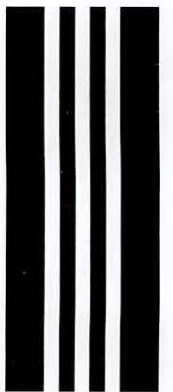
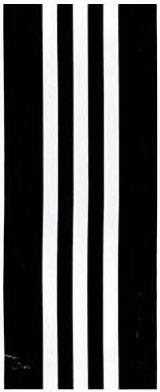




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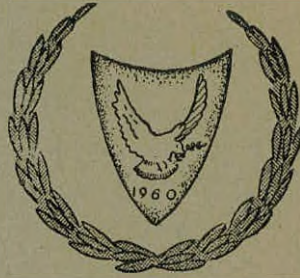
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B. 6801



REPUBLIC OF CYPRUS

ANNUAL REPORT  
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DEPARTMENT  
OF  
WATER DEVELOPMENT  
FOR THE YEAR  
1967

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REPUBLIC OF CYPRUS

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ANNUAL REPORT  
OF THE  
DEPARTMENT  
OF  
WATER DEVELOPMENT  
FOR THE YEAR  
1967

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Prepared by  
Mr. C.A.C. Konteatis  
Director,  
Department of Water Development.

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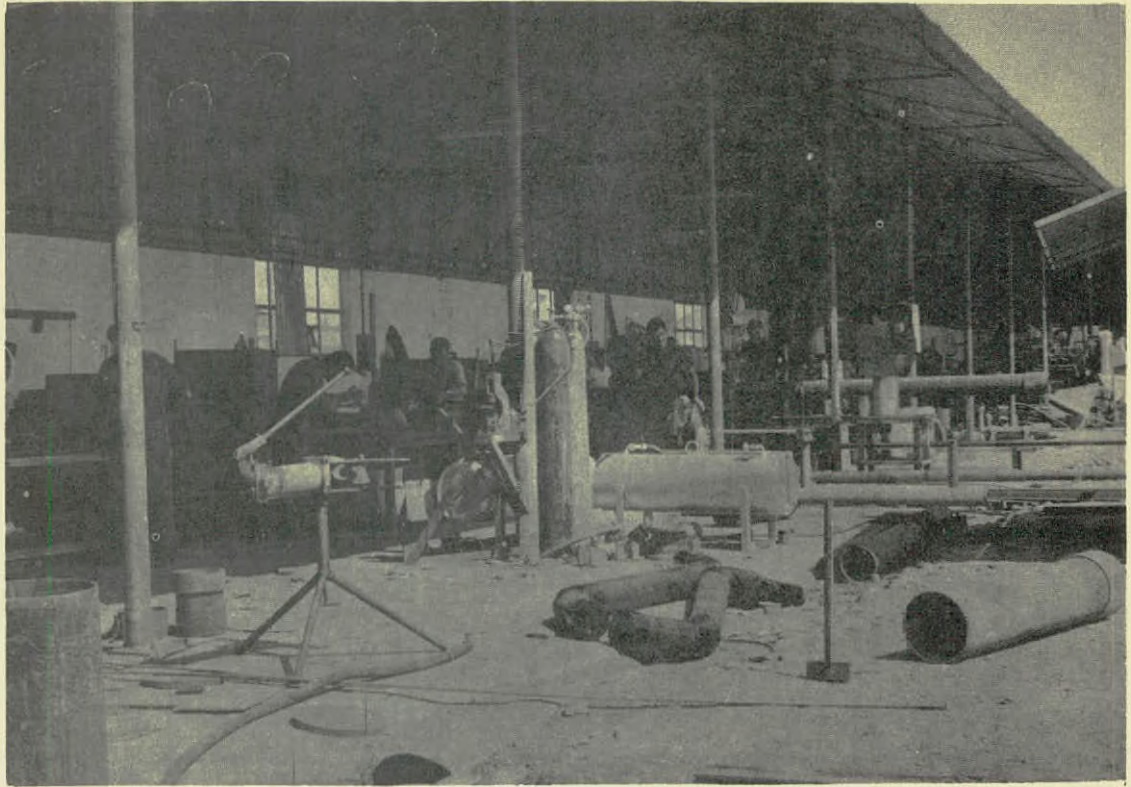


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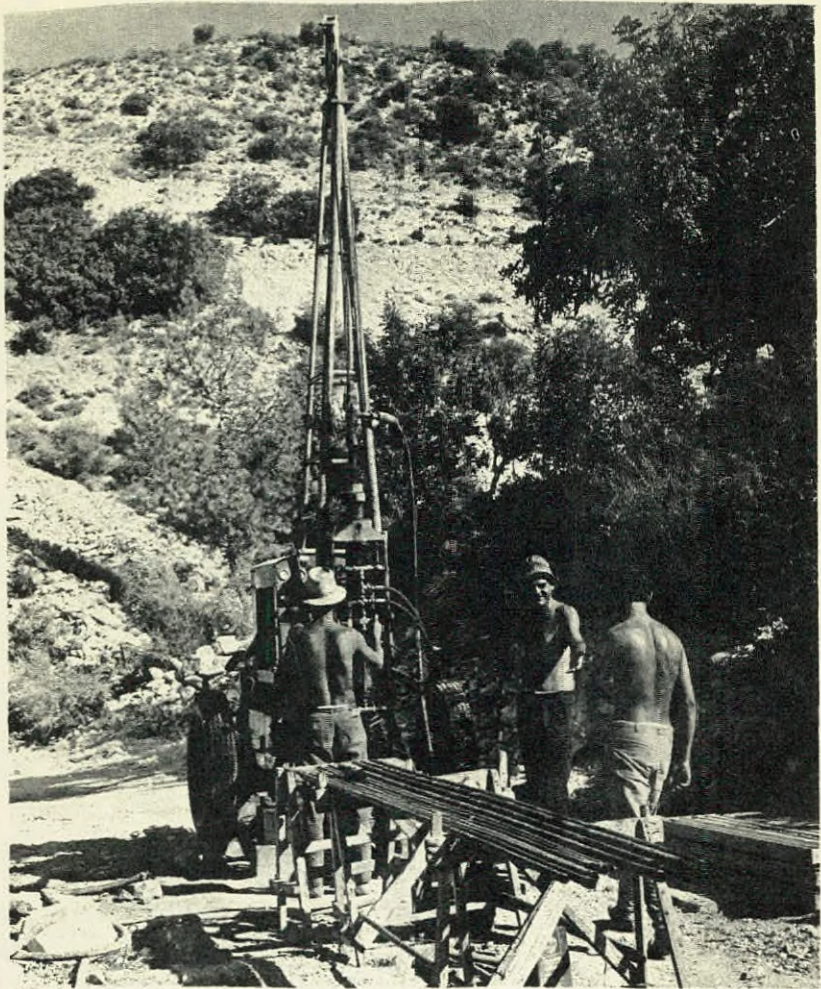


GENERAL VIEW OF PART OF THE DEPARTMENTAL  
MECHANICAL WORKSHOPS  
Photo by courtesy of P.I.O. (No 51/27/11)



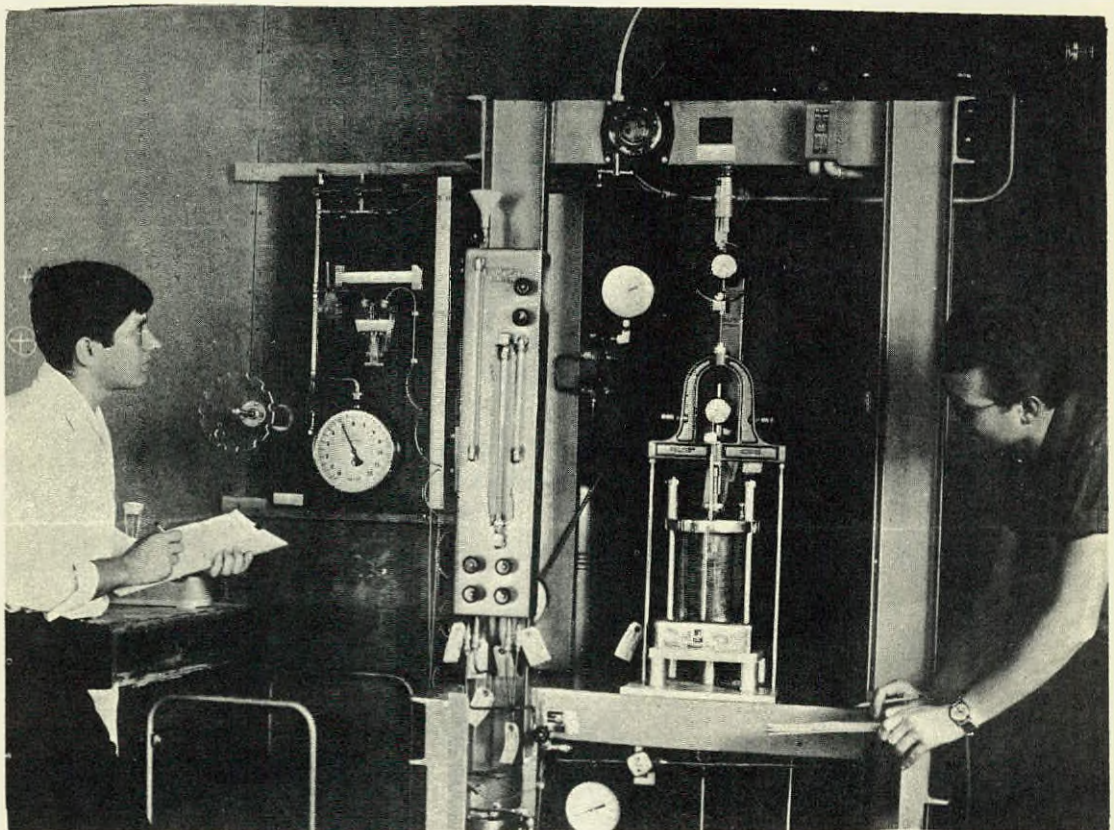
GENERAL VIEW OF THE DRAWING OFFICE  
Photo by courtesy of P.I.O. (No 51/27/1)





TYPICAL CORE DRILLING FOR FOUNDATION  
INVESTIGATION FOR A PROPOSED DAM

Photo by courtesy of P.I.O. (No SI/30/4)



TRIAXIAL TEST OF A SAMPLE FOR MATERIAL TO BE USED  
FOR THE CONSTRUCTION OF A DAM

Photo by courtesy of P.I.O. (No SI/27/8)





MEASURING WEIR WITH AUTOMATIC RECORDER  
AT KALOPANAYIOTIS MARATHASA RIVER

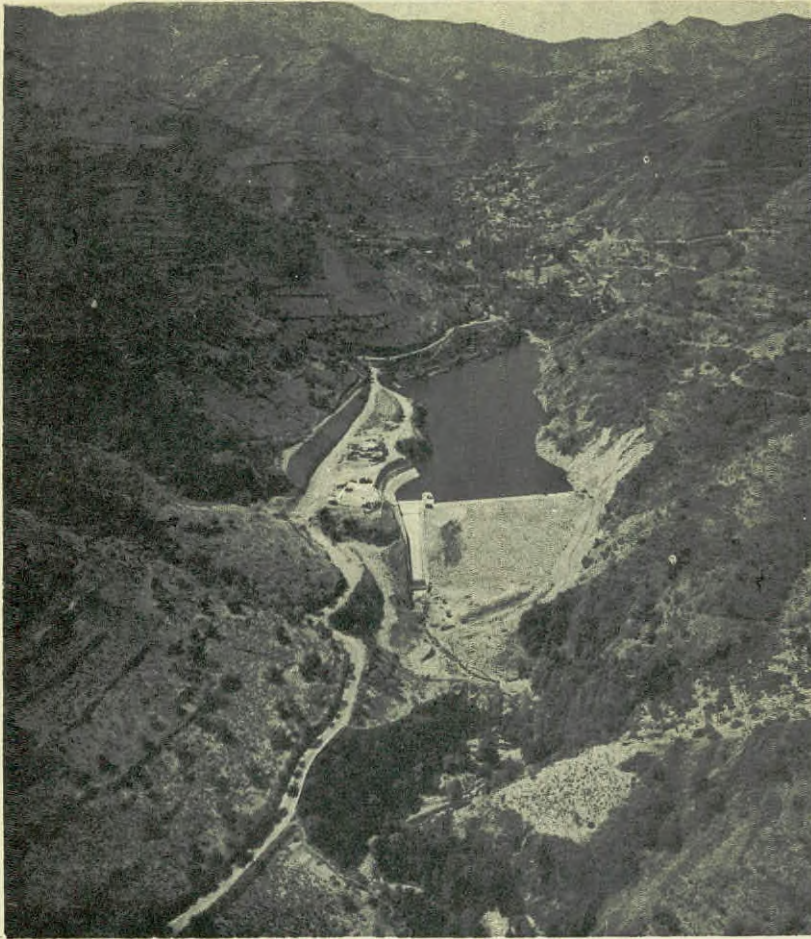
Photo by courtesy of P.I.O. (No SI/28/9)



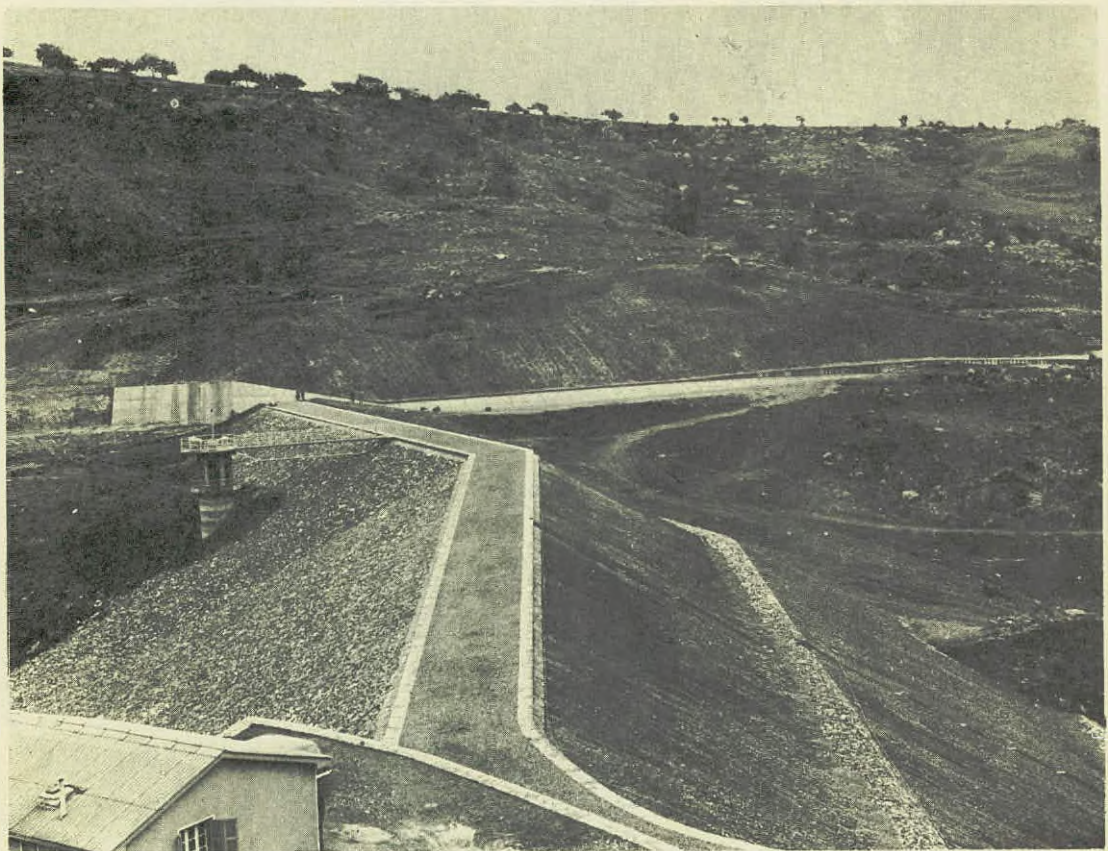
TYPICAL TEST PUMPING OF A NEWLY  
DRILLED BOREHOLE FOR WATER

Photo by courtesy of P.I.O. (No SI/25/8)



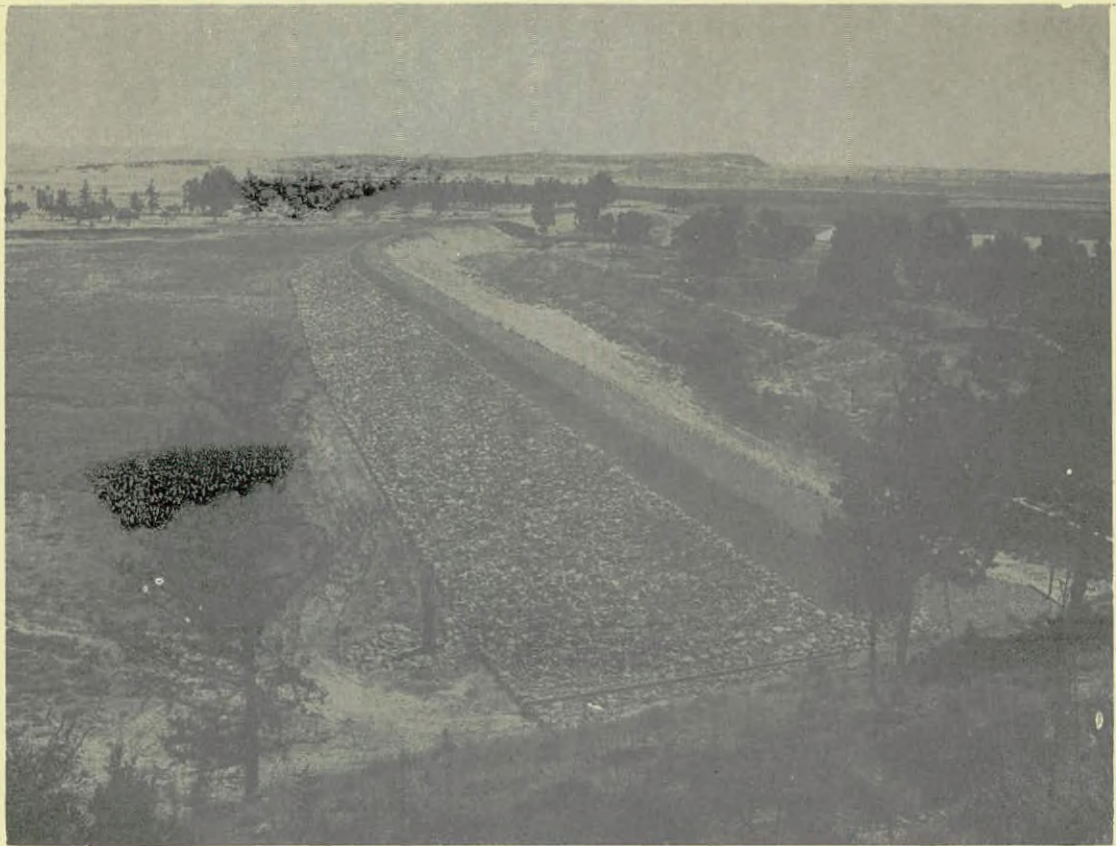


**KALOPANAYIOTIS EARTH DAM**  
Capacity: 90 million gallons. Height:-110 ft  
Area to be irrigated: 445 donums  
Photo by courtesy of P.I.O. (No 51/19/4)



**MAVROKOLYMBOS EARTH DAM**  
Capacity: 480 million gallons. Height:-153ft  
Area to be irrigated: 2000 donums  
Photo by courtesy of P.I.O. (No 55/5/67)



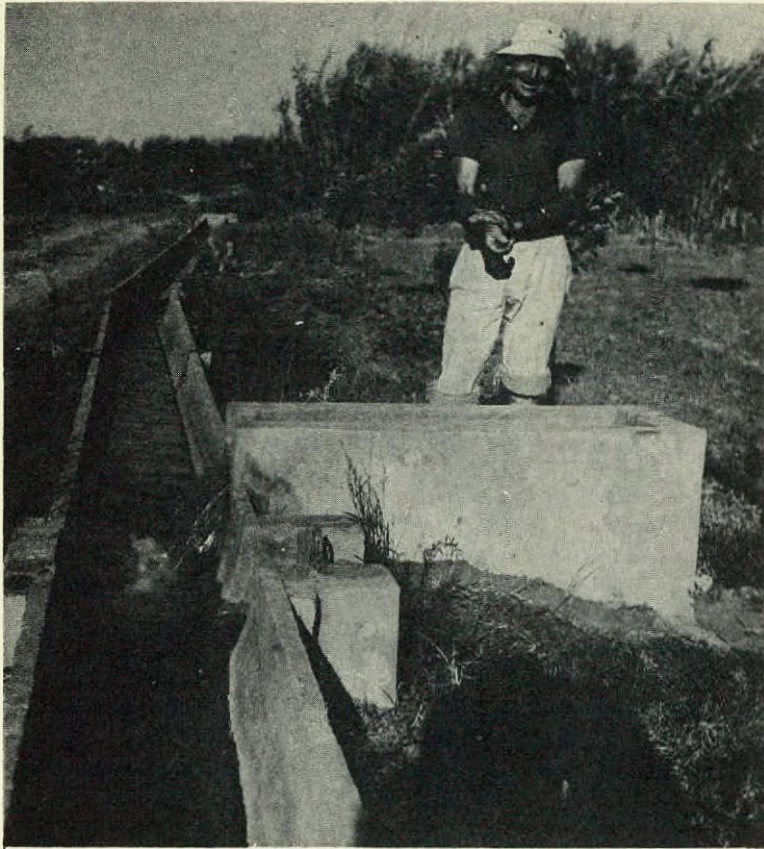


**SYNGRASI EARTH DAM**  
Capacity: 245 million gallons. Height :- 24 ft  
Photo by courtesy of P.I.O. (No SI/26/5)



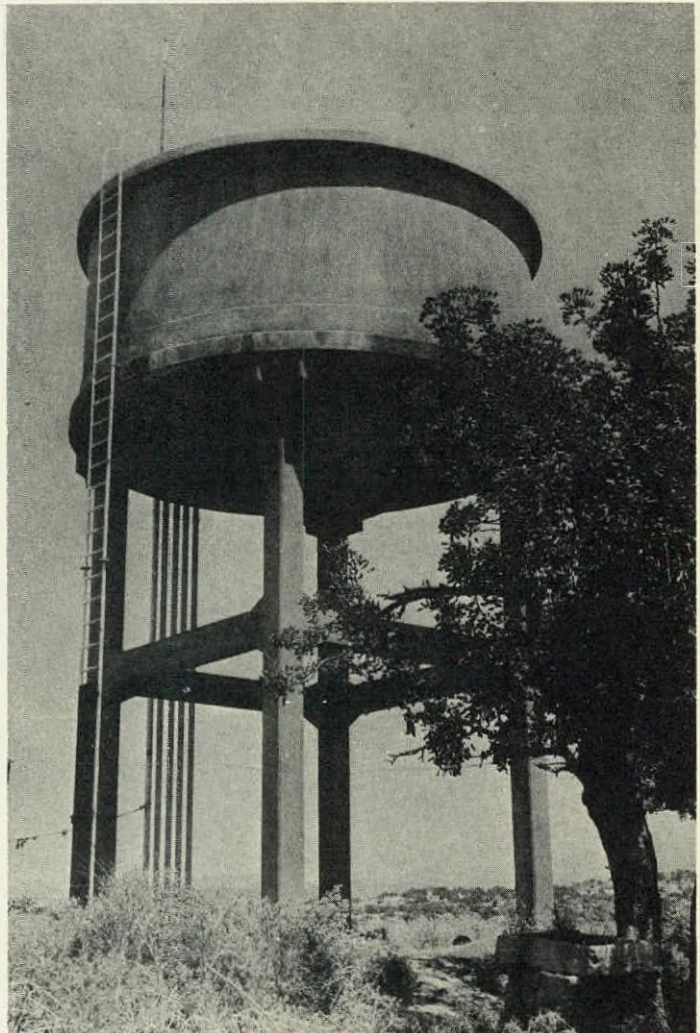
**KONDEA RECHARGE DAM**  
Capacity: 18 million gallons. Height :- 20 ft  
Photo by courtesy of P.I.O. (No 28A 2144)





PREFABRICATED POLYCENTRIC  
CANALS OF MORPHOU

Photo by courtesy of P.I.O. (No 52/1/11)



TYPICAL VILLAGE WATER  
SUPPLY TOWER TANK

Photo by courtesy of P.I.O. (No 28A 136.1)



## I. INTRODUCTION

The Department of Water Development is one of the Departments of the Ministry of Agriculture and Natural Resources and is responsible for the Government's over-all policy, water resources, planning, design and construction of all types of water development projects on the island. It also contributes towards the management of water resources and water development projects together with other interested Ministries and Departments. Such water development projects include domestic water supplies, irrigation and drainage projects, flood protection works, protection works against pollution of water resources, ground water recharge works and other relevant works. The general governmental organization and the role of the Department of Water Development are shown in the diagram Drg. No. BM/G/1-a. Regarding this over-all organization, we are now in cooperation with the United Nations Special Fund Project (C.W.P.P.) considering the possibility for improving this organization especially for the management of the water resources and projects in which a lot of other departments are involved. A basis for this study will be the already submitted report by F.A.O. on Cyprus Water Legislation dated October 1962.



### Brief History of Water Development in Cyprus

It is interesting and useful to write here a little about the history of water development in Cyprus and, in particular, since the British Occupation of Cyprus in 1878, when first water development was studied in an organized manner.

#### July 1878 - December 1879

During this first period of British Occupation, water works such as certain repairs to the domestic water supply of Larnaca and Nicosia were looked after by the Military Royal Engineers in the districts of Larnaca and Nicosia.

#### 1880 - 1896

In 1880 the Engineers Department was established in Cyprus and served for the design and construction of all engineering structures including water works of the Island. Mr. S. Brown, a Civil Engineer of great experience who had completed the Alexandria harbour works, was appointed as the Engineer. During this period, Mr. R. Russell a Senior Geologist of the Geological Surveys in London, was sent to Cyprus in 1880, who studied the water resources and water supply of the Island and submitted his report titled "Report on Existing Water Supply of the Island of Cyprus and on the Probability of Procuring Additional Water Supply from Artesian Wells" dated February, 1881.

#### 1896 - 1939

In November 1896, the Department of Public Works was established and Mr. Cartwright was appointed as the first Director of the Department which was responsible for the water development projects of the Island.



During this period the following important events happened:

I. Mr. Medlicott, an Irrigation Engineer, was sent to Cyprus to study the possibilities of irrigation works in Cyprus, 1898. He considered that the best irrigation works could be done in Messaoria by storing the water of the Pedhieos and Yialias rivers and using it by a system of canals for irrigating cereals and cotton in Messaoria. Works were started and the Koukklia, Akheritou and Syngrassi reservoirs were built by the year 1901. Mr. Medlicott also studied the possibility for diverting additional water to Messaoria from the rivers of the west, manely from the Akaki, Mericas, and Ovgos tributaries of the Serrakhis River.

II. With the execution of the Messaoria irrigation works, it was found necessary to establish a Department of the Public Works to administer these irrigation works. Mr. J.C. Gaffiero, Divisional Engineer of the Public Works, was appointed also to look after the irrigation works in 1898.

III. In 1905, Mr. C. Reid of the Geological Surveys in London was sent to Cyprus to report on the possibility of the groundwater development in Cyprus. In 1908 he submitted his report and based on that a series of drilling works upto a depth of about 1,000 feet were carried out in Western Messaoria, Nicosia and Eastern Messaoria. Also, an adit was driven in Kyrenia mountains for tapping water from the limestone. These first drilling works did not yield a satisfactory quantity of water.

IV. An Inspector of water supplies was appointed in the Public Works Department in 1914 to look after the domestic water supplies of the Island.

V. Col. W.N. Ellis, Chief Engineer of the Madras Presidency, India, was sent to Cyprus in August 1921, to advise on further irrigation works. His report, submitted in 1922, is very interesting for it has influenced the policy of the Government of Cyprus for a great number of years after his report. His conclusions, confirming the views of Mr. Medlicott of 20 years ago, are summarized on page 9 of his report dated the 10th March 1922, read as follows:

(a) "that there is no scope for extending irrigation by direct flow except by such minor extensions as may be effected by petty improvements to existing works or greater economy in the use of water.

(b) that generally the configuration of the country is unfavourable to the construction of cheap reservoirs and in most cases the cost of construction of reservoirs for irrigation would be out of all proportion to the revenue leviable for the use of the water.

(c) that the best method of conserving the water supply of the country for irrigation is by afforestation.

(d) that the best means of bringing about the extension of irrigation is by encouraging the sinking of wells for this purpose, and by giving advances on easy terms towards the cost



of these works or towards the cost of improvements to existing works such as are mentioned under item (a) above.

(e) that the improvement of the financial status of existing Government works cannot be effected by improvement of works but may be improved by alterations indicated in the system of using the water available".

It is of interest to quote a typical paragraph from the annual reports of the Government of Cyprus which had appeared under the chapter on Public Works, Irrigation, for a great number of years after the report of Col. Ellis was submitted. This paragraph reads as follows:

"It is now generally accepted that Cyprus is by natural configuration unsuited for the construction of irrigation works on a large scale, and, that the best method of conserving the water supply of the country is by afforestation. Encouragement is also afforded to the extension of irrigation by the sinking of wells and by the using of mechanical means to raise to the surface subterranean water of which a sufficient quantity is available in most parts of the Island".

As a result of the above mentioned policy, almost no irrigation works were carried out in Cyprus from 1921 to 1939.

VI. Following the report of Mr. Reid and the preliminary drilling carried out, ground water development started to give fruits first in Famagusta as from 1921 and in Morphou as from 1927.

#### 1939 - 1948

Early in 1939 a separate Department was established to look after water development works in Cyprus and was then called Water Supply and Irrigation Department. Dr. C. Raeburn was appointed as the first Director of the Department. During the period of Dr. Raeburn and until 1948 when he left the service, emphasis was given on ground water development. It was also his opinion that no important irrigation works could be economically carried out in Cyprus and it can be seen from his report on the Water Supply of Cyprus dated 1945 on page 5, that "it was only possible to carry out small irrigation works on a village scale and that we should not aim at the construction of big scale irrigation projects".

#### 1948 - 1959

Late in 1948, Mr. I.L. Ward was appointed Director of the Department and he organized the Department in order to enable it to design and construct projects of a much more major character that were being constructed in the past. Mr. Ward's opinion was that, in spite of difficulties, it was possible to construct larger projects on the Island. In his report "Hydrological and Water Development in Cyprus", submitted to the Institution of Civil Engineers in 1958, para. 54, he mentions that although dams in Cyprus are expensive per unit volume of water stored, due to the steep topography of the Island, due to



the variable flow of the rivers and due to the many water rights yet there were many suitable places where dams upto 100 feet high could be economically built and in a few places higher dams could also be worthwhile.

#### 1959 - 1966

In 1959 Cyprus gained its independence and a great emphasis was attached by the President of the Republic on Water Resources and Development. The President of the Republic Archbishop Makarios, in a speech to the House of Representatives in 1961, regarding the first five year programme of the Island, he put down the main aims for water development which were:

- (a) The carrying out of surveys towards water resources of the Island and of research so as to discover and exploit underground reservoirs or currents.
- (b) The replenishment and protection of existing underground water resources.
- (c) The concentration, storing, the measured use of rain water and the prevention of its flow to the sea.
- (d) The supply in sufficient quantities of piped water to all villages and towns for domestic and industrial use.

In the same year, 1961, a United Nations team, headed by W.C. Thorpe, submitted its recommendations about Cyprus development, a chapter of which included water development. Based upon this report, which stressed the importance of properly evaluating the water resources of the Island, proper planning and management of the works, the United Nations contributed largely ever since, to the work carried out by the Department of Water Development. Two United Nations Directors of the Department served during this period, Mr. P. De Gruyter and Mr. V. Kregaar. Also, a United Nations Special Fund Project for Groundwater and Mineral Resources Survey of the Island was established and several experts strengthened the Department.

