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Terms of Referenceの一例

PROPOSED WORK PLAN

FOR

SEWERAGE FEASIBILITY STUDY

BUTTERWORTH-BUKIT MERTAJAM METROPOLITAN AREA

State of Penang/Privince Wellesley/Malaysia

(December 1973)

Ministry of Health/Health Services Division

ENVIRONMENTAL HEALTH AND ENGINEERING SECTION

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II Table of Organization - Following Work Plan.

MAP I


FEDERATION OF MALAYA
SCALE OF MILES
10 5 0 10 20 30 40 50 60
THAILAND
KEDAH
PERLIS
Kangar
LANGKAWI ISLANDS
Alor Star
K. Kedah
Kota Bharu
Pasir Mas
Tumpat
Tanah Merah
Kg. Raja
KELANTAN
Kuala Krai
Kuala Trengganu
CHINA SEA
PROJECT AREA
PERAK
Port Weld
Ipoh
TRENGGANU
K. Dungun
Merapoh
K. Kerteh
Chukai
P. PANGKOR
Kuala Lipis
Bagan Datoh
Kuantan
PAHANG
Jerantut
Tanjong Malim
SELANGOR
Bentong
Pekan
K. Selangor
Kuala Lumpur
Nenasi
STRAITS OF MALACCA
NEGRI SEMBILAN
P. TIOMAN
BANGI
Port Dickson
Mersing
MALACCA
Malacca
SUMATRA
JOHORE
Batu Pahat
Johore Bahru
Pontian Kechil
Kukup
SINGAPORE
REFERENCE
Railways
State Boundaries
International Boundaries
Main Roads
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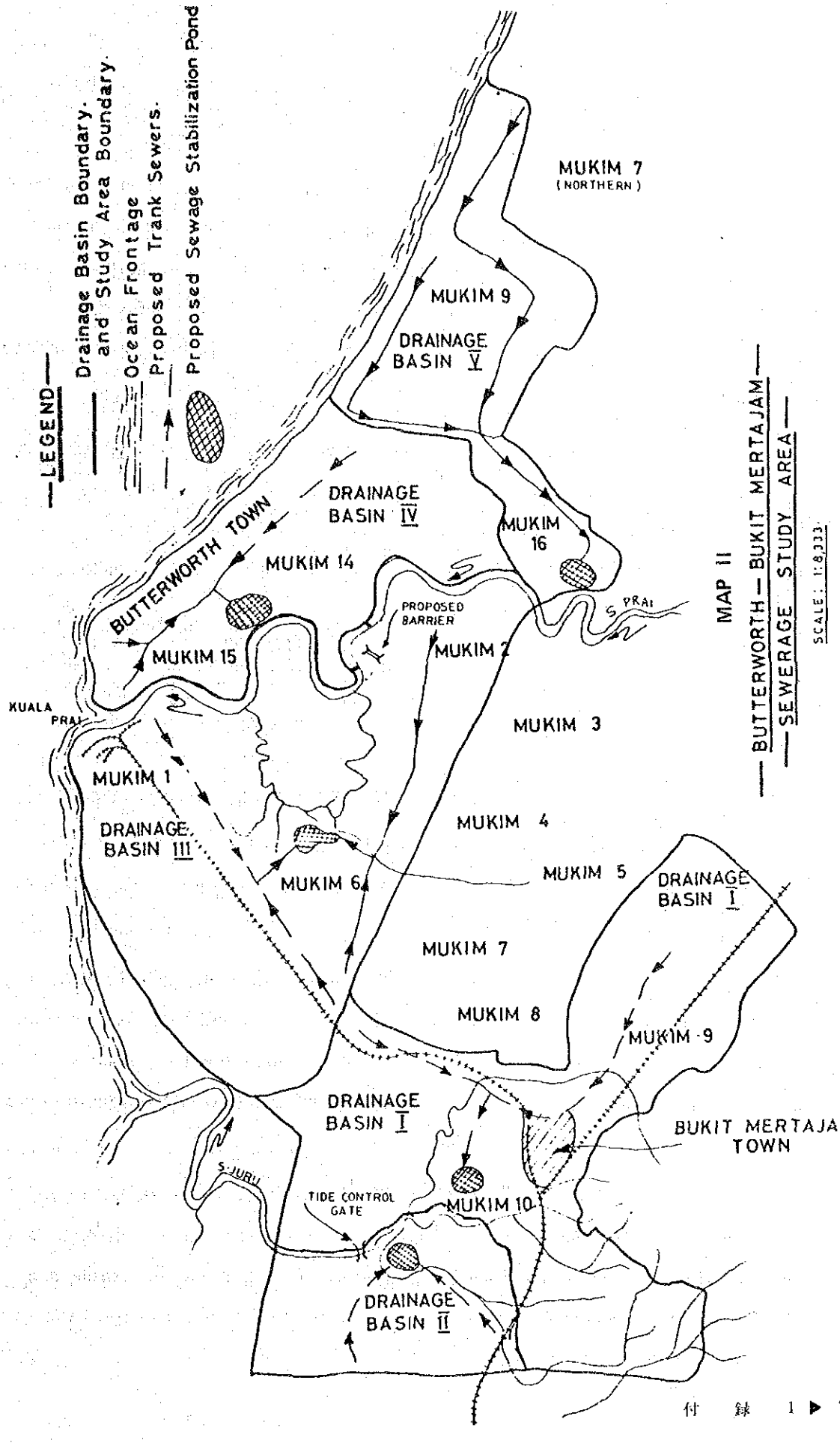
Survey Dept., Federation of Malaya No. 80-62


