "	322/55	386.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Ay. Memnon	69/38	- 1.20	- 4.24	- 0.32	- 5.60	- 7.49	- 7.57
5	" "	50/53	3.21	- 1.22	4.94	- 0.69	- 4.89	- 4.89
6	" "	18/62	- 4.89	- 7.47	- 3.97	- 9.64	-11.35	-11.81
7	Ay. Nicolaos Famagusta	89/56	29.50	25.75	24.83	28.80	24.38	23.92
8	Dherinia	2/62	29.93	17.65	19.86	15.49	12.07	10.36
9	"	12/62	24.13	13.68	21.01	1.97	- 3.24	- 3.07
10	Ephtakomi	163/55	496.39	461.28	460.18	489.22	459.80	458.39
11	Famagusta	15/62	-17.65	-19.87	-20.98	-20.97	-20.23	-21.15
12	"	16/62	-10.98	-14.73	- 2.81	-19.52	-21.14	-21.14
13	"	17/62	-14.03	-16.23	-15.44	-17.73	-18.73	-19.23
14	"	19/62	- 7.09	- 9.12	- 8.91	-12.45	-13.79	-15.20
15	"	20/62	-12.57	-15.67	-15.05	-20.41	-20.47	-20.05
16	"	27/62	-10.32	- 3.78	-12.03	-14.78	-16.36	-16.65
17	"	28/62	-10.99	-12.61	-12.11	-15.61	-16.40	-16.53
18	"	29/62	- 4.03	- 5.00	- 5.25	- 7.17	- 8.00	- 8.46
19	Kalopsidha	54/54	68.55	35.05	32.18	60.30	28.55	26.93
20	"	56/54	75.31	54.60	50.02	73.85	50.60	48.60
21	Khalassa	23/58	547.58	547.00	547.50	544.21	541.67	541.42
22	Kokkini Trimithia	90/50	686.60	650.33	645.35	682.40	647.75	642.02
23	"	160/50	682.70	652.42	648.85	679.40	650.17	646.14
24	"	161/50	686.00	618.50	616.53	679.40	615.88	613.07
25	Kolossi	88/54	12.29	8.13	3.71	5.79	1.69	- 3.54
26	Laxia	208/55	672.23	639.40	633.06	666.31	631.94	625.11
27	Liopetri	93/55	-	24.13	21.34	-	20.42	18.13
28	"	114/55	-	25.20	21.83	-	13.78	9.93
29	"	115/55	-	22.67	19.08	-	17.67	15.25
30	"	56/56	-	35.86	22.69	-	22.86	20.11

Ser No	Place	Bore-hole number & year	Maximum water level			Minimum water level		
			Year after drill-ing	63-64	64-65	Year after drill-ing	63-64	64-65
31	Makrasyka	48/54	117.00	80.50	83.42	110.70	64.83	56.46
32	"	49/54	120.10	92.90	89.94	116.90	88.90	86.73
33	Morphou	168/50	89.27	67.32	77.32	83.57	66.07	67.90
34	"	92/50	86.43	41.56	46.19	76.13	8.40	4.40
35	Ormidhia	189/57	- 1.50	- 1.77	- 1.98	- 2.27	- 2.52	- 2.36
36	"	227/57	0.70	- 0.72	- 1.09	0.20	- 1.55	- 1.76
37	"	246/57	0.22	- 0.73	- 1.07	- 0.32	- 1.57	- 1.73
38	Paralimni	1/63	51.68	51.10	54.85	-	50.27	49.85
39	"	19/63	43.69	43.23	45.11	-	42.48	42.19
40	"	20/63	66.77	65.72	69.56	-	64.31	63.85
41	"	21/63	54.31	53.56	56.69	-	52.39	51.98
42	"	22/63	19.79	20.46	21.79	-	19.12	19.04
43	"	23/63	52.42	52.17	61.00	-	51.75	51.80
44	"	46/63	9.07	27.15	66.15	-	- 6.10	- 7.22
45	"	47/63	39.27	44.64	61.85	-	19.52	24.52
46	"	55/63	30.59	29.63	38.88	-	27.79	27.71
47	"	56/63	11.88	0.47	45.88	-	-128.78	-120.62
48	"	57/63	29.49	29.82	31.20	-	28.40	28.78
49	Pendayia	95/50	10.60	7.83	8.79	8.00	4.25	2.33
50	Phrenaros North	108/52	72.20	35.36	30.36	70.60	28.69	24.36
51	" "	109/52	70.60	34.41	29.54	66.08	28.20	24.24
52	" "	110/52	70.20	34.58	29.16	66.16	28.71	24.16
53	" "	76/56	58.13	34.55	29.30	56.47	29.22	24.30
54	" "	77/56	64.13	56.88	56.05	62.80	55.97	55.51
55	" "	78/56	65.63	46.22	42.43	63.80	42.68	39.59
56	" "	79/56	72.77	41.85	31.85	71.27	32.35	26.64
57	Phrenaros West	51/51	87.10	55.67	47.93	86.50	52.63	44.18
58	" "	52/51	86.00	50.07	42.50	85.30	47.07	39.29
59	" "	53/51	85.20	28.72	-	84.80	21.55	-
60	" "	67/53	81.10	53.83	45.78	78.70	50.75	42.49
61	Prastio (Morphou)	93/50	31.49	0.77	- 2.39	24.29	- 6.89	-21.43
62	"	11/57	26.31	3.70	1.15	14.73	- 2.72	- 6.81
63	Syrianokhori	150/54	10.51	-	1.55	9.01	0.01	- 0.70
64	"	151/54	10.12	1.04	0.83	8.83	0.03	- 0.25
65	"	152/54	8.32	0.34	- 0.74	6.07	- 0.66	- 1.16

Ser. No.	Place	Bore-hole number & year	Maximum water level			Minimum water level		
			Year after drill-ing	63-64	64-65	Year after drill-ing	63-64	64-65
66	Syrianokhori	153/54	5.79	-	0.12	4.71	0.12	- 0.54
67	"	1/55	24.09	- 1.78	0.26	17.80	- 8.78	-10.62
68	"	23/55	21.89	- 2.61	- 6.61	17.64	- 9.94	-12.19
69	"	201/56	18.45	- 3.11	- 6.15	13.02	- 9.95	-11.95
70	"	209/56	17.24	- 0.92	- 4.17	12.49	- 9.05	-12.76
71	"	195/57	7.07	0.28	- 0.39	5.19	- 1.31	- 1.72
72	"	209/57	4.56	0.46	0.04	2.96	0.29	- 0.67
73	"	248/57	10.58	- 1.48	- 3.56	6.44	- 3.31	- 4.81
74	"	253/57	10.76	- 0.16	- 3.37	6.72	- 3.20	- 4.66
75	"	39/63	-	- 2.27	- 5.77	-	- 6.85	- 8.56
76	"	52/63	-	- 1.47	- 3.89	-	- 5.06	- 6.89
77	Xylophagou	70/51	19.10	5.97	4.05	17.50	3.47	1.47
78	"	71/51	13.10	- 5.42	- 7.33	11.20	-14.08	-14.75
79	"	72/51	17.15	15.40	18.65	14.65	12.03	11.73
80	"	73/51	6.03	4.70	4.03	4.03	3.03	2.70
81	Yermasoyia	134/59	47.65	19.23	29.40	16.40	4.57	3.26
82	"	191/59	46.61	17.78	27.69	15.19	3.61	2.36
83	"	113/61	54.38	21.13	32.46	17.54	4.71	3.38

10. VILLAGE DOMESTIC SUPPLIES

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

The work of the village domestic water supplies section, is confined to the domestic water supply not only for the villages, but also for the towns of Larnaca, Paphos and Kyrenia all representing a population of over 420,000 or 70% of the total population of the island. Moreover, this section has taken active part in the planning and execution of the new additional water supply scheme for Limassol.

The section deals with all aspects of waterworks and water engineering. The investigation and development of springs, the planning and execution of domestic supply waterworks, the planning and laying of supply and distribution mains, the construction of storage reservoirs pumping stations and pumping units, public fountains and house connections.

The activities of the section during the year 1965 have been as before and the high rate, and it may safely be stated that practically every village of the island whether big, or small, in central part or in isolation enjoys a safe, palatable water for domestic consumption. Above all, it is worth mentioning that villages housing a total population of 285,806 or 68.86% of the total rural population have a house to house service. In general Cyprus can now be classified among the very few highly developed countries in the world, where both urban and rural population consumes water from a public domestic supply.

The cost of each scheme is shared between the Government and the village on the fifty-fifty ratio as a practice. Any extra cost for a house to house service and all cost of house connection is borne entirely by the consumers. All supplies to the consumers are nowadays mostly controlled by watermeters, and thus the unnecessary wasteful consumption is reduced by over 30%.

The daily satisfactory supply per capita is considered at 20 gallons, but following the rapid and steady rise in the standard of living of the rural population it may be that after a very few years, this figure will increase to 25 or even 30 gallons per day per capita. This quantity per capita is well fitted to the universal standards for a well developed semi-arid country.

In general the section has satisfactorily completed the programme included in the 5 years development plan (1961-1965), adopted by Government, and now what it remains is renewals and improvements of existing water supplies, and additional development works to meet the demands of the expanding population and the rapid rise in the standard of living.

The most conspicuous place in the list of the schemes completed during the year by this section of the Department is taken up by the new schemes for the town of Kyrenia, Paphos and Larnaca. All these three towns were facing acute shortage of water for scores of years and the feeling of water shortage was stamped in their minds. Now this feeling is removed, and they enjoy a satisfactory supply after the completion of a new water supply scheme including the distribution systems, in Kyrenia and Paphos, and the phase I of Larnaca.

An amount of £486,000 was allocated for village domestic supplies, Larnaca, Paphos and Kyrenia towns during 1965. 47 village water supply schemes serving a population of 33,920 persons were completed. 144.42 miles of pipes varying from ½-15 inches in diameter were laid, 54 reinforced concrete reservoirs, of a total capacity of 1,763,000 gallons, and 20 pumping stations, 19 school tanks were constructed. A house to house service system was provided to 35 villages and 6,100 house connections were made. Moreover it may be mentioned that an area of 300 donums has been brought under perennial irrigation, within the environments of the villages by the use of the surplus water over their domestic requirements.

The three major schemes for Larnaca, Paphos and Kyrenia towns completed during this year are outlined as hereunder:-

Larnaca.

It may be worth mentioning that during the year a Water Board, for the management and improvement of the whole water supply system of the town was formed.

Phase I, estimated at £50,000 and being part of a major scheme for Larnaca was completed by the end of 1965. This part of the scheme includes the pumping of 400,000 gallons per day from two boreholes drilled few years ago near Trimithios river, into the service reservoirs of a total capacity of 400,000 gallons. The reservoirs have been connected onto the distribution system of the town by a 15 inch diameter asbestos cement pipeline 25,000 feet in length.

By this part of the scheme phase I, storage has been provided for the proper functioning of the system and adequate pressure is maintained for all areas in Larnaca. No more the consumer has to have an underground tank and motor to pump water to his roof tank and moreover the supply will be continuous.

It is expected that phase II estimated at £60,000 will be executed during 1966. This part of the scheme will provide an additional quantity of 600,000 gallons per day from two new successful boreholes already drilled near the Trimithos river.

The town will be divided into 6 areas of supply and a ring main 15' and 12 inch in diameter, of a total length of 3.5 miles will be laid.

Paphos.

The scheme for the supply of 750,000 gallons of water per day from the two boreholes near Xeros river, estimated at £100,000 and put in hand in 1964, was completed by the end of 1965.

The water is pumped from the two boreholes located near Xeros river (Nos. 94/61 and 40/64) into a 60,000 gallons capacity balancing tank near Anarita village, and from there it flows by gravity through a 12 inch diameter,

42,000 feet in length Asbestos cement pipeline into the three reservoirs of 100,000 gallons capacity each. The water is properly chlorinated by the newly installed automatic chlorinating plants.

A length of 25,000 feet of distribution mains varying from 3-10 inch diameter were also laid. The whole town has been divided into 4 areas of supply and a metered control system was installed and put in operation. In all 2000 water meters were installed. Also, the old 4 inch diameter 22,000 feet long pipeline conveying the water from "Kourka", "Kalamos" & "Klimataria" springs situated near Tsadha was replaced, and connected with the new system.

Kyrenia.

The scheme for this town estimated at £51,000 and put in hand in 1964, was completed by the end of the year. This project included the construction of a second reservoir of 100,000 gallons capacity and the replacement of the old distribution system within the Municipal Boundaries of Kyrenia, which was unserviceable and liable to pollution and contamination. New house connections were installed and in all 1000 water meters ½ inch diameter were in operation at the end of the year. Kyrenia town has now a pure hygienic water supply to the extent of 200,000 gallons per day and a system of big capacity maintaining adequate pressure for all areas and the multifloor hotels.

Successful drilling carried out during 1964 and 1965 made it possible to provide a number of villages in Nicosia, Kyrenia, Famagusta and Larnaca Districts with adequate domestic water. Some of the important schemes executed during the year are outlined hereunder:-

a) Mia Milea and Koutsoventis.

An important pumping scheme for Mia Milea and Koutsoventis has been completed during 1965, and now Mia Milea, which, for a number of years had to be provided with domestic water by means of a tanker, enjoys a satisfactory piped supply. The source of supply is a successful borehole No. B 13 drilled on the Hilarion Limestone east of

Koutsoventis village. The water is pumped at the rate of 5,000 gallons per hour into a 30,000 gallons capacity. Balancing tank situated near the pump-house and from there it flows by gravity to the storage tanks of the two villages. A completely new distribution system has been installed at Mia Milea, and each house has a meter controlled continuous supply. In all about 400 water meters of 1/2 inch diameter have been installed in the two villages.

b) Regional Scheme for Ergates, Episkopio, Kambia and Analyondas.