#### 1966 - to present time

As from 1966 Mr. Konteatis was appointed Director of the Department of Water Development and the Department was organized in its present form, details of which are given later in this report. The main event was the starting of a new United Nations Project in 1967, entitled the Water Resources and Utilization Special Fund Project (C.W.P.P.), details of its work are also given later on in this report.

On reading some of the opinions of the experts, before the time of Mr. Ward, one may wonder whether those views are diametrically opposite to what we are now doing in Cyprus.



Although it is true that the views are different, yet the views of the previous experts, before the time of Mr. Ward, could be justified because of:

1. Lack of knowledge on the design and construction of earth dams or difficult foundations especially on deep alluvium river beds and on limestone abutments.

2. Lack of machinery and equipment for carrying out such difficult projects.

3. In Cyprus, undoubtedly, groundwater development yields water at much cheaper rates than by the construction of dams. Therefore, it was natural that the groundwater development should precede the construction of dams in Cyprus. We have now reached, since many years, the state of over-development of our groundwater resources and, therefore, we are now looking forward to new water resources. These new water resources are surface water resources, a great portion of which can only be utilized through the construction of several dams and, admittedly, due to the configuration of the country, the steep terrain and difficult geologic conditions, render the projects amongst the most costly dams in the world regarding the cost of water per unit volume stored. However, as we have no other water resources available and as long as the feasibility study of each project shows a benefit cost ratio exceeding 1, then the project is considered economic and is approved for execution.

4. Lack of good marketing facilities for the crops produced.

Our main objectives for the years to come are summarized as follows:

1. To draw up an inventory of the island's water resources and produce a preliminary master plan for the most economic utilization of the water resources, due consideration being taken of the agricultural benefits, domestic and industrial.

2. To effect the control of groundwater extraction from the main aquifers.

3. To maintain the supply of water to the existing irrigated areas, and particularly to the citrus plantations, which is now based to a large extent upon the groundwater over-pumpage.

4. To increase the irrigation efficiency by reducing the water losses through lining canals, laying of pipelines, land levelling and land consolidation where necessary as well as by efficient irrigation systems on the farm.

5. To build more dams for the storage of the water which now runs to waste from our rivers, for maintaining and expanding irrigated areas.

6. To maintain and expand the domestic and industrial water supply needs.

7. To maintain and expand small irrigation systems on the mountains and in other areas where large irrigation systems are not possible.



8. To improve the irrigation systems in certain areas, such as Central Mesaoria, to enable the supply of water until spring time in order to make possible the conversion of the cropping pattern in certain areas from winter irrigation, such as cereals, to spring crops.

9. The utilization of brackish water in certain areas, such as Mesaoria, for the cultivation of salt tolerant crops, for promoting animal husbandry or for promoting fish culture.

10. To consider the possibility of maintaining and increasing our water resources by artificial methods such as artificial rainfall, desalting of sea water, sewage water recovery and evaporation control measures.

11. To improve the institutional and legal aspects in connection with planning, construction and management of water development projects. ←

## II. DEPARTMENTAL ORGANIZATION

By the end of 1967, the Department was organized in its present form, as shown on Drg. No. BM/G/1 and, which is substantially different from the organization made up by Mr. Ward some twenty years ago. The main aspects of the new organization are:

### 1. Division of Water Resources

This Division groups together all services required for the collection of hydrological and hydrogeological data whether groundwater or surface water, drilling works, control of groundwater extraction and engineering geology problems, as connected with the planning and execution of water work projects.

### 2. Division of Planning

This Division is a new one and was created in order to enable the preparation of reconnaissance and feasibility studies prior to the detailed design of such projects. The works for planning include field investigations for hydraulic structures, laboratory testing for these structures, water and land use studies, hydrological evaluations as regards the hydrologic structures, evaluation of benefits, techno-economic studies, as well as, engineering geology problems, as connected with foundations.

### 3. Division of Design

This Division deals with the detailed design and specification work required for major projects after they have been approved as feasible.

### 4. Division of Construction

In this Division we have now grouped all construction work which was previously done by the various sections of the Department. Therefore, there is now a better and more centralized use of the available staff, machinery, equipment and labour force.



5. Division of Operation and Maintenance

This Division is meant to give the services required for the operation and maintenance of the major projects such as dams and town water supplies. Usually, there is a District Water Board or a Town Water Board for domestic water supplies, which is headed by the District Officer of each district and to which we are a member.

6. Division of Small Projects Planning

This Division is meant to plan and design small irrigation and domestic water supply projects which are of a rather routine nature and do not need elaborate planning and design procedures.

7. Regional Offices

Two regional offices have been established: one regional office in Famagusta and one regional office in Limassol with a sub-regional office in Paphos. Also, a sub-regional office in Morphou has been established. In these regional offices the main work carried out is hydrological measurements, collection of data and control of construction work from the administrative point of view.

8. Office Management

Here, we have a more centralized control of the office service, accounts, labour, personnel, and stores. At the same time, a financial control and coordination branch is included which deals with financial aspects including the control of expenditure.

9. Legal Advisor

The Government has appointed a Legal Advisor to help solve the various legal problems of the Department which include water legislation problems, contractors' problems, water rights problems and other problems.

10. Staff (See Appendix No. 1)

(i) Mr. H.S. Hue, Senior Water Engineer on contract from the Republic of China, completed his contract and left on the 2nd of October. During his period of service in Cyprus, Mr. Hue was the Chief Government Engineer on the Yermasoyia dam.

(ii) Mr. B. Mechim, Senior Water Engineer on contract from France, completed his contract and left on the 25th of May. During his period of service in Cyprus, Mr. Mechim helped in the planning of the various projects.

(iii) Mr. A. Tymvios was appointed Executive Engineer as from the 11th September, 1967.

(iv) Mr. P. Stamatis, Executive Engineer, left the service for personal reasons and by the end of the year immigrated to Australia.



(v) Mr. Y. Hji. Georgiou, Executive Engineer, left the service during the year and joined the United Nations as a Dam Expert in Tokoland.

(vi) Mr. C.H. Pierides, Ex-President of the Court, was appointed as a Legal Advisor to the Department.

(vii) Mr. S. Bayzda, Mechanical Engineer, Mr. Kypris, Geologist-Geophysicist, as well as, other junior staff, continued to be attached to the United Nations Groundwater and Mineral Resources Special Fund Project as counterparts.

(viii) Mr. G. Zaphiris, Geologist, passed away after a long illness.

(ix) The Turkish employees of the Department, who still hold their posts officially, have not returned to their posts throughout the year.

### III. SCHOLARSHIPS, CONFERENCES, VISITS ABROAD

1. Mr. C. Konteatis, Director of the Department, together with the Minister of Agriculture Mr. G. Tombazos and the Director of the Geological Department, Mr. Y. Hji. Stavrinou, participated in the "Water for Peace Conference", which was held in Washington, D.C. between the 23rd to 31st of May 1967. In this conference a great number of countries participated and papers were submitted and discussed on all aspects of water. Mr. Tombazos submitted a paper on Organizations for Water Supplies and Mr. Konteatis a paper on Water Resources and Development in Cyprus. Mr. Konteatis was also the Rapporteur in the conference for the subject on Organizations and Institutions for Water Works. In March of the same year, Mr. Konteatis went to London on duty to discuss matters relating to Yermasoyia dam grouting with various experts.

2. Mr. G. Charalambous, Senior Inspector of the Department, completed a course in the United States on Water Supply Management, which was sponsored by the United States AID Mission. This scholarship was held between January and August of the same year.

3. Mr. C. Phanartzis, Inspector of Works of the Department, completed a three year scholarship in hydrology in the University of Arizona and returned to Cyprus on the 1st August, 1967. This scholarship was sponsored by the United States AID.

4. Mr. J. Karoglanian, Technical Assistant, completed one year's training in concrete and materials testing in the Bureau of Reclamation, Denver, Colorado, and returned to Cyprus in November, 1967. His training was also sponsored by the United States AID.

5. Mr. J. Kastanas, Technical Assistant, left Cyprus by the end of the year for the United Kingdom, having been awarded a scholarship sponsored by the British Government in order to be trained in grouting works.

6. Mr. C. Lytras attended a conference sponsored by UNESCO in Israel, which was held in March, on Groundwater management and Recharge Problems.



#### IV. FOREIGN EXPERTS AND TECHNICAL ASSISTANCE

Apart from the United Nations Special Fund Project about which we shall deal with later, Cyprus received a lot of foreign assistance, as follows:

1. Mr. B. Griffin, Senior Hydraulic Engineer of the United States AID, left Cyprus in May, after having spent nearly five years with us. Mr. Griffin, throughout his service, showed great interest for our works having actively contributed in the various activities of the Department and, moreover, his assistance in getting a great number of scholarships, training facilities, equipment, books and other materials, were of great value. His Departure coincided with the closing down of the United States AID Mission, after decision of the United States Government.
2. Mr. T.L. Hsu, Senior Engineer, Geologist of the Republic of China, joined our Department having been made available to us as a Chinese Technical Assistant to Cyprus. His work is mainly on the selection of damsites from the geological point of view and he is very helpful especially in work carried out in connection with the Special Fund Project.
3. Mr. K. Marelius from Sweden, Associate Expert of the U.N.D.P., completed his two years' service in Cyprus and left in October.
4. Mr. S. Eresund from Sweden, Associate Expert of the U.N.D.P., completed his two years' service in Cyprus and left in September.
5. Mr. T. Meijer, Associate Expert, F.A.O., continued his work mainly assisting Mr. B. Milinusic on design of irrigation systems.
6. Mr. E. Dahmen, Associate Expert of F.A.O., completed his work as an Associate Expert on hydrological works and he joined the staff of the United Nations Special Fund Project as an assistant to the Senior Hydrologist.
7. Mr. B. Milinusic, Expert of F.A.O., continued to work with us throughout the year advising us on construction works, contractors supervision, irrigation systems and general planning work.
8. Mr. S. Hsu, U.N.D.P. Expert on dams, continued his work with us throughout the year having been occupied on supervision of the design of dams, consultants' and contractors' work.
9. United Nations Special Fund Project for Groundwater and Mineral Resources. This Project continued its work throughout the year under the supervision of its Project Manager, Dr. Tornqvist, and its Co-Manager, Mr. Y. Hji Stavrinou, Director of the Geological Department. We have continued to contribute to this Project by means of geologists, one mechanical engineer, one chief drilling foreman, various technical assistants and foremen, drilling equipment, the carrying out of hydrological measurements and observations and various other works required by this Project.



10. British Technical Assistance. Technical assistance continued to be given by the British Government as follows:

a. Dr. Dixey, Senior Hydrogeologist, continued his visits to Cyprus and helped us in the groundwater explorations carried out in the area between the Vasilikos and the Tremithios rivers, in connection with the town water supply of Famagusta.

b. Technical assistance was also given to us through the Consultants Sandeman and Kennard, who were engaged in giving advice on the grouting works carried out on Yermasoyia dam, on the cracks on Kalopanayiotis dam, on the seepage from Polemedhia dam and on the possibility of constructing a dam at Palekhorri. Mr. Kennard of this Company visited Cyprus several times during the year and on two of those visits he was accompanied by Dr. Morgenstern of the Imperial College, in connection with the Mavrokolymbos and Kalopanayiotis movements.

c. A scholarship on grouting was given to Mr. Kastanas as previously mentioned.

11. The services of consultants continued in connection with the construction of Yermasoyia and Mavrokolymbos dams by ENERGOPROJEKT of Yugoslavia and in connection with Kalopanayiotis dam by Howard Humphreys of London.

#### V. WATER RESOURCES AND UTILIZATION SPECIAL FUND PROJECT

The United Nations Special Fund Project started its operation in January, 1967, with the arrival of the Senior Hydrologist who was the first expert to arrive; but, officially, the Project was signed between the Republic of Cyprus and the United Nations in July 1967. This Project, which is scheduled to be completed in thirty months, is estimated to cost about \$1,000,000 to the United Nations and \$1,000,000 to the Government of Cyprus. In particular, the purpose according to the Plan of Operation is as follows:

(a) undertake a reconnaissance survey of the island's watersheds. The objective will be to establish an inventory of the existing resources both of underground and surface water. The hydrogeological studies will be carried out to the maximum possible extent under the UNDP (Special Fund) assisted survey of groundwater and mineral resources in Cyprus, for which the United Nations is the Executing Agency. These data will be compared with information on present water use to establish the water balance for each area and for the island as a whole. Future water requirements for domestic use, industry and agriculture will be estimated; in the case of agriculture, this assessment will take into account possible modifications in the pattern of production in favour of high value crops which make the best use of the land and water resources, having regard to costs of production and marketing possibilities. Studies will also be made on methods of increasing the rate of recharge of groundwater aquifers.



(b) Identify for each major watershed possible development projects, such as irrigation dams and other water retention structures, and make broad estimates of investment and other costs required for and of the benefits to be derived from the various projects.

(c) A detailed feasibility survey will be undertaken of selected watersheds in the Paphos area of the southern coast west of Limassol. Aspects to be examined will include hydrology, hydrogeology, soils and crops, as well as existing engineering works, agricultural practices, water rights and land tenure patterns. On the basis of these studies a phased water development programme will be prepared for the watersheds, including preliminary designs for the construction of dams and irrigation systems with cost estimates having a 20% margin. Agronomic trials will be undertaken and a pilot demonstration scheme for irrigated agriculture will be established, on the basis of which recommendations will be drawn up on improved land use and the introduction of advanced crop production techniques. The survey and demonstration work in the Paphos watersheds of the UNDP (Special Fund) assisted Agricultural Research Institute at Nicosia will be closely coordinated with this project. The Government extension services will be strengthened by the provision of in-service training on the pilot demonstration scheme.

(d) Using the results both of the overall surveys and of the detailed survey and demonstration work in the Paphos area, the Government will be assisted in drawing up a comprehensive water resources development plan, to include not only specific investment schemes but also measures for improving extension services, expanding agricultural research facilities, introducing modern water control legislation and establishing the institutional structure necessary to execute coordinated water management.

Any projects with immediate investment potential identified during the course of the project will be presented as interim feasibility reports in order to provide information before the final report is prepared.

(e) The UNDP (Special Fund) will contribute to the project the services of experts and consultants totalling nineteen and a half man-years, in the fields of water planning, irrigation, civil engineering hydrology, soil science, irrigated agriculture, agricultural economy, water recharge, geophysical work, etc. Fellowships totalling five man-years will be awarded to train local staff, particularly in the fields of water works planning and water management. Equipment will include vehicles, laboratory and field equipment for hydrological survey and soil testing and for an agricultural sub-station and the pilot demonstration scheme. Under sub-contracts the UNDP (Special Fund) may provide for the feasibility study of the Paphos watersheds.

Also, according to the Plan of Operation, the Projects work is described as follows:

(i) The island will be divided into surface areas based on consideration of surface drainage and on extent of ground-water basins. All available hydrological and geological data will be reviewed and compiled in such form as to provide a basis for a complete inventory of water resources. Field checking will be done only where absolutely necessary.



The inventory of surface resources will include an analysis of seasonal and long term trends in precipitation and runoff selection of a base period for analysis, and preparation of synthetic hydrographs for all unmeasured potential diversion and dam sites. This analysis will include availability of sewage effluent and any other local waste waters. The inventory of groundwater resources will include as complete a description of the limits and characteristics of the water-bearing rocks as possible, including present and potential recharge areas, movement of groundwater, losses to the sea and intrusion of sea water. Effects of various possible engineering solutions on water levels will be determined on a digital computer by using a mathematical model. These studies will utilize mainly data available from the UNDP (Special Fund) assisted Survey of Groundwater and Mineral Resources in Cyprus, for which the United Nations is the Executing Agency. The possibility of sediment control and water conservation through watershed management practices will be analysed and the necessary laws, policies and economic factors considered.

(ii) A potential land and water use map will be prepared. Present and potential irrigated land will be shown as well as present and potential urban and industrial areas. Present and potential population will be estimated. Present and potential industrial urban and agricultural water requirements will be determined. With these data service areas will be delineated which may or may not correspond to hydrologic areas and present and potential water use requirements under various possible future conditions will be estimated. Critical areas and water use will be identified for possible policy and/or legal considerations.

(iii) All present and planned engineering developments will be compiled. Surface storage facilities will be studied from both a seasonal and a long term view point. All available cost data will be compiled and reduced. Numerous combinations of surface facilities and surface-groundwater facilities will be studied to determine maximum possible long term yield. Criteria will be developed to provide cost data for each study. While all water cannot be captured, it is planned to study costs in terms of increments of runoff which would be wasted under present conditions up to 100%. All reasonable alternatives of combined use of surface and groundwater will be considered. Studies will be made of potential costs and benefits of conserving water through more efficient irrigation, changes of crops or redistribution of crop patterns. Economic feasibility analysis of the numerous alternatives will be made to establish both a master plan and a priority of the various parts of the master plan. Costs will be compared with probable costs of conversion of sea water and its distribution as well as with watershed management and use of sewage effluent.

(iv) All organizations existing and proposed in Cyprus will be reviewed to evaluate necessary organizational, training, extension and other human resources required to implement the proposed Water Plan. Various potential economic trends will be assumed to evaluate the possible influence on financing of changing conditions. These studies may include agricultural as well as other major economic sectors.



(v) By subcontract a survey will be made in the Paphos area to include evaluation of available hydrologic, geologic, water quality, land use and land classification data. Dam sites will be selected and test holes and test pits will be dug to determine their suitability. Preliminary designs and cost estimates of alternative multiuse schemes and timing for detailed designs and construction of dams, canals and laterals, related irrigation structures, drainage works and possible groundwater recharge works will be carried out. Studies will include capital costs, operation and maintenance costs, expected revenues and economic evaluation of alternative schemes, as well as an evaluation of the contribution to Cyprus economy. A pilot irrigation demonstration scheme will be constructed and operated by the Department of Agriculture in close co-operation with the executing agency. Agronomic trials will be carried out by the Agricultural Research Institute at a sub-station in Paphos which will be assisted in equipment by the project. The results of these trials will be made available to the project. The purpose of this subcontract and demonstration will be to provide a guide for future approach in other regions. Specific terms of reference for the feasibility study will be embodied in a contract between the executing agency and the contractor drawn up in agreement with the Government of Cyprus.

(vi) Computer techniques will be used where possible.

(vii) Training of local personnel will be included as a part of the project. Headquarters will be in Nicosia with a field office in Paphos.

The executing agency on behalf of the United Nations is the Food and Agriculture Organization (FAO) whose Headquarters are in Rome.

As can be seen from the description above, this Project will deal with work now carried out by many Government Departments, such as the Department of Water Development, the Department of Agriculture, the Agricultural Research Institute, the Planning Bureau, the Geological Department and the Ministry of Interior. Therefore, the co-operating agency was chosen to be the Planning Bureau of the Government of Cyprus, which is in a position to co-ordinate the work of the various Departments. The main contribution is given by the Department of Water Development, which contributes most of the staff, equipment, and data. Most of the counterparts required are budgeted in the Departments budget. Mr. Konteatis, Director of the Department, was appointed to be the Co-Manager of this Project. The counterpart staff, provided by the Government, is made up of the Project Co-Manager, 3 - 4 Civil Engineers including 1 Senior Engineer, 1 - 2 Geologists, 1 - 2 Hydrologists, 1 Irrigation Engineer, 1 Irrigation Agriculturist, 1 Agricultural Economist, and the necessary clerical and administrative staff.

At the same time, a lot of Senior Officers in the Department of Water Development, Department of Agriculture and other interested Departments, spend a lot of time looking after the work of the Project. Also, over 40 junior technical assistants have been recruited to work for the Project in work, such as drawing, surveying, hydrological observations and similar technical work.



The United Nations provides the Project Manager a Deputy Project Manager, A Senior Engineer, an Irrigation Agriculturist, an Economist, an Agricultural Economist, a Senior Hydrologist and an Assistant Hydrologist. During the year, the Project Manager, Mr. D. Cavassilas, was appointed and arrived in Cyprus early in 1967. During 1967, most of the work was concentrated on the collection of data, such as hydrological, soil surveys, agro-economic data, inventory of irrigated areas and crops, selection of damsites and similar work.

## VI. LEGISLATION

No new Water Legislation Law was enacted during the year. However, a very important Land Consolidation Bill was prepared and submitted to the House for approval in May, 1967. This Bill, if enacted into law, will be of very great value to our design of irrigation systems and to an efficient use of water and in general, the improvement on benefits from the lands that are irrigated. This Land Consolidation Bill provides for the establishment of authority as well as a technical committee to both of which the Department of Water Development will be a representative. By this Bill, it is possible to have an obligatory land consolidation in areas where irrigation projects will be constructed. It is certain that with the application for land consolidation for our irrigation projects, considerable savings will be achieved in the length of pipelines or canals, water meters, farm irrigation systems and land levelling. At the same time, an increase of agricultural products is anticipated and a higher efficiency of the management of the irrigation systems, as well as, of individual farms is also expected.

One great event last year was the appointment of Mr. Ch. Pierides, Ex-President of the Court, as our Legal Adviser and, ever since, we have been able to cope with the great volume of work in this field such as, water legislation, contractors' claims, water rights and various other legal problems. Substantial changes are being prepared to the Water Works Law and to the Irrigation Divisions Law, to enable the proper functioning of the Irrigation Divisions for projects declared as Government Water Work.

## VII. COMMITTEE MEETINGS

### (a) Interdepartmental Co-ordinating Committee

During the year, this committee which is made up of members of the Department of Water Development, Department of Agriculture, Department of Forests and Department of Geological Surveys under the Chairmanship of the Director of Water Development, met three times and discussed problems relating to the design of Palekhori, Masari and Koma-tou-Yialou dams, as well as, Palekhori, Masari and Yermasoyia distribution systems.



(b) Hydrological Decade Committee

This committee, which as it is known, was established in order to follow up work carried out in connection with UNESCO'S hydrological decade, met once during the year and discussed various hydrological problems and in particular our contribution to the hydrological decade in the form of hydrological measurements, on river flows, surface and sub-surface from a given catchment, a study of the relationship of the runoff to rainfall, topographic, geological and vegetative conditions prevailing in the catchment. The committee is made up of the Director of Water Development, as Chairman, with members the Director of the Geological Department, Director of the Forest Department, Director of the Department of Agriculture, Director of the Agricultural Research Institute and the Chief of the Meteorological Surveys.

VIII. WATER RESOURCES

Details about the hydro-geological and in general the water resources situation of the Island are given later on in this report by Mr. Lytras, Chief of the Water Resources Division. We have gone ahead with the extension of the hydrological areas for measurements of groundwater tables, salinities and the preparation of an inventory for the type of crops and extent of irrigation in the various groundwater regions of the Island. A big number of junior staff is assigned for this job which now has been extended to cover the whole areas in all the important aquifers of the Island. At the same time, more detailed data is being collected in the areas which have been declared to be controlled under the Special Measures Law; namely, in Western Mesaoria, in South-Eastern Famagusta and in the Limassol Akrotiri Peninsula. Work has started for the installation of water meters on every well in order to enable the accurate determination of the water extracted from the boreholes and in order to enable the control of this extraction within the limits of the permit issued by the District Officer of the District, with our advice. The amount of water allocated to every well owner is calculated on the basis of high efficient systems of irrigation and in all these areas, the Government readily gives loans and grants to facilitate the farmers to apply these efficient systems of irrigation with the application of the Special Measures Law. We made a bold effort to save these regions from devastation which otherwise would occur due to the uncontrolled extraction and in the form either of sea intrusion or deterioration of the quality of groundwater inland or complete depletion of the aquifer. We are afraid that in South-Eastern Famagusta, where the situation has gone out of hand since many years, now due to the illegal drilling going on in that region and due to the uncontrolled extraction, not much can be done to save this region at least from partial depletion.

We continued throughout the year work in the areas between Vassilikos and Tremithios in connection with Famagusta domestic water supply and regional development. Dr. Dixey, Expert Hydro-geologist, visited Cyprus twice during the year to assist us in this work.



The drilling work was carried out on the basis of the report prepared by Mr. Konteatis on Famagusta Water Supply and was concentrated on three particular aquifers, the Lapithos Formation, the Pakhna Formation and the recent alluvium aquifers in the river valley of the Vassilikos river. Significant success was achieved in this project and although quantitatively the amount of water is in abundance, we also found enough water which is also quantitatively satisfactory to satisfy the phase II supply to Famagusta, as estimated in Mr. Konteatis' report. As part of the water in the Vassilikos valley is polluted by the Hellenic Mines upstream, contacts are being made with the authorities of the mines in order that they divert the effluent away from the gravel aquifer.

Drilling work has also gone ahead on the Kyrenia limestone and we are aiming at preparing a proper evaluation of the water resources in this important aquifer by the end of 1969.

Regarding the surface water, the measurements of the various rivers continued through our automatic recorders, as well as, special current meter measurements. The United Nations Special Fund Project is now in the course of preparing detailed hydrological evaluations of the surface water flows in the various catchments of the Island. Basically, Mr. Mero's formula of Tahal is used for these evaluations and the use of computer has been introduced.

#### IX. PLANNING AND DESIGN OF PROJECTS

Details of the work carried out by the Division of Planning is given later on in this report by Mr. Ioannides, Chief of the Division, and details about design work is given also later on by Mr. Hasapis, Chief of the Design Division.

We continued at great intensity with investigations on damsites including drilling with core recovery, necessary laboratory tests for the dams, suitability of sites, as well as, the suitability of materials required for the construction of structures. The work was continued for the collection of water rights and water use data in the various catchments to enable the planning of irrigation projects. Most of the planning work is of course now concentrated on the Water Resources and Utilization Special Fund Project and, we therefore, confine the departmental planning work for major projects to what is considered to be an absolute necessity. One of our essential projects is the Famagusta Water Supply which is pressing and has to be executed as a matter of urgency in order that additional water becomes available to the town of Famagusta by 1969. The planning work within the frame work of the Special Fund Project has been confined mainly in the South-Western Paphos watersheds for which eventually a consultant is expected from F.A.O. to undertake the feasibility studies for the water development of the South-Western Paphos region. Two damsites are being investigated in detail and at the same time several others are being studied. Work has been also going ahead on the collection of other data required for the feasibility studies.



The detailed design work has been going on for the design of a dam at Palokheri, for the Skledros Irrigation Division to supply water to the lands now commanded by the existing canals, a dam at Masari to enable the groundwater recharge of the Western Mesaoria aquifer through direct infiltration through the river gravels. This recharge dam at Masari will also be supplemented by a series of spreading ground on either side of a canalized river-bed between the proposed dam and the existing Morphou dam. It has been found that a lot of groundwater recharge can be achieved through this river-bed which is in direct contact with the aquifer. A dam at Karavas has also been designed in detail, the main purpose of which is the storage of the surplus winter flow of the Kephlovryos spring so that it can be used more usefully during summer months when shortage of water is experienced in the village. Also, during the year, detailed design work has been going on for the distribution systems of Yermasoyia, Polemidhia and Mavrokolymbos dams.

#### X. CONSTRUCTION OF PROJECTS

Details for the construction of the major projects are given later on in the report. The main projects under construction during the year were the Yermasoyia dam, the Mavrokolymbos dam, Syngrasi dam and the distribution systems of Mavrokolymbos, Polemidhia and Kalopanayiotis dams. A great number of small irrigation and domestic water supply schemes were executed in the year and the total expenditure incurred on these projects was of the order of £1,400,000.

For the execution of the projects only one contractor was used, SYBARCO on the Yermasoyia dam. All other works were executed by the Department.

The average number of labourers employed in the Department during 1967 was 1199 as compared with 958 in 1966. 19.3% were classed as regulars whilst approximately 37.1% were skilled employees, 18.8% semi-skilled and 44.1% unskilled. 1.5% of the labourers employed were Turks.

The approximate monthly average of labourers engaged was as follows:

January .. . . . .	928
February .. . . . .	852
March .. . . . .	891
April .. . . . .	943
May .. . . . .	926
June .. . . . .	1066
July .. . . . .	1305
August .. . . . .	1547
September .. . . . .	1547
October .. . . . .	1497
November .. . . . .	1430
December .. . . . .	1457
	<hr/>
Average	1199



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

#### XI. OPERATION AND MAINTENANCE OF THE PROJECTS

Considerable difficulties continued throughout the year in the management of some of the projects, such as Argaka-Magounda dam, Pomeo dam, Ayia Marina dam, Agros dam, Kiti and Mia Milia dams. The main problem for Argaka-Magounda remain the water rights of the downstream holders who refuse to buy water from the dam until their water rights are settled. The matter has gone to the Court and it is hoped to have an agreement in 1968. Therefore, no land distribution system has been constructed this year, pending the agreement with the villagers. Regarding the Pomeo dam, the main argument of the villagers is that it should be taken over by the Government as a Government project, and that additional distribution systems should be constructed. Similarly, for the Ayia Marina dam, the villagers still insist that this dam should be taken over by the Government. At Kiti dam we have to line more distribution systems and control better the use of water in order that the water sold can be properly evaluated. At Agros dam we have serious leakages and we have started a project for clay blanketing of the reservoir, plus the conveyance of additional water into the reservoir. At Mia-Milia, the villagers insist that their distribution system should be lined before they undertake their obligations for paying off their loan.

It must be admitted that the present organizational set-up for the management of major projects is not satisfactory. Too many Departments and Ministries are involved in this and it is difficult to take decisions and act quickly. We intend, within the scope of the United Nations Special Fund Project, to study the organization required for the management of water projects. It is hoped that in 1969, proposals will officially be made to the Government regarding this critical problem.

#### XII. FINANCE AND EXPENDITURES

It can be seen from Appendix No.2 that the total expenditure of the Department during the year reached £1,716,991 out of which £183,927 represents administration costs. The largest item of expenditure was the irrigation works including major projects, the expenditure of which reached £1,162,300.

Appendix No.3 shows the monthly statement of expenditure for 1967. It can be seen that very little is spent during the first months of the year the minimum expenditure being in May at £52,855, whilst the maximum in December being £233,612. This great variation of expenditures from month to month is mainly attributed to the formalities which have to be undergone during the first months of the year for the approval by the beneficiaries of the contributory schemes, as well as, the provision of the necessary loans. It will be necessary that formalities for contributory schemes start being processed as soon as projects are approved by the Planning Bureau after consideration of the budgetary proposals.