LEGEND
Drainage Basin Boundary and Study Area Boundary
Ocean Frontage
Proposed Trank Sewers
Proposed Sewage Stabilization Pond
MAP II
BUTTERWORTH — BUKIT MERTAJAM
SEWERAGE STUDY AREA
SCALE: 1:8,333
MUKIM 7
(NORTHERN)
MUKIM 9
DRAINAGE BASIN V
DRAINAGE BASIN IV
BUTTERWORTH TOWN
MUKIM 14
MUKIM 16
MUKIM 15
PROPOSED BARRIER
MUKIM 2
S. PRAI
KUALA PRAI
MUKIM 3
MUKIM 1
DRAINAGE BASIN III
MUKIM 4
MUKIM 5
MUKIM 6
DRAINAGE BASIN I
MUKIM 7
MUKIM 8
MUKIM 9
DRAINAGE BASIN I
BUKIT MERTAJAM TOWN
S. JURU
TIDE CONTROL GATE
MUKIM 10
DRAINAGE BASIN II

I. BACKGROUND TO SUPPORTING INFORMATION

A. Justification for the Project

1. The Georgetown - Butterworth area is the second largest growth centre of Peninsula Malaysia. The 1970 population of the proposed Butterworth Bukit Mertajam Metropolitan area was 160, 000. While this at present includes around 50, 000 essentially rural people the area is expected to fill in and assume urban characteristics and population density. Past and projected future population are as follows:-

Year	Populations			Growths Rate of
	Butterworth	Bukit Mertajam	Total Area	
1947	21, 255	-	-	7. 0 %
1957	42, 506	-	-	3. 5 %
1970	61, 252	-	160, 600	9. 0 %
1975	-	-	250, 000	4. 0 %
1985	-	-	385, 000	3. 5 %
1995	-	-	545, 000	-

The large percentage increase shown for the 1970 to 1975 period is partly due to errors in projections from 1957 to 1970 but also reflects a rapid increase due to development.

2. Economic development is expected to be associated with growth of medium and heavy industry together with associated services and housing, and port activities. The area will complement the growth of Georgetown and Penang Island which will retain its position as the main commercial, tourist and service centre of the area.

3. Although the Butterworth - Bukit Mertajam area has not suffered from severe epidemics of gastro-intestinal disease general incidence of disease associated with poor sanitation has been considerably higher than desirable and steadily increasing density of population will more than proportionately increase

disease transmission. Installation of sewers is necessary to raise levels of sanitation to offset the effects of increase population density.

4. In economic terms sewerage is justified for urban areas for the following reasons:-

a) It provides for sanitary collection of all domestic and normal industrial waste waters and conveyance to points of treatment and suitable disposal at least cost and in such a way as to improve the general efficiency of the urban area.

b) The cost of inferior alternative systems such as use of individual septic tanks is much higher. Studies in Ipoh have shown that capital and annual costs of severs are only 40 per cent of the cost of septic tanks. Further the septic tanks are designed to receive only W. C. was water and do nothing to resolve the problems of contaminated sullage or trade wastes.

c) Investment in sewerage is reflected in an increase in property values at least as great as the investment itself.

d) A community which provides sewerage is attractive to industry as it provides a least cost solution to industrial waste water disposal and at least partially relieves industry of direct responsibility for control of environmental pollution.

e) Through improved sanitation the urban community enjoys a higher level of health and well-being which in part is reflected in lowered costs for medical care, drugs, reduced absence from work, school, and longer useful employment of workers.

5. Detailed planning for the future development of the Butterworth-Bukit Mertajam area is timely and sewerage planning should be integrated with overall planning to ensure that the necessary treatment work sites are provided for and that rational location of trunk and lateral sewers is possible.

6. Priority has been placed upon provision of safe piped water supply and approx. 61 % of the population is served with piped water into the living quarters and a further 10 % have access to standpipes. It can be anticipated that approaching 100 % of the population will have safe water piped into the homes is the future.

Or the other hand used waste water disposal has not been adequately provided for. Some 30 % of the population have flush toilets with disposal usually to septic tanks and open drains, 63 per cent are served by conservancy (bucket) systems, and the remainder (7 %) use pit latrines or have no facilities. Sullage, which is usually as heavily polluted as W. C. waste water, is universally disposed of to surface drums.

7. The use of septic tanks in built up urban areas is never satisfactory even when sub-surface disposal of affluent is initially possible. Under conditions at Butterworth-Bukit Mertajam where soils are relatively fine and ground water levels are high soil absorption is not possible and effluents have to be disposed of to open drums within the built-up area. This allows for general urban environmental pollution; the breeding of mosquitoes (in drains and septic tanks), flies and cockroaches etc, and provides a ready food source for rodents and other disease vectors.

In addition septic tanks as designed in Malaysia do not provide for sullage wastes which are often as badly polluted as the W. C. wastes. Consequently sullage is disposed of to open drains and further adds to the problem. Such drains also provide a convenient place for disposal of refuse etc.