Another combined pumping scheme for Ergates, Episkopio, Kambia and Analyondas and estimated at £34,000 has been completed during the year. The source of supply is a successful borehole drilled near Pera village from where water is pumped at the rate of 10,000 gallons per hour into a 60,000 gallons capacity balancing tank. From this tank Ergates and Episkopio are taking their supply by gravity whilst a pumping station near the balancing tank is lifting water at the rate of 5,000 gallons per hour for Kambia and Analyondas. A house to house service system has been provided for all villages and in all 360 water meters have been installed. In future, Lythrodontas village may also be supplied with domestic water from the same source, when funds are available.

c) Troulli.

A pumping scheme in the Larnaca district executed during the year has provided Troulli village with adequate domestic water. This scheme is combined with Ayia and Avdellero, and eventually these two villages may be supplied from the same source. The source of supply is an underground infiltering tunnel in the gravels of the Yialias river near Potamia village. The water is pumped at the rate of 5,000 gallons per hour into a high level 60,000 gallons capacity balancing tank, and from there it flows by gravity through a 40,000 feet, 4 inch pipeline to Troulli. A house to house service with water meters has been installed in Troulli village.

Appendix No. 5.

LENGTH OF PIPES LAID IN 1965

(Galvanized mild Steel Pipes)

Size Nominal Diameter	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	Vict. pipes 6"	Total
Length in miles	19.934	3.118	6.121	24.520	22.500	18.518	11.351	8.682	7.688	0.905	123.337

(Asbestos-cement pressure pipes)

Size Nominal Diameter	2"	3"	4"	6"	8"	10"	12"	15"	Total
Length in miles	1.653	3.689	4.555	3.363	0.017	0.520	1.830	5.456	21.083

Reinforced concrete tanks:-

Service reservoirs	54 (1,763,000 gallons capacity)
School tanks	19
Pumping stations	20
Public fountains	2
House connections	35 villages (6,100 consumers)

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 were 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 6, 7, 8 and 9.

Appendix No. 6.

DEPARTMENT OF WATER DEVELOPMENT

NUMBER AND PERCENTAGE OF VILLAGES WITH PIPED SUPPLIES 1965

District	Satisfactory Piped Supply								Unsatisfactory Piped Supply								No piped supply				Total No. of Villages	Total Population
	Villages with House-to-house				Villages with fountains				Villages with House-to-house				Villages with fountains				Villages					
	No.	%	Pop.	%	No.	%	Pop.	%	No.	%	Pop.	%	No.	%	Pop.	%	No.	%	Pop.	%		
Nicosia	84	47.19	113765	72.80	63	35.39	25885	16.56	-	-	-	-	29	16.30	16151	10.34	2	1.12	478	0.30	178	156279
Kyrenia	18	38.30	13236	48.10	14	29.80	5145	18.70	1	2.12	3496	12.70	13	27.66	4448	16.16	1	2.12	1192	4.34	47	27517
Famagusta	50	51.02	50397	63.30	22	22.45	7271	9.13	7	7.15	8374	10.52	19	19.38	13573	17.05	-	-	-	-	98	79615
Limassol	68	59.65	46377	72.79	34	29.82	10168	15.96	-	-	-	-	11	9.65	6798	10.67	1	0.88	370	0.58	114	63713
Paphos	48	36.36	25025	50.99	83	62.88	23801	48.50	-	-	-	-	1	0.76	250	0.51	-	-	-	-	132	49076
Larnaca	23	38.98	22506	57.95	21	35.59	8247	21.23	2	3.39	2630	6.77	11	18.65	4551	11.72	2	3.39	902	2.33	59	38836
Total	291	46.34	271306	65.37	237	37.74	80317	19.41	10	1.59	14500	3.49	84	13.37	45771	11.03	6	0.96	2942	0.70	628	415036

Note: Certain schemes that were previously satisfactory are now considered not satisfactory for the reasons of:-

(a) Boreholes have been exhausted by the depletion of the aquifer.

(b) Yield of springs greatly reduced by the continuous drought.

(c) Higher consumption demand as a result of the increasing population and standard of living.

(d) Schemes with less than 10 gallons per day per capita are classified unsatisfactory.

Appendix No. 7.

VILLAGE DOMESTIC WATER SUPPLY
SCHEMES COMPLETED IN 1965

Ser. No.	Village	Type of scheme	G.P.D. Daily quantity available	Population	Nature of work	Amount spent £
	NICOSIA & KYRENIA DISTRICT					
1	Akaki	Pumping	30,000	1,511	H	646
2	Mia Milia	"	22,000	1,076	* H	6,893
3	Koutsovendis	"	4,000	163	* H	
4	Ayia Irini	"	10,000	471	* H	7,402
5	Dhiorios	"	20,000	670	+ H	
6	Kormakitis	"	30,000	1,115	* H	
7	Meniko	"	15,000	770	* H	10,915
8	Vasilia	Gravity	17,000	1,071	H	2,670
9	Ayios Amvrosios	Pumping	30,000	1,508	+ H	7,000
10	Ayia Marina (Skyllouras)	Gravity	3,000	440	+	3,000
11	Linou	"	7,000	358	+ H	11,374
12	Phlasou	"	10,000	525	+ H	
13	Kapedhes	"	6,000	411	+ H	11,828
14	Politiko	Pumping	5,000	248	* H	2,292
15	Kalokhorio (Klirou)	Gravity	2,000	531	+	200
16	Evrykhou	"	20,000	950	H	2,292
	Total		231,000	11,798		66,512
	FAMAGUSTA DISTRICT					
1	Akanthou	Pumping	30,000	1,507	+ H	2,965
2	Ay. Andronikos	"	25,000	1,238	* H	10,629
3	Boghaz	"	3,000	90	+	2,115
4	Gastria	"	6,000	261	* H	3,180
	Total		64,000	3,096		18,889

Ser. No.	Village	Type of scheme	G.P.D. Daily quantity available	Population	Nature of work	Amount spent £
	LIMASSOL DISTRICT					
1	Dhora	Gravity	16,000	715	* H	4,192
2	Yermasoyia	Pumping	40,000	1,748	+	3,082
3	Kaminaria	Gravity	15,000	608	* H	10,708
4	Tris Elies	"	8,000	381	* H	3,870
5	Apeshia	"	8,000	292	+ H	5,377
6	Apsiou	"	10,000	593	+ H	1,755
7	Mathikoloni	"	3,000	111	* H	2,525
8	Akrounda	"	7,000	265	+ H	4,811
9	Arakapas	"	8,000	401	+ H	4,776
10	Vasa	"	4,000	151	+ H	4,250
11	Moni	"	3,000	255	+ H	2,500
12	Akapnou	"	4,000	175	+ H	2,538
13	Alassa	"	3,000	141	+ H	2,600
14	Pissouri	"	25,000	1,072	+ H	3,600
	Total		154,000	6,908		56,584
	LARNACA DISTRICT					
1	Aradippou	Pumping	80,000	3,632	+	2,345
2	Khirokitia	Gravity	10,000	406	+	4,275
3	Troulli	Pumping	18,000	817	* H	16,755
	Total		108,000	4,255		23,375
	PAPHOS DISTRICT					
1	Kouklia	Pumping	24,000	1,041	+ H	8,106
2	Yeroskipou	"	50,000	1,727	+	16,055
3	Kissonerga	Gravity	20,000	698	H	5,800
4	Konia	"	9,000	394	* H	11,274
5	Anavargos	"	8,000	312	* H	
6	Trimithousa	"	10,000	418	+ H	
7	Salamiou	"	12,000	810	H	4,300
8	Messana	"	8,000	304	+ H	2,150
9	Kelokedhara	"	12,000	758	H	1,750
10	Peyia	"	35,000	1,401	+	6,922
	Total		188,000	7,863		56,357

\+ Improvement to an existing supply.
* New Scheme.
H House-to-house service.

Appendix No. 8.

VILLAGE WATER SUPPLY SCHEMES
IN HAND AT THE END OF 1965

Serial No.	Village	Amount Revoted
	Nicosia & Kyrenia District	
1	Ayios Epiktitos)	£11,550
2	Klepini)	
3	Sykhari)	2,670
4	Vouno)	
5	Ayia Marina)	1,835
6	Xyliatos)	
7	Ergates)	19,700
8	Episkopio)	
9	Kambia)	
10	Analiondas	
11	Kalopanayiotis	6,265
		42,020
	Famagusta District	
1	Kantara	4,356
2	Melanagra	490
3	Ayia Napa	960
		5,806

Includes Village share

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Appendix No. 9.

VILLAGE DOMESTIC SUPPLY SCHEMES

PREPARED AND SUBMITTED FOR CONSIDERATION AND APPROVAL

Nicosia & Kyrenia District

Ser. No.	Village	Population 1960 census	Nature of Scheme	Quantity of water to be available in G.P.D.	Estimated cost
1	Morphou	6,642	* H	300,000	£ 86,000
2	Aredhiou	355	A H	7,000	8,450
3	Dhenia	1,163	New supply	24,000	25,000
4	Mammari				
5	Kharcha	600	A H	12,000	8,900
6	Karmi	1,776	A * H	30,000	21,000
7	Trimithi				
8	Ayios Yeorghios				
9	Kythrea	2,995	* H	60,000	23,500
10	Kythrea Lower Villages	5,100	A * H	100,000	30,000
	Neochorio				
	Trakhoni				
	Palekythro				
	Voni				
	Epikho				
	Exometochi				
	Bey Keuy				
11	Mathiatis	409	New supply	8,000	11,000
12	Gourri	392	A * H	8,000	1,900
13	Lythrodondas	1,448	A * H	30,000	17,000
14	Pyroi	466	H	10,000	2,000
15	Lymbia	1,383	A * H	30,000	25,000 approx.
16	Ayia Kebir	418	A * H	10,000	16,150
17	Pendayia	1,105	A * H	22,000	9,000
18	Kalokhorio (Orinis)	328	A * H	6,500	12,200
19	Alona	569	A * H	12,000	40,000
20	Platanistasa	590		12,000	
21	Apliki (Orinis)	120	H	2,400	1,750
22	Kambi (Pharmaka)	228	A * H	4,500	2,600
23	Klirou	1,008	* H	20,000	8,850
24	Nikitari	450	A * H	9,000	6,600
	C.F.	27,550		717,400	£338,900

Ser. No.	Village	Population 1960 census	Nature of Scheme	Quantity of water to be available in G.P.D.	Estimated cost
	B.F.	27,550		717,400	£338,900
25	Sarandi	164	* H	3,400	2,500
26	Tembria	690	H	13,800	12,120
27	Varisha	223	H	4,600	2,600
28	Vroisha	235	H	5,000	6,700
	Total	28,862		743,200	£362,820
	Famagusta District				
1	Trikomo	2,195	*	50,000	£ 7,000
2	Yialousa	2,541	*	60,000	2,600
3	Mandres	398	A * H	8,000	2,900
4	Marathovouno	2,020	A * H	40,000	9,900
5	Korovia	297	H	6,000	1,600
6	Leonarisso	707	A	14,000	2,500
7	Yerani	211	* H	4,000	500
8	Komi-Kebir	952			
9	Ofkoros	362			
10	Patriki	581	A * H	50,000	25,910
11	Kridhia	353			
12	Dry Villages Messaoria	-	A	100,000	20,000
13	Asha	2,209	* H	44,000	19,500
14	Angastina	778	* H	16,000	6,800
15	Ayios Theodhoros	828	A	16,000	7,310
	Total	14,432		408,000	£106,520
	Limassol District				
1	Pano Platres	413	A	15,000	£ 8,500
2	Kato Mylos	192	A * H	4,000	4,100
3	Asomatos	340	New supply	7,000	6,700
4	Ay. Ioannis (Agros)	875	A * H	18,000	5,600
5	Kilani	1,034	H	20,000	2,300
6	Sykopetra	217	A * H	4,000	2,800
7	Pendakomo	598	A * H	12,000	11,900
	C.F.	3,669		80,000	£ 41,900

Ser. No.	Village	Population 1960 census	Nature of scheme	Quantity of water to be available in G.P.D.	Estimated cost
	B.F.	3,669		80,000	£ 41,900
8	Pareklishia	577	Supply to New Quarter	4,000	2,400
9	Potamos tis Yermasoyias & the Coastal Area	1,748	A Tourist Zone	40,000	47,000
10	Ayia Phyla	5,231	H	100,000	5,600
11	Prastio (Evdhimou)	342	H	7,000	3,300
12	Yerasa	243	* H	5,000	1,200
13	Souni-Zanadja	66	*	1,000	900
14	Vouni	990	H	20,000	2,300
15	Erimi Kolossi	1,352	H	27,000	2,400
16	P. Kividhes	456	H	9,000	4,150
17	Ay. Demetrios	223	H A	5,000	3,900
18	Phini	924	H	20,000	5,000
19	Paleomylos	200	H	4,000	1,700
20	Anoyira	620	H	12,000	4,000
21	Kouka	63	H	1,000	1,100
22	Pyrgos	702	H	14,000	1,800
23	Zoopiyi				
24	Kelaki	408			
25	Prastio	195			
26	Kalon Khorion	549	A * H	40,000	46,100
27	Louvaras	328			
28	Eptagonia	427			
	Total	19,313		389,000	£174,750
	Larnaca District				
1	Melini	221	A * H	5,000	3,000
2	Meneou	170			
3	Pervolia	732			
4	Tersephanou	458	A * H	40,000	32,600
5	Dhromolaxia	594			
6	Avdhellero	153	A * H	2,000	7,500
7	K. Dhrys	307			
8	Vavla	133			
9	P. Lefkara	1,771	A * H	40,000	39,200
10	K. Lefkara	304			
	Total	4,843		87,000	£ 82,300

Ser. No.	Village	Population 1960 census	Nature of Scheme	Quantity of water to be available in G.P.D.	Estimated cost
	Paphos District				
1	Polis-Prodromi	2,163	* H	42,000	£ 19,000
2	Kritou-Terra	518	H	10,000	1,900
3	Emba	1,027	H	20,000	6,500
4	Peristerona	355	H	7,000	2,000
5	Ay. Nicolaos	418	H	8,000	3,200
6	Episkopi	726	H	14,000	5,600
7	Ay. Ioannis	819	A H	16,000	2,900
8	Lemona	241	H	5,000	1,400
9	Magounda	196	H	4,000	700
10	Akoursos	194	*	4,000	2,200
11	Arnadhiou	203	*	4,000	1,500
12	Kilinia	229	* H	4,000	500
13	Kedhares	259	H	5,000	1,800
14	Loukrounou	35	*	1,000	350
15	Polemi	880	H	17,000	8,400
16	Pretori	392	H	8,000	720
17	Stavrokonnou	627	*	12,000	1,000
18	Tsadha	907	H	18,000	5,100
19	Yiolou	605	H	12,000	2,150
20	Phiti	342			
21	Lassa	279			
22	Ay. Demetrianos	234			
23	Kathikas	763	*	65,000	10,000
24	Polemi	880			
25	Psathi	65			
	Total	13,357		276,000	76,920

S U M M A R Y

Serial No.	District	Amount £	Remarks
1	Nicosia & Kyrenia	362,820	
2	Famagusta	106,520	
3	Limassol	174,750	
4	Larnaca	82,300	
5	Paphos	76,920	
	Total	803,310	

A = Additional.
* = Improvements.
H = House-to-house.