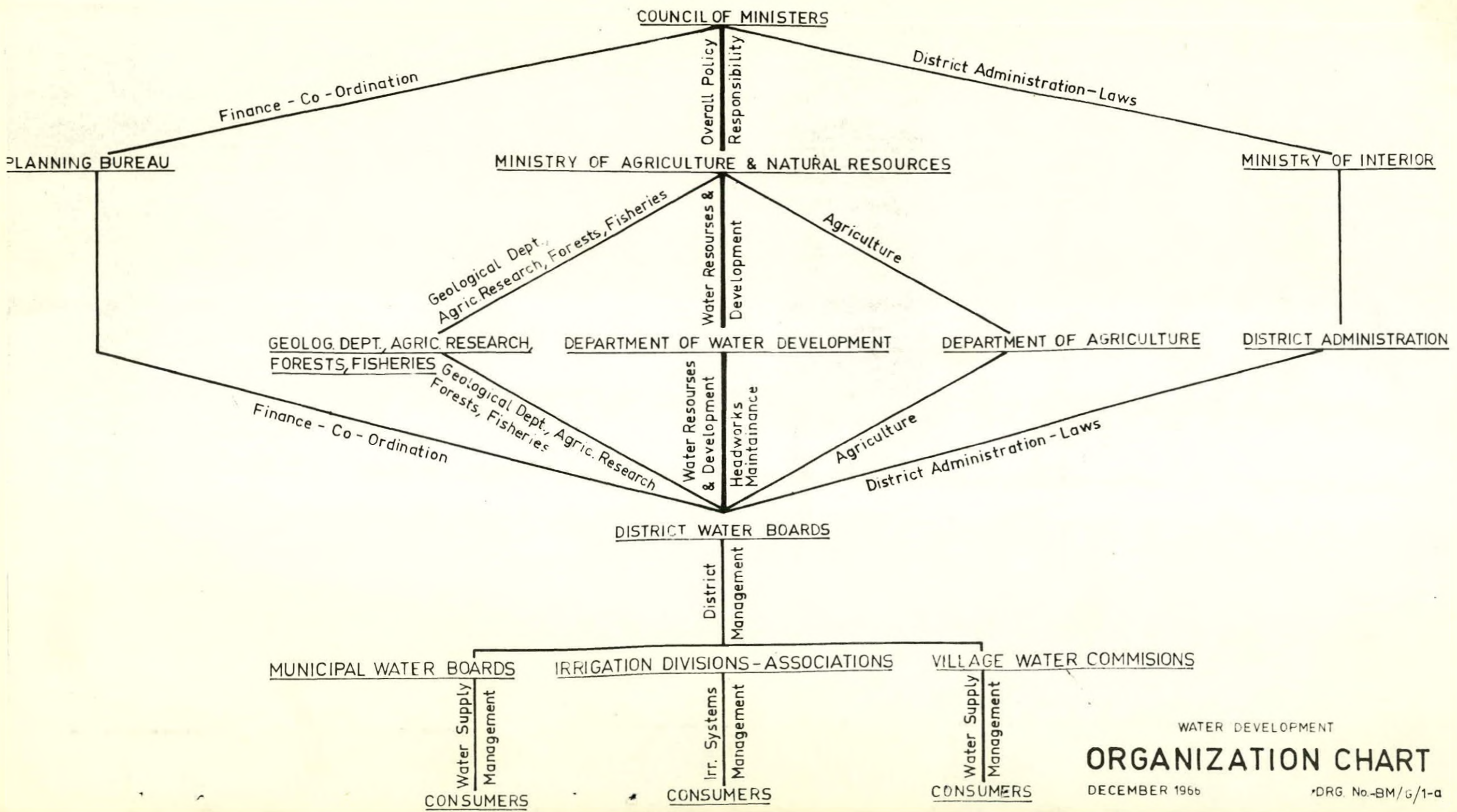
Appendix No. 4 shows the expenditures of various budgetary items since the establishment of the Department in 1939. On this Table an effort is made to show the relationship of expenditure between items which can be considered as overhead and administration costs as compared with actual works expenditure. From this Table we can see that the maximum expenditure in the history of the Department was realized in 1964 and reached £1,807,751 whilst the minimum in 1941 was £22,268. The percentage of overheads to works expenditures vary over the years from 6.6 in 1950 to 56.3 in 1959. With the present organization, the amount of investigation, planning, design and supervision required, it appears from the last few years that this percentage should be of the order of 20%. A case was presented to the Government about the possibility of charging some of these overheads, especially items which are included in the development estimates to the actual works, and, the Government is still considering the matter.

### XIII. PUBLICATIONS

During the year the following important Publications, prepared by the staff of the Department, were published:

1. The Water Resources of Cyprus,  
their Conservation and  
Development  
by Mr. C.A.C. Konteatis January, 1967
2. The Rainfall of Cyprus  
by Mr. Nicos Chr. Toufexis May, 1967
3. Cyprus Stream Discharges  
1965 - 1966  
by Mr. Nicos Chr. Toufexis November, 1967





WATER DEVELOPMENT  
**ORGANIZATION CHART**  
 DECEMBER 1966  
 DRG No.-BM/G/1-a



C. Konteatis Director										
Vacant AstDirector										
DIVISION OF WATER RESOURCES C. Lytras G Head N. Toufaxis SW Ast Head	DIVISION OF PLANNING N. Ioannides EE Head Chr. Christodoulou EE Ast Head	DIVISION OF DESIGN K. Hassabis EE Head Chr. Markoulis EE Ast Head	DIVISION OF CONSTRUCTION H. Karakannas EH Head A. Karoglaniou SW Ast Head	DIVISION OF SMALL PROJECTS PLANNING P. Pantelides SW Head S. Girogossian SIW Ast Head	DIVISION OF OPERATION & MAINTAINANCE O. K. Hassabis EE Head A. Josephin SIW Ast Head	OFFICE MANAGEMENT Head Ast Head	REGIONAL OFFICE No. 2 FAMAGUSTA Head	REGIONAL OFFICE No. 3 LIMASSOL-PAPHOS C. Andreou EE Head	LEGAL ADVISER Ch. Pierides LA	FOREIGN EXPERTS & STAFF
Surface Water Resources Branch Chr. Phanartzis H Head	Applied Hydrology Branch Chr. Christodoulou EE Head	Surveying Branch A. Evripidou IW Head	Construction Control Branch N. Yiannakou SIW Head	Irrigation Drainage & Special Problems Branch S. Girogossian SIW Head	Irrigation Branch A. Josephin SIW Head	Office Services D. Demetriades CC Head	Construction & Management Section Vacant Head	Construction & Management Section Ph. Njioamou IW Head		B. Millinovic FAO S.W. Hsu UNDP T. L. Hsu Rep of China V. Janzar SWE DWD B. S. Sivan SWE DWD Th. Meyer (Assoc) FAO
Surface Water Measurements Section P. Neophytou IW Head	Flood Hydrology Section Chr. Christodoulou EE Head	Field Surveying Section D. Pitsillides IW Head	Region No.1 Nicosia-Larnaca-Kyrenia Section G. Konstantinides IW Head	Rural Domestic Water Supply Branch I. Serghides SIW Head	Domestic Water Supply Branch G. Charalambous SIW Head	Filing & Communications Section G. Demosthenous C Head	Water Resources Section G. Frangopoulos IW Head	Water Resources Section L. Savva IW Head		
Sedimentation Measurements Section O. P. Neophytou IW Head	Water Use & Water Rights Section O. A. K. Savva TA Head	Photographic Cartographic Surveying Section A. Evripidou IW Head	Region No.2 Famagusta Section P. HjiPakkos IW Head	Region No.1 Nicosia Larnaca-Kyrenia Section P. Kazamias IW Head		Typing Stenography Duplicating Section D. Demetriades CC Head		Paphos Sub-region Section O. E. Eliades TA Head		
Ground Water Resources Branch I. Iakovides H Head	Field Investigations Branch A. Georgiou EE Head	Drawing & Records Branch O. S. C. Pitsillides D Head	Region No.3 Limassol Paphos Section A. Makrides IW Head	Region No.2 Famagusta Section E. Ioannou CF Head		Personnel & Employment Section G. Tantas C Head				
Ground Water Measurements & Control Section M. Antonides IW Head	Laboratory Branch A. Georgiou EE Head	Drawing Section O. S. C. Pitsillides D Head	Labour Materials Machinery Equipment & Safety Control Section G. Michael CF Head	Region No.3 Limassol Paphos Section V. Ioannou IW Head		Labour & Employment Section N. Chrysostomou C Head				
Ground Water Drilling Permits Section O. F. Butler D Head	Soils Section J. Karoglaniou TA Head	Library Records & Technical Information Section O. S. C. Pitsillides D Head	Progress & Programmes Section S. Georgiou IW Head			Accounts Branch G. Antoniou AD Head				
Drilling Branch M. Pappis G Head	Concrete & Materials Section J. Karoglaniou TA Head	Distribution Systems Branch O. K. Hassabis EE Head	Estimates Analyses & Specifications Section C. Georgiou IW Head			Accounts Section C. Zachariades C Head				
Morphou Sub-region Office S. HjiPavlou IW Head	Hydraulic Chemical Biological Section J. Karoglaniou TA Head	Irrigation Systems Section P. Neophytides IE Head	Tenders & Procurement Section S. Georgiou IW Head			Stores Section N. Krasias S Head				
Engineering Geology Branch D. Kypris G Head		Domestic Water Supply Systems Section C. Papadakis IW Head	Workshops Branch A. Karoglaniou SW Head S. S. Baydas ME Head			Financial Control & Coordination Branch A. Sophokleous SA Head				
Geology Geophysics Section D. Kypris G Head C. Lytras G Head		Mechanical Hydraulic & Structural Branch O. K. Hassabis EE Head	Mechanical Electrical & Building Section S. Kypris CF Head			UN CWRP Counterpart Office Services A. Armaganiou D				
Foundations Treatment Section N. Ioannides EE Head		Mechanical Hydraulic Section A. Tymvios EE Head	Transport & Haulage Section L. Messaris CF Head							
Grouting I. Kastanos TA Head		Structural Section A. Georghiades EE Head								
		Dams Branch Chr. Markoulis Head								

Note: \* On loan to the National Agricultural Museum  
\* On loan to the UN Cyprus Water Planning Institute  
O Vacant

REPUBLIC OF CYPRUS  
MINISTRY OF AGRICULTURE & NATURAL RESOURCES  
DEPARTMENT OF RURAL DEVELOPMENT

**DEPARTMENT OF WATER DEVELOPMENT**

**ORGANIZATION CHART**

DECEMBER 1967 DO DRG No BM/G/1



Monthly Statement of Expenditure for 1967

Month	Expenditure		Balance	% to date expenditure	
	Monthly	Up-to-date			
January	61,014	6,104	1,784,250	3.3 %	
February	57,162	118,176	1,727,088	6.4 %	
March	79,006	197,182	1,648,082	10.7 %	
April	205,195	402,377	1,442,887	21.8 %	
May	52,885	455,262	1,390,002	24.6 %	
June	188,697	643,959	1,201,305	34.7 %	
July	100,912	744,871	1,000,393	40.2 %	
August	138,611	883,482	961,782	47.9 %	
September	70,133	953,615	12,939 <sup>≠</sup> 904,588	51.3 %	Special Warrant
October	189,685	1,143,300	11,080 <sup>≠</sup> 725,983	60.3 %	Special Warrant
November	71,990	1,215,290	653,993	65 %	
December	233,612	1,448,902	3,133 <sup>≠</sup> 423,514	77.38%	Special Warrant



1967 Expenditure-Water Development Dept.

D e t a i l s	Government Funds £	Contribution by Beneficiaries £	Total £
1. Administration	183,927	-	183,927
2. Irrigation Drainage & Dams	1,060,405	101,895	1,162,300
3. Town Water Supplies	-	31,080	31,080
4. Village Water Supplies	83,840	46,500	130,340
5. Drilling & Prospecting	35,029	-	35,029
6. Hydr. Observ. Res. & Weirs	20,538	-	20,538
7. Workshops (Maintenance)	14,848	-	14,848
8. Purchase of Machinery - tools and equipment	12,927	-	12,927
9. Government Water Supplies	1,699	-	1,699
10. Consultants' Fees	32,040	-	32,040
11. Major Projects Investigations and Surveys	11,781	-	11,781
12. Greater Nicosia Scheme	67,083	-	67,083
13. Water Supply - Special Measures Law	2,672	-	2,672
14. Erection of a new Arcon Building	4,472	-	4,472
15. Stores	6,255	-	6,255
	<hr/>		
Includes Ordinary and Development expenditure	£1,537,516	179,475	1,716,991
	=====		
<u>Breakdown of Administration</u>			
1. Personal Emoluments	102,212	-	102,212
2. Casual Assistance	7,556	-	7,556
3. Technical Assistance	30,830	-	30,830
4. Travelling	19,295	-	19,295
5. M'ce & Oper of M. Transport	14,293	-	14,293
6. Office Expenses	1,094	-	1,094
7. Leave Pay to Reg. Employees	8,647	-	8,647
	<hr/>		
Total	£ 183,927		183,927
	=====		



Statement of Expenditure as From 1939

Ser. No.	DETAILS	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
1.	Administration	4,716	5,652	4,322	4,111	5,157	8,586	9,245	15,974	15,078	19,033
2.	W/shops & M'ce of Plant	467	587	500	398	254	284	414		350	
3.	Purchase of Machinery, tools etc	1,970	224	199		184	105	195		420	
4.	Hydrological Observations										
5.	Consultants' Fees										
6.	Major Projects Investigations										
	Sub-total "A"	£ 7,153	6,463	5,021	4,509	5,595	8,975	9,855	15,974	15,848	19,033
7.	Drilling of water	680	952	527	486	642	2,700	3,180	660	360	25,171
8.	Water Meters for Wells & B/HS										
9.	Town Water Supplies	1,169	925	908	1,043	1,169	1,827	2,448			
10.	Village Water Supplies	8,980	9,613	5,560	4,956	6,887	5,730	3,413	19,000	31,871	42,190
11.	Small Irrigation Projects	2,770	7,979	10,252	35,809	74,134	116,334	100,470	166,493	177,144	120,278
12.	Major Irrigation Projects										
	Sub-total "B"	£ 12,599	19,469	17,247	42,294	82,832	126,591	109,511	186,153	209,375	187,639
	Grand Total	£ 19,752	25,932	22,268	46,803	88,427	135,566	119,366	202,127	225,223	206,672
	% of A to B	56.8	33.2	29.1	10.6	6.7	7.0	8.9	8.5	7.5	10.1



Ser. No.	DETAILS	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
1.	Administration	18,156	19,146	26,270	23,991	38,050	52,950	54,350	61,699	80,790	95,256
2.	W/shops & M'ce of Plant			39,111	10,826	14,150	13,000	13,500	15,688	25,960	20,995
3.	Purchase of Machinery, tools etc			3,339	2,840	17,000	10,050	10,800	91,987	16,700	15,950
4.	Hydrological Observations				1,066	1,000	1,500	3,500	19,626	13,000	4,450
5.	Consultants' Fees										
6.	Major Projects Investigations										
	Sub-total "A"	£ 18,156	19,146	68,720	44,723	70,200	77,500	82,350	189,000	136,450	136,651
7.	Drilling of water	27,349	30,666	26,719	24,712	41,100	48,600	58,350	78,641	75,750	45,824
8.	Water Meters for Wells & B/HS										
9.	Town Water Supplies			155,116	119,481	235,000	303,900	93,200	152,476	417,600	648,350
10.	Village Water Supplies	53,410	106,370	100,137	214,732	256,000	255,000	196,850	280,955	215,600	87,225
11.	Small Irrigation Projects	111,352	150,980	172,154	166,493	154,500	116,900	150,850	116,100	168,600	81,075
12.	Major Irrigation Projects				15,000	15,000	20,000	30,000	35,000	50,000	50,000
	Sub-total "B"	£ 192,111	288,016	454,126	540,418	701,600	744,400	529,250	663,172	927,550	912,474
	Grand Total	£ 210,267	307,162	522,846	585,141	771,800	821,900	611,400	852,172	1,064,000	1,049,125
	% of A to B	9.4	6.6	15.1	8.2	10.0	10.4	15.5	28.4	14.7	14.9



Ser. No.	DETAILS	1959	1960	1961	1962	1963	1964	1965	1966	1967
1.	Administration	81,677	64,255	70,527	81,983	151,580	130,164	135,410	145,389	183,927
2.	W/shops & M'ce of Plant	20,441	28,979	30,238	31,789	14,000	16,150	15,500	14,147	14,848
3.	Purchase of Machinery, tools etc	960			31,712	120,000	46,030	16,875	10,973	12,927
4.	Hydrological Observations	7,090	6,059	10,640	40,520	40,500	43,223	28,200	18,863	20,538
5.	Consultants' Fees						39,378	45,065	51,297	32,040
6.	Major Projects Investigations						10,202	15,290	7,733	20,880
	Sub-total "A"	£ 110,168	99,293	111,405	186,004	326,080	285,147	256,340	248,402	285,160
7.	Drilling of water	45,084	48,837	83,607	82,151	63,700	47,588	40,200	24,253	35,029
8.	Water Meters for Vells & B/HS								983	2,672
9.	Town Water Supplies	113,853	220,370	88,282	97,724	70,900	197,871	178,010	138,390	68,782
10.	Village Water Supplies	113,493	137,825	602,436	620,537	486,000	507,679	404,600	108,926	130,340
11.	Small Irrigation Projects	68,274	49,288	141,712	253,817	383,052	400,046	95,002	113,636	221,169
12.	Major Irrigation Projects	50,000	50,000	120,000	150,000	414,948	369,420	691,348	689,010	941,131
	Sub-total "B"	£ 390,704	506,320	1,036,037	1,204,229	1,418,600	1,522,604	1,409,160	1,075,198	1,399,123
	Grand Total	£ 500,872	605,613	1,147,442	1,390,233	1,744,680	1,807,751	1,665,500	1,323,600	1,684,283
	% to A to B	28.2	19.6	10.7	15.4	22.9	18.7	18.1	23.1	20.3



## DIVISION OF WATER RESOURCES

Prepared by C. Lytras,  
Head of Division

### (a) Prospecting Drilling and Groundwater Hydrological Survey

There have been no depletions or additions to the complement of Drilling Rigs since the last Annual Report. The present holding is: One heavy duty Bucyrus (60 R.L.) and 10 Bucyrus 22 W for standard drilling. Three other Bucyrus 22W remain in the hands of the Turks. Unfortunately one of these and the only one of its kind held, was adopted for rotary drilling.

Throughout the year two Bucyrus Drilling Rigs were made available to the U.N. Special Fund Project for Groundwater and Mineral Survey for the drilling operations carried out by the Project.

Forty one boreholes were drilled for water with an aggregate footage of 13,807 feet and an average depth of 337 feet. Appendix No. 7 gives a clear picture of results by districts and sub-divided districts. Another 14 boreholes were drilled for observation, technical and geological purposes making a total of fifty five.

The average time taken to complete a borehole including when considered necessary, the laying of casings and a preliminary test pumping of about 8 hours duration was 38 days. The average footage drilled per day was 7.5. Five old boreholes were renovated or pumping installations improved.

A total of nine boreholes and wells were subjected to lengthy durability and potential test pumpings ranging from about 10 hours to 100 hours continuous duration. The volume of water pumped was 7,772,300 million gallons over a total pumping time of 631 hours. Most of the tests were carried out by means of an electrosubmersible pump of 7½" Ø with a specified capacity head range of 18,000 gph from 100 feet, to 15,000 gph from 450 feet.

#### Drilling Costs

The average cost of departmental drilling in 1967 was £613 per borehole or £1.9 per foot of drilling. These costs are inclusive of the expenses of laying casing pipes as well as, a short preliminary pumping test of boreholes with promise of a fair water yield. They are exclusive of purchase price of borehole casings 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 supervising staff are not included.

The comparatively high cost per borehole is due to the fact that during this year several deep boreholes upto the depth of 1500 feet were drilled.



Number and Footage of BoreholesNumber of Boreholes Drilled  
1946 - 1967

Purpose	1946- 1960	1961	1962	1963	1964	1965	1966	1967
For Private Individuals	2,084	55	22	12	11	2	8	11
For Government	568	126	207	190	86	215	83	44
For N.D.	318	18	18	11	14	16	7	--
Total	2,970	199	247	213	111	233	98	55
Aggregate Footage Drilled	585,642	49,681	51,292	40,301	22,825	27,506	16,980	15,008
Average Depth	197	245	208	189	206	118	173	273



Boreholes Drilled for Water in 1957Summary of Results

District	Locality	Number Drilled	Number Successful	Percentage Successful	Hours Pumped	Total Output (gallons)	Average Yield G.P.D.
Nicosia	Kato Pyrgos	1	1	100.0	6	24,000	
	Phylia - Massari	3	2	66.6	* 75	794,100	254,110
	Morphou	3	3	100.0	* 94.5	2,193,700	557,136
					* 49	892,700	437,230
	Vyzakia	2	1	50.0	5	17,000	
	Xeros	1	1	100.0	8	48,000	
Kyrenia	Halevga	2	1	50.0			
	St. Hilarion	2	-	--			
Larnaca	Ayia Anna	3	-	--			
	Kalavassos- Mari- Vasilikos	5	4	80.0	* 89.25	913,870	245,760
					* 65.5	355,980	130,440
					* 35	554,200	380,000
	Arsos	2	-	--			
	Psematismenos	1	1	100.0	*100.5	1,589,770	379,630
	Ayios Theodho- ros	1	1	100.0	7	16,000	
	Klavdhia	2	2	100.0	8	13,600	
					24	108,000	108,000
	Agglisidhes	1	1	100.0	* 10	90,000	
Pyla	3	1	33.3				
Limassol	Polemidthia	1	-	--			
	Pissouri	1	1	100.0	8	28,800	
	Kellaki	2	1	50.0			
Famagusta	Vatyli-Lysi	3	1	33.3			
Paphos	Orites Forest	2	1	50.0	* 46	132,570	69,600

\* Boreholes tested with an electrosubmersible pump.



Boreholes Drilled in 1967

Purpose	No.	Existing Well Footage	Footage Drilled	Percentage Successful	Total Tested Yield G.P.D.
Irrigation	6	--	2,034	83.3	1,064,000
Domestic W.S.	5	457	2,214	20.0	--
Prospecting	30		9,559	60.0	1,498,000
Total for Water	41	457	13,807	56.1	
Conservation	4	--	177	--	
Technical and Geological	10	--	1,024	--	
Total Drilled	55	457	15,008	--	



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 deposits 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 the thicker saturated alluvial sediments filling 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. 23/67 (Grid Ref: N.37,035; E.20,010)

This borehole is located in the alluvial gravels of the Tremithios River, Larnaca.

It penetrated 91 feet thick gravelly deposits and the saturated zone was 43 feet thick. After completion the borehole was tested with a piston pump with an output of 4500 gph and the maximum drawdown after 24 hours pumping was 8 inches.

Serial No. 26/67 (Grid Ref: N.72,040; E.71,210)

This borehole was drilled in the river gravels near Morphou and met 234 feet of gravels and sands having 157 feet thick saturated zone. It was tested with an output of 25,000 gph for 94 hours and the maximum drawdown was 19 feet.

Serial No. 39/67 (Grid Ref: N.19,640; E.99,580)

This borehole is located in the Vasilikos River and penetrated 52 feet of gravels of which 20 feet were saturated. A test was carried out with an electrosubmersible pump with an output of 15,000 gph during the dry season and with 30,000 gph in the wet season. The maximum drawdown after pumping for 96 hours at 35,000 gallons per hour was 3 feet.

Serial No. 41/67 (Grid Ref: N.63,820; E.56,100)

This borehole was drilled in gravel filling of the Xeros River near Karavostasi. It penetrated 130 feet of gravel of which a thickness of 94 feet was saturated. A preliminary test with a piston pump was carried out for 8 hours with an output of 6000 gph and with a maximum drawdown of 6 inches. The maximum output of this potential borehole will be determined in the following dry season with an electrosubmersible pump.



Drilling in the Pliocene sediments gave very good results. Borehole Ser. No. 14/67 (Grid Ref: N.69,320; E,79,830) was drilled near the village of Phylia. Drilling penetrated in succession reddish calcareous sandstone, a considerable thickness of pebble beds and a further thickness of calcareous sandstone of the Athalassa Formation. These porous, permeable beds had a total thickness of 158 feet of which a thickness of 90 feet was saturated. This borehole was tested with a piston pump for 8 hours yielding 6000 gph with a maximum drawdown of 9 feet. The water struck in this borehole is of very good quality.

Prospecting drilling in the Pakhna Formation met good success in the areas of Psematismenos and Pissouri. Borehole Ser. No. 16/67 was located on the upper horizons of Pakhna and just below the Gypsum member. It penetrated 383 feet of grey marls and then met about 150 feet of saturated calcareous sandstones. It is interesting to note that this borehole was drilled to a final depth of 1500 feet. In a test with the electrosubmersible pump the borehole yielded 14,000 gallons and in twenty one hours there was a drawdown of 280 feet.

Serial No. 20/67 (Grid Ref: N.13,220; E.44,910)

This borehole was drilled in the rocks of the gypsum facies of the Pakhna Formation which represent the end of the depositional cycles of the Pakhna Formation. The borehole is near Pissouri village and it penetrated 197 feet of gypsum. The static water level was at 19 feet from ground level and a preliminary test with a piston pump was carried out. The borehole yielded 4000 gph for eleven hours and with a maximum drawdown of 18 feet. Water struck in gypsum aquifers is usually highly mineralized but it is quite suitable for irrigation purposes. This borehole was drilled in order to form an irrigation division in the area.

Very interesting and promising results were given by deep drilling in the Lapithos chalks; namely, borehole Ser. No. 18/67 (Grid Ref: N.33,080; E.13,730) near the village of Anglisidhes was drilled to a final depth of 1500 feet and yielded artesian flow.

Another borehole in the Lapithos chalks Ser. No 19/67 near the village of Klavdhia on the main Larnaca - Limassol road (Grid Ref: N.36,790; E.18,910) which was drilled to a final depth of 965 feet again yielded free artesian flow (600 gph). The water, however, is of high salinity.

Interesting results were obtained from borehole Ser. No. 32/67 drilled at Kellaki. This borehole was located on the Diabase-Gabbro rocks of the Troodos Igneous Complex. It reached a final depth of 113 feet and struck water at 27 feet in fractured zones. At a preliminary test the borehole yielded about 2000 gph and had a drawdown of 30 feet. This borehole will be enlarged into a well for better storage. This borehole will meet the domestic water needs of the village of Kellaki.

Drilling in the Hilarion Limestone on the Kyrenia Range, a borehole was completed down to the final depth of 950 feet. This borehole was drilled about one mile to the East of Halevga station on the Halevga - Kharja main road.



Water was struck at the depth of 756 feet. The borehole will be tested with a deep electrosubmersible pump. Drilling of another borehole on the Kyrenia Range, half a mile to the East of Halevga station, was commenced.

New Sources for Famagusta Town Water Supply  
Drilling in the Tremithios-Vasilikos area

Famagusta is the town which faces the most acute problem of domestic water supply in the island. The nearby aquifer of Phrenaros from where Famagusta is presently deriving its water supply, is rapidly being exhausted due to heavy over-pumping in the area. In parallel, the problem becomes more critical because of the increasing demand for domestic and industrial purposes and the requirements for tourism development. These demands could not possibly be met from the already over-pumped aquifers in the south-eastern Mesaoria and new water sources had to be sought outside this area.

The Department has carried out a reconnaissance investigation in order to find the most suitable area which could supply the required quantities of water. Details of this study appear in the report "A Reconnaissance Report on the Development of the Water Resources between the Tremithios and the Vasilikos River Basins" by the then Assistant Director, C.A.C. Konteatis, published in February, 1966.

A programme was originated for assessing the ground and surface water inventory of the area. From a preliminary survey carried out by the author on the groundwater potentialities of the area it was found out that this area presented good prospects for tapping exploitable aquifers consisting mainly of chalks, limestones and sandstones of the Lapithos and Pakhna Formations, as well as, of alluvial deposits within the river valleys. The aquifers in this region are the least developed in Cyprus and drilling investigations could, in addition to the required quantities for Famagusta, provide new sources for regional agricultural development.

At the initiation of the drilling programme the services of Dr. F. Dixey, Consultant Hydrogeologist were made available through the British Technical Aid Mission who has paid during the year under review two visits and proposed exploratory deep drilling in the Lapithos and Pakhna Formations. In the same area the United Nations Special Fund Project Ground Water and Mineral Survey commenced deep drilling near the coastal plain.

From the deep exploratory drilling of the Department, the following conclusions were reached:

Drilling in the Lapithos rocks (Borehole Ser. No.18/67 at Anglisidhes) revealed an entirely new aquifer at a depth of 1500 feet. This borehole was subjected to a lengthy pumping with a constant output of 9000 gallons per hour. The NaCl content of this water is 400 ppm but due to its excessive hardness, it is not suitable for drinking but it remains of great value to the agricultural development of the area. This finding is of great significance to future prospecting for water in the Lapithos chalks which have a wide distribution in the island,



and further drilling in these rocks should be undertaken not only in this area but also at the periphery of the Troodos igneous massif and around the Troulli igneous inlier.

The deep drilling which was undertaken by the Department in the Pakhna Formation (Borehole Ser. No. 16/67 near Psematismenos) showed indeed very good results. The calcareous sandstones have an appreciable thickness going down to about 500 feet. This borehole was tested continuously for 190 hours with a steady output of 15,000 gallons per hour of good quality water suitable for domestic purposes.

Drilling in the Pakhna Formation has been planned mainly along the main Nicosia - Limassol road having taken into account the following two main factors:

- a) Because of the nature of these rocks and their southward dip, drilling further to the south towards the coastal plain would not yield water suitable for drinking purposes, as this would have been drawn from the confined part of the aquifer where the concentration of salts is expected to be high, and
- b) in order to maintain a reasonable altitude and distance from the main conveyor.

Following the successful drilling in this region of the Pakhna Formation, further exploratory and production boreholes are to be drilled in 1968.

Drilling in the alluvial deposits has been undertaken in the Vasilikos river valley with the sinking of four boreholes out of which three were successful, particularly borehole Ser. No. 33/67 which was tested with an output of 15,000 gallons per hour in the dry season and with a 35,000 gallons hourly output during the winter season. The advantage of drilling in this aquifer is mainly that due to its free yielding nature, considerable quantities of water are being lost as underground flow to the sea, and pumping from this aquifer especially during the winter months would exploit otherwise lost water and in the same time relieve pumping from the boreholes in the Pakhna Formation.

For the proper management of this aquifer, its hydrological parameters should be known, i.e., the geometry of the aquifer, transmissivity, hydraulic gradient, etc. For this, pumping tests were carried out and a close observation network has been established. The results obtained are very encouraging and additional production boreholes are to be constructed.

#### Hydrogeological and Engineering Geology Investigations

During the year under review, several problems have been studied in relation to proposed engineering construction works including impounding reservoirs, recharge works, irrigation pumping schemes, water supply projects, as well as, problems arising from the construction of major engineering works, i.e., leakages from dams, land slides, etc. The following reports have been prepared:



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 electrically driven pumps so as the amount of water extracted to be estimated from the readings of the electric meters.

It is however hoped that the enforcement of the Water Supply (Special Measures) Law 32/64 will proceed the soonest possible, and the so much desired accurate figures of extraction will be taken from the water meters to be installed on each borehole as the above Law provides.

For the proper execution of the increasing areas under hydrogeological survey and investigation the establishment of Regional Offices was found absolutely necessary and for this reason the following Regional Offices have been established:

1. Famagusta Regional Office for the works involved in this District and Larnaca District.
2. Limassol Regional Office with a sub-office at Ktima.
3. Morphou Regional Office.
4. The areas of Nicosia - Kyrenia are being covered by the Nicosia Headquarters.

During the year of 1967 the following programme in the Hydrological Surveys has been completed by the above offices:

- (a) the whole coastal strip of the Paphos area, commencing from the west bank of Kouris river and covering Avdhimou, Pissouri, Kouklia, Akhelia, Ayia Varvara, Yeroskypou, Khloraka, Kissonerga and Peyia was completed in the sense of plotting all the wells and levelling of selected network of observation wells. Also the initial routine observations were made on the water levels, pumping installations, and sampling of water for chemical analysis.
- (b) In the Limassol District the Hydrological Surveys covered Pano Polemidhia, Ayios Athanasios, Yermasoyia village, Ayios Tykhonas, Pareklisia, Monagroulli and Pendakomo area.
- (c) In the Larnaca District the area covered by plotting included Mazotos, Anaphotia, Anglissidhes, Alethrico, Avdhelero, and Troulli village boundaries.
- (d) In the Nicosia and Kyrenia Districts, the area covered was that of Margo, Pyroi, Ayios Sozomenos, Eylenja, Ayios Amvrosios, Khartzia, Trapeza, Klepini and Ayios Epiktitos.



2. The Water Development Department started an early accumulation of the hydrological and hydrogeological data concerning the important groundwater producing areas of Mesaoria, Eastern Cyprus, the Akrotiri Peninsula and Yermasoyia - Moni areas, the Kiti - Pervolia - Dhromolaxia Aradhippou area, Central Mesaoria, Kyrenia Coastal belts, the Ayia Marina - Polis areas and the catchments of the rivers of Mavrokolymbos - Ezuza - Xeropotamos and Kha-Potami. The Hydrogeological Surveys area are expanded year after year so that a close observation network is established over the whole Island and a good knowledge of the groundwater 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 by far 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 belt, Zakaki area, Kiti - Pervolia area and now at Syrianokhori has resulted in the inland underground movement of the sea water. The catastrophic results of the citrus groves of Famagusta - Ayios Memnon was due to sea intrusion because the aquifer was very heavily over-pumped. The importance and scope of knowing the hydrogeological conditions of an over-developed 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 hydrological surveys is 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.