8. The use of the bucket system of night soil collection with disposal to land burial sites is a serious hazard to the health of conservancy workers and the public. Buckets are also open to disease carrying rodents and insects. Funds spent on such systems are not justified as they do little to solve health or waste disposal problems.

9. Rainfall run-off is generally collected in open, usually concrete, monsoon drains. These drains receive septic tank effluent, direct discharge of sullage, trade wastes & effluents, and are open for promiscuous dumping of refuse. The combined, heavily polluted flow is discharged to surface streams and the ocean leading to pollution which affects the fish food chain and use of the waters for recreation and water contact work.

In the more highly developed areas of the urban area it is usually deserable to provide buried pipe rainfall run-off drains both to prevent or reduce contamination and to make the road surfaces more useable. Provision of sewerage

eliminates most of the pollution of surface run-off drains.

Planning of surface drainage for urban areas is often carried out in coordination with the planning of the sewerage system as the two systems are closely related in many respects.

10. Sewerage is a necessary amenity intimately involved in the basic concept of the modern city and urban life. "To introduce cities without sewerage, anti-malarial medicines without birth control, is to tear a culture apart, and subject its members to excruciating, often insoluble problems" (From "Future Shock", by Alvin Toffler).

B. Institutional Framework

11. At present Butterworth is mainly included in the Northern Administration District and Bukit Mertajam in the Central administrative District of Penang P. W. It is understood however, that the three administration districts of Province Wellesley are to be combined under a single District Administration. Responsibility for sewerage basically rests with the District Administration although both the State and Federal Government are concerned in relation to public health and planning.

12. Water supply is the responsibility of the Penang State Water Authority which will be able to supply all forseeable future requirements of the area. Domestic water charges are $M 0.60 per 1,000 gallons for the first 5,000 gallons and $M 0.95/1,000 gal. for additional amounts. Industrial water is supplied $M1/30 per 1,000 gallons.

13. It is anticipated that the District Administration through its District Engineer will be responsible for sewerage of the area. To undertake this work he will need to develop a competent staff which initially (Stage A) should includes:-

(i) An Assistant Engineer (Sewerage) who will require academic and practical training on sewerage planning, design, construction, operation and management. The candidate should preferably be brought on duty before the commencement of the feasibility study so that he can work with the Consultant as counterpart during the course of the study and should be sent for further

training on a fellowship immediately thereafter. As it is likely that up to one year will elapse between completion of the feasibility, study and commencement of designed construction the incumbert should have returned to participate in this phase prior to assuming operating responsibility.

(ii) A Chemist, to be responsible for operation of maintenance of sewage treatment facilities and monitoring of effluent of downstream water quality. The incumbent should be recruited and brought on duty to assist in the feasibility study as counterpart staff. The position responsibilities could include related miscellaneous duties on a time available basis. Fellowship training in water of sewage chemistry and biology for a period of from 3 to 6 months would be needed immediately following completion of the feasibility study.

Additional non-professional staff will be needed for sewer and treatment plant operation and maintenance as the system becomes operational.

14. The various administrative and drainage basins of the area are shown on Map 2, attached.

C. Provisions for Government Follow-up

15. No funds have as yet been allocated by Government to cover the costs of a feasibility study or design and construction. It will probably be possible to commence a feasibility study by March to June/1974 if a request for assistance is made by the District Administration (through appropriate State Authorities as and if indicated) to the Economic Planning Unit by the end of 1973.
Allowing one year for the feasibility study it should be possible to support inclusion of funding of Stage "A" design and construction in the Third Malaysia Plan (1976-80).

D. Other Related Activities

16. Development of several areas within the study area are at various stages of implementation as follows:-

DI - Mak Mandin Industrial Estate-Largely completed but with need for further development and infra-structure.

DII - Prai Industrial Complex-Approx. 30 % complete and progressing.

DIII - Industrial areas of Butterworth-20 % complete.

DIV - Bagan Serai Complex; Industrial, Residential and administrative areas - development started.

DV - Prai Barrage Area - Advanced planning.

During the interim period until sewers can be installed careful planning will be needed to avoid unnecessary expenses on construction of liquid waste disposal facilities. If possible local area plans should be made for sewerage in conformity with the general plan outlined in the Preliminary Report prepared by the WHO Engineer/Ministry of Health. Interim treatment could be provided by use of low cost temporary stabilization ponds or by chlorine disinfection etc.. These sewers would be built as part of the development project by the developer in lieu of unsatisfactory and costly septic tanks etc., and be turned over to the District Administration for operation and maintenance at the time of connection to future trunk sewers - interim operation and maintenance would be by the developer unless arrangements could be made with the District.

17. Plans are also in process for a highway bridge, tunnel, or causeway to connect the study area with Penang Island. This connection will probably affect special development within the study area and may affect some aspects of sewerage planning and effluent disposal.

II. OBJECTIVES OF THE PROJECT

1. The Ministry of Health/Environmental Health and Engineering Section with the assistance of the World Health Organization, Western Pacific Regional Sanitary Engineer has completed a preliminary study of sewerage needs for the Butterworth-Bukit Mertajam Urban area, with concurrence of and cooperation by the District Administration. The preliminary report recommends that:- "These study be followed by to detailed feasibility study . . . ". The feasibility study is needed fully establish the need for the sewerage system, measure its costs and benefits, evaluate it environmental impact, establish its engineering and financial feasibility, and to detail methods of implimentation, financing and management. It is hoped that arrangements can be expeditiously made to impliment this feasibility study.