11. PROSPECTING DRILLING AND HYDROGEOLOGICAL SURVEYS

By C. S. Lytras, M.Sc. (Lond.), D.I.C., B.Sc. (Athens), F.G.S., Geologist.

The writer took up duties with this Department on the 15th October, 1965, as Head of the Drilling and Hydrogeological Section. Prior to his appointment to the Water Development Department he was dividing his time between his parent Department of the Geological Survey and the Drilling and Hydrogeological Section of this Department.

Since the last Annual Report there has been no change in the complement of Drilling Rigs. The present holding is: one heavy duty Bucyrus (60 R.L.), and 10 Bucyrus 22W for standard drilling. Three other Bucyrus 22W remain in the hands of the Turks. All those rigs are of the percussion type. Two small bore generated operated drilling rigs are used for technical purposes, mainly to carry out geological foundation tests for proposed dam sites.

Two of the Bucyrus Drilling Rigs were at the free disposal of the U.N. Special Fund Project for the drilling operations carried out by the Project.

68 boreholes were drilled for water with an aggregate footage of 18,472 feet and an average depth of 272 feet. Appendix 11 gives a clear picture of results by districts and sub-divided districts. Another 165 boreholes were drilled for observation, technical and geological purposes, making a total of 233. The average time taken to complete a borehole, including, when considered necessary, the laying of casings and a preliminary test pumping of about eight hours duration was 11.9 days. The average footage drilled was 9.9. 22 old boreholes were renovated or pumping installations improved, and the days involved in that work represented the equivalent to drill 20 new boreholes.

A total of 14 boreholes were subjected to lengthy test pumpings ranging from 48 hours to 449 hours continuous duration. The volume of water pumped was 26.5 million

gallons over a total pumping time of 2,336 hours. All tests were carried out by means of an electrosubmersible pump of $7\frac{1}{2}$"Ø with a specified capacity head range of 18,000 g.p.h. from 100 feet, to 15,000 g.p.h. from 450 feet. Experience has shown that potential test pumpings are essential in order to determine the reliability of the aquifers.

Only two boreholes were drilled directly for irrigation purposes during 1965, but some of those classified as prospecting boreholes will undoubtedly be brought into use for irrigation later on.

The area now being irrigated as a result of Government drillings is conservatively estimated to be 111,000 donums. The 1946 census estimated that in that year some 53,000 donums were being irrigated perennially by pumped water. By the end of 1965, as a result of Government drilling alone this has been increased by 208 per cent to 164,000 donums. The above estimate is based only on the initial test of each borehole.

Drilling Costs.

The average cost of departmental drilling in 1965 was £164.3 per borehole or £1.390 per foot of drilling. These costs are inclusive of the expenses of laying casing pipes as well as a preliminary short pumping test of boreholes with promise of a fair water yield. They are exclusive of purchase price of borehole casing pipes and the capital cost and installation charges of permanent pumping plant. They include the wages of drilling crews, fitters and blacksmiths, and the cost of workshop maintenance of drilling tools and equipment. Depreciation of drilling plant and the salaries and expenses of supervisory staff are not included.

Appendix No. 10.

Number and Footage of Boreholes

Number of Boreholes Drilled

1958-1965

Purpose	1946-1958	1959	1960	1961	1962	1963	1964	1965
For Private Individuals	1,764	155	165	55	22	12	11	2
For Government	546	9	13	126	207	190	86	215
For W.D.	281	27	10	18	18	11	14	16
Total	2,591	191	188	199	247	213	111	233
Aggregate Footage Drilled	487,505	48,250	49,887	49,681	51,292	40,301	22,825	27,506
Average Depth	188	253	265	245	208	189	206	118

Boreholes Drilled in 1965

Purpose	No.	Existing Well Footage	Footage Drilled	% age Successful	Total Tested Yield G.P.D.
Irrigation	2	-	254	100.0	429,600
Domestic W.S.	10	-	2,997	80.0	960,000
Prospecting	56	-	15,221	43.0	3,793,200
Total for Water	68	-	18,472	50.0	5,128,800
Observation	4	-	797	-	-
Technical & Geological	161	275	8,237	-	-
Total Drilled	233		27,506	-	-

Old Boreholes Renovated: 22.

Boreholes Drilled for Water in 1965

Summary of Results

District	Locality	Number Drilled	Number * Successful	% age Successful	Total Tested Output G.P.D.	Average Yield per Successful Borehole G.P.D.
Nicosia	Potamos tou Kambou	1	1	100.0	120,000	120,000
	Peristerona	1	1	100.0	105,600	105,600
	Nisou-Yeri-Lakatamia	5	4	80.0	456,000	114,000
Larnaca	Skarinou	1	-	-	-	-
	Alethrico-Klavdhia	7	5	71.4	1,639,200	327,800
	Lymbia	1	-	-	-	-
	Dhekelia	9	7	77.7	840,000	120,000
Limassol	Yermasoyia	4	1	25.0	120,000	120,000
	Erimi-Episkopi	3	1	33.3	120,000	120,000
Famagusta	Ay. Memnon-Phrenaros	4	1	25.0	72,000	72,000
	Syngrasis-Lapathos	9	2	22.2	151,200	75,000
	Yialousa-Ay. Andronikos	5	2	40.0	288,000	144,000
	Lysi-Vatili	3	1	33.3	90,200	90,200
	Kantara	1	-	-	-	-
Paphos	Anatoliko-Mandria-Kouklia	4	3	75.0	549,600	183,200
	Akamas Forest	6	1	16.7	108,000	108,000
	Argaka-Goudhi	4	4	100.0	768,000	192,000
		68	34	5.0	5,128,800	150,800

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

Some notes on certain prospecting boreholes of special hydrogeological interest.

Prospecting drilling was carried out this year in various geological formations and useful information about new aquifers as well as a more detailed knowledge of the already known aquifers was obtained.

A short hydrogeological description of a few selected boreholes is given below.

Drilling in the river valleys, where high yielding aquifers are known to exist, gave very good results. The aquifers are essentially made of gravels and sands which have infilled during recent times the older river beds. The success in selecting the borehole sites lies in the locating of the deeper depressions in the older river bed. For this, the results obtained from the 1958 seismic geophysical survey and the use of the aerial photographs for geomorphological evidence offered a very helpful guidance.

The most interesting boreholes drilled in this type of sediments are:-

Serial No. 100/65 (Grid Ref.: N. 57,125; E. 22,665).
Serial No. 140/65 (Grid Ref.: N. 56,635; E. 23,285).

Both boreholes were drilled in the Argaka river valley and the thickness of the river gravels for each site was 107 and 100 feet respectively; the saturated zone of the gravel deposits was about 80 feet.

Serial No. 17/65 (Grid Ref. N.16,930, E.30,830) was drilled in the Dhiarizos river valley and penetrated 133 feet of coarse river deposits, the saturated zone being over 100 feet thick.

Serial No. 65/65 (Grid Ref. N.64,990, E.53,005). This borehole was drilled at Potamos tou Kambou (with funds provided by the Cyprus Mines Corporation as a donation to Potamos tou Kambou village) and it met 125 feet thick gravel and sand deposits.

Serial No. 110/65 (Grid Ref. N.21,100, E.78,640) was drilled in the Yermasoyia river valley and penetrated 113 feet thick coarse river sediments.

None of the above boreholes has been test pumped yet with an electrosubmersible pump, but their yields are expected to be - judging from other boreholes in similar beds - in the order 20,000 g.p.h. with a relatively very small drawdown. When these boreholes were tested with a piston pump of a maximum capacity 5,000 g.p.h. the maximum drawdown was only few inches. It is evident that these aquifers, because of the coarse character of their sediments and their good replenishment from the surface river flow, are high yielding water basins.

Although most of these river valleys are being exploited in full capacity there are still several others where good prospects for further exploration do exist.

Drilling in the Pliocene Sediments near Lakatamia gave good and encouraging results. Borehole Serial No. 135/65 (Grid Ref.: N. 59,400; E. 99,870) went down to 542 feet depth and it met four aquifers made of pebbles and sands within the essentially marly succession of the Pliocene Sediments in this area. This borehole is to be used for the Lakatamia village water supply. Similar to this borehole was also the one drilled near Xeri, Serial No. 70/65 (Grid Ref.: N. 58,110; E. 02,560) except that the fourth aquifer which was met at a depth between 624 and 630 was saline and as this borehole has been earmarked for the Nicosia Water Supply, the hole was back-filled with clay to 606 feet to blank off the saline water.

A very useful finding was the borehole Serial No. 45/65 (Grid Ref.: N. 04,700; E. 76,600) which was drilled in the very important groundwater basin of Ayios Andronikos which supplies water for domestic purposes to a large group of villages in the Karpas Peninsula. This borehole went deeper than the other existing boreholes with the result of finding another deeper aquifer unknown before consisting of calcareous sandstone at a depth between 260 and 290 feet.

Borehole Serial No. 145/65 (Grid Ref.: N. 51,575; E. 05,775) drilled near Pera Khorio was very successful as after passing through 80 feet thick gravel deposits it met at the depth of 102 feet a very porous reef type limestone which forms the upper part of the Pakhna Formation. The quantity and quality of the water is very good and this hole has been earmarked for the water supply of Lymbia village. The upper part of the Pakhna Formation is usually made either of reef limestones or gypsum beds, both rock types are good absorbers of water and as it has been stated also in the last Annual Report further exploration of these rocks is fully justified either where they are exposed on the surface or where they can be found near the contact with the overlying younger sediments.

During the year under review a prospecting drilling programme was initiated in the unexploited and hydrogeologically unknown as yet area of the Akamas Peninsula. The purpose of this drilling programme is to develop this area into small farming units.

Geologically the Akamas Peninsula is essentially made of rocks belonging to the Troodos Igneous Complex and to the Trypa Group. The Trypa Group is in this area represented mainly by rocks of the Mamonia Complex and some small occurrences of the Akamas Sandstone. The Mamonia Complex consists of an heterogenous mélange of rocks, among which serpentines, lavas and shales are the most predominant rock types. The rocks of the Complex have generally this in common that they are essentially impermeable.

The coastal plains of the Peninsula are very narrow and they are usually made of thin Plio-Pleistocene calcareous sandstone. The alluvial deposits in the Akamas Peninsula cover very limited areas being confined along the shallow and narrow streams.

From the general geological composition and structure of the Akamas Peninsula it appears that the possibilities of finding fairly good quantities of ground water are limited either in the Plio-Pleistocene calcareous sandstones and alluvial gravels or in the fractured and

fault zones dissecting the rocks of the Troodos Igneous Complex and the Mamonia Complex.

Three boreholes met a fair success in finding water in shallow river deposits. These holes will be converted into wells in order to increase their yields.

Borehole Serial No. 96/65 (Grid Ref.: N. 52,700; E. 06,450) was very successful in finding water in fractured rocks of the Mamonia Complex which were found below alluvial sands and gravels. This borehole when tested with a piston pump was yielding 4,500 gallons per hour with a maximum drawdown of 9 feet; it will be soon tested with an electrosubmersible pump so as to determine its capacity.

The prospecting programme in the Akamas Peninsula will continue also in the following year.

Hydrogeological Surveys.

1. The hydrogeological surveys have as a target the evaluation of the water resources of the Island. For this, intensive field work, study and research is required. Field work includes the plotting and levelling of the wells and boreholes, the periodical measuring of the depth to the water table, the sampling for chemical analysis of the quality of ground water, especially the Cl^- content, and the measuring or estimating the amount of water extracted from each well, borehole or spring.

2. The Water Development Department started an early accumulation of the hydrological and hydrogeological data concerning the most important groundwater producing areas of the Western Mesaoria, Southeastern Cyprus, the Akrotiri Peninsula, Ayia Marina-Polis, the Kiti-Pervolia and Kyrenia coastal belts. The hydrogeological surveys are expanded year after year so that a close observation network is established over the whole Island and a good knowledge of the ground water inventory of Cyprus is obtained.

3. In addition to the geological and geophysical investigation of an area, the study of its hydrological conditions is absolutely essential for the discovery,

development and conservation of its groundwater resources. This study is particularly very essential and necessary for a semi-arid country like Cyprus, in which uncontrolled and irrational pumping exceeding in many places the annual replenishment of the aquifers, has caused a progressive decline of the water table to a dangerous level. The excessive and uncontrolled pumping in the coastal areas, such as Famagusta-Paralimni, Zakaki and Kiti-Pervolia has resulted in the inland underground movement of the sea water. The catastrophic results on the citrus groves of Famagusta-Ayios Memnon was due to sea intrusion because the aquifer was very heavily overpumped. The importance and scope of knowing the hydrogeological conditions of such an overdeveloped area is not limited in the estimation of the amount of water to be safely extracted from the underground reservoirs but generally it offers the background on which all artificial recharge works are based so as to improve effectively the deteriorated conditions; the speeding up of the expansion of the hydrogeological surveys must be considered as a matter of top priority because this will serve as the diagnosis of a situation for which the general rule "it is better to prevent than to cure" fully applies.