4. A very difficult problem we face is the estimation of the amount of water extracted from each well or borehole. As there are no water meters installed on every well or borehole, except for those used for the domestic water supplied to the towns and some villages, the amount of water extracted every year from each well or borehole is somehow concluded by questioning the owners of the boreholes/wells. 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 transmissivity 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.



- 1) "Makrasyka Recharge Earth Dam" (feasibility report).
  - 2) "Kondea Recharge Dam" (feasibility report).
  - 3) "Study of the Liopetri Dam Effect on the Water Table of the Area".
  - 4) "Cyprus Plantations - Experimental Recharge"
  - 5) "Report in the Hydrogeology and Safe Yield Appraisal of the Pendayia Area".
  - 6) "Morphou Mathematical Model (two preliminary reports)".
  - 7) "Preliminary Geological Report on the Komatou Yialou Proposed Dam Site".
  - 8) "Preliminary Geological Report on Morokambos Proposed Dam Site".
  - 9) "Preliminary Geological Report on Krystallia Proposed Dam Site".
- ) by  
J. Jacovides  
Hydrologist
- ) by  
M. Peppis  
Geologist

A special study initiated in the last half of the year under review which is considered of interest and worth mentioning, is the Mathematical Model of the Morphou-aquifer.

This study consists of the compilation and formulation of the available data obtained by the hydrological surveys and studies done by this Department, the Cyprus Water Planning Project, the Geological Survey and the United Nations Special Fund Project, Groundwater and Mineral Survey, a mathematical model which can reliably simulate the hydraulic properties of the Morphou aquifer and which can react or respond in a similar manner that the Morphou aquifer itself would respond to alternative operational schemes and climatologic conditions.

Using this model as a working tool, after it is achieved and verified, all managemental operations will be able to be checked before-hand through the usage of a computer.

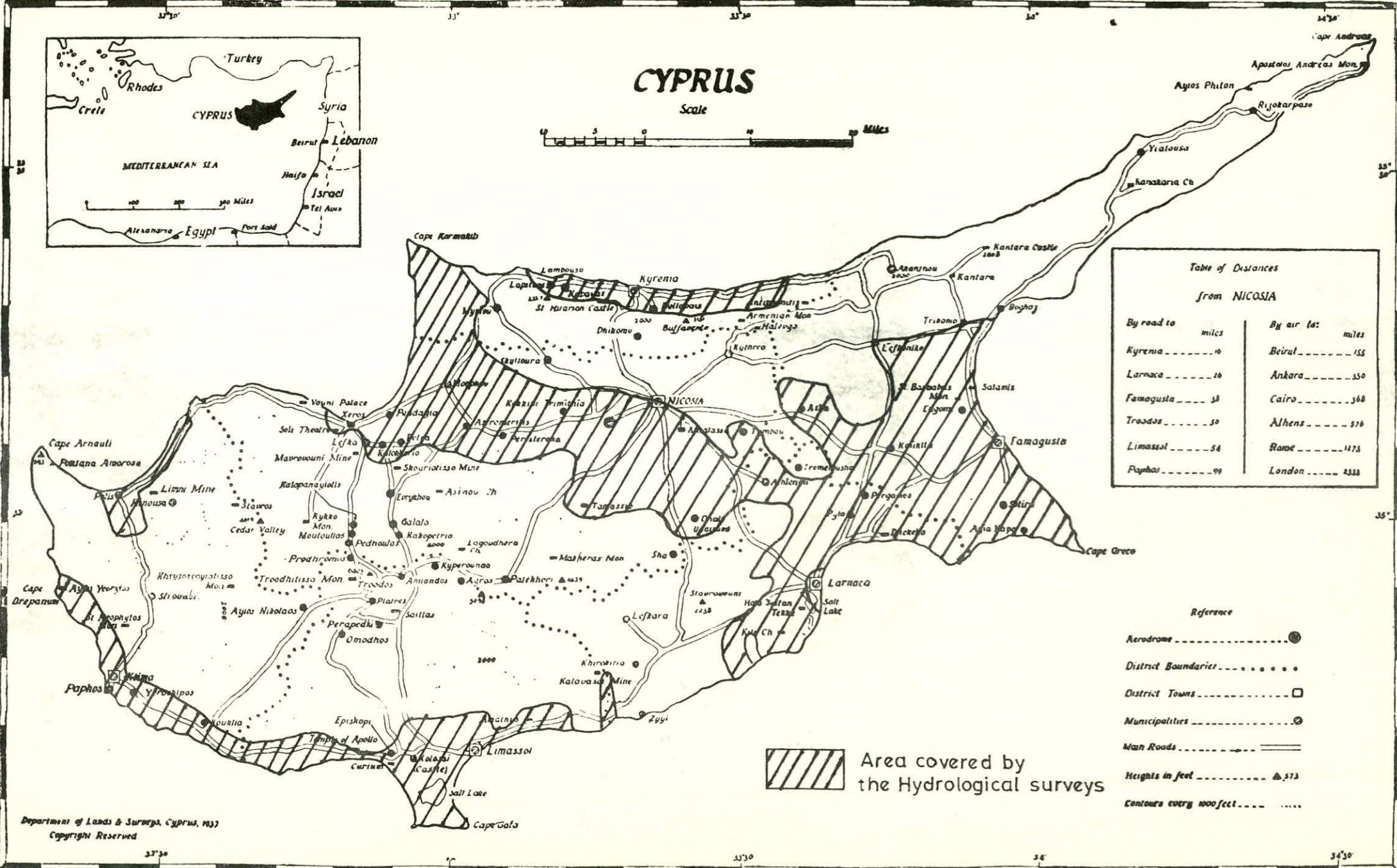
These alternative plans of surface and ground-water management will be evaluated at selection of the optimum plans for future implementation will be made.

Close cooperation has been kept with the UNSP Water Planning Project Cyprus and the UNSFP Ground-water and Mineral Survey and useful exchange of information has been followed through the year.

#### Hydrological Surveys

The Hydrological Surveys have as a target the evaluation and control 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 monthly measuring of the depth of the water table in a number of wells and boreholes especially selected, the sampling for chemical analysis of the quality of the ground-water, and the measuring or estimating the amount of water extracted from each well, borehole, or spring and the area irrigated.





# CYPRUS

Scale

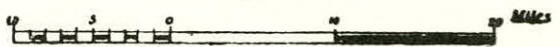


Table of Distances  
from NICOSIA

By road to	miles	By air to:	miles
Kyrenia	16	Beirut	155
Larnaca	26	Ankara	350
Famagusta	31	Cairo	368
Troodos	50	Athens	576
Limassol	54	Rome	1173
Paphos	99	London	2333

- Reference
- Aerodrome ..... (circle with dot)
  - District Boundaries ..... (dotted line)
  - District Towns ..... (square)
  - Municipalities ..... (circle with dot)
  - Main Roads ..... (double line)
  - Heights in feet ..... (triangle with number)
  - Contours every 100 feet ..... (dashed line)

Area covered by the Hydrological surveys

Department of Lands & Surveys, Cyprus, 1937  
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The whole area covered, amounted to approximately 1254 sq. miles. The area covered by the Hydrological Surveys is shown in Appendix No. 8.

In addition to the above in the course of the routine work of the surveys the water levels of about 3530 selected wells or boreholes were measured and recorded six times in the year under review, i.e., February, March, April, October, November and December. These water level measurements were used in the preparation of ground water contour maps of the main aquifers in Cyprus covered by the surveys.

Further to the above, sampling of water from selected boreholes was made to determine the salinity content and study the progress of the sea-intrusion, in particular coastal aquifers where the exploitation of the ground water is exceeding the natural replenishment and the sea has caused inland movement. To that effect isosalinity maps were drawn for the periods of March and November.

(b) Surface Hydrology Work (by N. Toufexis)

Meteorological

The principal features of the weather during the year were:

a) The average rainfall over the whole island was 27.08 inches which is 136.63% of normal as compared with the average since 1908 which is 19.82 inches. See Appendix 9 and 10.

b) October, December, January, June, August and September were the months with below average rainfall. Precipitation during the other months was very much above normal.

c) The highest daily rainfall in the year was 8.15 inches, which occurred at Kyrenia town on the 11th November, 1966.

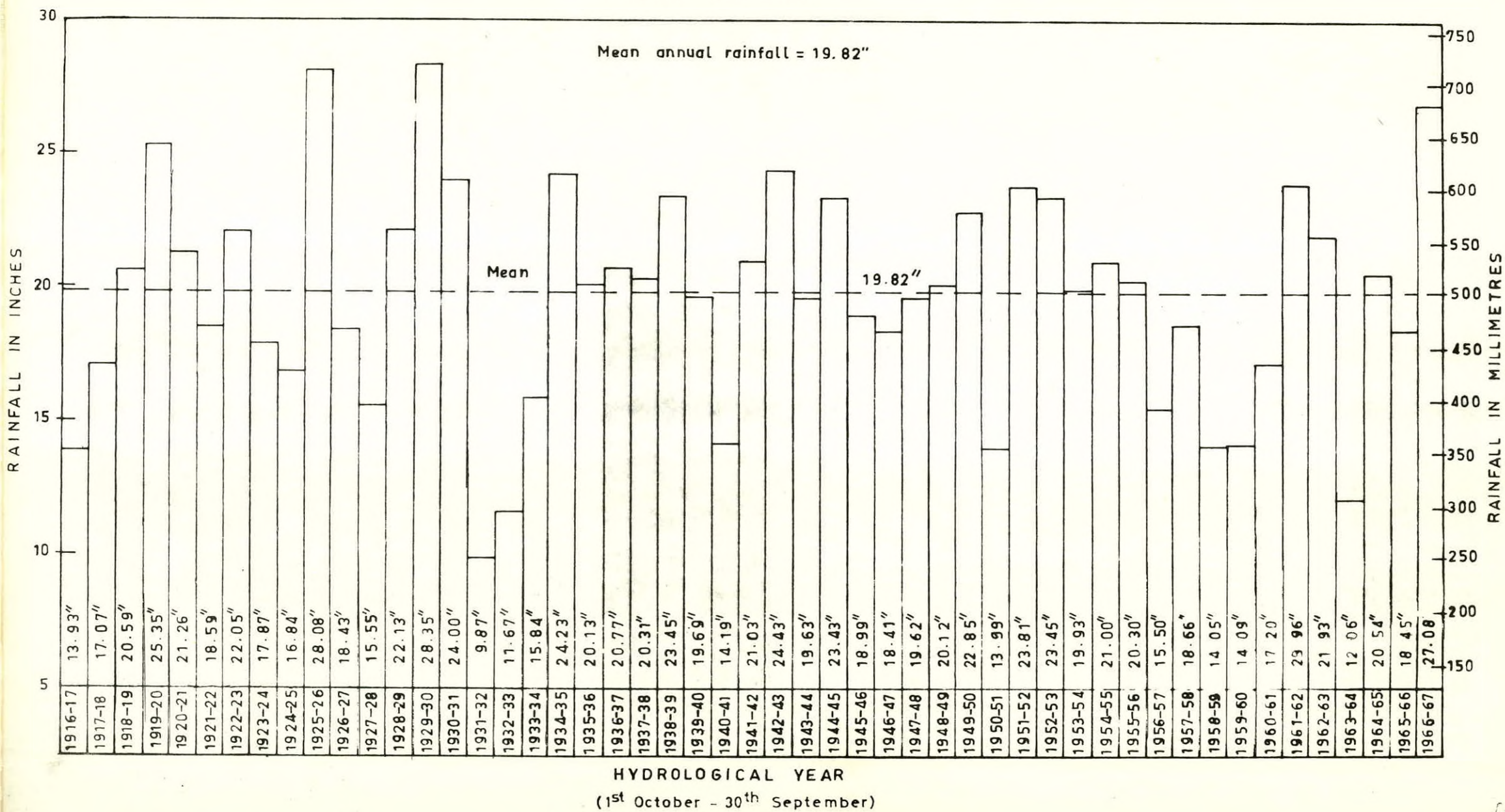
d) Snowfall started at the high altitudes of Troodos mountains in the middle of December 1966 and continued till late in March, 1967. The snow depth was in excess of 6 feet at Olympus peak and 3 feet at Troodos square in February and March 1967. The snow cover persisted till the second fortnight of April, 1967.

e) Temperatures were above normal in October and November 1966, below normal during winter and spring months becoming normal in summer months.

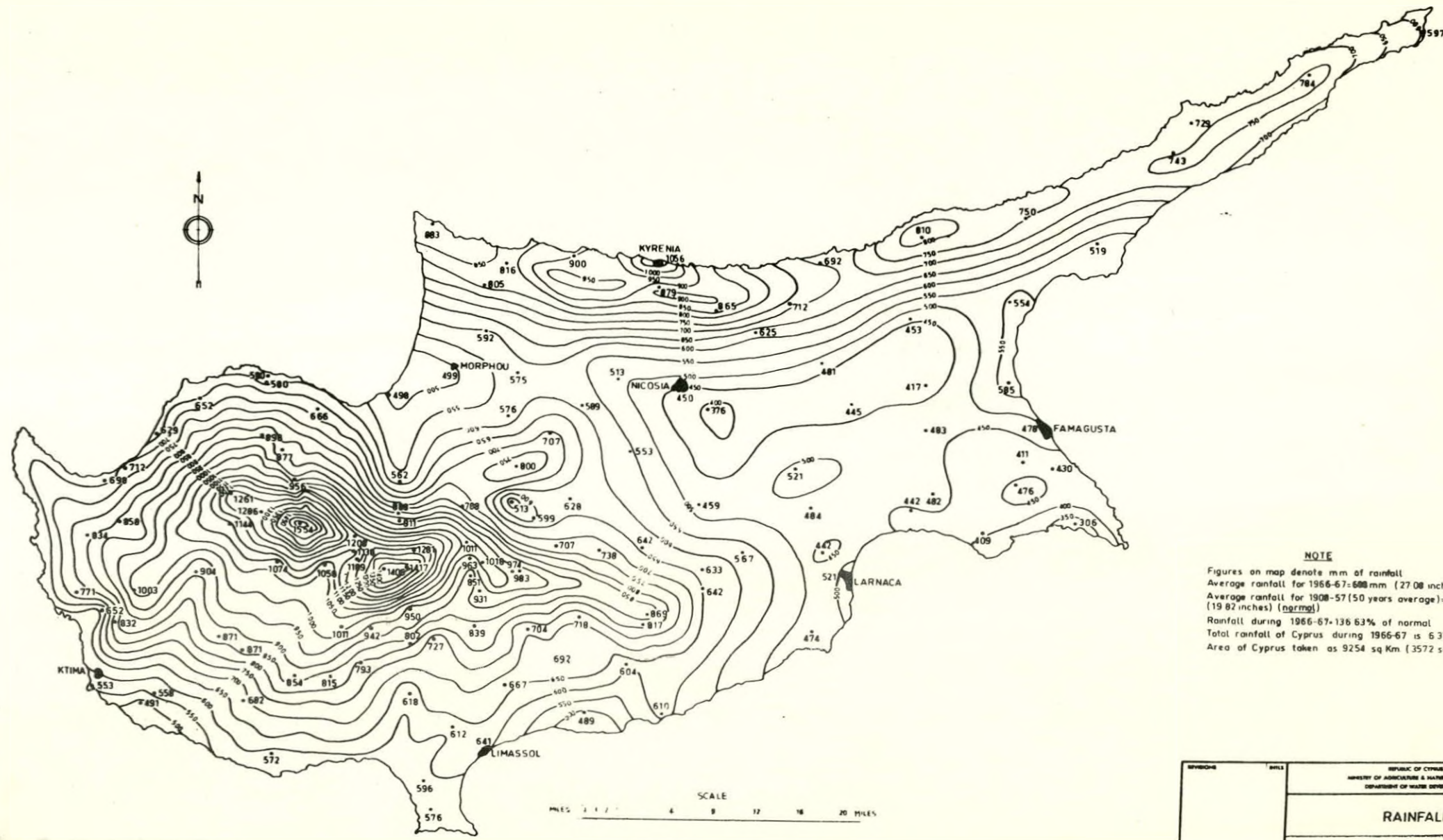
The highest temperature recorded at Nicosia was 102° F on the 9th, 10th, and 12th August 1967, and the lowest 29° F on 22nd January, 1967.



# ANNUAL AVERAGE RAINFALL OF CYPRUS FROM 1916 - 1967







**NOTE**  
 Figures on map denote mm of rainfall  
 Average rainfall for 1966-67=608mm (27.08 inches)  
 Average rainfall for 1908-57 (50 years average)=503mm (19.82 inches) (norm)  
 Rainfall during 1966-67=136.63% of normal  
 Total rainfall of Cyprus during 1966-67 is 6.37x10<sup>9</sup> m<sup>3</sup> (224.85x10<sup>9</sup> ft<sup>3</sup>)  
 Area of Cyprus taken as 9254 sq Km (3572 sq miles)

REPUBLIC OF CYPRUS MINISTRY OF AGRICULTURE & NATURAL RESOURCES DEPARTMENT OF WATER DEVELOPMENT	
<b>RAINFALL</b>	
<b>ISOHYETAL MAP OF CYPRUS BASED ON RAINFALL FROM 1st OCT 1966-30th SEP 1967</b>	
JANUARY 1968	D. G.
DRAWN BY:	TRACED BY:
CHECKED BY:	CHECKED BY:
APPROVED BY:	APPROVED BY:



Flood Discharges

Many heavy floods were reported during the hydrological year 1966 - 1967. The highest flood-flows were 7504 cusecs in Dhiarizos river recorded at Koukليا (Paphos) on 10th November, 1966, and 4732 cusecs in Ovgos river recorded at Pnasi Monastery near Morphou on 17th February, 1967. The rainfall on 9th November, 1966 was 1.26 inches at Orides Goat Unit and 3.03 inches at Sisklipos on 17th February, 1967.



The following table summarizes some of the larger floods and the rainfall measured in the catchment or in adjacent catchment on the day of the flood or on the previous days. Floods of less importance have been ignored.

No.	River	Location	Peak Flow		Rainfall		
			Cusecs	Date	Inches.	Place	Date
27	Khrysokhou	Skoulli	688	16/12/66	1.15	Stroumbi P/Station	15/12/66
					1.65	"	16/12/66
			768	22/3/67	1.86	"	21/3/67
					1.29	"	22/3/67
			211	13/5/67	0.28	"	12/5/67
28	Stavros-Psokas	Evretou			0.12	"	13/5/67
			408	16/12/66	2.15	Stavros - tis Psokas	16/12/66
			247	28/1/67	1.50	"	28/1/67
			261	20/2/67	1.10	"	20/2/67
			1148	22/3/67	2.80	"	21/3/67
			268	14/5/67	1.02	"	14/5/67
			228	23/6/67	0.65	"	23/6/67
30	Dhiarizos	Kouklia	1255	18/10/66	0.76	Prodromos Forestry College	17/10/66
			7504	10/11/66	0.82	"	9/11/66
					1.26	Orides Goat Unit	9/11/66
			1501	16/12/66	0.95	"	16/12/66
					1.30	Kykkko Monastery	16/12/66
			556	26/1/67	1.76	Prodromos Forestry College	26/1/67
			662	20/2/67	0.78	"	20/2/67
			4803	22/3/67	2.42	"	22/3/67
					4.43	Kykkko Monastery	22/3/67
					2.10	Orides Goat Unit	22/3/67
		316	4/4/67	0.75	Prodromos Forestry College	3/4/67	
		609	14/5/67	1.02	"	13/5/67	



No.	River	Location	Peak Flow		Rainfall		
			Cusecs	Date	Inches	Place	Date
43	Mavrokolymbos	Potima - Locality	1203	8/11/66	3.10	Ay. Neophytos Monastery	7/11/66
					2.47	Mavrokolymbos Dam	8/11/66
			325	22/3/67	1.86	Stroumbi P/Station	21/3/67
44	Ezuza	Akhelia	253	14/11/66	1.29	"	22/3/67
					0.78	Anatoliko (Akhelia)	14/11/66
			1393	16/12/66	1.60	Ayia Forest Station	15/12/66
					1.82	" "	16/12/66
			930	28/1/67	0.37	Anatoliko (Akhelia)	28/1/67
					0.75	" "	20/2/67
			978	20/2/67	0.80	Pano Panayia P/Station	"
					0.90	Ayia F/Station	"
			2397	22/3/67	2.47	" "	21/3/67
					2.60	Pano Panayia P/Station	"
			279	4/4/67	1.20	Anatoliko (Akhelia)	"
0.60	Pano Panayia P/Station	3/4/67					
404	15/5/67	0.77	Ayia F/Station	4/4/67			
		1.06	" "	14/5/67			
0.61	Pano Panayia P/Station	"	"	"			
		0.61	Pano Panayia P/Station	"			
45	Khapotami	Kouklia	1589	10/11/66	0.75	Omodhos E. School	9/11/66
					1.25	Orides Goat Unit	"
			1377	22/3/67	2.10	" "	22/3/67
					2.20	Dhora E. School	"
			3.45	Omodhos E. School	"		
Ezuza	Kannaviou	213	10/12/66	1.25	Ayia F/Station	10/12/66	
				1.29	Stavros-tis Psokas F/Station	"	
		226	17/2/67	0.47	Kannaviou E. School	16/2/67	
				0.50	Ayia F/Station	"	



No.	River	Location	Peak Flow		Rainfall						
			Cusecs	Date	Inches	Place	Date				
61	Ezuza	Kannaviou	1354	22/3/67	2.80	Stavros-tis Psokas F/Station	21/3/67				
					2.60	Pano Panayia P/Station	"				
					2.47	Ayia F/Station	"				
					1.22	Pano Panayia P/Station	22/3/67				
					3.43	Kannaviou E. School	"				
					67	Xeros	Peyia	1913	8/11/66	1.70	Peyia E. School
67	Dhiarizos	Philousa	597	16/10/66	1.20	Kaminaria E. School	16/10/66				
					0.95	Trikoukia N. Garden	"				
					583	16/12/66	1.19	" "	15/12/66		
							2.20	" "	16/12/66		
					2009	22/3/67	2.96	Kaminaria E. School	21/3/67		
							2.42	Prodromos F/College	"		
							3.10	Pedhoulas P/Station	"		
							1.10	" "	22/3/67		
					212	4/4/67	0.77	" "	3/4/67		
							0.75	Prodromos F/College	"		
							0.87	Kaminaria E. School	"		
					3	Ovgos	Morphou - Pnasi Monastery	2020	13/11/66	1.15	Kapouti E. School
1.05	" "	13/11/66									
1803	29/1/67	2.87	Sisklipos	28/1/67							
4732	17/2/67	3.03	" "	17/2/67							
445	22/3/67	0.77	Phylia E. School	21/3/67							
		1031	14/5/67	0.85						" "	13/5/61
				1.02						Prodromos F/College	"
				1.49						Trikoukia N.G.	"



No.	River	Location	Peak Flow		Rainfall			
			Cusecs	Date	Lines	Place	Date	
4	Ovgos - Serakhis	Syrianokhori	1714	13/11/66	0.88	Ghourri E. School	12/11/66	
					0.68	" "	13/11/66	
			1083	29/1/67	1.34	" "	28/1/67	
			2350	18/2/67	2.30	Ay. Epiphanius (Orinis)	17/2/67	
			1422	22/3/67	3.25	Palekhori (Private)	21/3/67	
				0.58	" "	22/3/67		
6A	Marathasa	Nicosia - Xeros main road	257	23/3/67	1.10	Pedhoulas P/Station	22/3/67	
10	Pyrgos	Phileyia	774	22/3/67	2.80	Stavros - tis Psokas F.S.	21/3/67	
11	Limnitis	Limnitis Saw Mill	616	22/3/67	2.20	Kambos E. School	21/3/67	
14	Peristerona (Nicosia)	Near Panayia Forest Station	296	16/12/66	1.87	Palekhori	16/12/66	
			682	18/2/67	1.25	Panayia Bridge F.S.	17/2/67	
			1474	22/3/67	2.24	Polistipos E. School	21/3/67	
23	Akaki	Near Malounda	900	13/11/66	0.88	Ghourri E. School	12/11/66	
					0.68	" "	13/11/66	
			758	20/2/67	2.07	Ay. Epiphanius (Orinis)	19/2/67	
					1.03	" "	20/2/67	
			900	22/3/67	2.50	Kambi E. School	21/3/67	
				297	10/5/67	1.01	Ghourri E. School	10/5/67
24	Skylloura	Near Ayios Vasilios	2064	12/11/66	2.87	Sisklipos	12/11/66	
			227	17/12/66	1.10	" "	16/12/66	
			1478	29/1/67	2.87	" "	28/1/67	
			3903	17/2/67	3.03	" "	17/2/67	
			279	20/3/67	0.55	" "	19/3/67	
33B	Karyiotis	Evrykhou	281	16/12/66	2.50	Platania F.S.	16/12/66	
			449	22/3/67	3.60	" "	21/3/67	
			604	9/5/67	2.16	" "	9/5/67	
35	Elea	Ghaziveran	606	17/10/66	2.22	Kapoura F.S.	17/10/66	



No.	River	Location	Peak Flow		Rainfall		
			Cusecs	Date	Inches	Place	Date
37	Atsas	Upstream of Petra Dam	1342	9/5/67	2.97	Kakopetria E.S.	9/5/67
49	Kambos	Potamos-tou Kambou	203	22/3/67	2.20	Kambos E.S.	21/3/67
57	Elea	Vizakia	486	22/3/67	1.28	Kapoura F.S.	21/3/67
			1242	14/5/67	0.69	" "	13/5/67
					0.64	" "	14/5/67
8	Aloupos	Aloupos Chiftlik	792	13/11/66	1.15	Kapouti E.S.	13/11/66
					1.05	" "	13/11/66
			471	29/1/67	1.05	" "	29/1/67
			1002	17/2/67	1.80	" "	17/2/67
8	Serakhis	Over Spillway of Morphou Dam	749	13/11/66	0.88	Ghuri E.S.	12/11/66
					0.68	" "	13/11/66
			801	20/2/67	2.07	Ay. Epiphaniou (Orinis)	19/2/67
					1.03	" "	20/2/67
			1889	22/3/67	2.50	Kambi E.S.	21/3/67
73	Panagra	On Panagra-Kyrenia old road bridge	355	13/11/66	1.40	Panagra E.S.	12/11/66
					0.50	" "	13/11/66
			338	28/1/67	1.50	" "	28/1/67
			1767	17/2/67	2.43	" "	17/2/67
7	Kouris	Erimi Bridge	294	15/10/66	0.60	Lania E.S.	15/10/66
			383	16/12/66	1.00	Saittas N.G.	16/12/66
			210	24/12/66	0.70	Pano Amiandos	24/12/66
			349	26/1/67	2.05	" "	26/1/67
			225	20/2/67	1.17	" "	20/2/67
			1669	22/3/67	3.03	Kilani P.S.	21/3/67
					0.70	" "	22/3/67
			210	4/4/67	1.00	Platres I.B.	4/4/67
			513	18/4/67	2.03	Khalassa E.S.	18/4/67
			430	14/5/67	1.27	Ay. Theodoros E.S.	14/5/67
			615	6/7/67	0.90	Kyperounda P.S.	5/7/67
					0.80	" "	6/7/67



No.	River	Location	Peak Flow		Rainfall		
			Cusecs	Date	Inches	Place	Date
29	Syrgatis	Skarinou	247	11/10/66	0.50	P. Lefkara P.S.	11/10/66
			462	10/11/66	2.00	" "	9/11/66
					1.39	" "	10/11/66
			218	17/2/67	0.80	" "	17/2/67
			289	21/3/67	1.55	" "	21/3/67
47	Vasilikos	Kalavastos	260	21/3/67	1.30	Ora P.S.	20/3/67
					0.75	" "	21/3/67
48	Maroni	Khirokitia	739	9/11/66	3.05	P. Lefkara P.S.	8/11/66
					2.00	" "	9/11/66
52	Kouris	Khalassa	343	16/10/66	0.83	Saittas N.G.	16/10/66
			241	19/3/67	2.50	Pano Amiantos	19/3/67
			664	22/3/67	4.53	" "	21/3/67
					0.77	" "	22/3/67
			217	4/4/67	1.10	Troodos	3/4/67
					0.70	" "	4/4/67
			343	18/4/67	0.40	Lania E.S.	18/4/67
			253	9/5/67	1.68	Saittas N.G.	9/5/67
			410	11/5/67	0.50	Pano Amiantos	11/5/67
			217	14/5/67	0.53	" "	13/5/67
					0.24	" "	14/5/67
53	Kryos	Khalassa	241	6/7/67	0.95	Troodos	6/7/67
			231	16/10/66	0.83	Saittas N.G.	16/10/66
			370	22/3/67	2.55	Ay. Therapon E.S.	22/3/67
			245	11/5/67	1.05	Platres I.B.	10/5/67
				0.48	" "	11/5/67	
54	Zyghos	Khalassa	654	15/10/66	0.73	Ayios Theodoros	15/10/66
			202	10/11/66	1.25	" "	9/11/66
					0.62	" "	10/11/66
			494	16/12/66	1.72	Kapilio E.S.	16/12/66
			214	26/1/67	2.09	" "	26/1/67
			549	22/3/67	2.29	Agros E.S.	21/3/67
					0.38	" "	22/3/67
			287	18/4/67	0.63	Kapilio E.S.	18/4/67
			370	15/5/67	1.29	" "	15/5/67
887	6/7/67	0.90	Kyperounda P.S.	5/7/67			
				0.85	" "	6/7/67	



No.	River	Location	Peak Flow		Rainfall		
			Cusecs	Date	Inches	Place	Date
9	Kha-Potami	Kissousa	204	22/3/67	2.30	Platres I.B.	21/3/67
					0.75	" "	22/3/67
A	Yialias	Nisou	240	20/2/67	1.38	Kionia F.S.	20/2/67
			2119	23/3/67	1.44	Lythrodonda E.S.	23/3/67
			539	10/5/67	0.78	Perakhorio P.S.	10/5/67
B	Yialias	Pyroi	1015	10/11/66	2.55	Makheras Monastery	10/11/66
			343	29/1/67	1.30	Perakhorio P.S.	28/1/67
			724	20/2/67	1.38	Kionia F.S.	20/2/67
			1589	23/3/67	1.44	Lythrodonda E.S.	23/3/67
			1015	15/5/67	0.68	Perakhorio P.S.	14/5/67
			777	2/9/67	0.32	Mandra tou Kambiou F.S.	2/9/67
5	Overflow of Kiti Dam	Kiti Dam	388	25/3/67	0.65	Psevdhas E.S.	23/3/67
2	Alakati	Ay. Amvrosios	247	12/11/66	1.50	Halevga F.S.	12/11/66
4	Tremithios	Ay. Anna	432	26/10/66	0.64	Psevdas E.S.	26/10/66
			506	10/11/66	2.00	Kornos E.S.	10/11/66
			432	23/3/67	0.65	Psevdhas E.S.	23/3/67
			360	14/5/67	2.81	Kornos E.S.	13/5/67
0	Pouzis	Mazotos	404	10/11/66	1.70	Kornos E.S.	10/11/66
6	Vathis	Athalassa	387	17/10/66	4.50	Deftera P.S.	17/10/66
0	Mylou	Kornos	2556	11/11/66	2.00	Kornos E.S.	10/11/66
			225	16/12/66	0.82	Lythrodonda E.S.	16/12/66
			691	26/1/67	1.25	Kornos E.S.	26/1/67
			410	20/2/67	1.10	Kornos E.S.	20/2/67
			691	21/3/67	1.36	Lythrodonda E.S.	21/3/67
			2975	15/5/67	2.81	Kornos E.S.	13/5/67
					0.38	" "	14/5/67
0	Panayia Yematousa	Aradhippou	933	10/11/66	1.82	Aradhippou E.S.	10/11/66
			283	27/12/66	0.39	Avdhellerio E.S.	27/12/66
			1108	20/2/67	1.76	" "	20/2/67
			277	14/5/67	0.37	" "	14/5/67



No.	River	Location	Peak Flow		Rainfall		
			Cusecs	Date	Inches	Place	Date
71	Aradhippou	Aradhippou old bridge	441	10/11/66	1.82	Aradhippou E.S.	10/11/66
			268	20/2/67	1.61	"	20/2/67

### III. River Discharges

As a result of the high rainfall intensities experienced over the island during the year, the total discharges from all 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
2A	Yialias	Nicosia - Nisou Bridge	Water level recorder on bridge.
2B	"	Nicosia - Pyroi Bridge	Water level recorder on bridge.
3	Ovgos	Morphou - Pnasi Monastery Bridge	Water level recorder on 35 ft. bridge.
4	Ovgos and Serakhis	Syrianokhori	Water level recorder on 40 ft. measuring weir.
5	Xeros (Nicosia)	Nicosia - Xeros Bridge	Water level recorder on 71 ft. bridge.
6A	Matathasa	Nicosia - Xeros main road	Water level recorder on 50 ft. measuring weir.
6B	"	Upstream of Lefka dam	Water level recorder on 23' - 9" bridge.
8	Avgorou	Near Avgorou	Water level recorder on 40 ft. measuring weir.
9	Paralimni	Near Paralimni lake out flow	Water level recorder on the recharge channel.
10	Pyrgos	Phileyia	Water level recorder on 30 ft. measuring weir.
11	Limnitis	Limnitis Saw Mill	Water level recorder on 30 ft. measuring weir.