2. The principal objectives of the proposed sewerage project are to:-

(1) Improve urban sanitation by eliminating the night soil conservancy (bucket) system.

(2) Alleviate pollution of the urban environment including surface drains and streams and ocean beach areas.

(3) Provide a modern efficient sewerage and trade waste collection, treatment and disposal system (or systems) to meet the general physical development needs of the Butterworth-Bukit Mertajam Urban area.

(4) Avoid continued investment in much more costly and unsatisfactory or less satisfactory facilities for domestic and industrial wastewater disposal.

(5) Schedule implementation of the project in stages based upon the findings of the feasibility study and as generally outlined in the preliminary report.

(6) Provide institutional organization and management bases for effective future sewerage system development and operation - including training of needed specialized staff.

(7) Develop a financial plan for the design and construction of proposed works and to support future expansion and service.

All items are to be studied and the results incorporated in a Sewerage Master Plan made up of long range, first and second stage, and interim programs designed to generally coincide with five year National Development planning periods.

A. Long Range Objectives

3. The long range purpose of the project is to assist the Government of Malaysia, the State Government of Penang/Province Wellesley, and the Butterworth-Bukit Mertajam District Administration in the proparation of a "Master Plan" for Sewerage, Sewage treatment and Disposal for the Butterworth-Bukit Mertajam Urban area." A Master Plan is a long range plan comprising field investigations; surveys; and interrelated socio-economic, financial and organizational studies; which establish the basis for a multi stage program for the development of sewerage systems.

4. The Master Plan will cover the Butterworth-Bukit Mertajam Urban area as depicted on Map 2. This includes an area of 43.5 square miles and a 1970 population of 160,600 projected to 575,000 by 1995.

5. The Master Plan will provide for a complete modern sewerage system (or systems) including collection, treatment, and disposal facilities for the Butterworth-Bukit Mertajam Urban area. The early elimination of the bucket (conservancy) system will be a priority objective of the plan.

6. The Master Plan will include provision for interim measures to improve wastewater collection, treatment and disposal pending installation of the new sewerage system. This would include sewer installation by developers with Temporary Treatment and/or disposal facilities and temporary facilities for industrial wastewaters.

7. Proposals for treatment and disposal of wastewaters included in the Master Plan will be based upon pollutional control study of the receiving waters with due consideration of water quality requirements of the existing and anticipated future uses of the receiving waters, including ocean waters.

8. The Master Plan will include studies of existing industrial wastewaters and recommendations covering methods of determination of acceptability into the public sewers as to amounts, quality, and need for pre-treatment and costs balanced against alternative costs for separate treatment and disposal by the industry, either individually or by discharge to a separate industrial waste sewer for joint treatment and disposal. Projections will be made of future industrial waste loads both as to quantity, and quality by industrial classification to aid in overall planning and determination of the recommended scheme.

9. The Master Plan will recommend a long-range development program, envasioning a project period of 20 years from 1975 to 1995, and interim programs (stages) covering the first two five year plan periods of 1976-80 and 1981-85. These programs will be associated with studies of the institutional, management, training, and financial aspects of providing sewerage services.

10. The long range plan will include a review of present methods of financing sewerage services and recommend short-term and future long-term arrangements.

11. The Master Plan will contain a program in phases of implimentation and investment covering a 20 year period, together with provisional preliminary engineering and feasibility studies based on cost estimates, economic and other factors characterising the country's need and capability to accomplish the program considering the different means of finance, both national and international.

12. The Master Plan is to be presented in a concise report with plans and estimates for both the recommended plan and alternatives studied by stages for implimentation. All basic records, calculations, maps and criteria used in development of the master plan will be made available in original form to and become the property of the Government.

13. The Master Plan will contain a training component for professional and sub-professional staff needed to supervise and review design and construction work, to plan future extensions, to maintain and operate the system(s), and to carry out monitoring of receiving waters for pollution control purposes.

B. Immediate Objectives

14. Based on an in addition to, the recommendations and studies described under "A" above, the interim programs will include preliminary studies of Stages I and II (1976-80) and (1981-85) of construction of wasterwater facilities. These are studies comprising detailed investigations, surveys, and technical analyses of alternate plans and schemes for the various elements of the wastewater facilities which are proposed for the first two 5 year stages of implimentation under the Master Plan.

15. These studies will be carried out for works which are to be constructed within the first two five year stages. (1976-85). The preliminary engineering designs will be presented in report form with comparative analyses, recommendations, justifications, preliminary specifications and cost estimates of the various alternatives, including cost of construction, financing, operation, and maintenance. All basic data and original calculations and schedules used to develop the preliminary engineering designs will also be made available to Government and will become Government property. The information presented should provide for the preparation of final engineering designs and contract documents with a minimum need for additional field investigations and studies. The purpose of preliminary engineering studies is to provide guidance for selection of the most favourable alternative with respect to layout, design criteria and capacity of the system etc.