A very difficult problem which we face is the estimation of the amount of water extracted from each borehole. As there are no water meters installed on each borehole, except for those used for the domestic water supplies of the towns and some villages, the amount of water extracted every year from each borehole is somehow concluded by questioning the owners of the boreholes. This method is obviously very inadequate, and although the information obtained from the farmers is checked and compared with the extent of land irrigated and type of crops, the accuracy of this estimation is always questionable. Furthermore this questioning does not provide analytical information on the distribution of pumping during the year. For detailed hydrogeological investigations which will enable us to draw the water balance and estimate the safe yield of each aquifer, a close observation network of monthly measured boreholes is required together with the corresponding amount of water extracted between the monthly

water level observations. The fluctuations of the water table compared with the amount of water extracted can give us the profit or loss in the water contained in the aquifer, the storativity and transmissibility of the aquifer having been predetermined by means of pumping tests, the estimation of the amount of water which replenishes the aquifer can be then determined by means of a mathematical equation. In order to improve the accuracy of the hydrogeological data collected from the farmers, the hourly output of most of the boreholes was measured while pumping and provided that we can find out the hours for which each borehole was pumping for each month then we can reach a better estimation of the amount of water extracted. Other methods applied for the same purpose include the comparison of the electricity consumed per hour and the hourly output of electrically driven pumps so as the amount of water extracted to be estimated from the readings of the electric meters. These improved methods were applied with the cooperation of the U.N. Special Fund Project Experts in order to obtain better hydrological information until the installation of water meters is achieved.

Additional wells and boreholes were brought under monthly observations. In the Famagusta District where the U.N.S.F.P. has recently drilled several observation boreholes separately for each aquifer will be soon included in the monthly observation network.

4. The survey of Western Messaoria, South-Eastern Cyprus triangle, Kyrenia, Akrotiri-Peninsula and Yermasoyia-Moni has now been completed in the sense that all wells and boreholes have now been plotted on L.R.O. plans and maps have now been produced on a scale of 1:10,000 showing the topographical features as well as the water table contours. Once monthly the water levels of a number of selected wells/boreholes are measured. Water table contour maps are prepared twice a year, once in spring (just before pumping starts) when the water table reaches its maximum and then for the autumn period (after pumping has stopped and just after the first rains) when the water table goes down to its minimum. Spring and chain-of-wells are measured in spring and autumn to determine their maximum and minimum

yield. Figures of the area irrigated in donums and type of crop and quantity of water extracted from each borehole or well or spring or chain-of-wells are also taken once a year.

5. Water samples from a number of observation boreholes for chemical analysis are taken, but in Akrotiri Peninsula where sea intrusion has occurred water samples are taken every two months for which contours are prepared on 1 : 10,000 scale maps.

6. The most part of the field work this year was concentrated in gathering as much information as possible from the existing hydrogeologically surveyed areas. In addition the South Eastern Messaoria was extended to Xylotimbou-Ormidhia-Akherytou-Engomi-Ayios Serghios-Syngrasis-Lapathos-Limnia and Gypsou where the plotting of wells/boreholes on L.R.O. plans was completed late in 1965 covering an area of 40 sq. miles. It is our target that the survey will be considerably extended in 1966 to an area of about 120 sq. miles. The extension of the South-eastern Mesaoria Hydrological area is to include the villages of Lysi, Kontea, Kouklia, Kalopsidha, Makrasyka, Pyla, Voroklini. It is also our intention to extend the Western Mesaoria towards the north, south and east. The Akrotiri, Phassouri, Yermasoyia Hydrological area is to be extended so as to include the catchments of the Rivers Garyllis, Kourris, Dhiarizos, Xeropotamos and Ezuza.

12. TOWN WATER SUPPLIES

By G. Haralambous, Senior Inspector of Works.

1. The Section of the Town Water Supplies has continued its activities which consist mainly on the administration of the Greater Nicosia Scheme and giving technical advice to the Water Boards of Nicosia, Limassol and Famagusta.

2. Nicosia Town and Suburbs. By the addition of the third borehole of the "Morphou Emergency Scheme" and the close co-operation which existed between the Authorities concerned, water supply was met satisfactorily during 1965.

3. The total amount of water conveyed to Nicosia from the various sources reached the figure of 6,395,826 c.m. and was distributed as below:-

(a) 2,164,103 c.m. for Greater Nicosia "area of supply".

(b) 3,535,161 c.m. for Water Board "area of supply".

(c) 693,562 c.m. for Water Commission "Town within walls".

This quantity was made available from all existing sources and privately owned boreholes from which water is purchased. In this respect, it is noted that the sources of Greater Nicosia Scheme were, as anticipated, not capable to "self suffice" the demand in the respective area and, therefore, a good quantity of water was borrowed from the Nicosia Water Board for return in 1966, if possible.

4. The highest daily consumption was 23,974 c.m. or 5,254,280 gallons which equals to 52.5 gallons per capita. It is recorded that the consumption in the areas occupied by Turks - particularly in Omorphita (Area 12) - has increased considerably but no control can be exercised over it.

5. During 1965, the distribution system of the Greater Nicosia Scheme was extended by 21,150 ft. or 4.0 miles of asbestos cement pipes. Most of the extensions were carried out at the expense of private developers whose land was divided into building sites. The number of consumers by the 31.12.1965 was 7,510.

6. Perhaps the present political situation renders the study over the administration of the town and suburbs water supply difficult but definitely the water position necessitates the planning of a scheme for supplementary supplies in order that a regular supply is maintained. It might be a long-term project which would suffice future requirements and would provide the substitution of certain existing sources where the water level is declining.

7. A statement of expenditure and revenue of the Greater Nicosia Scheme is given in Appendix 12.

8. Limassol. A regular water supply could be maintained from the existing sources even though the yield of the springs diminished considerably during summer months. The maximum daily consumption rose to 11,058 c.m. on 8/6/1965.

9. The construction of the "Yermasoyia River Scheme" was by the end of 1965 at its completion stage. The installation of the submersible pumps which are now in store will follow the supply of electricity by the E.A.C. In the meantime, a contract has been signed for the distribution of electricity from the switch room to the four boreholes points. The erection of the chlorination room and reception chambers which was delayed due to financial difficulties is in progress and its completion is expected some time in March 1966. Pumping however, from this scheme will be possible before summer next. Following a decision taken by the Limassol Water Board, the distribution system within the Mesayitonia village will be undertaken by the Board and will be dealt with in conjunction with the extension of the boundaries which is at present pending.

10. The distribution system in the "area of supply" has been extended by approximately 5.0 miles and the number of consumers by 31.12.65 was 12,150.

11. With a view to utilizing the 10" Ø steel pipeline from the springs which during summer months as a result of the low yield is used only at 30% of its capacity, efforts are being made for the location of aquifers by drilling boreholes at suitable places.

12. Famagusta. The existing sources could not cope with the requirements of this town during summer and restrictions were imposed at night time. In fact, the town was out of water from 9.00 p.m. to 5.00 a.m. for most of the summer period.

13. The maximum daily consumption rose to 6,057 c.m. and the number of consumers to 8,730 by 31.12.65.

14. The Hydrological survey carried out in the area of Famagusta has been completed and the results obtained are rather discouraging as regards the town's water supply. Whilst the demand in water is increasing, the reliability of the existing aquifers is doubtful due to the progressive decline of the water level. In the circumstances, this Department has undertaken to consider the possibility of providing supplementary supplies from places where such quantities may be reserved. The study is in progress and a preliminary report will be submitted in due course.

15. Facts about Water Boards of Nicosia, Limassol and Famagusta are given on Appendices Nos. 13, 14 and 15 respectively.

Revenue and expenditure account of the Greater Nicosia Scheme for the year 1965

Expenditure		
(a) Pumping Charges	£15,075	
(b) Purchase of water	3,570	
(c) Maintenance charges	2,727	
(d) Collection fees	13,894	
Total		£35,266
(e) Administration	£ 2,000	
(f) Amortization (£650,000 in 30 years at 4%)	37,590	
		39,590
Grand total		£74,856

Revenue	
(a) Sale of water	£93,737
(b) Connection fees	712
* (c) Usage of pipes by Water Board	2,500
(d) Other revenue (Stores etc.)	2,902
Total	£99,851
Profit for the year	£24,995

* The sum of £10,150 paid by Water Board of Nicosia for making use of the Morphou main pipeline is excluded.
(An approximate amount of £15,000 being value of water supplied to Turks could not be collected due to the abnormal political situation.)

Appendix No. 13.

FACTS ABOUT NICOSIA WATER BOARD.

1.	The total quantity of water supplied from all sources (Water Board and Water Commission) during 1965	4,519,974 c.m.
2.	Total quantity of water consumed including Nicosia Water Commission	4,073,807 c.m.
3.	Total maximum summer consumption	15,464 c.m.
4.	Total number of consumers as at 31st December, 1965	10,151
5.	(i) Extension of Distribution System	9,490 ft. A.C. pipes 4" Ø and 1,210 ft. A.C. pipes 6" Ø
	(ii) Total length of Distribution System	Figure not available.
6.	(i) Number of fire hydrants installed in 1965	11
	(ii) Total number of hydrants installed within the Board's Area of Supply	Figure not available.

Appendix No. 14.

FACTS ABOUT LIMASSOL WATER BOARD.

1. Total quantity of water supplied from all sources 2,926,676 c.m.

2. Total quantity of water consumed, registered by area meters, and supplied direct from boreholes 2 and 7 2,727,080 c.m.
overflow 72,979 c.m.

3. Total maximum summer consumption per day on 8/6/65 11,058 c.m.

4. Total number of consumers as at 31.12.65 12,150

5. i. Extension of distribution system:
Pipelines laid for 1965

I.	23,768'/4"	
	2,519'/6"	
	354'/8"	
Total	26,641 feet	

ii. Total length of distribution system 31.12.65

II.	465,666'/4"	
	68,288'/6"	
	16,156'/8"	
	27,000'/10"	
Total	577,110	

6. i. Number of hydrants installed in 1965 28

ii. Total number of F.H. 540

Appendix No. 15.

FACTS ABOUT FAMAGUSTA WATER BOARD.

1.	Total quantity of water supplied from all sources, month by month	1,756,516 c.m.
2.	Total quantity of water consumed registered by area meters	1,680,167 c.m.
3.	Total maximum summer consumption per day	6,057 c.m.
4.	Total number of consumers by 31.12.65	8,730
5.	i. Extension of distribution system in ft. run and size of pipes	11,785 ft. Ø 4" & 3,237 ft. Ø 6"
	ii. Total length of distribution system (including extensions for 1965)	82.14 miles
6.	i. Number of hydrants installed in 1965	17
	ii. Total number of hydrants installed within water supply area	499

13. REPORT ON MINOR IRRIGATION, RECHARGE, ANTIFLOOD, DRAINAGE AND IRRIGATION DISTRIBUTION CONSTRUCTION.

By P. Pantelides, Superintendent of Works.

A. MINOR IRRIGATION.

The usual quota of smaller new irrigation works for Divisions and Private Associations all over the island was practically cut-off in 1965 because of shortage of funds and the activities of this section in this particular field have been confined to:-

a) The completion of schemes which were continued from 1964.

b) The preparation of new schemes.

c) Investigations and reports by request from local and other Government Authorities.

a) Completion Schemes 1964-1965.

A total number of 13 schemes has been completed during the year at a total cost of £67,250 as per details given in Appendix 16. The agricultural area benefiting from these works consist of 4,250 donums of winter crops (mainly cereals) irrigated from river spates, 1927 donums of spring and early summer crops such as potatoes and vegetable irrigated from seasonal flows and 655 donums of permanent crops irrigated from perennial sources.

The works for these small projects can be separated in three main types which are briefly described as follows:-

(i) Improvement of old-time gravity irrigation systems with a view of saving as much water as possible; these include proper diversion and intake works, the lining of canals, small storage tanks etc.

(ii) Tapping new gravity sources or/and development of existing sources for greater output combined with watertight distribution works.

(iii) Pumping works on vertical boreholes and distribution in new development areas.

Although the order of magnitude of each project varies from a few hundred to several thousand pounds and the extent of new land brought under irrigation perennially varies from a few to several hundred donums, yet the aggregate benefit is quite appreciable and these small schemes continue to enjoy great popularity among the farmers. Apart from the widespread agricultural benefits, these small works offer the advantage of employment to local farm labour at times of need, and to the largest proportion of the regular technicians of the Department. The unit capital cost very rarely exceeds £100 per donum for new perennial irrigation, of which the Government subsidy covers 2/3 in the case of Irrigation Divisions.

Some typical small schemes completed in 1965 are described herebelow:-

Ayios Ioannis (Maloundas). (Cost £6,800.) This is the only scheme included in the 1965 budget and not continued from 1964; the works consists of general improvements and repairs to an old-time chain-of-wells which had collapsed in several sections with the result that the flow in the dry months of the year had practically stopped. With the repairs the flow at the rate of approx. 100,000 gallons per day in summer has been reinstated and some 80 donums of perennial cropping will be maintained.

Galata (Esso valley) (£8,200). A new gravity spring at the rate of 92,400 gallons per day has been tapped by horizontal adits in the volcanic rocks forming the river bank in the Esso Galata valley. New reinforced concrete distribution channels have been completed for the irrigation of new garden land (77 donums) which is being developed by the land-use service of the Department of Agriculture. A second stage of the scheme has been put forward for implementation when funds become available; this postulates the extension of the distribution system and some further spring development.

Kelokedhara (Paphos) (£15,000). This scheme was described in last year's report but it is worth mentioning that the completed pumping works on the vertical borehole in the river gravels was delivering, during the summer,

at the rate of 25,000 gallons per hour with a negligible draw-down. A total of 555 donums can be irrigated from these works including some 100 donums of marshy land which has been properly drained. Some secondary distribution channels are required and these should be undertaken as soon as the land will have been properly levelled by assistance from the Land Use Service of the Department of Agriculture.