Recorder No.	Catchment	Location	Type of installation
13A	Kourris (Trimiklini)	Limassol - Troodos Bridge	Water level recorder on 18 ft. measuring weir.
13B	" "	Near 13A	Water level recorder on 1' - 6" flume.
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	Kourris (Erimi)	Erimi Bridge	Water level recorder on 66 ft. bridge.
17B	" "	" "	Water level recorder on 55' - 6" bridge.
18	Kalopannes	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 Asprovounio-tissa Church	Water level recorder on 40 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 Ayios Vasilios	Water level recorder on 60 ft. measuring weir.
27	Khrysokhou	Near 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 70 ft. 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 on 15 ft. measuring weir.
34	Tremithios	Near 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 Ayios 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	Masari main bridge	Water level recorder on 58' - 6" bridge.
38B	"	" "	Water level recorder on 39' - 6" bridge.
41	Yialia (Polis)	Kato Yialia main road bridge	Water level recorder on 14' - 10" 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	Kha-Potami	Near Kouklia	Water level recorder on 50 ft. measuring weir.
46	Garyllis	Near the Armenian Cemetery at Kato Polemidhia	Water level recorder on 60 ft. measuring weir.
47	Vasilikos	Near Kalavastos	Water level recorder on 75 ft. measuring weir.
48	Maroni	Near Khirokitia	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	Kourris	Khalassa-Lophos road bridge	Water level recorder on 23 ft. measuring weir.
53	Kourris and Kryos	Near Khalassa	Water level recorder on 101 ft. measuring weir.
54	Kourris - Zygos	Mia Kremmon Locality	Water level recorder on 75 ft. measuring weir.
55	Elea Asinou	Near Nikitari	Water level recorder on 25 ft. measuring weir
56	Vathis	Near Athalassa	Water level recorder on 33' - 6" measuring weir.
57	Elea Vizakias	Near Vizakia	Water level recorder on 29' - 6" measuring weir.
58	Aloupos	Aloupos Chiftlik	Water level recorder on 55 ft. measuring weir.



Recorder No.	Catchment	Location	Type of installation
59	Kha-Potami	Near Kissousa	Water level recorder on 20 ft. measuring weir.
60	Syrgatis Mylou	Near Kornos	Water level recorder on 30 ft. measuring weir.
61	Ezuza	Near Kannaviou	Water level recorder on 45 ft. measuring weir.
62	Xeros	Near Peyia	Water level recorder on 40 ft. measuring weir.
63	Melini	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	Near Philousa	Water level recorder on 60 ft. measuring weir.
68	Serakhis	On Morphou Dam Spillway	Water level recorder on 250 ft. dam's spillway.
70	Aradhippou	Near Panayia Yematusa church	Water level recorder on 16 ft. measuring weir.
71	"	On Nicosia - Larnaca old road bridge	Water level recorder on 27' - 9" measuring weir.
72	Akrounda	Downstream of Akrounda Dam	Water level recorder on 25 ft. measuring weir.
73	Panagra	On Panagra - Kyrenia old road bridge	Water level recorder on 27 ft. measuring weir.

All water level recorders used on the above stations are of the float operated type except on stations No. 2A, 2B, 6B and 14, on which Pneumatic recorders have been installed.



V. Measured discharges 1966 - 1967

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

No.	Catchment	Rainfall during 1966 - 67 10 <sup>6</sup> cu.ft.	Runoff during 1966 - 67 10 <sup>6</sup> cu.ft.	Maximum discharge in a day 10 <sup>5</sup> cu. ft	Maximum flow cusecs	Runoff in % rainfall 1966-67
2A	Yialias-Nisou	2125.3	315.2	23.8	2119	14.8
2B	Yialias - Pyroi	4414.4	423.7	34.7	1589	9.6
3	† Ovgos - Morphou	5238.3	412.6	96.5	4732	7.9
4	† Serakhis & Ovgos	16986.5	476.5	82.0	2350	2.8
5	† Xeros-Karavostasi	2812.5	191.0	10.0	123	6.8
6A	† Marathasa - Xeros	2650.7	233.9	14.6	257	8.8
8	Avgorou	379.3	-	-	-	-
9	Paralimni	369.0	-	-	-	-
10	† Pyrgos	1339.9	513.5	39.9	774	38.3
11	† Limnitis	1869.6	538.3	31.4	616	28.8
13	† Kourris - Trimiklini	2307.1	684.5	13.7	186	29.7
14	Peristerona - Panayia Forest Station	2320.7	527.1	94.0	1483	39.8
15	Tremithios - Kiti dam	-	23.4	15.9	388	-
16	† Yermasoyia (Yermasoyia) Police Station	4765.4	375.0	14.1	164	7.8
17	Kourris - Erimi	11301.5	1654.4	98.9	1670	14.6
18	Kolopannes	-	1.8	0.1	3.2	-
19	Arinna	656.2	-	-	-	-
20	Phrenaros	196.4	-	-	-	-
22	Liopetri	183.3	0.2	0.1	1.7	0.10
23	Akaki - Malounda	2469.6	885.0	71	900	35.8
24	Skylloura - Ay. Vasilios	2120.7	318.2	37	3903	15.0
27	Khrysokhou-Skoulli	2200.8	345.4	29	768	15.7
28	Stavros-tis-Psokas (Evretou)	3448.5	731.2	45.8	1148	21.2
29	† Syrgatis - Skarinou	3467.6	327.4	11.7	462	9.4
30	Dhiarizos-Kouklia	9228.9	2650.0	271.6	7504	28.7
32	† Alakati-Ay. Amvrosios	368.3	24.2	3.1	247	6.57



No.	Catchment	Rainfall during 1956-57 10 <sup>6</sup> cu. ft.	Runoff during 1956-57 10 <sup>6</sup> cu. ft.	Maximum discharge in a day 10 <sup>6</sup> cu. ft.	Maximum flow cusecs	Runoff in % rainfall 1956-57
33A	Karyiotis - Pendayia	2599.2	297.0	7.2	113	11.4
33B	Karyiotis - Evrykhou	2294.4	801.4	20.8	604	34.9
34 *	Tremithios - Ay. Anna	1737.1	189.1	8.2	507	10.89
35 *	Elea - Ghaziveran	4350.5	37.5	10.5	606	0.9
36A	Ay. Loukas - Akhyritou outlet tunnel	-	-	-	-	-
36B	Ay. Loukas Lake	-	0.69	0.2	17.6	-
37	Atsas - Upstream of Petra Dam	901.2	335.8	15.2	1342	37.3
41	Yialia - Near Kato Yialia	598.6	99.6	3.2	55	16.6
43	Mavrokolymbos	1193.6	181.5	11.0	1203	15.2
44 *	Ezuza - Akhelia	8850.0	2014.3	150	2397	22.8
45	Kha-Potami - Kouklia	3489.5	616.6	88.5	1589	17.7
46	Garyllis - Kato Polemidhia	2223.4	90.8	2.0	23	4.1
47 *	Vasilikos - Kalavastos	3416.7	300.4	9.4	260	8.8
48 *	Maroni - Khirokitia	1525.6	148.6	5.2	739	9.7
49 *	Kambos - Potamos - tou - Kambou	1504.8	175.9	8.2	203	11.7
50 *	Pouzis - Mazotos	1194.0	43.4	3.7	404	3.63
52	Kourris - Khalassa	3799.9	1043.1	47.2	664	27.5
53	Kryos - Khalassa	6000.0	1301.7	63.7	890	21.7
54	Zygos - Khalassa	3931.3	677.9	41.5	887	17.2
55	Asinou - Nikitari	454.9	40.2	2.46	45	8.8
56 *	Vathis - Athalassa	514.5	8.6	2.7	387	1.67
57	Elea - Vizakia	2432.1	538.1	26.5	1242	22.1
58	Aloupos - Morphou	1977.3	164.0	20.3	1002	8.3
59 *	Kha-Potami - Kissousa	1408.4	189.7	14.0	204	13.5
60	Mylou - Kornos	811.5	241.8	14.6	2975	29.79
61	Ezuza - Kannaviou	3097.8	758.8	67.1	1354	24.5
62 *	Xeros - Peyia	451.0	31.8	2.0	1913	7.1
63	Melini - Ay. Trias	108.8	10.2	1.2	158	9.38



No.	Catchment	Rainfall during 1966-67 10 <sup>6</sup> cu.ft.	Runoff during 1966-67 10 <sup>6</sup> cu.ft.	Maximum discharge in a day 10 <sup>6</sup> cu. ft.	Maximum flow cusecs	Runoff in % rainfall 1966-67
64	Ay. Nicolaos - Kakopetia	678.4	543.2	5.1	59	80.1
65	Platania - Kakopetria	432.6	167.1	4.6	156	38.6
67	Dhiazizos - Philousa	5394.4	1970.6	128.2	2009	36.5
68	Serakhis - Morphou Dam	11328.3	534.7	135.7	1889	4.7
70	Aradhippou - Near Panayia Yematousa Church	347.5	34.7	5.9	1108	9.98
71	Aradhippou - N/sia L/ca old road bridge	664.3	15.8	2.1	441	2.38
72	Akrounda	709.8	59.9	4.5	143	8.4
73	Panagra	1290.8	113.9	34.8	1767	8.8

The runoff figures for these rivers are liable to alteration, after the establishment of a calibration curve for each station is completed.

#### VI. Spring discharges

During the Hydrological year, 2483 spring discharges were measured, averaging to 207 measurements every month. The output of 363 springs is now being measured regularly, 236 of these at monthly intervals, 40 every two months, 23 every three months, 26 every four months, 25 every six months and 15 every year.

Because of the above normal rainfall in all parts of the island spring discharges were generally above average. The increase in the flow of springs commenced in February. Their yield was considerably higher than last year and in most cases the highest for the last ten years.

On the Troodos mountains the combined flow of springs used for the water supply of Troodos was 57,000 gallons per day in September and it is the highest yield for this month of the year since regular measurements commenced in 1957.

On the northern slopes of the Kyrenia Range the Kephlovrysos Lapithos was flowing during April at the rate of 1,314,000 gallons per day and this yield is the highest since 1951.



On the southern slopes the Kephlovrysos Kythrea increased from 1,702,000 gallons per day to 3,075,000 gallons per day from October to May and it remained same till the end of the year.

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

#### VII. Chemical Analyses

During the year 5330 samples of water were sent to the Government Analyst for partial chemical analyses. Of these 1165 samples were taken from springs, wells or boreholes which are used or proposed as water supply sources. The remaining 4165 samples derived from springs, observation boreholes and from other miscellaneous sources. In addition 465 samples of water were taken from boreholes used for irrigation purposes

#### VIII. Bacteriological Analyses

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

<u>Water Supply</u>	<u>Number of Samples</u>	<u>Number of Unsatisfactory Samples</u>
Nicosia	703	75
Famagusta	199	7
Limassol	101	2
Larnaca	38	3
Paphos	44	7
Kyrenia	24	-
	<u>1,109</u>	<u>94</u>

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 and Ktima were usually of unchlorinated water. All chlorinated samples at the main reservoirs were satisfactory.

#### IX. New Measuring sites

By the end of the hydrological year 1966-67, the following measuring sites were completed and automatic water level recorders were installed.

##### 1. Pedhieos river near Kambia.

A 40 ft. broad crested measuring weir with 4' x 1" notch for low flows.



2. Ayios Onoufrios river near Kambia.

A 20 ft. broad crested measuring weir 4' x 1' notch for low flows. An iron foot bridge has also been installed for the measurement of high flows with current meter.

3. Maroni river near Ayios Minas Monastery at Vavla.

Stabilization of the river bed by constructing a 28 ft. broad crested measuring weir with a 4' x 1' notch for low flows under the bridge on Kato Dhrys - Vavla road.

4. Vasilikos river near Kalavassos Mine.

Installation of an automatic water level recorder on the 66 ft. existing irrigation weir by reducing the lower section of the weir by 36 feet with a notch 4' x 1' for low flows to serve both as an irrigation and measuring weir at the same time.

The above four stations are situated on the igneous rocks just before their contact with the sedimentary rocks.

5. Alikos river near Ayios Sozomenos.

A 30 ft. broad crested measuring weir with a 4' x 1' notch for low flows.

6. Boghaz river near Kyrenia.

A 28 ft. measuring weir with a V notch.

7. Limnitis river near the Ex. Limnitis Saw Mill.

A new type of structure for flow measurements in steep streams by Harrison A.J.M. and Owen M.W., published in Proc. Inst. Civil Engineers, 36 February 1967, Paper No. 6998, pages 273 - 296.

X. Repairs and improvements to the existing measuring sites.

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

1. Yialias river near Pyroi.

Stabilization of the river bed under the Nicosia - Larnaca main road bridge.

2. Marathasa river upstream of Lefka dam.

Raising the sill of the weir by 2 feet which had been covered with gravels both upstream and downstream of the station.



3. Dhiarizos river near Philousa.

Installation of an iron foot bridge  
for the measurement of high flows  
with current meter.

XI. Hydrological Surveys and Construction of  
Measuring Weirs Costs

	Approved Estimated Cost	Actual Expenditure
	<u>          </u>	<u>          </u>
Hydrological observations and Research		
(Surface and Ground Water Hydrology)	£ 13,940	£ 11,900
Construction and Mainte- nance of Measuring weirs	£ 10,000	£ 9,110
	<u>          </u>	<u>          </u>
Totals =	£ 23,940	£ 21,010
	=====	=====



## PLANNING DIVISION

Prepared By W. Ioannides,  
Chief of Division.

The Division of Planning of the Department deals with the following aspects:

(a) General planning of the Department's major projects dealing with:-

- (a) Collection of water use data.
- (b) Investigations.
- (c) Foundations and Engineering Geology problems.
- (d) Laboratory.
- (e) Field control during construction.

The year of 1967 was a busy year of study and planning. Some works proposed for the second five year plan were started with some minor alterations.

(a) Collection of water use data for watershed planning.

The collection of data for watershed planning consists of plotting of intakes, springs, wells, etc., as well as the land irrigated and type of crops of the various existing irrigation schemes from surface and spring water resources within the catchment areas of the selected rivers.

2. This work originally was put in hand in 1965 but due to the shortage of staff it was delayed and started again in the middle of the year by the employment of three pensioners on hourly basis under the supervision of a monthly paid Technical Assistant.

3. The work is being carried out in three stages:-

Stage one consists of the preparation of the draft plans. Spot investigations are carried out in the fields and enquiries are taken from the persons concerned or the village authorities. During the field investigation certain difficulties arise due to the reluctance of the people to give correct information. Also more difficulties arise when Turkish villages are within the catchment area under study.

Stage two consists of the preparation of the final plans by the Departmental Drawing Office.

Stage three consists of the preparation of a proper report on the existing registered or ab antiquo water rights and is undertaken after the completion of the above two stages.



4. During 1967 the field investigations were continued and completed on the "Khrysokhou" river in Paphos District. Also "Ovgos" river catchment was started and completed. A start was also made on the "Serakhis" river catchment and the work was completed on the three tributaries i.e. "Akaki", "Peristerona" and "Merikos" as well as on a great part of the main "Serakhis". For the time being the field investigations are carried out within the Morphou area.

(b) Investigations:

These include:

- (a) Material investigations.
- (b) Detailed geologic map of dam and reservoir sites.
- (c) Foundation investigations.
- (d) Laboratory testing.
- (e) Interpretation of results for design.
- (f) Report.

Schemes investigated in 1967 were as follows:

1) Palechori Dam investigations

(a) Material investigations were carried out and the following material were found within a reasonable distance from the proposed dam site:

- (i) Core material
- (ii) Filter material
- (iii) Rock-fill material
- (iv) Rip-rap
- (v) Random fill
- (vi) Concrete material.

(b) Detailed geologic maps of the dam and reservoir sites were prepared, by the Geological Department.

(c) After a study of the geologic maps prepared 15 boreholes were drilled, 4 test pits and 2 trenches were excavated. Pressure tests were carried out in all the boreholes drilled. Gravity permeability tests were also carried out in the test pits.

(d) Samples of materials as well as samples from the cores recovered from the boreholes were tested.

(e) Report for the material and foundation investigations were prepared.

2) Aradhippou Dam Investigations

(a) Core material investigations were carried out and borrow areas were located. Investigation for filter, random fill and rip rap will be carried more fully in 1968.

(b) Detailed geologic maps of the reservoir and dam sites were prepared.



(c) Foundation investigations were started and they will be finished in 1968.

(d) Samples of core material were tested. Tests on the rest of the materials and on cores to be recovered from the boreholes will be carried out in 1968.

(e) Report for material and foundation investigation will be completed in 1968.

### 3. Koma tou Yialou

This river flowed quite in abundance in 1967 and it gave the opportunity to the department to study its salinity. This however proved higher than what was originally anticipated. So all further investigations have been postponed till this rather serious problem will be fully investigated.

### 4. Investigations for other departments

#### (a) Grain Commission

After a request from the manager our Department has undertaken and is still carrying on a foundation investigation for grain silos.

A number of investigation pits and boreholes have been decided upon preliminarily and it is expected to have them finished by early 1968.

The site is at Psonas in Limassol and belongs to the Commission.

### (c) Foundations and Engineering Geology problems

#### 1. Kalopanayiotis dam

A big crack has appeared on top of the west abutment for this dam and studies were and are being carried out to check:

- (a) On the extent of the disturbance
- (b) On its possible area extend, present and future, and
- (c) On any effects that this may have in future for both the dam and reservoir.

#### 2. Mavrokolymbos dam

Studies are continued and works are being executed for the stabilization of the reservoir sides where major and minor slides have and may possibly continue in future.

Piezometers have been ordered to be installed in order to have a better idea of the behaviour and water content of the reservoir sides.

#### 3. Polemichia Dam

A study has been made of the leakage through the embankment of this dam and a grouting programme is being proposed.



4. Grouting at Kalopanayiotis dam

Grouting was continued and finished in 1967 at the Kalopanayiotis dam.

The grouting was started under the supervision of Howard Humphreys of London (Consultants) and with contractors, but continued and finished with both personnel and supervision of the Department.

A grouting group has been formed and will thus enable the Department to undertake cheaper and more effective grouting in future whenever it is needed, mainly in dam construction.

(d) Laboratory

In 1967 the Water Development Department laboratory was equipped with the following apparatus.

For tests on cement, aggregates and concrete

- (i) Le chatelier apparatus.
- (ii) Vicat apparatus.
- (iii) Riffle box for aggregates.
- (iv) Sieves for aggregates.
- (v) Aggregate crushing strength apparatus.
- (vi) Silt and moisture content determination apparatus for aggregates.
- (vii) Determination for organic impurities apparatus.
- (viii) Slump test and compacting factor apparatus.
- (ix) Cubes (different sizes).
- (x) Air entrainment apparatus.
- (xi) Curing facilities.
- (xii) Crushing machine (capacity 250 tons).

For test on soils

- (i) Liquid limit apparatus.
- (ii) Normal and rapid moisture content determination apparatus.
- (iii) Standard and modified proctor apparatus.
- (iv) Sand replacement apparatus.
- (v) Sieve analysis hydrometer and pipette apparatus.
- (vi) Permeameters (falling and constant head) for horizontal and vertical permeability.
- (vii) Unconfined compression apparatus.
- (viii) Triaxial apparatus (1½ inch diameter specimens).
- (ix) Shear box apparatus.
- (x) Consolidation apparatus.

Miscellaneous

- (i) Model tank for dam design investigation.
- (ii) Seismic apparatus for geophysical investigations.

The following new equipment was acquired in 1967.

- (1) One large 17" d. by 10" long sample, constant head permeameter.
- (2) One extruder for different diameter sizes.

Both the above apparatus were made in W.D.D. Workshop.



From the above it can be seen that 16,455 tests were carried out in the Laboratory of the Water Development Department in comparison to 12,511 tests carried out in 1966, an increase of 32%.

(e) Field control during construction.

During construction control was carried out at different sites, and laboratory personnel were posted permanently on the site in order to observe and test the quality of construction.

From the tests above it can be seen that 12,656 tests for construction were carried out, i.e. about 76% of the total tests.



Tests carried out in 1967

During 1967 the following tests were carried out.

(i) For Public Works Department

For the investigations for Limassol Port the following tests were performed in the W.D.D. Laboratories.

	No.
Liquid Limit	68
Plastic Limit	68
Moisture content	150
Sieve analysis	18
Consolidation	14
Shear tests	33
Specific gravity	16
	-----
Total	367

(ii) For Geological Department

Sieve analysis 25

(iii) For Water Development Department

The tests carried out for construction and investigation are shown below:



TEST ON SOILS

TESTS		FOR CONSTRUCTION					FOR INVESTIGATIONS					Total of each kind of test.	% increase from year 1966	% decrease from year 1966
		Scheme and Number of tests.					Scheme and Number of tests.							
		YERIASOYIA DAM	SYNGRASIS DAM	KALOPANAYIOTIS DAM	POLEMIDHIA DAM	AGROS DAM	PALECHORI	ARADHIPPOU	KHCGLAGOVOUNOS	MERSINAS RIVER	AKIOTIRI LAKE			
i	Atterbergh Limits	338	42	12		15	136	102	9	9	1	664	41.8	
ii	Moisture Content	7867	405	38		64	575	424	39	39	5	9456	80.9	
iii	Standard Proctor	339	25			5	54	34	3	3		463		-23.2
iv	Rapid Compaction (on)	196										196	19500	
v	Sand Replacement	293										293	737	
vi	Core Cutter	1919	190									2109	203	
vii	Sieve Analysis & Hydrometer	551	26	5		8	111	68	6	4	2	781	58	
viii	Permeability	194	5			4	62	33	3	3	1	305	703	
ix	Silt Content & Salinity		2		8							10	900	
x	Triaxial	18					42	27				87	8600	
xi	Shear Test						18	18				36	3500	
xii	Consolidation	6										6	500	
xiii	Specific Gravity	68	6	2		5	67	31	3	2		184	384	
	TOTAL	11.789	701	57	8	101	1065	737	63	60	9	14.590		



TESTS ON AGGREGATES & CEMENT

TESTS	FOR CONSTRUCTION						FOR INVESTIGATIONS		Total of each kind of tests	% increase from year 1966.	% decrease from year 1966.
	Scheme and Number of Tests						Scheme & No. of Tests.				
	YERMASOYIA DAM	SYNGRASSIS DAM	OVGOS DAM	KATOKOPIA	NIKITAS	PRASTION	PALECHORI	ARADHIPPOU			
i	Le Chatelier & Setting Times										-
ii	Sieve Analysis	49	10					25		84	-82
iii	Aggregate Crushing							20	3	23	-36
iv	Silt & Moisture Content										-
v	Slump	154	28	12	4	17	19			234	-74
vi	Compactive Factor										100
vii	Cubes prepared & crushed	625	110	48	16	68	76			943	1.2
viii	Constant Head Permeability							11		11	1000
ix	Water Absorption							25	3	28	-22
x	Los Angeles Abrasion test							24		24	2300
xi	Tests on Bendonite	74								74	7300
xii	Acid Test		5					10	3	18	1700
xiii	Specific Gravity							13	3	16	-98
xiv	Cores Strength							18		18	1700
	TOTAL	902	153	60	20	85	95	146	12	1473	



## DESIGN DIVISION

Prepared By K. Hassapis,  
Chief of Division.

(a) Design Branch.

The work of the Design Branch during the year 1967 was concerned as usual with the preparation of the designs for the Major Water Development Projects i.e. Dams and the related Distribution Systems for Irrigation, etc.

During 1967, design work was done on the following projects:

1. Palaechori-Sklidros Dam.

This is a rockfill dam, 90 ft. high and having a capacity of 150 Million Gallons of water. The purpose of the project is to provide water for the irrigation of an area of about 600 donums which may then be planted with deciduous and seasonal crops.

An alternative concrete dam for the same purpose is under study.

Design work on the distribution system has commenced.

2. Massari Recharge Works Project.

This project comprises of:

- (a) An earth dam of 500 Million Gallons capacity to be built in Serrakhis River upstream of Massari Village.
- (b) Recharge basins in the river bed between the proposed dam and Morphou dam.
- (c) A conveyor system from the dam to the existing irrigation outlets below the proposed dam for conveying water for surface irrigation.

The main purpose of the project is to utilize the major part of the flow of Serrakhis which is now lost to the sea, to recharge the intensively overpumped aquifer of the region. In connection with this project the following minor irrigation projects were also prepared for:

- (i) Kyra Irrigation Association.
- (ii) Phylia Irrigation Association.
- (iii) Massari Phylia Soil Conservation Division.



3. Subsidiary Distribution System for Kalopanayiotis to complete the distribution system for Kalopanayiotis Dam.

4. Subsidiary Distribution System for Kissonerga village. This is an extension of the main distribution system of Mavrokolymbos Dam.

5. Extension of Polemidhia Distribution System to Chiftlikoudhia.

6. Pumping scheme from Yermasoyia Dam to Akrounda-Phinikaria.

7. Yermasoyia Dam Distribution System, to utilize the water of Yermasoyia Dam. The design work for this project will be completed in 1968.

8. Extension of the Kiti Dam Distribution System.

9. Argaka-Magounda Dam Distribution System. This scheme was designed by Mr. Meijer, U.N. Associate Expert.

10. Famagusta Water Supply conveyor pipeline. This study was partly done by Mr. Jancar, Foreign Expert.

(b) Topography Branch.

With the Departmental re-organization, the Topography Section was made a Branch of the Design Division. This Branch carried out the surveying assignments for the Departmental and for the United Nations Development Special Fund Project's needs. The co-operation between the Drawing Branch and this Branch contributed to the efficiency of the activities of the Topography Branch. Final drawings and plans were undertaken by the Drawing Branch and thus the surveying teams were kept operating in the field as much as possible.

Eight daily paid Technical Assistants were appointed in April 1967 and sent to this Branch to receive training in surveying but two of them have already resigned from their posts and left the Department. Another experienced daily paid Technical Assistant resigned from his post and a monthly paid Technical Assistant was on sick leave during the period of 23/4 - 31/7. A Surveyor, who had been working with the Department before, returned and was appointed again in October 1967.

The staff during this year was as follows:



The Projects, this Branch dealt with this year, were:-

Project	Type of Survey	Remarks
1. Massari Distr. System	Profile	Investigations and Design purposes
2. Sklidhros Dam	Contour Survey	"
3. Karavas Dam	"	"
4. Vavla Dam	"	"
5. Akapnou Dam	"	"
6. Aradhippou	"	"
7. Polemidhia Distr. System	Profile	"
8. Yermasoyia Distr. System	"	"
9. Akrounda Phinikaria Distr. System	"	"
10. Argaka Magounda Distr. System	Contour Survey	"
11. Re-location of Road at Phinikaria	Profile	Construction purposes
12. Neo-Khorio-Kythrea Dam	Contour Survey	Investigations and Design purposes
13. Kalopanayiotis Dam, Slide area	"	"
14. Kouklia Reservoir	"	"
15. Kiti Distr. System	Profile	"
16. Morphou Dam	Cross sectioning	"
17. Kalopanayiotis Dam, Site plan	Topography	"
18. Xyliatos Dam	Contour Survey	"
19. Sklidhros, Alternative Dam site	"	"
20. Mia Milea Dam, Site plan	Topography	"
21. Zalatsia Dam site	Contour Survey	C.W.P.P.
22. Asprokremos Dam site	"	"
23. Krystalla Dam site	"	"
24. Khoghlovounos Dam site	"	"
25. Morokambos Dam site	"	"
26. Stenos Dam site	"	"
27. Petrovounos Dam site	"	"
28. Olos Dam site	"	"
29. Rona Dam site	"	"
30. Paleomylos Dam site	"	"
31. Vokolidha Dam site	"	"
32. Kattos Dam site	"	"
33. Ayios Nicolaos Dam site	"	"



Project	Type of Survey	Remarks
34. Vlakhos Dam site	Contour Survey	C.W.P.P.
35. Lavis Dam site	"	"
36. Monastiraki Dam site	"	"
37. Koukou ayias Dam site	"	"
38. ayias Dam site	"	"
39. Pavloudhia Dam site	"	"
40. Christos Dam site	"	"
41. Ayios Minas Lower site	"	"
42. Famagusta W.S.	"	"
43. Sklidhros Distr. System	Contour Survey	Continuing in 1968
44. Larnaca W.B.	Completion plans, plotting	Continuing in 1968



POST	NAME	REMARKS
I.W.	A. Euvripidou	i/c
"	D. Pitsillides	
"	G. Frangopoulos	Transferred to Hydrological Branch on 25/11/67
T/A Monthly paid	C. Hji.Loizou	
"	A. Eleftheriou	
"	A. Kourtellas	
"	G. Koumidhes	Transferred to Soil Laboratory on 7/8/67
"	G. Hji.Ioannou	Transferred to Topography Branch on 1/3/67
T/A Daily paid	D. Akridas	Resigned on 1/10/67
"	Chr. Georgiou	
"	St. Ioannou	Resigned on 6/12/67
"	St. Socratous )	
"	A. Ignatiou )	Appointed on 10/4/67
"	A. Tsiakouris (	
"	A. Neocleous	Resigned on 14/7/67
"	Chr. Loizides )	
"	Iac. Charalambous )	Appointed on 19/4/67
"	Ias. Charalambous (	
"	A. Papanastasiou (	
"	A. Panayides	Transferred to Topography Branch on 25/5/67
Surveyor	P. Antoniadis	Appointed on 11/9/67



(c) Drawing Office Branch.

A major change took place in the Drawing Office during 1967. Ten new members were recruited to be trained to work for the U.N. Development Special Fund Project. Due to the immediate demand by the Project some of the existing trained staff were used for Project jobs until gradually those recruited for the Project could take over completely. The drawing office staff during the year numbered 23 of whom 2 were on loan to the Geological Survey Department. All staff were female except those on loan to the Geological Survey Department. All members including the Officer in charge were on daily wages.

During 1967 the Drawing Office carried out practically all the Drawing work of the Department which includes the Dam Design Drawings, Irrigation Distribution Systems from Dam projects and Minor Irrigation schemes such as schemes for lining existing earth channels and new small schemes from irrigation boreholes or the diversion of stream flow to irrigation through reinforced concrete channels or pipelines.

In addition to the routine work 3 members of the staff were employed full time during 1967 on the preparation of a much needed all project map of Cyprus to include all existing works of the Department i.e. all the Dam projects, Distribution Systems, Domestic water supply schemes and all land under irrigation now, whether this is irrigated by pumped underground water or surface water through diversion of stream flow or spate irrigation. On the other hand the drawing section of a book giving details of all major Dam projects was being prepared in the Drawing Office. This book being prepared by the Director will include a drawing for each dam showing the main design features such as a plan, a maximum section of the dam including the outlet works, a geological section, a longitudinal section of the spillway and graphical representation of the reservoir areas and water capacity and the discharge of the spillway the desilting outlets and irrigation outlets. Another map to be incorporated in this work is one showing the plan of the distribution system from the dam projects and the land under irrigation.