16. In addition to the preliminary engineering studies described under 15 above, there will be prepared feasibility studies including pertinent legal, institutional, managerial, economic and financial matters and a complete financial plan with estimates of capital and recurrent costs and the total income needs to cover the cost of operation and maintenance, interest and amortization of the completed works, based on studies and recommendations of an equitable tariff structure. The results of these students should be presented in a form which will meet the requirements of financing institutions such as the World Bank (IBRD) or the Asian Development Bank. Such studies should be linked with the preliminary engineering design periods as applicable.

17. Analyses of available reports, documents, plans and maps related to the Master Plan study will be made to provide basic data for making population, waterwaste, land use and zoning, town and transportation planning and industrial wastewater estimates and development forcasts and for determining geological and soil conditions and other essential information.

18. Studies will be made to predict future quantities and composition of industrial wastewater based upon readily available data on water use, effluent quantity and quality, production, employment, population equivalents and waste quality by industrial classification. Surveys and analyses should only be carried out where the waste produced has unusual qualities for existing industries. General recommendations for pre-treatment of existing industrial wastes will be made based upon quantity and known characteristics of the wastewaters in relation to sewer materials and treatment processes recommended. Recommendations for methods of charging for industrial sewerage service and treatment designed to cover costs will also be prepared.

19. It will be necessary to establish a suitable small laboratory for carrying out tests on sewage, industrial wastes, and for receiving water quality studies needed during the course of the study. A Chemist or Laboratory technician will be needed to receive preliminary training and experience under the supervision of consultant staff-more detailed training to fully qualify the incumbert for future operational control work can be provided by means of fellowship immediately following completion of the feasibility study. This facility and staff should be designed to service the needs of the District Administration for future operation of the system, monitoring Industrial Waste discharges, and receiving water quality and other miscellaneous related duties, taking into account the availability of other existing Government analytical services and the need for direct control of testing capability.

20. Design criteria will be developed for the elements of wastewater facilities taking into consideration modern development in various types of wastewater stabilization ponds including aerated ponds, criteria already developed in the course of other similar studies in Malaysia, and the availability of materials manufactured in Malaysia.

21. Recommendations will be made for improved operation of conservancy and septic tank systems as an interim measure with due consideration to the use of oxidation ponds for treatment of nightsoil and septic tank pumpings. Areas now using conservancy (bucket) systems should receive priority as feasible for installation of sewers.

22. The present surface drainage system within the study area will be analysed relative to its influence on sewerage planning. As these systems now receive sullage flows, septic tank effluents, and promiscuous solid wastes, methods of interception of these flows and preventing solid waste disposal to them should be considered.

23. Unusual flow conditions, such as heavy rains and floods, and tidal effects, will be studied with respect to effects on design, operation, and maintenance of wastewater facilities and receiving water quality. Suggested precautionary measures will be incorporated in the Master Plan.

24. The training of professional and sub-professional staff needed for operation and maintenance of completed facilities, supervision of construction and design contracts, and planning future adjustments and extensions will be comprised of on the job training, fellowships, and counterpart experience.

C. Investment Potential of the Project

25. The objectives of the project relate substantially to the implimentation by the construction of wastewater facilities. The systems to be designed and detailed in the Master Plan, together with preliminary engineering and feasibility studies will be complementary to present and long-term water supply planning and will relate closely to urban and industrial development. Financing of wastewater facilities should therefore be closely correlated to financing of water supply and development project.

III. WORK PLAN

A. Description of Project Objectives

a) Preparatory activieies to be carried by Government* to assure timely implementation of the project:-

	Project Activities	Proposed timing and completion date
1.	The Government will establish a small steering or advisory committee to review project activities, give general guidance to the project and ensure cooperation of Government Agencies in the attainment of project objectives.	From March 31st, 1974 for duration of the project.
2.	The Government (BW/BM District Administration) will designate a project Co-Manager and arrange for counterpart staff to work with the Consultants' Project Manager and Project Engineer in the categories and numbers subsequently outlined in this document.	By June 1st, 1974 for duration of project and fellowship training for project Co-Manager. Others as scheduled below.
3.	The Government (BW/BM District Admin.) will make ready office and related furnishings, fixtures, equipment and supplies to accommodate project personnel and counterpart staff.	By June 1st, 1974 as needed by project and personnel development.
4.	The Government will assemble and make available to the project personnel the following materials:-	By June 1st, 1974 and there after as needed by project personnel.
	(i) Physical planning reports, maps and census date etc.	
	(ii) Water supply, sewage and drainage studies and maps.	

* Government includes the Federal Government and its various Ministries Department and Agencies, The State Government of Penang/Province Wellesley and the Butterworth-Bukit Mertajam District Administration.

(iii) Studies and data relative to hydrology, geology, climate, flood, tidal and current records, stream flow records, and water and wastewater analyses (including studies made on industrial wastewaters).

(iv) Topographic and other maps and air photographs of the study area (updated as necessary). Early arrangements should be made with the survey dept., to ensure the availability of suitable topographis maps and/or aerial photographs of the area.

5. Laboratory & Laboratory Equipment and Operation

(i) The Government will make available suitable building space, preferably near the office space (A, a, 3, above) for a small laboratory of approximately 200 square feet floor area. Initially this laboratory should be equipped with a 2 compartment stainless steel sink draining to a suitable disposal facility for chemical wastewaters, adequate lighting for nighttime laboratory work, at least 4 outlets of 20 ampere capacity, and air conditioning. The Government will make such necessary alterations as are required by the Project Engineer during the course of the study including installation of benches, cabinets, furniture, refrigerator etc. — By June 1st, 1974 for space and basic facilities specified.