Peristeronari (Nicosia) (£2,800). The ab-antiquo brushwood intakes on Karkotis river and the principal channel distribution outlets have been consolidated with proper and appropriate concrete structures. These works serve for efficient spate diversion and flood irrigation of about 1000 donums of cereals and some lesser extent of spring crops.

b) Designing and preparation of New Schemes.

The design of the smaller scheme calls for experienced staff capable of making a correct appreciation of the particular type of works required in each case. This requires at the same time intelligence and enthusiasm on the part of the designer but because of shortage of trained staff design work cannot proceed at a fast pace.

During the year it has been possible to accelerate preparatory work by assigning drafts to the drawing office for completion, and flow measurements to the Hydrology Section.

A list of new schemes whose plans have been submitted to the District Officers and can be undertaken by the Department when funds become available is given on appendix 17. The whole list postulates a total expenditure at £254,040.000 mils and envisages irrigation of 19,769 dons. seasonal and 5,232 dons. perennial. The most deserving schemes are those on the mountain villages particularly Pitsillia where perennial water sources are scarce and land development is difficult and expensive.

c) Investigation and Reports.

This Section is dealing with the main inflow of requests for irrigation works and general problems arising

thereof requiring field investigation and reports. It has always been difficult to cope very quickly with the amount of work involved in this particular field, but because of lesser pressure for executive work in 1965 we were able to deal with a greater than the usual number of such cases.

B. RECHARGE, ANTIFLOOD, DRAINAGE AND RIVER TRAINING.

A list of works completed in 1965 is given on appendix 18 at a total cost of £26,820; of these the more important scheme is the recharge works at Phrenaros in the Famagusta District which were continued from 1964 and consist of a number of small earth dams on minor torrents for water spreading. The demand for such or similar schemes whereby run off water is held up on spreading grounds, for artificial recharge of underground water has increased and several new scheme were prepared in 1965 as per appendix 19.

The most important of these new schemes is in Famagusta (£65,000) where it is proposed to divert into the existing recharge system the run-off waste waters of "Plakos" catchment (drainage area = 87 sq. miles); also to increase storage capacity of the system to 1050 million gallons and increase artificial recharge to a rate at $7\frac{1}{2}$ million gallons per day. This will be effected by enlarging the artificial lake at Ay. Loucas and distribute the water by pumping to new spreading grounds within the aquiferous area. These works have been designed on experience gained early in 1965 when a large quantity of water was collected in the lakes (760 million gallons) and a large quantity (175 million gallons) had to be conveyed into the aquifer by means of temporary pumping works and spreading grounds undertaken by the Division at their own cost (£10,070).

C. CONSTRUCTION OF LARGER DISTRIBUTION PROJECTS.

(i) Morphou (Terratsa). (£90,000)

Work commenced late in 1964 and completed at the end of 1965. A total of 111,000 feet of reinforced concrete irrigation channels and auxiliary works were constructed of a flow capacity at 17 cusecs to 3 cusecs.

The cost rate of channelling including auxiliary works is as follows:-

Flow capacity	Rate per foot run
17 cusecs	1,150 mils
10 cusecs	1,000 mils
5 cusecs	865 mils
3 cusecs	750 mils

The maximum number of workmen employed at any time was 200.

The works as completed provide leakproof irrigation canals along the principal routes of irrigation distribution from pumping boreholes and from the dam.

(ii) Morphou (Ovgos). (£40,000)

This is an extension of the Morphou main (Teratsia) system with Intake Facilities on Ovgos dam. Work was started late in 1964 and practically completed at the end of 1965. A total of 50,000 feet of reinforced concrete channels were constructed. This is the first stage of larger network of Irrigation canals extending in the more recently developed area on the Ovgos valley in the outskirts of Morphou.

(iii) Kiti. (£50,000)

The work was started in August, 1965, and will be continued in 1966. By the end of 1965, 15,500 feet of reinforced concrete main channels have been completed out of a total of 32,000 feet. The scheme includes a conveyor pipeline from Kiti dam to the top of the distribution system, a pumping scheme from the dam outlet to Tersefanou intake and auxiliary small works and measuring devices.

Some more secondary lined irrigation canals will have to be constructed at a later stage to complete the distribution network from the dam to an area of about 3,000 donums of land in the Tersefanou-Kiti-Pervolia area.

Appendix 16.

Irrigation schemes completed in 1965.

No.	Village and Name of Division	Type of works	Total Estimated cost £	Approximate extent of land irrigated in a normal run off year			Remarks
				Seasonal		Per-ennial	
				Winter	Spring		
				Donums	Donums	Donums	
	NICOSIA						
1	Peristeronari	Intake and distribution works	2,800	1,000	-	-	Improved and new irrigation.
2	Xyliatos (Palevros)	Diversion and Distribution works	3,550	120	80	-	New irrigation.
3	Galata	Development of Mountain springs and Distribution works	8,200	-	49	77	Improvement seasonal and new perennial Irrigation.
4	Spilia	Diversion and distribution works	4,335	-	-	33	Increased perennial irrigation.
5	Kourtalis (Vathys)	Storage tank and distribution works	480	-	5	4	Improved seasonal, new perennial.
6	Ay. Ioannis Maloundas	Repairs to tunnel and lining of channels	6,800	-	400	80	Improved seasonal, increased perennial
7	Pyrgos, Tyllirias (Katouris)	Distribution works (Extensions)	3,200	1,600	600	-	Improved Irrigation.
	KYRENIA						
8	Karavas (Platani)	Development of springs and Distribution works	1,700	-	-	30	Perennial irrigation increase.
	FAMAGUSTA						
9	Styllos Limnia (Plakos)	Diversion weir and distribution works	9,500	1,130	-	-	New Irrigation.

No.	Village and Name of Division	Type of works	Total Estimated cost £	Approximate extent of land irrigated in a normal run off year			Remarks
				Seasonal		Per-ennial	
				Winter	Spring		
				Donums	Donums	Donums	
	LIMASSOL						
10	Arsos	Lining of channels	2,520	-	60	30	Improved & new Irrigation.
11	Paleomylos	Intake works and lining of channels	6,740	-	-	215	- do -
	PAPHOS						
12	Neokhorio (Kefalovrysos)	Distribution channels and pipes	1,560	-	27	25	- do -
13	Kelokedhara (Ziripillis)	Pumping scheme Drainage River and distribution channels combined scheme	15,000	400	-	155	New Irrigation
14	Panayia (Sarkos)	Development Distribution works	870	-	6	4	Improved and new Irrigation.
		Total	67,255	4,250	1,227	655	

Appendix 17.

LIST OF SMALL IRRIGATION SCHEMES READY FOR CONSTRUCTION WHEN FUNDS BECOME AVAILABLE

Ser. No.	Village	Locality	Nature of works proposed	Estimated costs £	Village Contribution %	Approximate extent of land irrigated in a normal runoff year		
						Seasonal		Perennial
						Winter	Spring	
	NICOSIA DISTRICT					Dons.	Dons.	Dons.
1	Pera-Politiko	Pedieos River (Div.)	Diversion Groyne and Intake channel for winter flood Irrigation	4,600	1/5	450	-	-
2	Erghates	- do -	- do -	2,000	1/5	300	-	-
3	Peristerona-Astromeritis	Dhimma-tis-Peristeronas Div.	Lining of channels	21,000	1/4	4,000	4,000	-
4	Akaki	Div. No. 2 - Domoskes Mersini	Lining of channels	1,200	1/3	-	50	10
5	Kato-Kouiraphas	Valianitiko Div.	Lining of channels	1,650	1/4	-	160	-
6	Kalo-Khorion Lefkas	Sub-surface Dam Div.	Well with infiltration gallons and pumping scheme	2,000	58%		-	120
7	Kannavia	Vati Div.	Lining of channels	580	1/3	-	5	2
8	Milikouri	Platis Div.	Pumping Scheme	12,000	1/3	-	-	180
9	Kythrea	Kefalovrysos of Kythrea Assoc.	Lining of channels	12,379	50% (£6,150)	-	-	1,000
10	Argates	Kourtoudji (Assoc.)	Regarding lining of exfiltration Tunnel and general improvements	7,176	48%	190	266	93

Ser. No.	Village	Locality	Nature of works proposed	Estimated costs £	Village Contribution %	Approximate extent of land irrigated in a normal runoff year		
						Seasonal		Perennial
						Winter	Spring	
						Dons.	Dons.	Dons.
11	Palechori	Kamini (Assoc.)	Storage tank & lining of channels	970	44%	-	15	10
12	Pharmakas	Koshina (Assoc.)	Distribution system and lining of channels	2,800		146	-	70
13	Pano Deftera	Pavlaki (Assoc.)	Chain-of-wells, improvements and lining of channels	10,000	52%	700	99	31
14	Lakatamia	Mavrovryssi (Assoc.)	Lining of channels	27,000	56%	2,800	800	200
15	Galata	Ganos, Gyros, Ay. Paraskevi Division	Distribution works (channels and pipes)	3,500	1/3	-	70	345
16	Galata	Esso Galata Division	Development of Mountain springs and Irrigation Distribution works	11,500	1/3	21	235	104
17	Kakopetria	Apliki, Taoutidhes etc. Division	Lining of irrigation channels	12,000	1/3	45	115	100
18	Galini	Mersinaki Division	Diversion weir and earth channels for spate irrigation of cereals	1,550	1/5	100	-	-
	Total Nicosia District			132,905		8,752	5,815	2,265
	LIMASSOL DISTRICT							
1	Ay. Ioannis	K. Agros (Div.)	Distribution works	1,500	630	-	10	30
2	" "	Ay. Georghios Division to be formed	Small Tank and Distribution Works	2,300	?	-	25	26
3	" "	Pervolia (Div.)	Distribution Works pipes and channels	540	140	-	-	16

Ser. No.	Village	Locality	Nature of works proposed	Estimated costs £	Village Contribution %	Approximate extent of land irrigated in a normal runoff year		
						Seasonal		Perennial
						Winter	Spring	
						Dons.	Dons.	Dons.
4	Agridhia	Kaouris (Div.)	Distribution Works pipe and channels	900	300	-	-	17
5	"	Pano Enetikon (Div.)	Distribution works pipe and channels	1,740	580	-	21	14
6	"	Vryssi tou Khoriou (Div. & Assoc.) to be formed	Distribution pipes	500	?	-	1	7
7	Dhini	Chrisomilies (Division)	Distribution pipes	350	117	8	11	16
8	Agros	Dhikhalorotsos (Div. to be formed)	Small Tank, Distribution system	930	?	-	-	10
9	Agros	Taliou (Div.)	Small Tank, Distribution system	8,140	380	-	-	15
10	Pera-Pedhi	Near the village (Div.)	Extensions & Improvement to the irrigation distribution system	2,200	734	-	-	120
11	Kyperounda	(Kholetra) (Deisis) (Div.)	Pipe Distribution system	3,730	1/3	-	49	57
12	Kyperounda	Vassiliko (Div. to be formed	Extension of Distribution pipes	420	1/3	-	49	9
13	Kyperounda	Solomides (Div. to be formed	New Irrigation System Weir, Tanks & Distribution Works	2,000	1/3	-	13	15
14	Ay. Pavlos	Domes (Div.)	Distribution pipe system	1,060	354	-	-	22
15	" "	Stirakas (Div.)	Conveyor pipes	560	187	-	8	32

Ser. No.	Village	Locality	Nature of works proposed	Estimated costs £	Village Contribution %	Approximate extent of land irrigated in a normal runoff year		
						Seasonal		Perennial
						Winter	Spring	
						Dons.	Dons.	Dons.
		Pelendria						
16	Pelendria	Nikomitis Assoc.	Irrigation Distribution channels	630	252	-	-	15
17	"	Kato Psilo Assoc.	Irrigation Distribution works	940	395	-	16	16
18	"	Avlaki Hji Stylianou Assoc.	Small Concrete Tank (5000 gallons) Distribution channels	700	36%	-	3	8
19	"	Psilon (Div.) Enklisis	Small Tank, Distribution channels	1,000	334	-	-	20
20	"	Kanaris (Div. to be formed)	Distribution pipes	480	?	-	-	12
21	"	Sarakinos (Div.)	Irrigation Distribution pipes	440	147	-	-	17
22	Silikou	Lavrania (Div.)	Lining of channels	2,570	33%	-	-	73
23	K. Amiantos	Appis (Div.)	INTAKE OF AMIANTOS RIVER & DISTRIBUTION CHANNELS (construction of existing layer scheme)	1,325	1/3	-	-	20
24	Akrounda	Division	Distribution works	6,000	1/3	-	105	75
25	K. Amiantos Pelendria	Kato (Div.) Phylagra	Distribution works	2,600	1/3	-	5	30
26	K. Amiantos Pelendria	P. Philagra	Storage Tank and Distribution works	1,700	1/3	-	10	26

Ser. No.	Village	Locality	Nature of works proposed	Estimated costs £	Village Contribution %	Approximate extent of land irrigated in a normal runoff year		
						Seasonal		Perennial
						Winter	Spring	
						Dons.	Dons.	Dons.
27	Trimiklini		Extension of the Distribution	4,300	1/3	-	100	400
28	Pyrgos Limassol	Pattikha Division	Pumping scheme and Distribution system	4,300	1/3	-	10	75
29	Omodhos	Pigadhi	Irrigation Tank & distribution pipes	900	1/3	-	8	7
30	Arakapas	Angoulos Potamos Panayiotis (Div.)	Lining the distribution channels	2,600	1/3	-	18	62
31	Dhymes	Kambos	Lining of channels	1,100	1/3	-	-	20
32	Athrakos	Mavrosykiotis (Div.)	Irrigation Tank and Distribution pipes	960	1/3	-	14	26
33	Kyperounda	Frakti Postani (Assoc. to be formed)	Excavation of spring pump and Distribution works	1,200		-	8	7
	Total Limassol District			53,615		8	440	1,315
	PAPHOS DISTRICT							
1	Dhymou	Old village spring (Div.)	Excavation and building of spring, construction of storage tank, lining of channels and laying of pipes	1,450	33%	-	20	14
2	Ayia Marina Kelokedhara	Klimaterous Division	Excavation and building of spring	300	33	-	-	-
3	Mandria	Chain of wells (Division)	Lining of channels	12,700	33	2,200	1,300	600

Ser. No.	Village	Locality	Nature of works proposed	Estimated costs £	Village Contribution %	Approximate extent of land irrigated in a normal runoff year		
						Seasonal		Perennial
						Winter	Spring	
						Dons.	Dons.	Dons.
4	Tremithousa	Assoc.	Laying of pipes	180	44	-	5	10
5	Nata	Vrysi Livadhi (Division)	Excavation and building of springs, construction of two storage tanks and laying of pipes	2,100	33	-	20	17
6	Ay. Ioannis	Palia Vrysi (Division)	Construction of storage tank and laying of pipes	700	33	-	6	7
7	Prastio	B/H 173/61 (Division)	Pumping unit	8,000	1/3	-	40	120
8	Ay. Varvara	Ezuza river (Division)	Lining of channels	9,500	33	-	-	300
9	Timi	B/H No.22/62 (Division)	Pumping scheme	10,000	33	-	40	160
10	Anarita	Pumping scheme (Div.) BH 87/62	Pumping works and distribution system	13,500	1/3	-	40	140
11	Miliou	Potima (Div.)	Weir and distribution system	2,950	1/3	-	-	30
12	Dhrinia	Division	Distribution pipes	1,580	1/3	-	21	19
13	Kholi	Arghaki tou Knoussou (Div.)	Distribution system	1,560	1/3	-	22	25
14	Kelokedhara	Ziripillis (Div.)	Extensions 1964-1965	3,000	1/3	-	40	210
	Total Paphos District			67,520		2,200	1,554	1,652

Appendix 18.