During 1967 the Officer in charge of the Drawing Office prepared the Department's Instructions manual No. 2, on watershed surveys. This manual will be finally printed and circulated in 1968 and will deal with instructions for the work on the river basins and including the work on the Hydrological Surveys in the plains.

Library and Technical Information Section.

During 1967, 17 new books were bought by the Department through the Crown Agents and subscription was continued of 12 Technical Periodicals throughout the year. The Library continued to issue monthly or bimonthly reports of publications received and of articles in Periodicals of interest to the Technical Staff.



Technical information was provided through the Ministry to questionnaires by various newspapers and other institutions.

The Department took part in an exhibition at the Technical School Hall organized by the U.S.I.S. dealing with desalinization of water. The Department provided illustrations of major Water Development projects carried out during the first 5 year development plan.

By kind permission the President's helicopter was used in photographing Dam projects from the air for the first time by the Department of Public Information. It is hoped that giant prints of these and other photos will be produced and exhibited in Cyprus and abroad to illustrate the strides in Water Development Projects since the independence.



## MINOR IRRIGATION PROJECTS

Prepared by P. Pantelides  
Superintendent of Works

### Introduction

The term "minor irrigation Projects" comprises all the small irrigation schemes designed mainly for village Divisions and for private Associations and for artificial recharge of underground aquifers. Additionally, the Minor Project Section has dealt with the design and construction of river training and antiflood works and more recently with the construction of irrigation distribution network from the larger dams.

In 1967 a comparatively large amount of money was budgeted for minor irrigation projects, but because of the usual delay experienced in securing the village share of the expenditure (loans from Government) some works which were scheduled for construction in 1967 were not started in time before the onset of the rain season, and work had to be deferred for 1968. One difficulty experienced in 1967 during peak construction period in summer was the lack of hand labour particularly in developing areas; the scarcity of labour was more noticeable during periods of increased demand of labour for seasonal agricultural activities like the collection of carobs, olives etc.

In spite of adverse timing, and labour difficulties, a total amount of £407,063 was spent on construction in 1967 as detailed on the following table.

Table A  
Expenditure Detail. Minor Project.  
Construction 1967

No.	Description of Expenditure	Amount Spent	Remark
1.	For the completion of work in hand at the end of 1966, and continued in 1967	£ 43,133	Appendix "A"
2.	For Schemes started and completed in 1967.	48,130	Appendix "B"
3.	Lining of Canals in Western Messaoria.	70,000	Appendix "C"
4.	For Schemes left incomplete in 1967 and continued in 1968.	15,800	Appendix "D"

Cont/d.



No.	Description of Expenditure	Amount Spent	Remark
5.	Morphou Irrigation Recharge Project (started late in 1967.	£ 30,000	
6.	Polemidia Distribution Scheme.	150,000	
7.	Mavrokolymbos Distribution System.	90,000	
8.	River Training & Antiflood.	5,000	
	Total	£407,063	

The demand for new schemes has continued unabated during 1967 and several new projects have been added to our waiting-list (a revised edition is shown on appendix E).

Unfortunately it was not possible to respond very readily to in-coming applications from District Officers or directly from village Authorities because of pressures of executive work; consequently, we have had to send a lot of brief and stereotype replies of acknowledgement, indicating belated dates for investigations and action to be taken, in accordance with priorities, and with a growing programme of field work assigned to individual technical staff.

With the new inter-departmental re-organization as applied at the end of 1967 whereby this Section of the Department will be dealing only with the design and planning of new projects including village domestic water supplies, it is expected to increase and improve the annual turnover of new attractive schemes, and to deal quickly and effectively with applications.

A more detail description of activities and work carried out in 1967 is given in the following paragraphs.

#### Minor Irrigation Schemes

New irrigation schemes were completed in 18 villages during the year at a total cost of £34,460 covering an area of 501 donums of permanent and 396 of seasonal cultivation. Another sum of £48,130 and £15,800 was spent for work carried over from 1966 and continued in 1968 respectively.

Some schemes included in the budget for 1967 but not started because of administrative or other difficulties are given in table "B" herebelow ; works will, however, be undertaken in 1968.



Table B<sup>n</sup>

Schemes included in the budget of 1967  
but not carried out

No.	Name of Division	Description of work	Estimated cost
1.	Potami (Nicosia)	Pumping Scheme	£ 10,000
2.	Pyrga (Limassol)	Pumping Scheme	£ 4,300
3.	Ay. Theodoros (L/ca)	Pumping Scheme	£ 7,250
4.	Ay. Ioannis (Agrou)	Small tank Distribution	£ 2,300
5.	K. Amiandos	Intake and Dis- tribution Works	£ 3,925
6.	Arakapas	Intake and Storage Save	£ 4,000
7.	Kelokedara (Paphos)	Distribution Extension Work	£ 3,000
8.	Ormidia	Recharge Works	£ 12,000
		Total	£ 46,770

Most of the small schemes completed in 1967 are on the mountain villages especially in the Pitsilia area and consist of intake works on minor streams, small tanks for night storage and distribution pipes or channels. Intake works include, sometime, the development and consolidation of mountain springs issuing from cracks or fissures in the mountain rocks. Owing to steep topography and limited catchment it is not possible to design large storage works in these villages and it appears that the small schemes will continue to provide the only source of irrigation and contribute at the same time for landscape effect on the mountain villages.

In Ayios Theodoros near Agros underground water has been tapped in gravel and sedimentary deposits on the bed of a stream and will be made to gravitate on the surface by means of an underground concrete wall. Works were started later in the year and had to be discontinued during the winter season. The scheme includes also general improvements to existing distribution works at a total cost of £4,710.

At Trimiklini and Pera Pedhi on the lower hills of Limassol where intensive development has been effected by Irrigation from two concrete gravity dams the distribution systems were extended with concrete channels and pipes for higher irrigation efficiency at a cost of £4,300 and £2,300 respectively.



In Gastria of Famagusta District (Karpasia) a pumping scheme was completed at a cost £5,200 for perennial irrigation of about 100 donums. Water is pumped from a borehole which was drilled by the Department several years ago and yields good quality water, unlike the brackish water usually encountered by boring in that particular area.

Gypsos works in Famagusta District consist of lining of channels distributing water from an earth dam constructed over 10 years ago for seasonal irrigation at a cost of £6,300.

In Maroni of Larnaca District a 50,000 gallon concrete tank was constructed for night storage of water issuing from underground collector weir which was very successfully completed in past years; the cost of the tank and some extra concrete channels was £2,320.

In Peristerona and Astromeritis a notable scheme estimated at £20,000 was started along the banks of the Peristerona river for the benefit of a combined Division; the works provide for lining in reinforced concrete the main conveyor canal diverting seasonal water flowing in the Peristerona river for spate and seasonal irrigation of several thousand donums. Unfortunately, soon after starting, the villagers from nearby Orounda village objected to the undertaking on grounds that they should also benefit from the works, because the intake was situated within their own village boundaries. This is a typical case of village disputed water rights, very vigorously contested by holders and very often the cause of delay for development works.

#### Lining of Distribution Canals in Western Messaoria.

We call Western Messaoria the plain extending west of Nicosia from Kokkinotrimithia as far as Xeros on the Morphou bay. The rapid development of a profitable citrus industry in this area has created a vast network of earth channels for irrigation distribution of water pumped from deep boreholes. About 20% of water pumped is estimated to be lost by percolation through these channels and because of continued depletion of the underground aquifers and the need of saving water, a scheme providing watertight canals along the principal distributaries was inaugurated in 1966 and continued in 1967.

A list of works designed for execution in prospective years by staged budgetary provision appear on appendix "C" and postulates expenditure estimated at £680,000. In 1967, £70,000 was spent for lining of canals in the villages of P. & K. Zodhia, Argaki, Katokopia, Prastio, Nikitas and Ovgos in Morphou. Plans have been prepared for similar works in Peristerona, Astromeritis and Akaki and investigations are continuing in other villages on the Morphou plain.

At the end of 1967 a start has been made with the introduction of prefabricated reinforced concrete canal sections with a view to reduce cost and for higher efficiency.



A contract for the fabrication and supply of approximately 100,000 feet of sections in 5 meter length was awarded to a private firm of contractors. The first lot of channels supplied were erected within Morphou village and have met with good success. It is currently estimated that with widespread application of this new method, the overall cost saving will be about 20%, but these channels can only be erected at places accessible to vehicular transport.

### Recharge Works

The more notable scheme started in 1967 is the "Morphou Recharge Project" designed for phased implementation for which a provision of £70,000 was made in 1967. The works were started rather late in the year and most of the work (£40,000) will be continued in 1968, together with the second phase of the scheme at £25,000 i.e. a total at £65,000 is scheduled to be spent in 1968 on this project.

The works are designed as a safety measure against sea-water intrusion in the coastal zone where the ground water table has dropped below sea level - a similar effect has taken place in Famagusta coastal area. The method is to reduce pumping in the zone area by providing alternative sources of irrigation to several thousand donums of citrus which are now supplied with irrigation water on payment from pump owners within the depressed zone. It is estimated that water extracted will be reduced by 50% when the scheme covering the whole area will have been completed. The new sources will come from boreholes to be drilled on safe pre-determined sites along the inland bed of Serakhis where works for intensive artificial recharge will be constructed. Two large spreading grounds of 30 million gallons capacity have already been constructed just below the Serakhis dam. Similar spreading grounds are planned for construction lower down below the Morphou-Kyrenia bridge at the locality "Protopapas"; the scheme includes pumping equipment and watertight conveyor canals from the boreholes to distribute the water to individual farmers within the area. The overall scheme is divided into three types of works viz: the spreading grounds for artificial recharge, the borehole pumping and conveyor works and the lining of distribution canals. The area to be treated extends within the lower boundaries of Morphou, Syrianokhori, Nikitas and Prastio. The villages are contributing 1/2 of the cost for the channels and 1/3 for all other items.

It is strongly believed that drastic reduction of pumping in this area is the only means of fore-stalling widespread catastrophic results to one of our most productive citrus industry.

Some lesser recharge works were constructed in Famagusta and Larnaca District as detailed at the end of Appendix "B".

Ormichia Recharge was a project of particular importance cost £12,000, which we could not start in 1967 because the village loan was not available in time.



On table "C" herebelow we give a list of Recharge schemes planned and ready for implementation at the end of 1967.

Table "C"

List of Recharge Schemes Ready for Construction  
at the End of 1967

No.	Village	Description of Works	Storage capacity (H.G.)	Estimated Cost
1.	Famagusta-Dherinia	Supplementary works in view of the need to extend the recharge grounds further inland	-	£ 17,500
2.	Vrysoulles (F/sta)	Earth Dam on the Pharagas valley for artificial recharge	31	8,600
3.	Akhna	Small earth dams	9	5,950
4.	Akanthou	Small earth dams on the principal valleys for artificial recharge of the shallow coastal aquifer and two check dams higher on the hill for recharge of the V.W.S. spring	7	7,000
5.	Xylotymbou	Small earth dam and spreading grounds for artificial recharge	35	5,500
6.	Ay.Yeorghios (Kyrenia) Stage II	Supplementary small recharge dams for artificial recharge	4½	4,000
7.	Ay. Epiktitos (Kyrenia) Stage I	- " -	7½	4,000
8.	Elea of Karavas	- " -	4	3,000
		Total	98	£ 55,550



## Distribution from Major Dams

### Mavrokolymbos

The first part of the work estimated at £124,000 was practically completed at the end of the year. It consists of a conveyor channel from the dam as far as Kissonerga village and lateral distribution pipe covering the Government Chiftlic of Potima and the lands of Kissonerga.

The main conveyor canal is made of cast-in-situ reinforced concrete channels of capacity ranging from 10 to 15 cusecs with 3 major pipes crossing of 24"  $\emptyset$  asbestos cement pipes. The total length of canal completed is 15,000 feet and total length of pipe crossing is 2,600 feet.

The conveyor canal has been one of the most difficult works of its kind in a much as it traverses rough and precipitous country where most of the excavation for access and terracing had been effected by blasting; the secondary distribution network covers a total length of 37,270 feet of pipes from 6" to 12" diameter with all the necessary accessories and structures for outlet and measuring devices.

### Polemidhia Distribution

The conveyor system from Polemidhia dam to Zakaki has been practically completed by the end of the year. A provision of £119,000 was made for these works of which £105,000 has been spent in 1967. The work is being continued in 1968.

Essentially the works consist of a composite pipeline of 30"  $\emptyset$  and 21"  $\emptyset$  from the dam to the main road of Zakaki of 27,000 feet length, two reinforced concrete pressure tank and one R.C.C. balancing tank, a concrete subsurface weir below the dam for the interruption of leakages and a number of special fittings and structures for branch division. At the time of writing the main branch line from Zakaki to Fasouri plantation of 7,400 feet x 24"  $\emptyset$  pipe is being laid for the completion of works included in the budget for 1967. The pipes used are Asbestos-Cement Class "B" but most of the special pieces for branch and measuring devices have been made of steel in the Departmental Workshops.

This is one of the largest works involving large diameter asbestos pressure pipes undertaken by the Department and special care has been taken for testing the pipelines.



LIST OF SCHEMES  
CONTINUED FROM 1966  
AND COMPLETED IN 1967

No.	Name	Money Spent to Completion 1967
1.	Western Mesaoria Lining of Canals	£ 20,000
2.	Ay. Yeorghios (Kyrenia) Recharge works	£ 2,000
3.	Famagusta - Dherinia Recharge Works	£ 6,666
4.	Makrasyka Recharge Works	£ 3,333
5.	Avgorou Recharge Works	£ 4,000
6.	Phrenaros Recharge Works	£ 1,334
7.	Kondea Recharge Works	£ 800
8.	Sotira (Famagusta) Recharge Works	£ 2,000
9.	Xylophagou (Larnaca) Recharge Works	£ 3,000
	Total	<u>£ 43,133</u> =====



LIST OF NEW IRRIGATION SCHEMES  
COMPLETED IN 1967

No.	Village	Nature of Work	Amount Spent £	Area Irrigated		Remarks
				Perennial	Seasonal	
<u>NICOSIA DISTRICT</u>						
1.	Galini ✓	Diversion Weir and channels for seasonal irrigation	1,550		100	
<u>LIMASSOL DISTRICT</u>						
2.	Pera-Pedhi ✓	Distribution Canals	2,200	120		
3.	Phini ✓	Distribution Pipe	350	16	19	
4.	Agros ✓	Small tank Distribution Works at the locality "Paliou"	1,140	15		
5.	Ay. Pavlos ✓	Conveyor Distribution Works (Locality Paliou and Stirakas)	1,620	54	8	
6.	Pelendri ✓	Small concrete Tanks and Distribution Works "Kato Psilo" "Hjstylianou" "Englissis"	2,640	44	29	
7.	Arakapas ✓	Lining of Distribution channels Locality "Avgoulos"	2,600	62	18	
8.	Dhymes ✓	Lining of channels Locality "Kambos"	1,100	20		
9.	Athrakos ✓	Irrigation Tank and Distribution Pipes (Mavrosykha)	960	26	14	
B.F.			14,160	357	188	



No.	Village	Nature of Work	Amount Spent £	Area Irrigated		Remarks
				Perennial	Seasonal	
		C.F.	14,160	357	188	
		<u>LARNACA DISTRICT</u>				
10.	Maroni ✓	Concrete Storage Tank & channels	2,370			
11.	Ay. Theodoros ✓	Repairs	750			
		<u>PAPHOS DISTRICT</u>				
12.	Kholi ✓	Distribution System Locality: Avlaki-tou-Knossou	1,560	25	22	
13.	Drymou ✓	Spring Development Tank and Distribution Works Locality: Old Village Spring	1,400	14	20	
14.	Drynia ✓	Distribution Pipes	1,580	19	21	
15.	Messa-Khorio ✓	Conveyor Pipes	300			
		<u>FAMAGUSTA DISTRICT</u>				
16.	Gastria ✓	Pumping Scheme	5,200	60	45	
17.	Gypsos ✓	Lining of channels	6,300		100	
18.	Kilanemos ✓	Conveyor and Distribution Works	840	26		
		<u>RECHARGE SCHEMES</u>				
19.	Ay. Napa (Famagusta) ✓	Construction of 3 No. small earth dams of total storage 5½ million gallons	3,300			
		C.F.	37,760	501	396	



No.	Village	Nature of work	Amount Spent £	1958		Remarks
				Perennial	Seasonal	
		B.F.				
20.	Pervolia ✓ (Larnaca District)	Two No. spreading grounds of 5 million storage capacity	37,760  750	501	396	
21.	Lyssi ✓	One earth dam of 17 million storage capacity	5,500			
22.	Akhna ✓ (Famagusta District)	One No. earth dam of 20 million storage capacity	3,250			
23.	Strovilia ✓ (Ay. Nicolaos of Famagusta)	One earth dam of 2 million storage capacity)	870			
		Total	£48,130	501	396	



MORPHOU PLAIN

(Lining of Irrigation Canals)

Appendix No. 13

No.	Name of Division	Quality of water conveyed gallons/hour	Total Estimated Cost	Money spent		Length completed		Balance for completion £
				1966	1967	1966 feet	1967 feet	
1.	Pano Zodhia ⊗	305,000	48,000	9,000	10,000	8,300	12,300	£ 29,000
2.	Kato Zodhia ⊗	473,000	56,000	9,000	10,000	9,560	13,200	£ 37,000
3.	Argaki ⊕	895,000	82,000	6,000	10,000	6,150	11,350	£ 66,000
4.	Katokopia ⊗	258,000	77,000	6,000	10,000	6,000	14,350	£ 61,000
5.	Prastio ⊗	619,000	63,000	9,000	10,000	8,500	12,000	£ 44,000
6.	Nikitas ⊗	246,000	30,000	9,000	10,000	10,850	14,600	£ 11,000
7.	Ovgos (Morphou) ⊗	1,000,000	84,000	7,000	10,000	8,000	11,000	£ 27,000 (£40,000 spent in 1965)
8.	Peristerona	384,000	100,000	-	-	-	-	£100,000
9.	Astromeritis	249,000	60,000	-	-	-	-	£ 60,000
10.	Akaki	190,000	80,000	-	-	-	-	£ 80,000
	Total	619,000	680,000		70,000		88,800	£515,000



LIST OF WORKS IN HAND  
AT THE END OF 1967  
AND CONTINUED IN 1968

No.	Name	Total cost	Money Spent in 1967	Remarks
1.	Peristerona-Astromeritis (Combined Division) Lining of the main conveyor canals ✓	£20,000	£ 7,000	
2.	Galata ✓	£11,500	£ 1,500	
3.	Milikouri ✓	£ 800	£ 100	
4.	Lyssi (minor recharge works) ✓	£ 400	-	
5.	Pyrgos (Limassol) Pumping scheme ✓	£ 4,300	-	
6.	Trimiklini ✓	£ 4,300	£ 3,700	
7.	Ay. Theodoros (Agros) ✓	£ 4,710	£ 3,500	
	Total Amount Spent in 1967		£15,800	



LIST OF SMALL IRRIGATION SCHEMES DESIGNED  
BY THE END OF 1967  
NICOSIA DISTRICT

Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
1	105/1963	Pera-Politiko	Division	Pedieos R.	Diversion Groyne and Intake channel for winter flood Irrig.	4,600	1/5	450 dons. Peren.
2	27/1939	Hrgates ✓	Division	Pedieos R.	- do -	2,000	1/5	300 " "
3	101/40	Akaki	Division N.2	Demoskes Mersini	Lining of channels	1,200	1/3	50 dons. Spring 10 dons. Peren.
4	57/51	Pato-Koutrafas ✓	Division	Valianitiko	Lining of channels	1,650	1/4	160 dons. Spring
5	45/51	Kalon Khorion Lefkas	Division	Sub-surface Dam	Well with infiltration gallons and pumping scheme	2,000	58%	120 dons. Peren.
6	127/40/112	Kannavia	Division	Vati	Lining of channels	580	1/3	5 dons. Spring 2 dons. Peren.
7	127/40/92/A	Milikouri	Division	Platis	Pumping Scheme	12,000	1/3	180 dons. Peren.



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
8	94/52/IV	Kythrea	Association	Kefalovryson of Kythrea	Lining of channels	12,379	50 (£6,150)	1,000 dons Peren.
9	36/42	Argates	Association	Kourtoutdji	Regarding lining of exfiltration Tunnel & general improvement	7,176	43	190 dons Winter 266 dons Spring 93 dons Peren.
10	107/52	Palekchori	Association	Kamini	Storage tank & lining of channels	970	44	15 dons Spring 10 dons Peren.
11	88/52	Pharmakas	Association	Koshina	Distribution system and lining of channels	2,800		146 dons Winter 70 dons Peren.
12	91/63	Pano Delftera	Association	Pavlaki	Chain-of-wells improvements and lining of channels	10,000	52	700 dons Winter 99 dons Spring 31 dons Peren.
13	127/40/56	Iakatamia	Association	Mavrovrysi	Lining of channels	27,000	56	2,800 dons Winter 800 dons Spring 200 dons Peren.



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution	Remarks
14	22/39	Galata	Division	Ganos-Gyros, Ay. Paraskevi	Distribution works (channels & pipes)	3,500	1/3	70 dons Spring 345 dons Peren.
15	127/40/25	Kakopetria	Division	Apliki, Taoutidhes	Lining of irrigation channels	12,000	1/3	45 dons Winter 115 dons Spring 100 dons Peren.
16	57/1951	Kato-Neoutrafas	Division	Near the village	Pumping scheme	7,000	1/3	53 dons Peren. 35 dons Spring
17	127/40/7/3	Moutoulidas	Division	Katouris River	General Consolidation of the exist. Distribution system	7,500	1/3	34 dons Peren. 32 dons Spring
18	61/1952	Farmakas	Association (2nd priority)	Dexameni tou Kaniniou	Distribution pipes	340	1/3	17 dons Peren.
19	103/44/IV	Yyliatos	Division	Palevros	Extension of the conveyor system	780	1/4	87½ Seasonal
20	94/53/IV	Upper Kythrea	Division	Pano & Kato Toumba Shellovarta Pertelemis	Lining of canals	2,400	1/3	92 dons Peren.



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
	<u>Solea Valley</u>							
21	"	Kaliana ✓	Division	Neron-Tis Tsappas	Lining of the conveyor canals	800	1/3	107 dons Peren. 43 dons Seasonal
22	"	Korakou ✓	Division	Esso Demma	" " "	4,800	1/3	587 dons Peren. 63 dons Seasonal
23	"	Tembria ✓	Division	Esso-Demma	" " "	5,200	1/3	242 dons Peren. 558 dons Seasonal
24	"	Evrykhou ✓	Division	Demma-Evrykhou	" " "	3,600		821 dons Peren. 679 dons Seasonal
25	"	Petra ✓	Division	Petrassis	" " "	4,000	1/3	322 dons Peren. 678 dons Seasonal
26	"	Katydhata ✓	Division	Neron-Tsamis Neron-Mylou	" " "	2,600	1/3	470 dons Peren. 230 dons Seasonal
27	"	<sup>ph</sup> Flassou ✓	Division	Koussouliotis	" " "	2,000	1/3	909 dons Peren. 91 dons Seasonal



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
28	127/40/103A	Lagon-dhara	Association	Pano Afrits	Irrigation tank & Distribution channels & pipes	600	List Wanted	10 dons Peren. 3 dons Seasonal
29	42/194E	Apliki	Association to be formed	Kalogyros (Tourkou)	Tank and pipes	2,250	List Wanted	31 dons Peren. 9 dons Seasonal
30	72/1963	Pendaya	Association	Kalokerinion Neron	Lining of canals	6,500	To be decided	143 dons Peren. 465 dons Seasonal
31	30/42/II	Galini	Division	Potamos tou Kambou	Lining of canals	25,000	1/3	1300 dons Peren.
32	69/52/III	Pyrgos	Division	Katouris Valley	Extension of the Distribution system for the dam. Stage I	10,000	1/3	1600 dons Seasonal
33	124/51/II	Kyra	Association	Summer Water	Pumping Scheme	10,600	44	(£4,664) (Combined with Massari Dam)

Note: (x) Schemes marked with asterisk are those included in the 1968 Programme of Works.



LIST OF SMALL IRRIGATION SCHEMES  
KYRENIA DISTRICT

Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contrib. %	Remarks
1*	79/1961	Karavas	Irrigation Association	Platani	Construction works lining of Distribution canals.	750	50	29 dons Peren.
2	50/1951	Yaravas	Association	Mezeze	Lining of channels.	500	49	15 dons Peren. 45 dons Seasonal

Note: (\*) Schemes marked with asterisk are those included in the 1968 Programme of Work.



LIST OF SMALL IRRIGATION SCHEMES

PAPHOS DISTRICT

Serial No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks (Irrigated area)
1	156/55	Ay. Marina Kelokednara	Division	Klimaterous wells	Excavation and building of spring	300	33	
2	96/44	Mandria	Division	Chain of wells	Lining of channels	12,700	33	2,200 dons Winter 1,300 dons Spring 600 dons Peren.
3	127/40/119	Tremithoussa	Association		Laying of pipes	180	44	5 dons Spring 10 dons Peren.
4	179/39/II	Nata	Division	Vrysi Livadhi	Excavation and building of springs, construction of two storage tanks and laying of pipes	2,100	33	20 dons Spring 17 dons Peren.
5	127/40/III	Ay. Ioarnis	Division	Palia Vrysi	Construction of storage tank and laying of pipes	700	33	6 dons Spring 7 dons Peren.
6	127/40/74	Kato Akourda-liu	Division	Pytharolakos	Construction of a diversion weir and distribution system	3,600	1/3	19 dons Peren. 33 Seasonal



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
7	127/40/L3	Prastio	Division	B/H173/61	Pumping unit	8,000	1/3	40 dons Spring 120 dons Peren.
8	99/54	Ay. Varvara	Division	Eziza river	Lining of channels	9,500	33	300 dons Peren.
9	20/43	Timi	Division	B/H No. 22/52	Pumping scheme	10,000	33	40 dons Spring 160 dons Peren.
10	88/61	Anarita	Division	BH 87/62	Pumping works and distribution system	13,500	1/3	40 dons Spring 140 dons Peren.
11	127/40/105	Miliou	Division	Potima	Weir and distribution system	2,950	1/3	30 dons Peren.
12	127/40/110/II	Parayia	Association	Sarka	Distribution pipes	2,380	40	25 dons Peren. 11 dons Seasonal
13	20/42	Kriton Terra	Division	Kefalovrysos	Channels and pipes for first distribution	7,410	1/3	88 dons Peren. 162 dons Seasonal



Ser. No. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
14	Milton	Association	Dexamet	Distribution pipes	1,200	40	9 dons Peren. Seasonal
15	Ejistrødt	Division	Kakoskala	Repairs to distribution system	480	1/3	9 dons Peren. Seasonal
16	Konla ✓	Division		Repairs	780	1/3	6 dons Peren. Seasonal
17	Kholetta ✓	Division	Village Division Nata-Kholetta	Lining of canals and repairs	1,120	1/3	Old irrigation
18	Tara	Association	Milari	Repairs	660	whole	Old irrigation

Note: (\*) Schemes marked with asterisk are included in the 1968 programme of work.



LIST OF SMALL IRRIGATION SCHEMES  
FAMAGUSTA DISTRICT

Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
1	143/39/II	Maratho- vounos Pyrga	Division	Neokhoritiko Merrades	Diversion weir & Earth Canals for spate irri- gation.	500	1/4	Flood irriga- tion
2	115/39/II	Styllos Limia	Division		Repair to culverts.	100	1/5	Spate irriga- tion



LIST OF SMALL IRRIGATION SCHEMES  
LARNACA DISTRICT

Ser No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
1*	58/42	Ay. Vavatsirias ✓	Division under formation	Kaloyiannos	Distribution works	1,035		Submitted 11/1/1956
2*	62/51	Ay. Vavatsirias ✓	Association	Diploma	Distribution works	1,050	49%	Submitted 11/1/1956
3	96/39	Khirokatia ✓	Division	Anefantis	Pumping scheme and Distribution System	3,400	1/3	120 dons Peren.
4	96/39	Khirokatia ✓	Division	Village Division	Phase II, extension of Distribution lined canals	5,200	1/3	350 dons Spring
5*	80/52	Ay. Vavatsirias ✓	Association	Kefalovrysos	Distribution pipes	1,000	1/3	6 dons Peren. 9 dons Seasonal

Note: (\*) Schemes with asterisk have been included in the 1958 Programme of Work.



LIST OF SMALL IRRIGATION SCHEMES  
LIMASSOL DISTRICT

Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
1	127/40/5/III	Ayios Ioannis ✓	Division	L. Akros	Distribution works	1,500	630	10 dons Spring 30 dons Peren.
2	"	" ✓	"	Pervolia	Distribution works, pipes and channels	540	140	16 dons Peren.
3	127/40/18/IV	Agridhia ✓	Division	Kaouris	- do -	900	300	17 dons Peren.
4	"	" ✓	"	Pano Enetikon	Distribution works pipes and channels	1,740	580	21 dons Spring 14 dons Peren.
5	"	" ✓	Association	Vrysi tou Khoriou to be formed	Distribution pipes	500	220	1 don Winter 7 dons Peren.
6	127/40/49/II	Kyperunda	Division	Deisis	Pipe distribution system	3,730	1/3	49 dons Spring 57 dons Peren.
7	127/40/134/2	Palerdria	Association	Nikomitis	Irrigation distribution channels	630	252	15 dons Peren.
8	61/42	Sililou	Division	Lavrania	Lining of channels	2,570	33	73 dons Peren.
9	109/44	Akrounda	Division		Distribution works	6,000	1/3	105 dons Spring 75 dons Peren.



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
10 <sup>⊠</sup>	112/59	K. Amiantos Palendria	Division	P. Phylagra	Storage tank and Distribution works	1,700	1/3	26 dons Peren.
11	45/44/II	Pvrros	- do -	Almyrovrisi	Lining of channels	4,000	( $\frac{1}{2}$ )1000	80 dons Seasonal
12	"	"	- do -	Dimma tis Regenas	- do -	3,500	( $\frac{1}{2}$ ) 875	300 dons Seasonal
13	127/40/23	Omodhos		Pigathi	Irrigation tank & distribution pipes	900	1/3	8 dons Spring 7 dons Peren.
14	127/40/49/35	Kyperourda	Association to be formed	Frakti Postani	Excavation of spring pumps & distribution works	1,200		8 dons Spring 7 dons Peren.
15	127/40/54	Athrakos	Division	Mavrosykotis	Irrigation tank and distribution (works) pipes	960	1/3	14 dons Spring 26 dons Peren.
16 <sup>⊠</sup>	127/40/34/II	Ynusa	Division	---	Extension and completion of the distribution system	3,100	1/3	59 dons Peren.
17	63/65	Lypaounda	Nothing	Livadhinitis Mesis	Irrigation tank and distribution pipes	1,250	1/3	22 dons Peren. 18 dons Spring
18	127/40/49/22	- do -	- do -	Klima	Irrigation tank and distribution pipes	1,000	1/3	10 dons Peren. 5 dons Spring



Ser. No.	W.D.O. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
19	28/42	Lemythou ✓	Division		Conveyor and distribution pipes	1,200	1/3	52 dons Peren. 8 dons Spring
20	27/40/15/C	Kalon-Khorion ✓	Division	Near the village	Consolidation of distribution system	1,150	1/3	44 dons Peren. 16 dons Spring
21	127/40/49/3	Kyperounda	Subject to the formation of Div. or Assoc.	Appis	Distribution R.C.C. canals and pipes	600	;	12 dons Peren.
22	127/40/95/II	Potamitissa ✓	Division	P. & K. Potami	Irrig. tank and Distrib. pipes	1,140	1/3	22 " "
23	127/40/95/II	" ✓	Nothing	Hassanis	Tank and irrig. channels	1,200		16 " " 4 dons Spring
24	127/40/47/II	Ay. Paidos ✓	Division	Thimmatou Khorion	Distribution pipes	500	1/3	50 dons Peren. 50 dons Spring
25	127/40/49/34	Kyperounda	(To be formed)	Thymon spring	Distribution pipes	1,350	;	20 dons Peren.
26	127/40/49/II	Kyperounda	Division	Kialia	Irrig. tank and Distr. pipes	900	1/3	14 dons Peren.
27	127/40/52/III	Ay. Ioannis Agrou	Division	Aggoulos Dhipotamia	Distribution channels	900	1/3	12 " "



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
28 <sup>#</sup>	127/40/134/C	Telemara ✓	Division	Kountourides	Distribution channels	1,100	1/3	45 dons Peren.
29	42/1943/2	Phini	Division	Thima tou Milou	Distribution works	9,300	1/3	371 dons Peren.
30	127/40/165,2	Tris Elies	Division	Milarga	Extension distribution works	2,800	1/3	50 " "
31	"	"	"	Drakontas	Extension distribution	5,700	1/3	180 " "
32	"	"	To be formed	Diplomata	Irrigation scheme, diversion & distribution system	2,300	1/3	25 " "
33 <sup>#</sup>	127/40/145/II	Kato Amiandos ✓	Nothing	Kardhama	Channels and pipes distribution system	1,100		17 " " 13 dons Spring
34	43/42/II	Kilani	Division	Asomatos-Skotini-Ayia Marri-Iacovides-Amoutti	Distribution works	6,650	2.217	150 dons Peren. 150 dons Spring
35	127/40/59/II	Louvaras	Nothing	Tsoukallas	Tank and distribution pipes	630		6 dons Peren. 4 dons Spring
36 <sup>#</sup>	127/40/99/V	Agros ✓	Division	Milos Lambada	Distribution channels	900	1/3	25 dons Peren.