(ii) The Government will provide needed laboratory equipment, glassware, and supplies to fully equip the laboratory for continued use as planned by the Consultant. Costs of basic equipment should not exceed $M. 15,000/-. (Details to be negotiated with the Butterworth-Bukit Mertajam — By Sept. 1st, 1974.

	District Administration after the Consultants Project Manager is on site). Additional equipment needed by the Consultant would be supplied by the Consultant and would remain as his property except as the BW/BM District Administration might agree to purchase it from the Consultant.	
(iii)	The Government (Butterworth-Bukit Mertajam District Administration) will provide for all operating expenses of the laboratory including electricity, telephone, water supply and laboratory supplies etc.	As needed June 30th, 1974 to March 31st, 1975.
(iv)	The Government will provide for all testing needed beyond the capability of the Laboratory through the Department of Chemistry or other Government facilities as requested by the consultant on the timely basis.	As needed
6.	Other technical equipment	
(i)	The Government will provide or give access to instruments for air photo interpretation of the "Orthographic" type or equal.	As needed after June 30th, 1974
(ii)	Surveying instruments, including levels, theodolites etc. and necessary auxiliary staff.	
(iii)	Equipment for soil exploratory drilling and laboratory testing of soil samples including staff or alternatively give access to a soils laboratory with staff, as needed.	
(iv)	Flow metering equipment for measuring open water channel discharge including auxiliary staff - or alternatively provide required flow data through its own facilities.	

7.	The Government will provide a suitable residence for use of the Consultant Project Engineer, Family and consultant temporary staff. (Details subject to negotiation prior to final agreement but a 3 bedroom house is indicated-furnished)	By June 30th, 1974 for duration of Assignment - approx. March 31st, 1975.
8.	The Government will provide a vehicle and driver for project use (Details to be negotiated prior to final agreement).	By June 30th, 1974 for duration of Assignment - approx. March 31st, 1975.

b) Direct Project activities which, unless otherwise indicated, will be carried out by the Consultant with support from professional and sub-professional Government Staff:

1.	Preparation of an "Inception Report" to detail the Consultants initial findings, problems, and concept of his duties and management responsibilities. This report will be submitted to the Steering Committee for review within 2 weeks of arrival of the project manager to commence the study.	By July 31st, 1974
2.	Preparation of a training program designed to meet the future operational needs of the design, construction & operation of the sewerage system. The training program should emphasis on-the-job training with consultant supervision and should also include academic training (fellowship) as indicated.	By July 31st, 1974
3.	Study of available data, reports, documents etc., on water supply and consumption; sewage collection, treatment and disposal; population and industrial development; drainage; Town and Transportation planning; hydrology; geology; rainfall etc.; soil; and other data essential for the study.	By July 15th, 1974

4.	Dilineation of sewerage drainage basins and zones in correlation with other physical planning activities and development, population and population density, routing of main collectors, location of pumping installations and of discharge points, treatment facilities etc., including analysis and evaluation of various alternatives. (Refer to WHO/Ministry of Health Preliminary Report).	By Sept. 1st, 1974
5.	Study of the present and proposed study area surface and rain water drainage system and its relation to the sewerage system; routing of main, tributary, roadside and backyard drains; advisability of covering open drains and making other improvments; the pollutional effects of drains on receiving waters under present conditions and projected future conditions with sewerage installation; and or diversion of low contaminated flows to the sewage system. Special attention should be given to the practice of connecting household and resturant and other "sullage" wastewaters and septic tank effluents to the drains, and the problems and costs involved in adjustment of plumbing to divert these wastewaters into the sewerage system(s).	By Nov. 30th, 1974
6.	Study and inventory of industrial wastewater sources in the study area, indentification of major wastewater produces, of discharge quantities and qualities (In-so-far as possible from available data on water supply and product quantities related to population equivalents or on data provided by the industry), and of their effect or the sewerage network, possible effects on design flows of sewers, and effects on design and operation of sewage treatment facilities. Suggested methods of control	By October 1st, 1974

	and pre-treatment needs of trade waste effluents as needed, balanced against costs of separate treatment and disposal and/or prohibitions of admission to the system, should be developed including location of industries in specially planned industrial parks where wastes could be handled separately from domestic sewage. Projections of future industrial wastewater loads both to the recommended and alternative sewerage schemes is to be made using available planned industrial expansion data and reasonably supported estimates, with a view towards providing for necessary sewerage and treatment plant capacities and estimating future condition of receiving waters.	
7.	Study of the tidal effects in the Prai and Juru river estuaries below the existing and proposed tidal barries with a view towards estimation of the probable water quality to be expected with implementation of the recommended sewerage scheme in relation to basic parameters such as "Disolved Oxygen, p H, Total Suspended Solid etc., and toxic materials. This study should include general consideration of effects on ocean beach areas for recreational use and effects on the aquatic food chain and fishery.	By October 31st, 1974 (4 months)
8.	Estimation of the probable water quality in the rivers Prai, Juru and Derhaka and tributaries as effected by effluents from treatment facilities of the recommended and alternative schemes for sewerage and separately discharged industrial effluents and surface drainage. This will also provide a basis for justification of the degree and type of sewage and industrial wastewater treatment recommended.	By Dec. 31st, 1974 (6 months)