Antiflood, River Training, Drainage, Recharge Schemes, completed in 1965.

No.	Village & Name of Division	Type of works	Total estimated cost £	Remarks
1	Nicosia Peristerona-Kato-Moni Road	Road drainage Works	£ 1,250	-
2	Famagusta Phrenaros	Recharge Scheme, small earth dams and spreading grounds	12,000	-
3	Famagusta-Dherinia Irrigation Division	Urgent Recharge Works	10,070	Supervision only (full cost to the Irrigation Division)
4	Limassol Pakhna	Drainage	3,500	-
		Total	£26,820	

Appendix 19.

LIST OF RECHARGE SCHEMES

FAMAGUSTA, LARNACA & KYRENIA DISTRICTS

Ser. No.	Village	Division or Association	Nature of proposed works	Estimated Cost £	Village Contribution %
	NICOSIA				
1	Kondea	Division	Small Recharge Dams	7,500	1/3
2	Avgorou	"	"	12,000	"
3	Famagusta-Dherinia	"	Supplementary Recharge Works	65,000	"
4	Sotira	"	Small Recharge Dams	7,500	"
5	Makrasyka	"	Recharge Dam	17,000	"
6	Phrenaros	"	Small Recharge Dams	5,700	"
	LARNACA				
1	Xylophagou		Small Recharge Dams	13,000	"
	KYRENIA				
1	Ayios Yeorghios	"	Small Recharge Dams	8,000	"

14. CONSTRUCTION SECTION ACTIVITIES

By J. Hadji Georghiou, Executive Engineer,
Head of Construction Section.

On May 10th, 1965, I was entrusted by the Director of Water Development Department to coordinate technically and administratively the activities of W.D.D. constructions for Major Irrigation Projects, i.e. the construction of dams for irrigation, recharge, water supply or flood control purposes.

The work in hand, during 1965, comprised projects constructed by W.D.D. directly and dams whose execution was entrusted to civil engineering contractors, under joint supervision from W.D.D. personnel and Consultants' engineers. The second half of the year saw the enforcement of the recommendations of the Sub-Committee appointed by the Working Committee of the Planning Bureau in early 1965 which introduced a stricter control over contracts and formed a committee under the chairmanship of the Ministry of Agriculture or the Director-General of the Ministry of Agriculture to administer and control the use of contingency funds, to which committee the Director of Department of Water Development had to give the necessary explanations before the use of contingency funds on any contract could be released. Of course the construction section was directly concerned with these measures.

In the field, the section employed 3 executive engineers, 3 inspectors and 4 technical assistants.

A. YERMASOYIA DAM.

The year was taken up for the design preparations, feasibility studies and investigations which led to the international tenders in July 1965 and the signing of the contract with Messrs. Cybarco, Civil Engineering Contractors, the lowest bidder, on October 23rd, 1965. The last two months of the year were taken up by the contractors for mobilization.

This multipurpose scheme is billed to cost £1,007,000 and will take 3 years to complete.

B. KITI DAM.

The year saw the completion of the construction programme which amounted to £140,000 on the one hand and the first trial after the reservoir was filled beginning of the year on the other. The full reservoir has developed leakage to the east towards the sea and under the spillway through the disused chain of wells and galleries. The Department has blocked the galleries leading to the Larnaca water supply chain of wells, as well as a manmade collection gallery under the spillway, which has caused appreciable losses.

In 1965 the first phase of the channels for the distribution system were started. The cost of the channels will amount to £50,000. Impoundment during the rainy period 1964-1965 was 355 million gallons of water.

C. POMOS DAM.

The Department continued this construction under labour force, completed the overspilling part of the spillway and part of the chute, as well as awarded the contract for the grouting of the right abutment and the tunnel to Messrs. Foundation Engineering of London. In 1965 the distribution system Stage I was completed, for the cost of £50,000.

The total expenditure on this major project up to December 1965 was (including 1963 and 1964 construction) £260,000 out of the estimated cost of £322,622.

In 1966, there remains to complete the spillway, the grouting works as well as the secondary system at a cost of £62,000.

Impoundment in the season 1964-1965 was limited because of the construction of the spillway to 40 million gallons out of the 200 million gallons capacity.

D. AYIA MARINA DAM.

This construction year saw the completion of the spillway and the primary distribution system, at a cost of £112,000 from the beginning of the construction in 1963.

In 1966 there remains the secondary system only at a cost of £17,000. Impounded capacity in the 1964-1965 season 40 million gallons.

E. ARGAKA-MAGOUNDA DAM.

In 1965 only minor works were executed to complete this project, the construction of the primary and secondary systems is still pending. Total expenditure since inception of the scheme is £274,358. Argaka-Magounda dam with a capacity of 270 million gallons overspills 2 and 3 times in the rainy season, with considerable quantities flowing to the sea.

F. LIOPETRI DAM.

In the construction field in 1965, Liopetri Dam has received the final touches i.e. rip rap, fencing in and the construction of a guard house. Total expenditure of this recharge project amounts to £30,000. Impoundment in the winter 1964-1965 was 80 million gallons.

G. AGROS DAM.

The Agros dam had its primary channels completed in early 1965 and with the acquisition/requisition charges paid, expenditure on December 1965, reached £48,000.

The placing of the secondary pipes for irrigation were postponed for 1966, when the land levelling by the Agricultural Department would be completed.

Impoundment in the first year of operation was 13 million gallons.

An auxiliary pumping scheme was studied and plans prepared for implementation in 1966 at a cost of £6000, this involves pumping of 10 million gallons of water from the KAVOURAS JUNCTION to the dam, through a head of 450 feet, from 1 January to March 15th each year, which pumped quantity will help to fill the dam completely in years of rainfall below average.

H. Mavrokolymbos Dam construction is given separately.

I. Polemidhia Dam construction is given separately.

J. Kalopanayiotis Dam construction is given separately.

15. MAVROKOLYMBOS DAM PROJECT

By A. Mavroudis, Executive Engineer.

This report is a detailed chronological account of events only.

A. At the beginning of 1965 the situation on the site was as follows:-

(a) Tunnel: Excavations from upstream reached to st. 0 + 380 approximately, the biggest part of it being supported by steel supports resting on continuous concrete footings. Some stone filling behind these steel supports was carried out at places of big overexcavation. It was abandoned later as uneconomical, due to the big quantity of steel plates required to support the stones. The excavation of the shaft had already started from the surface, the excavated material being dropped through a 12" borehole down into the tunnel and removed from there by a traxcavator. This method proved very efficient.

At the exit of the tunnel, after the first collapse of about 20 ft. of tunnel excavated in clay material, and the subsequent failure of the operations for an open cut due to the rainy weather, (end of 1964) all operations stopped until the weather improved, in 1965.

(b) The permeability test in the river bed: Already a borehole near the right abutment had been tested down to about 60', showing serpentine rock of high impermeability all along its depth. At the end of 1964 preparations were being made for another borehole near the left abutment.

(c) General: A telephone had just been connected to the site. The permanent house at the end of 1964 was at the stage of being built. In the tunnel and the shaft, work was going on in two shifts. The first 23 lengths of 16" Ø steel pipes arrived from Israel on the site at the end of 1964. The access road, from the main Ktima-Peyia road to the site, was constructed by separate contract. Some repairs were carried out to this road, owing to heavy rains.

B. Work in 1965:

(a) The permanent house was finished in March and the W.D.D. personnel, who were until then housed in a barrack provided by the contractor, moved in the new house. The W.D.D. Stores and part of the laboratory equipment are still housed in a barrack provided by the contractor.

The water connection to the house was done in July-August by direct labour, from a well excavated for this purpose. This was found to be the most economical and suitable arrangement. A small petrol pump is being used to pump the water to the house.

The electrical installation to the permanent house was done at the end of October, by direct labour. The power is supplied by the contractor.

(b) Permeability test in the river bed: After lengthy preparations the drilling machine started drilling the second test borehole, in the cut-off trench, near the left abutment, at the end of January. The first 9 ft. of borehole went through gravels, then below this into the serpentine bed rock. Much difficulty was met in carrying out the test and a lot of costly delays were suffered due to collapse of the soft serpentine walls of the borehole. Finally the hole reached down to about 65 ft. (end of February). The results obtained showed the serpentine rock to be highly impermeable. Geological observations on the cores recovered were carried out by the geologist of the consultants. The drilling machine (belonging to the contractor) was finally removed in the middle of March.

(c) Tunnel and shaft excavation:

(i) The excavations in the shaft were carried out in two shifts and reached the tunnel below on 20.1.1965. After this some trimming was carried out of the walls.

(ii) In the tunnel excavations proceeded in two shifts, from the intake only. The excavations were always being followed closely by the braced steel supports, which were resting on continuous concrete footing. Geologically, the tunnel was being driven through serpentine rock, in many

cases soft and decomposed. In all cases the joints in the rock were closed and although they seemed saturated, no water was freely flowing through them, indicating high impermeability. Big masses of limestone rock were met enclosed in the serpentine mass, mainly near the intake and under the shaft. As the tunnel proceeded downstream from the shaft the serpentine was becoming progressively softer. At station 470', while excavation progressed from the intake, the first collapse occurred on 3.2.1965, which resulted in the distortion of 2 round steel supports. Subsequently and as a result of this collapse and the clayey material met at this area of the tunnel, excavations from the intake stopped and preparations for concreting started. It was decided that the remaining tunnel will be excavated from the exit.

At the exit preparations started in the second half of January, and the surface excavations were carried out at the same time. In the second half of February tunnel excavation started in consolidated red clayey material. Explosives were used, against better judgment, for the excavation of this material. To minimize danger to the workmen steel supports were following closely the excavation face, with a big number of heavy section steel plates covering the walls and the ceiling. The second shift on the 24.3.65 achieved break through to the upstream part of the tunnel. At the same time a major collapse occurred at this point. Subsequently clearing of the collapsed material was attempted but a succession of collapses from the ceiling took the hole through the overlying 50 ft. of clay to the surface, within about one week. After this, trimming of the sites of the crater so formed started, to give them a stable slope. Even so a number of slides occurred in the walls of the crater which increased its size considerably, to over 3,000 c. yd. In the second half of May the sides were considered stable enough for men to enter under the crater and install 3 steel supports. Although some more collapses occurred (31.5.65: Overhanging big stone collapsed, closed tunnel, broke one support; 7.6.65: Collapse of a boulder distorted one support), the tunnel was closed under the crater and the bottom of the crater was concreted with one slab 1 m. thick

above the steel supports. This operation was finished on 26.6.65. Later, at the end of June one more support was installed under the water and 4 drainage pipes $1\frac{1}{2}$" Ø were put through the 1 m. ceiling slab into the crater, above for draining of the loose gravel material in the crater.

(d) Concreting of tunnel and shafts and other relevant works: Preparations, e.g. excavation of the 16" Ø pipe trench, rock surface preparation and shuttering started in the middle of February. In the beginning of March the first 16" Ø steel pipes were laid and welded and concrete zones were cast to hold them in position, upstream from the collapse, at station 4+10' the whole operation being carried out from the intake.

By the middle of March the concrete plant was properly organized on a platform near the intake, including a compressed air concrete pump and its carrier pipes 6" dia. After this, concreting of the whole invert began, at about 18.3.65, while on 6.4.65 concreting of the round lining begins, near the collapse. The shuttering used for the walls and the ceiling was wooden panels 6 ft. long by about 3 ft. wide, lined with iron sheets. As the thickness of the iron sheet lining was small the quality of the concrete surface deteriorated very fast. As a result the contractor will have to do a lot of surface trimming to bring the concrete surface to the standard demanded by the specifications.

On 7.7.65 the lining just downstream from the gate chamber was being cast. From the middle of July concreting of the tunnel lining upstream from the shaft goes on. On 23.8.65 concreting in the transition part of the intake takes place and at the end of August all intake structure and upstream tunnel lining is finished except for the top slab of the suction basket manhole.