Ser. No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
37	31/54/II	Ay. Demetrios ✓	Division	Kaloyiros	Irrigation tank and Distribution system	2,700	1/3	151 dons Peren. 34 " Spring
38	127/40/43/47	Kypounda	Nothing	Halospitia	Irrigation tank and distribution pipes	1,200		15 " Peren.
39	127/40/1/134/C	Pelendria ✓	Nothing	Pervoloudia	Irrigation tank and distribution pipes	1,150		8 " Peren. 4 " Spring
40	127/40/22	Dhemos	Association or Division to be formed	Hji. Pelendria	Distribution Canals	900	?	16 Cons Peren.
41	71/41	Potamicu	Division	Kha-Potami	Diversion & distribution works	2,150	1/3	27 " Peren.
42	70/49	Ypsonas	Division	Kourris River	Repairs	600	1/5	---
43	36/43/II	Eptayoria ✓	Association	(Pothos Piyi)	Tank & distribution pipes	2,600	42	13 " " 33 " Seasonal
44	127/40/99	Agros ✓	Division	1. Paliolinos	Channel and pipes	500	1/3	4 " Peren.
			Division ✓	2. Kaoukkaris	Pipes	600	1/3	6 " "
			Division ✓	3. Kato-Erimmos	Distribution canals and pipes	750	1/3	20 " "
			Association ✓	4. Dhikhalo-rotsos (2)	R.C.C. canals	1,200	data	20 " "



Serial No.	W.D.D. reference	Village	Division or Association	Locality	Nature of proposed works	Estimated Cost £	Village Contribution %	Remarks
45	95/45/II	Arsoz (I/3501)	Irr. Division		Extension of distribution system small dams	2,600	1/3	71 dons 59 dons
46	49/46/II	Dheroma		Kamaroudha	Repairs and improvements	300	1/3	
47	42/43/II	Print	Division	Ambelakt	Development of springs and distribution works	4,000		28 dons Peren. 14 dons Seasonal
48	127/40/7/II	Arsoz Pavlos	Division	Yemaitzin	Distribution works	510	1/3	12 dons Peren. 8 dons Peren. 2 dons Seasonal
49	127/40/18	Agriadhia	Association	Yeratzia Mersinaki	Distribution pipes	260		
50	127/40/59/1	Agros	Division	Dikhlorotsos	Small tank & distribution pipes	930		10 dons Peren.

Note: (\*) Schemes marked with asterisk are included in the 1968 Programme of Work.



## VILLAGE DOMESTIC WATER SUPPLIES

Prepared by H. Karakannas

The Village Domestic Supplies Section is dealing with the domestic water supply of all villages in the island, and the towns of Larnaca, Paphos and Kyrenia. The rural population together with the population of these three towns represents over 400,000 people or about 66% of the total population of Cyprus.

When in 1962 the Five Year Development Plan was adopted by the Government, it was well realized that no single factor has a more decisive influence on the behaviour and development of human beings than water for domestic use. For this purpose an amount of about £3,000,000 was earmarked, and the goal, so that every village in the island should have adequate and wholesome water for its social and economic benefits, has been achieved by the end of 1967.

The activities of the Section during 1967 have been above the normal rate, mostly in supplying water in greater quantities and modernizing the distribution system of the villages, connecting all houses to the public main, so that the housewife has water in the tap in the kitchen, and the farmer in the bath after his day's work in the fields. In general, that all the rural population has the same water facilities as the people in the towns, thus improving and maintaining his standard of living.

Notwithstanding the fact, however, that so much has been achieved in this sphere, and our island at this moment is privileged to be favourably compared with other well developing countries, more work will have to be done even at the normal rate as regards domestic supplies. Such work will be in providing additional water for those villages, where their sources have been diminished due to subnormal rainfall or the underground resources depleted by the interference from over pumping, at the same time, meeting the natural increase of population and rise in consumption demand as well.

For comparison, it may be stated that in 1932, 4 gallons per day per head were considered adequate. In 1950, 10 gallons per day per head were considered adequate. At present, the average consumption is 20 - 25 gallons per day per head, and it is expected to rise to 30, to meet the rapid rise in the standard of living of the rural population.

So, new water sources will have to be found and possibly in the years to come our villages in the plains may have to be supplied from the sea if there is a breakthrough in the desalination process, comparable economically with the conventional sources.

At the end of 1967, out of the 628 villages only 2 very small villages with a combined population of only 540 persons namely Asomatos and Meneou in Limassol and Larnaca Districts had not a piped supply.



Seventy four villages with a total population of 41,278 have an unsatisfactory piped supply ( a quantity of less than 10 g/p/h/d in summer ) and communal street fountains, needing up-to-date distribution system, and a house-to-house service on the Municipal Supplies standard. It may also be recorded that 314 villages with a population of 290,172 persons, or 69.48% of the total rural population of the island have a satisfactory piped supply, 20 - 25 g/p/h/d, with a house-to-house service, and 233 villages, with a total population of 77,603 or 18.58%, have an adequate supply, but their present distribution system (public street fountains) needs major improvements for its modernization on the present Municipal standards.

### Financing

The cost of each scheme is subsidized by Government by 50% as a practice. Any extra cost for the implementation of a house-to-house service over and above the village standard scheme is borne by the village, and the cost of the service pipes for the house connections is borne by the consumer.

It may be noted that the funds for new schemes were made available late in the year and most of the schemes could not be completed during the budgeting year. In spite of this the expenditure reached the figure of £194,000. Two of the major schemes, namely the scheme for the dry villages of Messaoria to be served from one borehole drilled in the Hilarion limestone at "Mouzomenos Spilios" north of Kythrea could not be put in hand due to administrative obstacles, and the other scheme to supply Stylos, Engomi, Limmia, Ayios Serghios and Salamina from one borehole in Kalopsida could not proceed, due to serious interference by the people of Kalopsida.

The main source of supply is, nowadays, the underground water through boreholes, and the safe guarding of the aquifers in the plains is of paramount importance for the upkeep of the domestic supplies to a satisfactory degree. All pumped supplies are operated by means of a turbine pump, assembled with a diesel engine, or where electricity is available by electrosubmersible pumps. The latter ones through rather delicate and of more complicated construction still in view of their simplicity in installation, light in weight and the deep aquifers, are more suitable and preferred to the diesel driven ones. In all schemes at least one day's storage is provided.

In 1967, an amount of £302,730, including revotes and deposits, was made available for village domestic supply schemes. Twenty seven schemes were executed serving a population of 23,873 persons. - 120.994 miles of pipes varying in size from 1/2 - 12 inches were laid. Eleven reinforced concrete circular tanks of a total capacity of 249,000 gallons and five pump houses were constructed. A house-to-house service system was provided to seventeen villages and 3,400 house connections were made.



A pumping scheme for Mathiatis village has been completed during 1967. This village had no piped supply before, and the people had to be supplied with domestic water from wells and other sources which were liable to contamination. The source of supply is a successful borehole No. 6/66 situated near the village. The water is pumped into a 10,000 gallons capacity R.C.C. circular tank and from there it is distributed throughout the village by means of water meters.

Another pumping scheme completed during the year in the Nicosia district is the scheme for Kato-Moni. The source of supply is again a successful borehole No. 58/66 from which water is pumped by means of an electrosubmersible pump into a 20,000 gallons capacity R.C.C. circular tank. A house-to-house service has been implemented and eighty water meters 1/2 inch in diameter have been installed.

Another new scheme for Kharcha village has been executed during the year in the Kyrenia district. The source of supply is a successful borehole No. B16 which also provides Ayios Amvrosios with domestic water. The scheme included the laying of 11,000 feet of galvanized iron main 2 inches in diameter between the borehole and the village, the construction of a 20,000 gallons capacity circular tank and the distribution of the water throughout the village. A house-to-house service has been implemented and 150 water meters 1/2 inch in diameter have been installed.

Reinforced concrete tanks

Service reservoirs Nos. 11 (249,000 gal.capacity).

School tanks No 5.

Pumping stations 5.

House connections 3,400.

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 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.

Lists showing the number of villages with piped water supply, schemes completed during the year, schemes on hand at the end of the year and schemes prepared for execution are given in Appendices 17, 18, 19, and 20.



LENGTH OF PIPES LAID IN 1967

Galvanized Mild Steel Pipes

Size Nominal Diameter	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	TOTAL
Length in Miles	7.519	0.390	9.518	18.507	10.636	18.128	6.689	15.306	9.954	96.647

Asbestos - Cement Pressure Pipes

Size Nominal Diameter	2"	3"	4"	6"	8"	10"	12"	15"		TOTAL
Length in Miles	0.231	7.329	7.021	6.630	0.529	1.802	0.805	-		24.347



VILLAGE DOMESTIC WATER SUPPLY

Schemes Completed In 1967

Ser. No.	Village	Type of Scheme	G.P.D. Daily Quant. Available	Population 1960 census	Nature of work	Estimated Cost £
<u>NICOSIA &amp; KYPRONIA DISTRICT</u>						
1.	Kato - Moni	Pumping	5,000	253	≠ H	£ 6,800
2.	Mathiatis	"	8,000	409	≠ H	£ 9,800
3.	Klirou	"	12,000	1,008	+ H	£ 8,850
4.	Kharcha	"	12,000	600	≠ H	£ 9,500
Total:-			37,000	2,270		£34,950
<u>FAMAGUSTA DISTRICT</u>						
1.	Trikomo	Pumping	44,000	2,195	+	£ 5,700
2.	Leonarisso Regional Scheme	"	70,000	3,523	+	£ 2,500
3.	Mandres	Gravity	8,000	398	+ H	£ 2,700
4.	Ephtakomi	Pumping	20,000	971	+	£ 2,400
5.	Makrasyka	"	15,000	747	+	£ 900
6.	Kantara	"	6,000	-	+	£ 800
7.	Yialousa	"	50,000	2,541	+	£ 600
Total:-			213,000	10,375		£15,600
<u>LIMASSOL DISTRICT</u>						
1.	Ayios Ioannis (Agros)	Gravity	18,000	875	≠ H	£ 6,900
2.	Episkopi	Pumping	40,000	1,987	+	£ 2,200
3.	Kalokhorio (z)	Gravity	11,000	549	≠ H	£ 6,650
4.	Vouni	"	20,000	990	+ H	£ 1,400
5.	Platres Pano	"	20,000	413	+	£ 800
6.	Platres Kato	"	6,000	309	+ H	£ 300
7.	Prastio (Kelaki)	"	4,000	195	+ H	£ 200
8.	Pyrgos	"	14,000	702	+ H	£ 400
9.	Lania	"	6,000	282	+ H	£ 200
10.	Mandria	"	6,000	272	+ H	£ 200
11.	Potamiou	"	5,000	247	+ H	£ 200
12.	Apsiou	"	6,000	293	+ H	£ 500
Total:-			156,000	7,114		£19,950



Ser. No.	Village	Type of Scheme	G.P.D. Daily Quant. Available	Population 1960 census	Nature of Work	Estimated Cost £
<u>LARNACA DISTRICT</u>						
1.	Mosphiloti	Pumping	5,000	353	+	£ 800
						£ 800
<u>PAPHOS DISTRICT</u>						
1.	Polis )	Gravity	32,000	1,645	≠ H	£ 19,000
2.	Prodhromi(		10,000	518	≠ H	
3.	Panayia-Amargeti	Gravity	32,000	1,598	+	£ 3,500
Main pipeline						
Total			74,000	3,761		£ 22,500

SUMMARY

Nicosia & Kyrenia	£ 34,950
Famagusta	£ 15,600
Limassol	£ 19,900
Larnaea	£ 800
Paphos	£ 22,500
<b>Total:-</b>	<b>£ 93,750</b>



VILLAGE WATER SUPPLY SCHEMES  
IN HAND AT THE END OF 1967

Ser. No.	Village	Amount Revoted
<u>Nicosia &amp; Kyrenia District</u>		
1.	Kalokhorio (Klirou)	£ 6,090
2.	Potamos - tou - Kambou	£11,180
3.	Khrysiliou	£ 2,540
4.	Ayios Epiphanius	£ 4,000
5.	Nikitari	£ 1,200
6.	Kythrea	£ 8,800
7.	Karmi )	
8.	Trimithi (	
9.	Ayios Yeorghios(	<u>£ 7,500</u>
		£41,310
<u>Famagusta District</u>		
1.	Eastern Mesaoria Dry Villages	£20,000
2.	Gypsos - Milia - Piyi - Peristerona	£ 730
3.	Stylos - Engomi - Limnia - Ayios Serghios - Salamina	<u>£ 9,330</u>
		£30,060
<u>Larnaca District</u>		
1.	Pyla	£ 5,140
2.	Voroklini - Livadhia	<u>£14,660</u>
		£19,800
<u>Paphos District</u>		
1.	Arminou	£ 4,600
2.	Polemi	<u>£ 5,240</u>
		£ 9,840

SUMMARY

Nicosia & Kyrenia District	£ 41,310
Famagusta District	£ 30,060
Larnaca District	£ 19,800
Paphos District	<u>£ 9,840</u>
Total:-	<u>£ 101,010</u> =====



VILLAGE DOMESTIC WATER 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 G.P.D.	Estimated Cost £
1.	Morphou	6,642	⊗ H	300,000	£ 86,000
2.	Aredhiou	355	⊗ H	7,000	£ 8,450
3.	Kythrea Lower Villages				
	Neokhorio ) Trakhoni ( ) Palekythro ) Voni ( ) Epikho ) Exometochi ( )	5,100	⊗ H	100,000	£ 60,000
4.	Vasilia ) Agridhaki ( ) Sisclipos ( ) Ayios Ermolaos ( ) Ayia Marina (Skyl.) ) Asomatos ( ) Panagra ( ) Orga ( ) Liveras ( )	3,531	⊗ H	70,000	£ 75,000
5.	Dhikomo Kato ) Dhikomo Pano ( )	2,592	+ H	50,000	£ 19,000
6.	Gourri	392	+ H	8,000	£ 1,900
7.	Lythrodontas	1,488	+ H	30,000	£ 12,200
8.	Pyroi	466	+ H	10,000	£ 2,000
9.	Lymbia	1,383	+ H	30,000	£ 11,600
10.	Ayia Kebir	418	⊗ H	10,000	£ 16,150
11.	Pendayia	1,105	+ H	22,000	£ 14,950
12.	Alona ) Platanistasa ( )	1,159	+ H	24,000	£ 40,000
13.	Apliki	120	+ H	2,400	£ 1,750
14.	Kambi (Pharmaka)	228	⊗ H	4,500	£ 2,600
15.	Sarandi	164	⊗ H	3,400	£ 2,500
16.	Nikitari	450	⊗ H	9,000	£ 6,600
17.	Tembria	690	+ H	14,000	£ 12,120
18.	Varishia	223	+ H	4,600	£ 2,600
	C/F	26,506		698,900	£375,420



Ser. No.	Village	Population 1960 census	Nature of Scheme	Quantity of Water to be Available G.P.D.	Estimated Cost £
	B/T	26,506		698,900	£ 375,420
19.	Vroishia	235	+ H	5,000	£ 6,700
20.	Palekchori (Orinis)	832	+ H	16,000	£ 3,300
21.	Pharmakas	479	+ H	10,000	£ 2,720
22.	Kato Pyrgos	1,049	+ H	20,000	£ 16,800
23.	Ayios Epiktitos) Klepini (	1,425	+ H	30,000	£ 7,000
24.	Bellapais) Kazaphani(	1,788	≠ H	36,000	£ 22,000
25.	Yierakies	520	+ H	10,000	£ 2,300
26.	Ayia Marina (Xyl.)	516	+ H	10,000	£ 6,900
27.	Kaliana	358	+ H	8,000	£ 2,700
	Total:-	33,708		843,900	£ 445,840
<u>Famagusta District</u>					
1.	Yialousa	2,541	+	60,000	£ 2,600
2.	Marathovouno	2,020	+ H	40,000	£ 9,900
3.	Korovia Regional Scheme	2,356	+	46,000	£ 3,600
4.	Komi Kebir) Ofkoros ( ) Patriki ( ) Kridhia ( )	2,248	+ H	45,000	£ 25,910
5.	Ashia	2,209	+ H	44,000	£ 19,500
6.	Angastina	778	+ H	16,000	£ 6,800
7.	Pyrga	449	+ H	9,000	£ 3,900
8.	Vitsadha	402	+ H	8,000	£ 3,500
9.	Kalopsidha	975	+	20,000	£ 3,400
10.	Kondea	1,305	+ H	26,000	£ 7,850
11.	Mousoulita	219	+ H	4,000	£ 1,330
12.	Aphania	811	+ H	16,000	£ 6,680
13.	Rizokarpasso	3,154	+	62,000	£ 1,800
14.	Ayios Nicolaos	309	+ H	6,000	£ 2,000
15.	Phrenaros	1,439	+	30,000	£ 4,000
16.	Phlamoudhi	299	≠ H	6,000	£ 8,000
	Total:-	21,514		438,000	£ 110,770



Ser. No.	Village	Population 1960 census	Nature of Scheme	Quantity of Water to be Available G.P.D.	Estimated Cost £
<u>Limassol District</u>					
1.	Soumi-Zanadja	66	≠ H	2,000	£ 4,000
2.	Asomatos	340	≠ H	7,000	£ 6,700
3.	Kilani	1,034	+ H	20,000	£ 2,300
4.	Sykopetra	217	≠ H	4,000	£ 2,800
5.	Pendakomo	598	+ H	12,000	£ 11,900
6.	Parekklishia	577	+ H	12,000	£ 2,400
7.	Potamos tis Yermasoyias and the coastal area	1,748	≠ H	40,000	£ 47,000
8.	Prastio (Evdimou)	342	+ H	7,000	£ 3,300
9.	Erimi ) Kolossi(	1,352	+ H	27,000	£ 2,400
10.	Pano Kividhes	456	≠ H	9,000	£ 4,150
11.	Ayios Dhemetrios	223	≠ H	5,000	£ 3,900
12.	Phini	924	+ H	20,000	£ 5,000
13.	Paleomylos	200	+ H	4,000	£ 1,700
14.	Anoyira	620	+ H	12,000	£ 4,000
15.	Kouka	63	+ H	1,000	£ 1,100
16.	Zoopiyi ) Kellaki ( ) Prastio ) Kalonkhorion( ) Louvaras ) Eftagonia ( )	2,172	≠ H	40,000	£ 46,100
		10,932		232,000	£148,750



Ser. No.	Village	Population 1960 census	Nature of Scheme	Quantity of Water to be Available G.P.D.	Estimated Cost £
<u>Larnaca District</u>					
1.	Livadhia	1,329	+ H	26,000	£ 8,900
2.	Ayia Anna	182	≠ H	4,000	£ 3,700
3.	Dhromolaxia	594	+	12,000	£ 4,600
4.	Kornos	859	+ H	18,000	£ 700
5.	Meneou	170	≠ H	4,000	£ 3,400
6.	Melini	221	+ H	5,000	£ 3,000
7.	Kato Dhrys ) Vavla ( ) Lefkara Kato ) Lefkara Pano (	2,515	≠ H	50,000	£ 39,200
8.	Alaminos	564	+ H	12,000	£ 1,100
9.	Pyrga	381	+ H	6,000	£ 3,600
	Total:-	6,815		137,000	£ 68,200

+ Improvement  
 ≠ New Scheme  
 H House to have supply.

Paphos District

1.	Nikoklia	139	≠ H	3,000	£ 2,600
2.	Yiolou	605	+ H	12,000	£ 4,900
3.	Kritou - Terra	518	+ H	10,000	£ 1,900
4.	Erba	1,027	+ H	20,000	£ 6,500
5.	Peristerona	355	+ H	7,000	£ 2,000
6.	Ayios Nicolaos	418	+ H	8,000	£ 3,200
7.	Episkopi	726	+ H	14,000	£ 5,600
8.	Ayios Ioannis	819	+ H	16,000	£ 2,900
9.	Lemona	241	+ H	5,000	£ 1,400
10.	Magounda	196	+ H	4,000	£ 700
11.	Akoursos	194	≠ H	4,000	£ 2,200
12.	Annadhiou	203	≠ H	4,000	£ 1,500
	C/F	5,441		107,000	35,400



Ser. No.	Village	Population 1960 census	Nature of Scheme	Quantity of Water to be Available G.P.D.	Estimated Cost £
	B/F	5,441		107,000	£ 35,400
13.	Kilinia	229	+	4,000	£ 500
14.	Arminou	250	+ H	5,000	£ 4,600
15.	Kedhares	259	× H	5,000	£ 1,800
16.	Loukrounou	35	× H	1,000	£ 350
17.	Polemi	880	+ H	18,000	£ 8,400
18.	Pretori	392	+	3,000	£ 720
19.	Stavrokonnou	627	+	12,000	£ 1,000
20.	Tsadha	907	+ H	18,000	£ 5,100
21.	Phiti ) Lassa ( ) Ayios Dhemitria- ) nos ( ) Kathikas ) Polemi ( ) Psathi )	2,563	+	65,000	£ 10,000
Total:-		11,583		243,000	£ 67,870

SUMMARY

1.	Nicosia & Kyrenia	£ 445,840
2.	Famagusta	£ 110,770
3.	Limassol	£ 148,750
4.	Larnaca	£ 68,200
5.	Paphos	£ 67,870
Total:-		£ 841,430



DEPARTMENT OF WATER DEVELOPMENT

NUMBER AND PERCENTAGE OF VILLAGES WITH PIPED SUPPLY 1967

District	Satisfactory Piped Supply								Unsatisfactory Piped Supply								No. Piped Supply				Total Pop.	
	Villages with House-to-house				Villages with Fountains				Villages with House - to - house				Villages with Fountains				No. of Villages					Total No. of Villages
	No.	%	Pop.	%	No.	%	Pop.	%	No.	%	Pop.	%	No.	%	Pop.	%	No.	%	Pop.	%		
Nicosia	90	50.56	119,243	75.06	62	34.83	24,877	15.66	-	-	-	-	26	14.61	14,735	9.28	-	-	-	-	178	158,855
Kyrenia	21	44.68	15,261	55.46	14	29.79	5,145	18.69	1	2.13	3,496	12.70	11	23.40	3,615	13.15	-	-	-	-	47	27,517
Famagusta	57	58.16	57,709	72.49	21	21.43	6,873	8.63	2	2.04	1,893	2.37	18	18.37	13,140	16.51	-	-	-	-	98	79,615
Limassol	73	64.00	49,178	77.18	33	28.95	9,178	14.40	-	-	-	-	7	6.14	4,987	7.83	1	0.88	370	0.59	114	63,713
Paphos	49	37.12	25,543	52.05	82	62.12	23,283	47.44	-	-	-	-	1	0.76	250	0.51	-	-	-	-	132	49,076
Larnaca	24	40.00	23,238	59.84	21	35.59	8,247	21.23	2	3.39	2,630	6.77	11	18.64	4,551	11.72	1	1.60	170	0.44	59	38,836
Total	314	50.00	290,172	69.48	233	37.10	77,603	18.58	5	0.80	8,019	1.92	74	11.78	41,278	9.88	2	0.32	540	0.14	628	417,612



CONSTRUCTION DIVISION

Prepared by H. Karakannas  
Chief of Division

(a) Major Projects

The activities of this Division during 1967 have been concentrated on the construction of the four major Dams, namely Yermasoyia, Mavrokolymbos, Kalopanayiotis and Synglassi of a total impounding capacity of 3,825 M.G.

The Division took charge of the administrative and technical supervising aspects of the Yermasoyia Dam, in conjunction with the consultants Messrs. Energoprojekt of Yugoslavia, while all structural work was carried out by Messrs. Cybarco Co. Ltd., to whom it was entrusted by Tenders, at the tendered price of £ 612,000. All work in the other three Dams, and the construction of the Phinikaria and Akrounda deviation roads was carried out by the Construction Division. Here under is an outline of the work executed during the year.

1. Mavrokolymbos Dam

This Dam is built in the Mavrokolymbos river, and was completed by Messrs. Cybarco at the end of 1966. During the period of maintenance the Contractor was working outstanding works and repairs.

In April 1967, left the site. During the year a group of labourers and artisans were employed continuously with the purpose of completing certain works recommended by the Inspecting Committee, such as, i) Random backfill behind the retaining walls of the spillway, ii) Drainage trenches situated above the spillway excavation with the concrete lining, and several other odd, finishing works.

Due to the abnormal high rainfall during 1967 over the catchment area of this Dam, as well as due to the excavations on the reservoir area, major landslides of the soils in the reservoir occurred with the result that it became unadvisable to fill the Dam, before site investigations were carried out, as to the possible movements of the ground slopes behind the Dam.

After studies and recommendations by Messrs. Morgenstern Kennard of London, in consultation with Messrs. Energoprojekt of Yugoslavia, some minor remedial works were commenced on the 24th of August. In November the above specialists visited the site again, and on their advice some pits were excavated for geological studies and the installation of Piezometers.

Remedial works in Zone 8 were carried out and the slide area regraded to a stabilized slope. The tunnel was also extended, and a new intake was constructed.



2. Yermasoyia Dam (by C. Andreou, Executive Engineer)

A. Introduction

The Yermasoyia Dam is an earth dam of a height of 111 feet from the river bed. It is situated above Yermasoyia Village at a distance of  $4\frac{1}{2}$  miles approximately from the main Limassol-Nicosia road. Its elevation above M.S.L. is about 180 ft. and its storage capacity 3080 M.G. After its completion, it will be the largest dam in Cyprus. The design of the dam was prepared by Messrs. "ENERGOPROJEKT", Consulting Engineers Beograd, and the construction was undertaken by Messrs. CYBARCO Ltd., in January, 1966.

This multipurposed scheme is estimated to cost £1.357.000, including the distribution system.

B. Progress of the works

I. Dam

1. Cut-off Trench Excavation and Filling

Most of the job for the excavation of the cut-off was done in 1966 from section 1A, section 6B in the river bed.

On the 25th April 1967, the Contractor was approved to continue with the excavation of the remaining part of the cut-off trench at the right side. The material from the excavation was stocked piled, to be used later for upstream shellfill of the embankment. On the 5th of July 1967 and between section 7 and 7E the underground water appeared at the elevation of 190'. The excavation was continued under difficult conditions and was completed on the 5th August, 1967, at the elevation 158' on profile 7D. The contractor proceeded very quickly with the rock surface preparation and after the underground water was controlled by continuous pumping the clay filling started on the 7th August. From bottom elevation of the cut-off (158') between profiles 7E - 7C the contractor used fat clay from Borrow area U2 (Phinikaria clay) upto the elevation 165 according to the Resident Engineer's instructions. The compaction of the area was done by traxcavators and pay loaders. From the elevation 165' up, it was used clay of medium plasticity from borrow area XB and the compaction was done by sheepfoot rollers. Parallel to the works the contractor started on the 2nd of August the dewatering of the flooded part of the cut-off trench which was filled up to the elevation 176 in 1966, from profiles 1A - 6B. The water was diverted to the left side of the cut-off from where it was pumped into the tunnel. By the 26th of August, the cleaning of the mud was completed and all leakages were under control. Soon after the Contractor started with the filling works with clay from borrow area XB. On the 2nd September, all the cut-off trench in the river bed was filled upto the designed elevation 180 feet.

2. Cut-off Trench Excavation in Abutment

This excavation was done periodically according to the Contractor's convenience. The right side was completed by the end of the year, whereas the left side is still of the elevation 263 feet.



### 3. Embankment

After the cut-off trench was completed the contractor proceeded with the filling of the embankment. From the beginning of September till the end of the year the contractor was working in two shifts. The average elevation of the bank on 31st December was 265'. The estimated fill-up to the elevation 291 according to the alteration of design was 650.000 cu.yds.

The following quantities of compacted material were placed:-

	<u>1967</u>	<u>Total</u>
Clay	86619	114363
First Filter Zone	41678	41678
Second Filter Zone	35553	47227
Random Fill	109798	266066
River Cobble Gravel	92384	97999
Weightening Zone	17634	24194
	<u>383666</u>	<u>591524</u>

We can say that 90% of the filling works was completed by the end of 1967.

### 4. Rip-Rap

The total amount of the rip-rap placed during the year is 11563 sq.yds which is 55% of the estimate quantity. No rip-rap was placed in 1966.

## II. Tunnel and Shaft Excavation and Concreting

The excavation and concreting of the tunnel was nearly completed during the first year of the construction. The remaining work at the inlet and outlet as well as the roof of the Valve Chamber were put in hand as soon as the river flow through the tunnel was terminated early in June. All concrete works connected with the tunnel and shaft were completed by November 1967.

## III. Spillway

### 1. Excavation

The spillway excavation continued throughout the year.

More importance was given to that part of spillway which was related with concrete works and was completed in May 1967. The remaining part of the spillway excavation at the right side stages continued along the year and it is still going on.

The total amount of excavation performed since 1966 is 208.649. The amount of 63 50 cu.yds was performed in 1967.



## 2. Concrete

The first casting on the spillway was on the 20th March 1967, on the flip bucket left wall. The contractor proceeded with the concreting of the spillway chute and side walls very quickly and by the end of October all concrete works connected with the spillway chute there were nearly finished.

The concreting of the weir and pier which is considered as the most complicated concrete part of the spillway started in April and is still going on in a very slow way. The total concrete works on spillway were estimated to 14,500 cu. yds. and the amount of 10,000 cu. yds were poured during 1967. No concrete work on spillway was done during 1966.

## IV. Grouting Works

### 1. Grouting Curtain

The Grouting sub-contractor started with the drilling in the zone two for the alluvium grouting on the 10th of January 1967. The first phase grouting composed of cement-bentonite started in the test block 1 on the 12th of April, 1967, and was completed by the end of May.

The grouting of the test block 2 started soon after the completion of the test block 1.

For the 2nd phase, grouting in the alluvium, it was originally designed that the mixture to be used should be composed of sodium bicarbonate and silicate. Early in May, a meeting was held on the site in the presence of Mr. Kennard, Representative of Sandeman, Kennard and Partners Grouting Consultants, London, and the Director of the Water Development Department, decided to use Cemex A instead of the sodium bicarbonate and silicate. The grouting with this material started on the 29th of May in block 1. All grouting works in the river bed cut-off trench, zone 2 were completed on the 17th of August, 1967, and the contractor moved to the right and left extension.