9.	The available maps of the study area shall be complied and checked with respect to their completness for use in preparation of the 1st and 2nd Stage Studies (1976-80 & 1981-85). Gaps found in map information shall be filled by Government. The Consultant shall utilize, to the extent necessary, air photographs available but not yet mapped, for interpretation both for completion of ground plans and for orthographic construction of contour lines and of elevations at specific points or areas. Government will provide up to date air photographs of the study area.	By Nov. 30th, 1974 (2 months) and as needed.
10.	Necessary surveying of elevations at critical or focal points within the sewerage network shall be done, in addition to routine surveying by the BW/BM District Administration or by the Government Consultant using counterpart equipment and labour.	By Nov. 30th, 1974 (3 months) and as needed.
11.	Existing soils data shall be evaluated with respect to Phase one and Stage 1 & 2 engineering design, including alternatives. Necessary additional soil sampling and testing shall be provided by Government equipment and personnel.	By Sept. 30th, 1974 (3 months)
12.	Based on the data, information and documents emanating from the above activities, interim programs will be prepared, including preliminary engineering and feasibility studies of the 1st and 2nd Stages (1976-80 & 1981-85), of sewerage and sewage treatment facilities. These studies will be prepared and presented in draft form, and shall meet the requirements and provisions outlined above. The draft reports will contain, among others;	By Dec. 31st, 1974 (6 months)

design criteria which should be produced in a format and in sufficient detail so that, upon approval, they will be adoptable in the final Master Plan designs without major changes.

13. Immediate and Interim needs for improvements to existing collection, treatment, and disposal methods will be studied and commented on at the earliest possible stages so as to insure current processing and action by Government authorities concerned and to meet possible requirements for financing. — By Nov. 30th, 1974 (3 months) or earlier

14. A mid-term review will be held by the Stearing Committee, the Consultant, and other concerned Government Agencies. The immediate needs program, the drafts of the interim and construction programs will be presented, explained, discussed, amended to the extent feasible, corrected, completed, and finally approved for future adoption in project procedure. — By January 1974 (1 months) (A formal meeting of the Steering Committee will be called at the end of the review period to grant final approval of findings)

15. Based upon the interim or final results and outlines of the preceding project phases, a Master Plan will be developed. Basic figures, findings and data used in the previous project activities will be reviewed, corrected completed and/or deleted, whichever is applicable. New developments will be considered and included; suggestions possibly submitted by other planning authorities will be carefully examined, evaluated and to the extent feasible incorporated in the Master Plan. Consideration will be given to the desirability of including house connections and the supply of internal plumbing needs and fixtures to owners at — By Dec. 1st, 1974 (4 months) (Plus final Peview & Editing)

cost by Government as an integral part of the Plan thus ensuring early connection to the completed sewers and possible savings to the people concerned.

16. *In the Master Plan report, there will be incorporated* a comprehensive catalog of sewerage design criteria applicable for the study area with special indication of which criteria and basic values will be equally applicable for other urban sewerage design in Malaysia. *As this study will follow the feasibility* studies for the Duala Lumpur Metropolitan area and Ipoh the Consultant will in-so-far as possible use similar design criteria. — *December 1974* (one month in preparation)

(i) Minimum & Maximum pipe diameters for the different pipe materials.

(ii) Criteria for determining flow velocities in sewers *and open drains under different conditions and in* respect to various pipe materials and pipe sizes *etc.*

(iii) Maximum & Minimum sewer depths.

(iv) Dry weather flows & allowance for infiltration into sewers

(v) Pipe material, joints & precautions against excessive loads, depths etc., to ensure safe pipe laying;

(vi) Standard locating, sizing, spacing and design of manholes to allow for easy access and maintenance of sewers.

(vii) Methods of avoiding corrossion of pipes and appurtenances, flow velocity chemical control, resistant pipe lining and materials.

(viii) Design criteria for appurtenances, such as connections and outlets, siphons, pump stations, rising mains, flushing facilities, house plumbing installations and house connections.

(ix) Unit Cost figures for estimating; construction, operation and maintenance.

17.	Complementary studies on environmental impact aspects within the scope of the project will be made covering storm water drainage, solid waste collection and disposal, Industrial Waste Disposal, vector control, street cleaning and public hygiene, and land use in relation to sewerage and sewage treatment - i. e. The evaluation of the impact of proposed works on the general environment of the study and its surroundings.	January - February, 1975 (2 months in preparation)
18.	A program for continued laboratory operation including sewerage treatment plant testing and water quality conditions in the receiving waters of the Sungai Prai and Juru etc., and ocean will be prepared for execution by Government, and included in the Interim and Master Plans.	By February 1st, 1975 (1 month in preparation)
19.	The Master Plan will be prepared in draft form and submitted for examination and Comments.	By March 31st, 1975 (1 month allotted)
20.	The Master Plan will be completed, after needed revision, printed & submitted in format and number agreed upon.	By May 31st, 1975 (2 months allotted)
21.	Review of Institutional framework, relationships and legislation relative to organization, management and finance of sewerage system development, operation and maintenance and suggestions for alternatives for future arrangements considering	By January 1st, 1975 (2 months allotted)

such possibilities as:-

(i) Presented future district administrative boundaries and authority and relationships to the study area and sewerage system operating unit.