In the gate chamber preparation work starts on the floor in the middle of April. The casting of the walls was carried out in three lifts between 20.5.65 and 16.8.65. The long time taken was due to the big amount of trimming of the walls.

From the second half of July work starts on the lining from station 410 downwards, the operation being carried out from the exit of the tunnel. During October concreting on the lining in the open cut is carried out. Early in November one coat of Asphalt paint is given externally to this exposed length of the tunnel lining.

At the same time preparations (excavations, blasting and trimming of rock) are carried out at the new exit structure from 14.8.65, and by 22.11.65 all concrete lining and exit structure is finished.

In the shaft preparations start on 20.9.65 for the concrete lining. By 18.10.65 the shaft reaches 6 ft. above ground level i.e. elev. 340' above M.S.L. On 22.11.65 the columns on top of the shaft are shuttered and by the end of November the shaft concrete structure is finished.

The drain filters on either side of the culvert, and the drain filter and filter pit between the dam downstream toe and the exit structure were carried out during November and first half of December.

The backfill over the culvert started on 30.11.65 with material from the stockpile formed from the surface excavations at the collapsed part of the tunnel. Later on material from the spillway excavations was used. This operation was carried into 1966.

At the end of November some trimming and shaping of the area round the intake structure was carried out.

(e) During March the contractor moved camp to a higher place, in preparation for stripping the random fill borrow area on which the original camp was situated.

(f) During the first half of March the painting of the 16" Ø steel pipes was carried out by W.D.D. labour force, after disagreement between the contractor and W.D.D. on rates.

(g) Excavations in the spillway: Stripping operations were carried out initially on the original position of the spillway, during the middle of March.

As a result of the collapses in the tunnel exit a W.D.D. drilling machine was brought on 21.4.65 on the site to investigate the possibilities for a change in the path of the spillway.

On 24.4.65 a slide was observed above the exit structure, on its left, along the interface between the overburden clayey material and the serpentine rock. This slide resulted from the deep surface excavation at the exit of the tunnel, at the foot of the slope. The slide increased to about 6 ft. movement in the following days, and part of the sliding material interfered with the excavations for the culvert. The drilling machine was removed on 18.5.65.

Between 11.5.65 and 20.5.65 several test pits were opened by excavator and labour down to 20 ft. deep at the instruction of the Consultant's Geologist, at the site of the new spillway.

More test pits were opened by labourers on the new path of the spillway between 19.6.65 and 12.7.65, to ascertain the geological conditions of the area.

Some excavations at the spillway approach channel were done in July, the material being used on the downstream random fill zone of the embankment. The excavations in the new spillway reached full swing in November. Some of the material was later used as backfill on the culvert (the exposed downstream part of the tunnel).

(h) Coffer dam and water control: Excavation (by excavator mainly) and filling with fine random material from the borrow pit B, properly spread and compacted, was carried out for the left half of the coffer dam between 19.4.65 and 18.5.65.

In the meantime during the first week of May the diversion of the river is carried out through 2 lines of 4" Ø steel pipes, by electrical pumps, and from 19.5.65 until the end of May the excavation and filling of the right hand half of the coffer dam is achieved.

These diversion pipes were lifted higher several times later on, as the embankment rose, until finally at the end of August they were taken through the tunnel.

On 27.5.65 two W.D.D. water pumps driven by diezel engines were sent to the site as stand-by. The one was later removed, on 4.8.65.

The pumping station was installed on a platform upstream from the coffer dam and well outside the dam foundations.

The coffer dam operations were carried out in two shifts.

(i) Dam foundation - preparations: Stripping in the river bed started at about the middle of March and went on intermittently to the 15.6.65. The excavator starts excavating in the cut-off trench on the left of the river bed at about 25.5.65. During the second half of June excavation by hand of the last 3 ft. and trimming of the sides is carried out.

The downstream toe trench excavation in the river bed started on 10.6.65 and continued on the abutments. The upstream toe trench was started later on.

In the following months continuous clearing and stripping operations and excavations in the cut-off trench and the two toe trenches, on the abutments, were carried out, on the embankment rose.

In the middle of July some test pits were excavated in the random fill borrow areas to ascertain the depth of material and its qualities.

Stripping on the clay borrow area was carried out during the second half of June.

(j) Filling Operations:

(i) Since the middle of June the toe trench in the river bed downstream was being filled with rounded boulders from the river bed. By the end of the month these filling operations reached on the abutments.

(ii) As from about 23.6.65 gravel material selected from the river bed excavations was being piled between the downstream toe and the cut-off trench, in layers, watered and compacted. As from the middle of July material from the approach channel of the new spillway was used on this area of the embankment. The W.D.D. Albaret Pneumatic tyred roller arrived on the site on 9.6.65 and was used, together with the contractor's sheep foot roller, for the compaction of the fine random fill from the spillway.

(iii) Filling in the cut-off trench started on 13.7.65 after the rock surface was cleaned by water and compressed air, and some small pits were filled with mortar. By the end of July the cut-off trench was filled up to the river bed elevation. From the beginning of August the clay core rose up together with the other zones of the embankment, and by 9.8.65 the embankment reached a general elevation of about 265'. The filling operations proceeded in two shifts of between 16 and 20 hours, depending on the requirements of the work. These hours were covered by 3 shifts of 8 hours each by the W.D.D. staff and good control was kept on the compaction methods and the dry density results and also on the agreement between the drawings and the actual work, in spite of many difficulties deriving from the restrictions imposed on the transport facilities and overtime work of W.D.D. staff by the central W.D.D. offices.

The progress of the embankment proceeded as follows:

Date	Elevation
9. 8.65	265'
30. 8.65	280'
30. 9.65	318'
30.10.65	352'
30.11.65	376'

In the first week of December the mass filling operations finished. On 9.12.65 the sheep foot roller was removed from the embankment.

Three horizontal filter layers were laid within the embankment: One downstream at elevation 265', connected to the filter zone, one upstream at elevation 312' and one upstream at elevation 346', all 2 ft. thick. These were not provided for in the original drawings. The Albaret was removed from the site on 1.12.65.

The rip-rap upstream started on 17.9.65, approximately, with rounded boulders from the river bed, upstream from the dam. Later, as much of this area was covered with unsuitable materials from the excavations, boulders from the river bed downstream from the dam and down to the sea, were transported and used in the toe trenches and in the rip-rap by the end of the year the rip-rap reached up to a general elevation of 372'.

On 24.7.65 an Italian specialist from the firm Galileo of Milano arrived for the piezometers. After he installed the first two instruments he left, leaving the remaining instruments to be installed by W.D.D. staff.

On 3.8.65 it was found that the cables of 8 of the already installed piezometers were cut by a bulldozer. Subsequently the instruments had to be exposed and reconnected.

All operations for the instalment of the instruments were done by direct labour, on week ends, to avoid delays to the contractors.

Continuous observations at short intervals were kept and the results were later sent to Energoprojekt for their elevation, in comparison to the original design data.

(iv) The massive concrete block between the embankment and the spillway was cast between 24.11.65 and 5.12.66.

(k) Grouting in the tunnel and shaft was executed between 2.10.65 and 16.12.65. Altogether a number of 266 holes in the tunnel and 32 holes in the shaft were grouted.

The amount of cement used was 2256 bags, i.e. nearly 113 tons.

(1) Hydromechanical equipment:

(i) The 16" Ø steel pipes arrived on the site from Israel as follows:

23 lengths 20 ft. long, on 30.12.64
24 lengths 20 ft. long, on 14. 1.64
One additional length was taken to the W.D.D. Workshops in Nicosia for shaping the bends.

(ii) During the second half of June the hydromechanical equipment from Greece arrived on the site (gate, gate frame, lifting mechanism and poles, and aeration pipe).

(iii) The two 15" hand slide valves arrived from Israel on 6.7.65.

(iv) The coarse mesh trash rack and its fittings arrived from the W.D.D. workshops on 5.7.65.

(v) The transition lining arrived on the site from a private firm in Nicosia, well before it was needed.

(vi) Other minor pieces, e.g. bends, steps, back-rests, the suction basket, the fine mesh trash racks, arrived on the site as we needed them.

Since 10.11.65 and in December the transition lining and the steps were painted by W.D.D. labour.

By the end of the year the only parts of the hydromechanical equipment cast in position were:

The coarse mesh trash rack fittings, the frame of the two fine mesh trash racks, the whole of the 16" Ø pipe, the steps and most of the back-rests in the shaft, and the suction basket.

A W.D.D. gang of 2 painters was at the end of 1965 engaged with the painting of all the equipment.

16. POLEMIDHIA DAM

By P. P. Stamati, Executive Engineer.

Polemidhia dam, the largest dam in Cyprus so far, is being completed on Garyllis river, four miles from Limassol. The dam structure itself was completed in 1965 and the grouting works will be completed in the first half of 1966. The main Contractors Messrs. Mowlem-Ridgway have already left the island and the grouting works are being carried out by the sub-contractors Messrs. Soil Mechanics of London in conjunction with Soletanche of Paris. The Water Development Department is carrying out the work on the diversion of the public road from Limassol to Apesha Village, by-passing the dam structure, by direct labour.

The dam started impounding water in October 1965. By the end of January 1966, the impounding reservoir behind the dam collected 270 million gallons of water (1.2 million tons) and the depth of water above the invert of the tunnel at the inlet end was 62 feet. The total capacity of the dam is 750 million gallons (3.4 million tons) and the total depth of water above the invert of the tunnel at the inlet end to the top of the spillway weir is 97 feet.

The water from the first rains was not stored but allowed to flow through the tunnel as it contained a lot of silt, twigs and other impurities, which would silt up the reservoir and might damage the hydromechanical equipment. Actually the amount of twigs and other impurities brought by the first floods was so big that they blocked the entrance to the tunnel at the trashrack, and eventually the latter was broken and had to be replaced.

No serious leakages were observed through the Control Gate. At the beginning some leakage was observed but this decreased rapidly as the water pressure increased behind the gate.

Recently some springs were observed on the right abutment near the outlet of the tunnel. These, presumably, are due to the seepage of water through the bed-rock, beyond the grouting curtain. Although the amount of water lost is not alarming, and the safety of the dam is not in

any danger, efforts are being made to minimize these losses by extending the grout curtain on the right abutment.

The work was carried out on a cost-plus basis and the total cost of the dam is expected to be about £800,000. This is much higher than the original estimate and is due to the following reasons:-

(a) Considerable increase of grouting works.

(b) Additional work due to ground conditions and modifications of design.

(c) Strict adherence to the Specifications by the Consulting Engineers, regarding the safety of the dam, bearing in mind that Limassol town is directly downstream of the dam.

Unfortunately the distribution system from this dam has not yet started due to technical and other difficulties. It is hoped that this will start very shortly and will cost about £120,000

The cost of the water from this dam (including the distribution system) will be in the region of 25 to 30 mils per ton. As it is reckoned to be too expensive it is hoped that the Government will sell the water at a lower price. As the cost of the dam was paid wholly by the Government, the water will be sold to the farmers through an Irrigation Division to be formed shortly.

In an average year, approximately 2,500 donums of land will be irrigated from this dam. Although some of this water will be given to the Polemidhia village, the bulk of it will be used in the Zakaki Area, which is greatly affected by sea-intrusion. Later on, when water from Kourris river is used for the Zakaki area, more water will be used in the Polemidhia area.

17. KALOPANAYIOTIS DAM

By Chr. Marcoullis, Executive Engineer.

Kalopanayiotis dam is the second dam to be constructed in the Marathasa River. The first one was Lefka dam which was completed in 1962.

Kalopanayiotis dam is an earthfill dam being designed by "Howard Humphreys and Sons", Consulting Engineers of London, and constructed by the Department. A resident engineer from the consultants is supervising the work and the representative engineer from the Department is assisted by an English engineer. The grouting works were undertaken by the "Foundation Engineer Ltd." of London in association with "Joannou & Paraskevaides Ltd." of Cyprus.

This dam is an earthfill dam, 95 ft. high above river bed. When completed it will impound about 86 million gallons of water which will be used for the irrigation of about 600 donums of land downstream of the dam. It is envisaged that after the necessary land levelling is carried out this area will be planted with deciduous trees.

Construction of the dam commenced in September 1964.

The main features of the design and information on work carried out in 1964 are included in the 1964 W.D.D. Annual Report.

Construction during 1965.

After the first works of preparation of the site, the construction of access roads, the stripping of the surface soil and the construction of the guard house which is now being used as an office and which works were done in 1964 the outlet works started.

Outlet works.

Excavation of the tunnel during 1964	2100 cu. yds. of soil
Concreting of the tunnel	800 cu. yds. of concrete
Concreting of the Valve Chamber	150 cu. yds. of concrete
Concreting of the forebay	150 cu. yds. of concrete

The tunnel was designed as follows:

Internal diameter:	7 ft.
Thickness:	12" and 18"
Length:	330 ft.

Coffer dam.

A 20 ft. high coffer dam of 7,600 cu. yards of clay with clay grouting of foundations was constructed during the period of 10/2/65 to 5/7/65.

Embankment.

Excavation on the cut-off trench started on the 4th January, 1965, and after certain delays due to the discovery of a fault and the bad quality of the rock in the west abutment it was feasible to start filling only on the 22nd of September, 1965. The filling material placed consisted of 22,500 cu. yards of clay, 2,930 cu. yds. of vertical transition zone filter, 1,550 cu. yds. of horizontal filter, 40,000 cu. yds. of general fill and 5,500 cu. yds. of rock material. Work on the embankment stopped on the 30th of November because of the winter season.

Spillway.

The mass excavation of the spillway started at the beginning of the year but it was on the 20th of September that the first concrete was poured. The 950 cu. yds. of concrete were used for various sections of the spillway.

Instead of piling under the spillway weir block as it was originally designed it was decided to construct a 5 ft. width cut-off wall of mass concrete. One half of the cut-off wall is now completed after an amount of 1000 cu. yds. of concrete was used.

Grouting.