### 2. Left Bank Extension

The grouting works on the left bank extension continued during the year with the exception of one break between May - August when the contractor's equipment was occupied in the river bed section for the alluvium grouting.

The whole work was completely finished before Christmas holidays.

### 3. Right Bank Extension

In July, 1967, the Resident Engineer requested the contractor to drill some exploratory holes on the right bank to determine the permeability of the rock. The permeability results were not satisfactory and the extension of the grouting curtain was decided. The work for the extension started on the 28th of August, and were entirely finished on the 21st of November.



#### 4. Tunnel Shaft and Valve Chamber Grouting

When the river flow through the tunnel was reduced to permit the commencing of the grouting work the contractor moved his equipment into the tunnel and started with the drilling on the 22nd of June. The grouting in the tunnel and shaft was completed in October 1967.

#### 5. Spillway Foundation Grouting

For the Spillway Foundation Grouting the contractor was instructed to embed stand pipes at the designed positions in the concrete to avoid the drilling through concrete and reduced the amount of drilling. The grouting works started on the 22nd of May and the work was fully completed on the 23rd June 1967.

#### 6. Contact Stage Grouting

This work was not included in the original design, but it was decided later in the steep left abutment and is estimated to cost £5,000 approximately. The work commenced on the 12th of December and is still going on with the process of drilling.

### V. Hydromechanical Equipment

#### 1. Irrigation Pipe

The 24"Ø discharge pipe was placed in 1966 under the tunnel and the whole length of this pipe is 750'. The intake perforated 33"Ø pipe which was constructed by the Water Development Department Workshop was placed in September 1967.

#### 2. Transition Adaptor Lining and Wheelgate

The installation of the transition lining in the Valve Chamber started on the 13th of July 1967 under the supervision of the manufacturer's representative and was completed by the middle of September 1967. Soon after the contractor proceeded with the installation of the gate and the lifting mechanism. On the 17th of October everything was ready and the gate was tested and was working properly. Meanwhile the aeration pipes of 24"Ø and the steel ladders were installed along the shaft. By the end of the year all works connected with the hydromechanical equipment including the painting, were completed.

### VI. W.D.D. Works by Direct Labour

#### 1. Diversion Road to Akrounda

The construction of the diversion road to Akrounda which started in 1966 continued throughout the year. The concrete bridge over Akrounda river was finished in February 1967. All drainage channels and culverts along this road were constructed during the year. All the finishing works were completed and the road is already used by traffic.



## 2. Diversion Road to Phinikaria

The works to the diversion road to Phinikaria which is to the left side of the reservoir started in April 1967. Most of the part of the road was excavated except a part 300 ft. long near the shaft which is prevented by the Dam works. All culverts and drainage channels were completed.

## 3. Permanent Guard House

The construction of the permanent guard house started in September 1967 and by the end of the year was ready for use. Only some finishing works at the house area will remain for 1968.

## 4. Piezometers

During the year there were installed at the designed places 20 electroacoustic manometers and 6 (six) total pressure capsules.

## 5. Investigations

The principal clay borrow area near Phinikaria and Akrounda Villages were abandoned and new investigations were carried out upstream of the dam from where finally the clay material was transported. Additional investigations were also carried out for the first material which was taken from many borrow areas in the river bed upstream of the dam.

## VII. W.D.D. Field Laboratory Activities

During the construction of the Dam in 1967 the following tests were carried out in the site laboratory.

Sand Replacement	153
Water Replacement	122
Sieve Analysis (dry)	132
Sieve Analysis (wet)	41
Hydrometers	181
Liquid Limit	136
Proctor	199
Core Cutters	1670
Rapid Control	240
Permeability	123
Slump Tests	137
Concrete Cubes	643

## VIII. Supervision

The supervision was done jointly with the designers Messrs. Energoprojekt and Water Development Department.

The consultants were represented by Mr. Huibner the Resident Engineer, Mr. Tasic the Grouting Engineer and 4 (four) technicians (concrete, grouting, soil mechanics and surveyor).



The Water Development Department was represented by:-

Senior Water Engineer	S. Hu (left in September 1967)
Executive Engineer	C. Andreou
Inspector of Works	Ph. H. Ioannou
Technical Assistant	T. Tsangarides
Technical Assistant	P. Makkoulas
Assistant Chief Foreman	A. Nicola
Assistant Chief Foreman	A.L. Ioannides

3. Kalopanayiotis Dam (By Chr. Marcoullis, Executive Engineer)

The construction of Kalopanayiotis dam on Marathasa river started in September 1964 and was substantially completed by the end of 1966.

During 1967 which was called as an "after construction period" the following works were performed.

1. Some secondary works on the construction of the dam.
2. Removal of all machinery and surplus materials from the site.
3. Grouting of the west abutment of the dam.
4. Inspection of leakages.
5. Inspection and treatment of a crack which appeared west of the reservoir about 1/4 of a mile away of the dam, under the road to Yerakies village.

The protection of the sides of the earthfill embankment by covering it with a 1 to 1½ - foot rock blanket started in 1966 and was completed in March 1967. All rock material was taken from the reservoir by crashing the big boulders found there during the construction of the embankment.

Some other related works being done during 1967 were the following:

- a) Some excavation on the road to Kalopanayiotis which was relocated for a distance of about 1000 ft.
- b) Some dry stone pitching on the spillway, to prevent erosion of the abutments.
- c) Railing of the area around the guard house.
- d) Installation of the settlement monuments.

The grouting of the west abutment undertaken by the department started in September 1966 and was completed in April 1967



The results were considered as not satisfactory due to the very poor condition of the rock at this abutment and it was decided to carry out a second row of grouting. This second row was completed in October 1967.

Although this grouting failed to stop leakage completely it was very helpful in reducing it and consolidating the foundations avoiding any danger for the structure due to piping.

During the construction of the dam some measuring structures were constructed downstream of the dam, at places where some springs existed and a lot of measurements were taken.

Soon after the dam was completed some tests were carried out by impounding water and measuring the leakage from the springs. It was found out that there was some seepage through the west abutment but it was impossible to measure it exactly, due to the fact that the most important spring was found in the riverbed downstream of the spillway. Therefore it could not be continuously measured and on the other hand it was not sure that all the water of the spring was due to seepage.

Now, since it is doubtful that any more grouting will reduce seepage further, a collecting weir will be constructed next year, in order to collect and divert the leakages into the distribution system.

Another problem raised after the dam was completed, was the development of a crack which appeared about 1/4 of a mile west of the dam and running all the way between an upstream and a downstream stream.

It first appeared in December 1966 as a crack of 2 to 3 in. wide. Later after the heavy rains during March and April last year a settlement of 3 ft. with a maximum 3.25 ft. horizontal movement towards the reservoir was observed.

Many experts visited the site and expressed their opinions on the cause of the crack as well as on some kind of treatment of the problem. At the same time some trenches were excavated and a geological map was made to help the investigations which will continue.

A rough drainage system was constructed on the road to Yerakies village in order to divert the most of the rain water away from the crack. A better measuring system was adopted at the last two months of the year, which will enable us to measure all horizontal and vertical movement. Fortunately after the summer of 1967 no appreciable movement was observed.

The cost for the construction of the dam at the end of the year was about £225,000. The first estimated cost of the dam was £230,000 and the revised one £249,700.



4. Syngrasi Dam (By A. Georghiadis, Executive Engineer)

Syngrasi dam is situated near Syngrasi village in Famagusta district, in the west of Messaoria plain, at a well known spot "Ta Tria Pethkia", about 40 miles from Nicosia.

The catchment area of Syngrasi reservoir is 17.25 sq. miles with a commanded area of 2000 donums and a storage capacity of 245 million gallons.

The construction of the dam commenced on 1st July 1967, and will be completed by the end of January 1968. The preliminary design of the dam was done by K. Marilius, U.N.A. Expert, but the final working drawings were completed by our design section.

Syngrasi dam is an earth dam of approximate length of 1600 ft. and maximum height of 22 ft. It is made of a homogenous clay core, (46,000 cu. yds.) with upstream and downstream slopes of 1:2-5 and 1:2 respectively. The upstream face and dam crest are covered with a protective layer of sandy gravel (2,750 cu. yds.) of an average compacted thickness of one ft. while the downstream face is covered with havara (5800 cu. yds.) of a similar thickness. Dumped rip-rap (2,350 cu. yds.) was also placed on the upstream slope, 4 ft. below dam crest, in order to prevent erosion of the embankment due to wave action. A cut-off trench of minimum width 10 ft. and 5 ft. deep, with sides sloping 1:1, acts as a Key-Anchorage to the embankment, as well as an impermeable blanket for preventing any seepage which might occur underneath the dam foundation. A toe drain of minimum width 3 ft and 3 ft. deep with sides sloping 1:1, with a filter blanket at the downstream toe of the dam section, acts as a drainage path, thus releasing any hydrostatic pressure due to seepage. Sandy gravel (3130 cu. yds) of permeability  $10^{-3}$  ccm/sec. was used as filter material.

A free flow spillway, with an Ogee crest made of mass concrete and reinforced concrete retaining walls with a stilling basin designed to U.S.B.R. type III basin, is capable of discharging 2400 cusecs i.e. the entire 100 yr. flood. For a thousand year flood, an emergency spillway will be acting as a reserve spillway, recharging additional 3,400 cusecs, thus both spillways together being able to take the entire 1000 yr. flood of 5800 cusecs.

An 18"  $\emptyset$  outlet pipe encasted in concrete at the deepest section of the dam, is capable of discharging 20 cusecs at maximum water level. A control Sluice-Valve has been installed downstream for future irrigation works.

In addition to the dam, the project involves a Recharge Scheme, which will enable the pumping of water from Syngrasi reservoir to Lapathos Village. It is estimated that nearly 50 M.G./year will be recharged into Lapathos aquifers, from where a number of dry villages in the far Eastern part of Messaoria will be fed. The entire pumping scheme is estimated to cost around £7,000.



The rate of pumping will be of the order of 7.4 M.G./week for a maximum period of two months giving a rate of 10.4 mils/cu. metre of water. It is also estimated that nearly 70 million gallons will be recharged through the reservoir bed, while the remaining 125 M.G. will be available for irrigation purposes, when agreement is reached with the proper authorities. When both schemes working together the cost benefit ratio will be 17 mils/cu. metre of water.

The pumping scheme is still to be finally approved, designed and constructed. The intake chamber however, where the pump-shaft is to be installed, was constructed together with the dam, as the water in the reservoir would not make possible its construction during the rainy season.

The entire cost for the dam construction including the pump-intake will reach maximum £22,000 hence making a saving of £5,500 from the original approved cost estimate of £27,500.

It is worth noting that the construction programme applied in this case was based on the Critical Path method, according to which the whole project should have been completed by mid-November 1967. However due to the fact that some contractors failed to deliver materials in the allocated time, where as the Tender Board hesitated to approve others, the observed delay in the completion time was unavoidable. In spite of this I could say that all works involved in the project were carried out, both technically and economically in the most proper manner.

(b) Report On Workshops (By. A. Karoglanian,  
Superintendent of Works)

The Workshop Branch 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 special pipe fittings for Polemidhia and Mavrokolymbos have been constructed for the above dams, distribution system.

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.

Seventy per cent of the employees of the workshop and stores are employed for development projects, such as irrigation schemes, village water supplies, hydrological works and drilling. Thirty per cent are employed for the maintenance of plant and tools.



In 1967 machinery to the value of £18,928 was bought for the needs of the Department such as overburden Land Crouser and Station Wagons Drilling Equipment.

A list of the chief items of plant now on charge is given in Appendix No. 2. 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.



Mechanical Plant

(as on 31/12/57)

<u>Mobil Plant:</u>	<u>No.</u>	1967.
Ruston Bucyrus Drilling rigs 22W .....	10	
Ruston Bucyrus Drilling rigs 60RL .....	1	
Allen Trencher 12" - 21' .....	2	
Caterpillar D8 .....	3	
Caterpillar Traxcavators 955 .....	3	
Caterpillar Traxcavator HT4 .....	1	
Allis Chalmers Shovel 150D .....	1	
Allis Chalmers Bulldozer .....	2	
Case Traxcavator .....	1	
International Bulldozer .....	1	
Ruston Bucyrus Excavator RB10 .....	1	
Ruston Bucyrus Excavator RB19 .....	1	
Excavator Smith 3/4 Cu. Yd. ....	2	
Core Drill 200 ft. Depth .....	1	
Grouting drill Pneumatic 150 ft. ....	1	
Wagon Drill .....	1	
Overburden .....	3	
Concrete Grouting machine .....	2	
Compressors .....	15	
Diesel alternator .....	6	
Electrosubmersible test pumps .....	10	
Turbine deep-well test pumping units .....	2	
Plunger deep-well test pumping units .....	2	
Centrifugal pumping units .....	4	
Portable works pumps .....	22	
Sheepfoots roller .....	16	
Vibrating soil compactors .....	3	
Vibrating Rollers .....	3	
Vibrators .....	28	
Concrete mixers .....	44	
Cranes .....	1	
Hoists .....	3	



	<u>No.</u>
Lorry Mounted Portable 3 Ton Borehole pump cranes	4
Thornycroft Tractive Unit for Low Loader .....	1
Bray Loader .....	1
Dumpers .....	1
5 ton diesel lorry (Austin) .....	1
Bedford R.L. lorry .....	1
Land Rovers .....	23
Toyota Land Grouser .....	6
Toyota Station Wagon .....	8
Cortina Station Wagon .....	1
Pump for test pipes .....	8
Rubber tyred Compaction Rollers .....	2
Sludge Pump Pneumatic .....	6

Workshop Plant:

Drilling Machine .....	3
Planing Timber Machine .....	1
Bandsaw Timber .....	1
Bar Bender .....	1
Bar Cutter .....	2
Electric Welders .....	6
Forges .....	1
Compressor air (Tecalemit) .....	1
Grinding Machine .....	4
Hack-saw Electrical .....	2
Wood-cutting Machine .....	2
Plate Bending Machine .....	1
Spark Plug testing Machine .....	1
Battery Charging Unit .....	2
Hydraulic Press 100 Ton capacity .....	1
Band saw Grinding Machine .....	1
Pipe Slotting Machine .....	1
Hydraulic Pipe Bending Machine .....	1
Tractor Track Servies Tool .....	1
Soldering Iron Heater .....	2
Cast iron, Aluminium & Bronze Casting Forge .....	1
Tube Vulcanizing Machine .....	1
Tyre Extracting Equipment .....	1
Paint Spraying Equipment .....	1
Letter Printing Machine .....	1



DIVISION OF OPERATION AND MAINTENANCE

The work of the Maintenance and Operation Division is confined to:-

- (a) Management of Irrigation waterworks constructed under the provisions of the Government Waterworks Law, Cap. 341.
- (b) Maintenance of all major Irrigation projects constructed by this Department
- (c) Management of domestic supplies under the provision of Law Cap. 350.

(a) Management of Government Water works  
by A.K. Savva

The Government waterworks are managed by A.K. Savva, through District Water Boards under the chairmanship of the District Officer concerned on which the Departments of Water Development and Agriculture are represented. The powers, duties and functions of the District Water Boards are the following:-

- (i) To make recommendations on the development, conservation, management and efficient use of water resources.
- (ii) To have overall responsibility for the management, operation and administration of all projects constructed at Government expense.
- (iii) To maintain and operate the waterworks with a view to improve the standard of irrigation practices and the methods of irrigation, to increase the revenue from land and water to the full economic value and to control the expenses of maintenance and management of the waterworks to the best possible degree.
- (iv) Undertake the sale or disposal of water on behalf of Government.
- (v) Impose the water rates fixed by Government from time to time.
- (vi) Solve minor problems arising out of the administration of waterworks.
- (vii) Prepare separate budgets for each waterwork in May of every year showing the revenue and expenditure in connection with its operation, management e.t.c. for the succeeding year for incorporation in the ordinary estimates.
- (viii) Prepare "specifications" as provided by section 15 of the Government Waterworks Law, Cap. 341 i.e. lists of lands and persons benefited or capable of being benefited by any waterworks e.t.c.

3. Although six major irrigation projects were declared as Government waterworks only Kiti dam was operated during 1967. The actual amount of revenue



collected from the sale of water from the Kiti dam amounted to £2,371. This revenue was derived from the sale of 37,260,000 gallons or 169,357 cubic meters of water at 14 mils per cubic meter. The quantity of water sold represents a very low percentage of the total volume of water contained in the reservoir due to considerable leakage from the reservoir, high loss in the earth canal system e.t.c. However, it is believed that the leakages observed in the reservoir will be diminished by the execution of certain remedial works in 1967, the effectiveness of which will be proved when the reservoir will be filled up in the forthcoming years.

Argaka-Magounda Dam. During 1967 the Argaka-Magounda dam was full of water but unfortunately the farmers that should have benefited by the project refused to purchase any water. With the declaration of the Project as Government waterwork under the provisions of the Government Waterworks Law, Cap. 341, the Argaka people raised objections to the District Court, Paphos, against the Register of water rights prepared by the Water Commissioners as provided by the said Law. The water is still pending with the Court.

Polemidhia Dam. Polemidhia dam was not operated during the year 1967 due to the lack of distribution system from the reservoir to the lands to be benefited at Phassouri area. The work on the distribution system has already started and the project will operate in 1968.

Kalopanayiotis Dam. The dam construction was completed and the reservoir filled with water in 1967. The work on the pipe distribution system was not completed and therefore the project was not operated in 1967, but is scheduled to operate early in 1968.

Mavrokolymbos Dam. Although the main construction on the dam and the distribution system (stage I) was completed, the dam was not closed to store water due to the remedial works carried out in the reservoir area which were considered essential after the land slides observed in the reservoir area.

Yermasoyia Dam. This dam is still under construction and therefore no water was collected in the reservoir.

(b) Maintenance of Projects.

by C. Georghiou.

There are now in Cyprus 44 completed dams which can impound 5,650 million gallons.

The following are the Government dams maintained at full cost to Government.

1.	Pomos	Capacity	189	million	gallons.
2.	Ayia Marina	"	66	"	"
3.	Argaka-Magounda	"	253	"	"
4.	Kiti	"	355	"	"
5.	Polemidhia	"	750	"	"

During 1967 this Division carried out the following works.



1. Kiti Dam:

This Dam was filled for the first time in 1964/65. It was noticed that a big quantity of water was leaking through the Bekir-Tasha chain of wells discharging into the Larnaca salt lake. These chain of wells are very old and used to supply water to Larnaca town. Now they are abandoned because they are demolished and unserviceable.

Works were carried out in '966 to stop this leakage but the results were not completely successful.

In '967 it was decided to fill part of the Bekir-Pasha chain of wells near the dam with clay. At certain places the chain of wells were cut across and concrete walls 2' thick were constructed. The results of this remedial work are not known yet, because the dam was not filled owing to poor rainfall over the Emithios catchment during the year.

2. Agros Dam:

This Dam was completed in 1965. During construction it was realized that the dam might be leaking and a clay blanket was placed of clay core up to about 15 feet from the toe of the dam. Some grouting was also carried out after excavating the cut-off trench, which was intended to consolidate the dam foundation and decrease any possible leakage.

After the filling of the reservoir some leakages were observed. The amount of water lost was considerable and remedial works are required to decrease the loss of water.

The W.D.D. after having studied carefully the conditions decided to place compacted clay on the floor and sides of the dam up to the level of 120.000.

This work was started in October '967 but owing to rainy weather it was postponed for 1968.

Agros Dam is constructed in Troodos mountain near the village of Agros. It has a very small catchment with a very little run-off, which cannot fill the dam always. For this reason a scheme was prepared during 1967 to convey water from a nearby river named "Enetikos" by means of an 8" pipeline to enable the filling of the dam. This work will be carried out also in 1968.

3. Polemidhia Dam:

This is the biggest Dam in Cyprus in capacity and will irrigate a big area extending from Polemidhia village to Phassouri citrus plantations.

This dam reached the maximum water level of 450.00 for the first time on the 3rd April 1967. The spillway level is 452.00.



It was observed that when the water level of the dam passed over the level of 4'0.00 the left abutment started leaking and the leakages increased while the level of the water was rising.

After careful study of the leakages and Piezometers the Department came to the conclusion that the water level of the dam should not be kept above the level of 4'0.00. The outlet pipe was then opened and in a week's time the level dropped to 4'0.00.

For remedying this serious situation a scheme was prepared for the extension of the grouting curtain in the left abutment of the dam, which will be carried out probably in 1968-1969.

4. Ovgos Dam:

This Dam was constructed in 1964 on the Ovgos river near Morphou. The water of this dam was intended to be used for irrigation.

During 1967 some brackish water entered the reservoir and after a series of analysis the water proved to be rather saline (1914 p.p.m.) and therefore unsuitable for irrigation.

The reason for this contamination proved to be the water of Ayios Vasilios Stream which flows into the reservoir. After analysing the water of this stream it was found that it was very saline with 3,000 p.p.m.

For facing this difficulty the Water Development Department constructed a diversion weir upstream off Ovgos reservoir area near Kyra village. An 8"  $\phi$  A.C. pipeline is used to convey the saline water from the weir and divert it outside the reservoir.

This pipeline had blocked and brackish water entered the reservoir.

A scheme was prepared for the purpose of improving the existing intake at the weir.

The scheme provides also for the installation of a pipeline from the Dam - to a point near the sea which will divert the saline water in order to prevent percolation of this saline water into the aquifer downstream of the Ovgos Dam.

This scheme will be carried out in the near future.

Maintenance work was carried out also for Lefka-Marathassa dam where damages caused by blasting to the dam were repaired during the year.

A new gate was also purchased which will be installed in 1968.



Management of Domestic Supplies under

(c) the Provision of Law Cap. 350.

by G. Haralambous.

Resulting from the organization implemented during the year under review, this section has come under the jurisdiction of the Maintenance & Operations Division. Its task remained, however, substantially the same i.e.:-

- (i) Administration of the "Greater Nicosia Scheme"
- (ii) Water supply to Nicosia Suburbs
- (iii) Water supply to Govt. residences and Institutions
- (iv) Technical advice to the Water Boards of Nicosia, Limassol and Famagusta.

2. Greater Nicosia Scheme: This scheme was completed in 1958 supplying ever since water to Nicosia suburbs, Orta Keuy, Trakonas, Omorhita, Kaimakli, Pallouriotissa and Eylenja. It was financed wholly by Government and was designed in a way that it could be easily incorporated with the existing scheme administered by the Nicosia Water Board, with a view to facilitating the taking over of this scheme by the same Board. For several reasons, the taking over of this scheme by the Nicosia Water Board could not be materialized so far, and efforts are now being made to the effect that amalgamation of all authorities may be achieved, under the administration of the Water Board which is considered to be more appropriate Authority for the purpose.

3. At this point, it is worth mentioning for general information that the water supply of Nicosia town and suburbs is, as a matter of fact, administered by three separate Authorities:-

- (i) Nicosia Water Commission (Town within walls) ✓
- (ii) Nicosia Water Board (Town mainly within Municipal limits) ✓
- (iii) Water Development Department (Town's suburbs)

4. Other than routine work, involving necessary improvements and maintenance to existing installations of the Greater Nicosia Scheme, this Department has undertaken the conveyance of water from 3 boreholes in Pentayia and which together with the boreholes of the "Emergency Section" would eventually form the source of the Morphou Bay Scheme on its designed capacity of 2.0 millions gallons daily. At present, pumping from Pentayia boreholes will be made only if and when it is absolutely necessary to cope with the peak consumption during summer months.

5. During 1967, the distribution system of the Greater Nicosia Scheme was extended by 17,840 ft. of asbestos cement pipes, the respective expenditure having



been borne by private developers 370 new house connections were made, this bringing the total number of consumers to 8,184.

6. A statement of expenditure and revenue of the Greater Nicosia Scheme is given as Appendix No. 23.

7. Nicosia town and suburbs water supply:-

Although, as stated, administratively the whole "area of supply" is separated into three zones, yet the problem of water supply is considered to be one and unique and it is faced by the authorities concerned through close co-operation among them. All available sources were put into Commission, using at the same time blending methods of brackish water in order to cope with the ever increasing demand during summer months. Due to the rich rainfall during 1967, the demand in water consumption was met satisfactorily and regular supply was maintained. The Morphou Bay Scheme for which pumping is undesirable has worked only for a few days when it was absolutely necessary to supplement supplies. In this respect, it is recorded that storage in the Sykhari Adit had reached its highest level amounting to 60 million gallons, whilst the water level of the Dhikhomo boreholes raised considerably:-

8. The total amount of water conveyed from the various sources reached the figure of 6,997,390 cm. and was distributed as follows:-

(i) Greater Nicosia Scheme "Area of Supply"	2,092,639 cm.
(ii) Nicosia Water Board	-do- 4,291,835 cm.
(iii) Nicosia Water Commission	-do- 612,916 cm.

9. The highest daily consumption was 24,600 c.m. or 5,412,000 gallons, which equals to 50 gallons per capital against a population of 107,000.

10. The quantities of water given in paragraph 8 represent the maximum yield of all existing sources. Evidently, supplementing of the supply has become a necessity and whether amalgamation of the three Authorities is materialized or not, new sources should be found immediately. These sources should be of such capacity that they can supplement future requirements within a long-term period and they should also be capable in relieving existing depleted water fields. Time has come that the area of the "Town within Walls" should be provided with pressurized water. The existing distribution system which, by the way, is very old and waste of water is apparent though leakage should be replaced and the existing "saccoraphi" measuring device should be abandoned so that all consumers be placed on a water metered supply basis. Execution of the work may be co-ordinated with the implementation of the proposed sewerage scheme. Therefore, planning and designing of the supplementary supplies should include the "Old City" as well, so that all citizens may enjoy a regular and satisfactory water supply.

11. Government Residences and Institutions: All



Government residences and Institutions in the Nicosia town area are supplied with water for domestic use either from the Nicosia Water Board or the Greater Nicosia Scheme, depended on each other's locality. The requirements for irrigation to these houses, however, is wholly supplied from Government owned boreholes situated within the inhabited area. This water is regularly - every month - examined chemically and bacteriologically and is found suitable for the purpose.

12. Limassol:- The completion of "Yermasoyia" scheme has well balanced the water supply of this town and pumping from "Chiftlikoudhia" chain of wells is no more necessary. The boundaries of the "Area of Supply" have been extended, mainly north to the inhabited area of the town including Mesayitonia village.
13. The maximum consumption has reached the figure of 12,665 c.m. daily.
14. The "Kourris" scheme which, for some time has been kept in abeyance, is now being implemented, having started with the drilling work. The object of this scheme is the better utilization of the existing pipeline conveying water from the springs during summer when it does not work at full capacity, due to the seasonal decrease in the yield of the springs.
15. Famagusta:- For another year this town has experienced shortage of water and restrictions of rather long period on the water supply were imposed. Existing sources were capable in providing approximately half of the requirements during summer months, estimated to 9,000 - 10,000 c.m. daily.
16. The need of supplementary supplies is very urgent. The new scheme planned to supply water from Vasilikos river is still at designing stage, following further studies. Pending the authorization of this scheme for execution, efforts should be made towards the finding of more water in the Frenaros Area so that the shortage at last could be minimized.
17. Facts about Water Boards of Nicosia, Limassol and Famagusta given on Appendices Nos. respectively.



FACTS ABOUT LIMASSOL WATER BOARD

1. Total quantity of water supplied from our sources ..... 3,427.123 c.m.  
(see attached statement)
2. Total quantity of water consumed, as registered by Area Meters and supplied direct from bhs 2 and 7..... 3,217.985 c.m.  
overflow 65.882 c.m.
3. Maximum daily consumption in summer - on 21.7.67 ..... 12.665 c.m.
4. Total number of consumers as at 31.12.67 14.065
5. (i) Extension of distribution system pipelines laid during 1967 .....  

40.293' /4"
8.461' /6"
3.171' /8"
<u>51.925'</u>

  
(ii) Total length of distribution system  

529.657' /4"
79.785' /6"
23.736' /8"
<u>27.000' /10"</u>
<u>660.178'</u>
6. Number of hydrants installed in 1967  
(i) 47  
(ii) Total number of F.H. 676
7. Yermassoyia scheme has been completed in all respects. Arrangements were made for boreholes to be drilled in Kourris area as part of a new minor scheme to be implemented in 1968.
8. Water supply has continued without restrictions during the whole year.



FACTS ABOUT NICOSIA WATER BOARD

1. The total quantity of water supplied from all sources (Water Board and Water Commission) during 1967 was 4,904.751 c.m. as per attached statement.

2. The total quantity of water consumed was as under:-

Area	No.		348.903	c.m.	✓
"	"	1	548.668	"	✓
"	"	2	435.287	"	✓
"	"	3	746.939	"	✓
"	"	4	1,216.830	"	✓
"	"	5	609.310	"	✓
"	"	6	<u>3,905.937</u>	c.m.	
Nicosia Water Commission			<u>612.916</u>	"	✓
TOTAL			4,518.853	c.m.	✓
=====					

3. The total maximum summer consumption was 15.600 c.m. (Including N.W.C.).

4. The total number of consumers as at 31st December, 1967, was 10.698.

5. (I) Extension of Distribution System:-

- 2.150 ft. of 6" A.C. pipes
- 17.204 ft. of 4" A.C. pipes

(II) Total length of Distribution System:-

- 12.109 ft. of 12" A.C. pipes
- 25.000 ft. of 10" A.C. pipes
- 12.930 ft. of 8" A.C. pipes
- 76.100 ft. of 6" A.C. pipes
- 534.304 ft. of 4" A.C. pipes

6. (I) Number of fire hydrants installed in 1967: 24.

(II) Total number of hydrants installed within the Board's Area of supply: 739.

7. Athalassa borehole was cleaned out in June 1967 and Laxia Borehole P.466 was cleaned out and lined with 8" casing in December, 1967.



(20 August)

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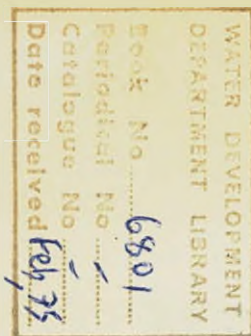
Appendix No. 24

FACTS ABOUT LIMASSOL WATER BOARD

1. Total quantity of water supplied from all sources, month by month as per enclosed statement, was 1,698,778 cu.m.
2. Total quantity of water consumed as registered by area meters, 1,620,499 cu.m.
3. Total maximum summer consumption per day in cu.m. 5,695.
4. Total number of consumers by 31/12/67, 9,260.
- 5.i. Extension of distribution system in ft. run and size of pipes, 29,784 ft. (5.64 miles): 25,285 ft.  $\phi$  4" and 4,499 ft.  $\phi$  6".
  - ii. Total length of distribution system (including extensions for 1967) 92 miles.
- 6i. Number of hydrants installed in 1967, 46.
  - ii. Total number of hydrants installed within water supply area, 577.
7. There were again no improvements to the water supply and the position deteriorated further owing to the steady fall of the water level of the boreholes. Pumping periods were stretched to the maximum limit but the quantity of water pumped during the year fell by 86,718 cu.m. and the maximum daily consumption in summer from 5,829 to 5,695 cu.m. Restrictions were doubled as water had to be cut for longer period during day time. During the months of April to November the water was cut for an average of 15 hours in each 24 hours period.



Revenue and expenditure account of the Greater Nicosia Scheme  
for the year 1966.



<u>Expenditure</u>	
(a) Pumping charges	£14,093.790
(b) Purchase of water	6,222.755
(c) Maintenance charges	3,221.397
(d) Collection fees	15,181.668
Total	£39,719.605
(e) Administration	4,000.000
(f) Amortization	37,590.000
Grand Total	£80,809.605

<u>Revenue</u>	
(a) Sale of water	£104,090
(b) Connection fees	1,084
(c) Usage of pipelines	2,500
(d) Other revenue including sale of stores.	2,446
Total	£110,120
Profit for the year	£29,310.395

- Notes. (a) The sum of £8,102.000 remained uncollected as outstanding a/cs.  
(b) An approximate amount of £15,000 being value of water supplied to Turks could not be collected due to the abnormal situation.