The grouting works started on the 3rd of June up to the 29th of September. During this period grouting works were performed under the river bed section around the tunnel and under the above mentioned cut-off wall. Some holes on the river bed and the west abutment are still to be grouted.

For all the above work hired and departmental machinery was used.

The actual expenditure of the project up to the end of 1965 reached £112,814 out of which £106,334 were spent in 1965. The total estimated cost is £230,000.

The engineer from the department in charge of the dam has left on the 30th of September, 1965, and was replaced by the writer.

DAMS IN CYPRUS

April 1966

Drg. No. AG/IR/9/11

Appendix 20

A: Dams constructed before 1963

NO	NAME	TYPE	HT.	M.G	YEAR
1	Lymbia	Masonry	17	4	1945
2	Lythrodhonda	"	35	7.5	1945
3	Kalokhorio (Kl.)	"	30	18	1947
4	Akrounda	"	22	5	1947
5	Galini	"	36	5	1947
6	Petra	"	30	7	1948
7	Petra	"	30	5	1951
8	Lythrodhonda	"	34	7	1952
9	Kafizes	"	75	25	1953
10	Ayios Loucas	Earth	11	100	1955
11	Gypsos	"	11	22	1955
12	Kandou	Masonry	43	8	1956
13	Perapedhi	Con Grav	60	12	1956
14	Pyrgos (Tyll)	"	60	30	1957
15	Trimiklini	"	105	75	1958
16	Sotira	Earth	25	10	1962
17	Prodhromos	"	20	25	1962
18	Panayia (F)	"	23	10	1962
19	Morphou	"	37	450	1962
20	Lefka	Con Grav	80	80	1962
21	Geunyeli	Earth	50	230	1962
22	Ayios Yeorghios	"	20	20	1962
23	Athalassa	"	42	174	1962
24	Aloa	"	15	4	1962

Total Storage Capacity 1334

B- 1963 Projects

No.	NAME	TYPE	HT.	M.G.
25	Argaka-Magounda	Rockfill	135	253
26	Ayia Marina	"	108	66
27	Ayia Napa (7)	Earth	27	12
28	Fista Anti-Flood	"	25	36
29	Fista Recharge	"	16	11
30	Kanli Kevy	"	63	245
31	Mia Milea	"	71	74
32	Orgos	"	52	186
33	Pomos	Rockfill	126	189
34	Tremithios	Earth	74	355
35	Paralimni (45)	"	15	25

Total Storage Capacity 1452

C.- 1964 Projects

No	NAME	TYPE	HT.	M.G.
36	Agros	Earth	86	22
37	Phrenaros (6)	"	18	25
38	Kalopanayiotis	"	120	86
39	Dherinia	"	20	5
40	Mavrokolymbos	"	153	480
41	Polemidhia	"	147	750
42	Liopetri	"	58	80

Total Storage Capacity 1448

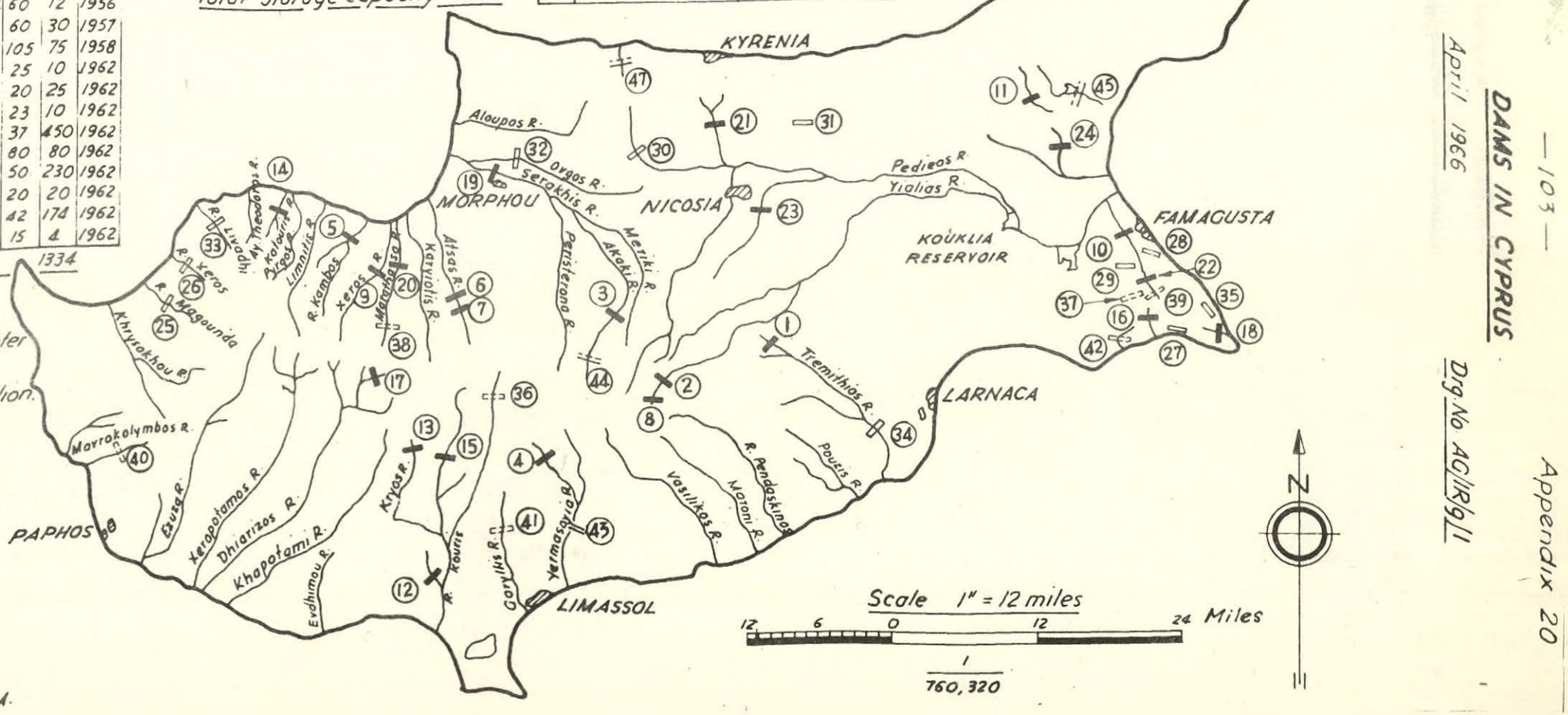
D- 1965 Projects

No.	NAME	TYPE	HT.	M.G
43	Yermasoyia	Earth	132	3000

E. Dams under design

No.	NAME	TYPE	HT.	M.G.
44	Palekhori	Earth-rock	105	165
45	Syngrasi	Earth	27	245
46	Koma-to[illegible]	"	50	277
47	Karavas	"	95	51

HT. refers to height in ft. from foundation.
M.G. means capacity of water in million gallons.
YEAR. is the year of construction.



Drawn by: C Hadjiloizou. T.A.

18. 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. Also the gate guides, transition lining, construction for Polemidhia and Mavrokolymbos have been constructed for the above dams, and the complete installation of the Hydromechanical equipment has been carried out by the W.D.D. Workshops at Polemidhia Dam successfully.

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.

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.

In 1965 machinery to the value of £8,000 was bought for the needs of the department such as core drilling and overburden equipment.

A list of the chief items of plant now on charge is given in Appendix 21. Other plant is hired from contractors or borrowed from other Departments as required. A lot of earth moving machinery was hired for construction. Heavy lorry transport is all hired from contractors, but some departmental Land Rovers were used for the transport of personnel, light tools etc.

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

Appendix 21.

MECHANICAL PLANT

(as on 31/12/65)

	No.
MOBILE PLANT:-	
Ruston Bucyrus Drilling rigs 22W ..	10
Ruston Bucyrus Drilling rigs 60RL ..	1
Water Dev. Department (1959) drilling rigs	-
Cheshire earth boring machine	-
Allen Trencher 12"-21'	2
Avelling-Barford Trencher	-
Caterpillar D8	3
Caterpillar Traxcavators 955	4
Caterpillar Traxcavator HT4	1
Caterpillar Bulldozer	-
International Bulldozer	1
Ruston Bucyrus Excavator RB10	1
Ruston Bucyrus Excavator RB19	1
Compressors	16
Morrison diesel alternator on trailer ..	5
Electrosubmersible test pumps	10
Turbine deep-well test pumping units ..	2
Centrifugal pumping units	4
Portable works pumps	12
Sheepfoots roller	18
Cranes	1
Hoists	3
Concrete mixers	40
Vibrators	32
Low loader	1
Austin Countryman Vans	-
Land Rovers	22
Fordson Lorry 3 ton	-
Thornycroft Tractive Unit for Low Loader	1
Dumpers	3
Bray Loader	1
Vibrating Rollers	3
5 ton diesel lorry	-
Soil compactors	3

	No.
Austin Gipsy	1
Vauxhall	1
Diesel engines	9
Water tankers Portable	4
Allis Chalmers Shovel 150D	1
Allis Chalmers Bulldozer	2
Excavator Smith 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. ..	2
Sludge Pump Pneumatic	5
Pneumatic Concrete Placer	1

WORKSHOP PLANT:-

Lathes	-
Shaping machine	-
Screwing machine	-
Drilling machine	3
Planning Timber Machine	1
Bandsaw timber	1
Bar Bender	1
Bar Cutter	1
Electric Welders	6
Forges	2
Pipe slotting machine oxy-acetylene ..	-
Vibrating table	-
Water Meter Testing Plant	-
Concrete block making machine	-
Compressor air (Tecalemit)	1
Milling machine	-
Grinding machine	1
Hack-saw Electrical	2
Concrete testing machine	1
Slotting Machine	-
Steel cutting machine (high speed) ..	-
Blow Knox Concrete Pump	1
Testing pipes machines	8

Appendix 22.

Important Reports issued by the Department in 1965.

1. A note on Cyprus Water Resources and Development
   by Mr. C. A. C. Konteatis — January, 1965

2. Argaka Magounda Irrigation Scheme, Preliminary Study
   by Mr. B. M. Milinusic, Senior Irrigation Engineer of F.A.O. — April, 1965

3. The Rainfall and Runoff of Cyprus
   by Mr. N. Toufexis, Supt. of Works — May, 1965

4. A Hydrological Study on the Proposed Yermasoyia River Reservoir
   by Mr. E. Dahmen, Associate Expert of F.A.O. — June, 1965

5. Ayia Trias-Yialousa Project Preliminary Report
   by Executive Engineers Messrs. N. Ioannides & Chr. Christodoulou — November, 1965

6. Comments on Yermasoyia Dam
   by Senior Water Engineer Mr. Hsing Sieh Hu — December, 1965

7. Groundwater Development, Kyrenia Range, Cyprus, 1965 (German Technical Assistance 1963/64) Report by German Water Mission to Cyprus.

8. Various Progress Reports on Dam Design and Construction (Nos. 8, 9 and 10) by Mr. Stanley W. Hsu, Dam Expert, United Nations.

9. Request for a pre-investment Survey on Water Planning and Utilization in Cyprus (United Nations Special Fund Project).

LIST OF SENIOR STAFF EMPLOYED IN THE DEPARTMENT

Ser. No.	Name	Appointment	Qualifications
1	V. J. Kregar	Director	C.E. B.Sc.
2	C. A. C. Konteatis	Assistant Director	B.Sc.(Eng.) A.M.I.C.E. A.M.I.W.E., A.M.I.E.T. (Archit.)
3	Haralambos Karakannas	Engineer Hydrologist	M.A.C.C.E. M.R.S.I., M.I.P.H.E.
4	Kyprianos C. Hassabis	Executive Engineer	B.Sc.(Eng.) Grad. I.C.E. Stud. I.W.E.
5	Panayiotis Stamatis	"	A.M.I.C.E., A.M.I.W.E. Higher National Certif. in Civ. Eng. Ordinary National Certif. in Mechanical Eng.
6	Nicolaos C. Ioannides	"	B.Sc.(Eng.) (London) Grad. I.C.E., A.W.P. DENSPM (Photogeologie) M.S.I.C.F. MSGF
7	Andreas Y. Mavroudis	"	B.Sc.(Eng.) (Rand.) Grad. M.I.S.A.C.E.
8	John Zambarloukos	"	B.Sc.(Eng.) Un. of London
9	Tefkros Harmantas	"	Diploma of Metsovion Polytechnic School of Athens in Civ. Eng.
10	Haralambos Christofides	"	Diploma of Metsovion Polytechnic School of Athens in Civ. Eng.
11	Christodoulos Christodoulou	"	Diploma of Metsovion Polytechnic School of Athens in Civ. Eng.
12	Christos Marcoullis	"	Diploma of Metsovion Polytechnic School of Athens in Civ. Eng.
13	Vassos Markides	"	B.Sc.(Eng.) (London)
14	Costakis Andreou	"	Technical University of Dresden, E. Germany
15	Andreas P. Georghiades	"	Kingston College of Technology, London
16	Petros Neophytides	"	Diploma of Metsovion Polytechnic School of Athens in Agronomy, Topography and Engineering
17	John Hji Georghiou	"	On contract. B.Sc. (Civ. Eng.) A.M.I.C.E. A.M.I.W.E.
18	C. S. Lytras	Geologist	M.Sc.(Lond.), D.I.C., B.Sc. (Athens), F.G.S.
19	Panos Pantelides	Supt. of Works	
20	Antranik Karoglanian	"	
21	Nicos Toufexis	"	

Ser. No.	Name	Appointment	Qualifications
22	Georghios Haralambous	Senior Inspector of Works	
23	Neophytos Yiannakou	"	
24	Samuel Giragosian	"	
25	A. F. Butler	"	
26	Armand Josephin	"	
27	Ioannis Serghides	"	
28	Costas Hoplaros	Admin. Off. Grade I	c.rr., g.oo., f.i., s.ll., t.o.
29	Andreas Hji Kallis	Accounting Officer	c.rr., g.oo., f.i., h.a.
30	Chr. P. Loucaides	Chief Clerk	c.rr., g.oo., f.i., t.o.