(ii) Relationships to Port & Airport Areas.

(iii) State of Penang/P. W., responsibilities for State wide authority relative to sewerage and water services.

22. Preparation of a Report on Institutional Framework findings & recommendations, including suggested legislation needed for implementation. The report should include references to discussions held with appropriate officials and the Steering Committee. — By Feb. 15th, 1974 (1 month allotted)

23. The Government will take the necessary steps to ensure adequate Institutional framework to facilitate implementation. The Consultant will assist Government as and if necessary in its deliberations relative to Institutional framework. — By March 31st, 1975 (During progress of study - 1 year allotted)

24. The Consultant will within the decided upon institutional framework suggest:- — By Feb. 29th, 1975 (1 month allotted)

(i) Organizational and staffing guidlines for sewerage service management.

(ii) Procedures, within the proposed organization, for planning, personnel administration, budgetting, accounting and cost accounting, fiscal reporting, procurement and stores, equipment management, and operation and maintenance.

25.	The Consultant will develop a financial plan for the first and second stages of Phase 1 sewerage development in suitable form as a bankable project by International Banks (IBRD & ADB etc.). This plan should include:- (i) Basic Charges and Rates (ii) Economic Impact (iii) Beginning balance sheet (iv) Cash flow and (v) Related documentation as prescribed in IBRD *Questionaire* for sewerage Projects, January 1969.	By March 31st, 1975 (1 month allotted)

c) Timing of Technical Reports, mid-term, and Terminal Reports:-

1.	Inception report to detail Consultants concept of work needed etc.	To be completed by July 1, 1974 for Steering committee
2.	Training program-on-the-job & fellowship etc.	Plan to be ready by July 30th, 1974
3.	Institutional arrangements for sewerage planning, development and operation.	Report to be ready by February 15th, 1975.
4.	Immediate needs for improvements to sewage collection & disposal.	Report to be ready by November 30th, 1974.
5.	Interim 1st & 2nd stage - Phase I construction program.	Drafts - Dec. 31st, Final - Jan. 15th, 1975.
6.	Mid-term progress report.	Report to be ready by Dec. 31st, 1974
7.	Master Plan & feasibility report.	Draft report, March 31st, 1975.
8.	Management & financial report.	Report to be ready by Feb. 28th, 1975.

9. Final Master Plan, feasibility, institutional, management and financial report. — May 31st, 1975.

Note: All reports submitted will be promptly reviewed by the Steering Committee to allow for incorporation of comments in project work. Normally review should be completed within 2 weeks of submission except for final Master Plan.

B. Description of Consultant (or Bi-lateral Government Aid) Inputs.

1. Preliminary Negotiations

Visits by Managerial Staff Member	
- 2 visits/2 weeks duration/@$4,000/- per visit	$8,000/-
Miscellaneous Govt. expense.	2,500/-

2. Personnel Assignments

Project Manager - 5 visits of 11 weeks total duration @$4,000/- each, plus 4 1/2 months work in the home office	31,000/-
Project Engineer - 10 months assignment plus one leave period at home (Self & Family)	75,000/-
Chemist - 2 visits of one month duration plus 3 weeks in home office	25,000/-
Economist & Financial & Mgt., Advisor - 2 visits of 5 weeks total plus 5 weeks in home office	28,000/-
Engineer - Investigation (Local Hire) - 6 months	30,000/-
Engineer - Design (Local Hire) - 6 months	30,000/-

3.	Reporting Costs etc.	15,000/-
4.	Contingency 20 %	50,000/-
5.	Contractors Overhead & Profits	75,000/-
	Total Estimate	$M369,500/-

C. Description of Government Inputs

The Government will finance the employment of all Counterpart staff listed below and provide supporting facilities, equipment and services as shown. It will also pay the transportation costs of employees sent on fellowship for training and salaries while absent. Contributions are shown (cash and kind) as detailed below:-

1. Assignment of National Staff

		Estimates
a)	Project Co-Manager 1/3rd of time of City Engineer) - 9 months	$8,000/-
b)	*Assistant Engineer Sewerage (or Technical Assistant/ Civil) (Trainee to be brought on duty by June 30th, 1973) - 1 year	18,000/-
c)	*Chemist (or suitable laboratory assistant for on the job training plus fellowship training as indicated). June 30th, 1973	16,800/-
d)	Surveyors (2) and auxiliary labour	9,400/-
e)	Draftmen (2)	15,000/-
f)	Plan Printer (1)	3,000/-
g)	Stenographer/typist (1)	3,500/-
h)	*Miscellaneous labour - *boatmen etc.*	10,000/-
i)	*Driver (1)	2,500/-
	Sub total	86,200/-

2. Training Privisions

Travel Costs ($M2,800/-)	2,800/-

3. Miscellaneous Component

a)	*Project Eng'rs Residence (Furnished)	12,000/-
b)	*Vehicle Costs @ 20,000 mls. @ $0.35¢	7,000/-
c)	*Laboratory Equipment	15,000/-

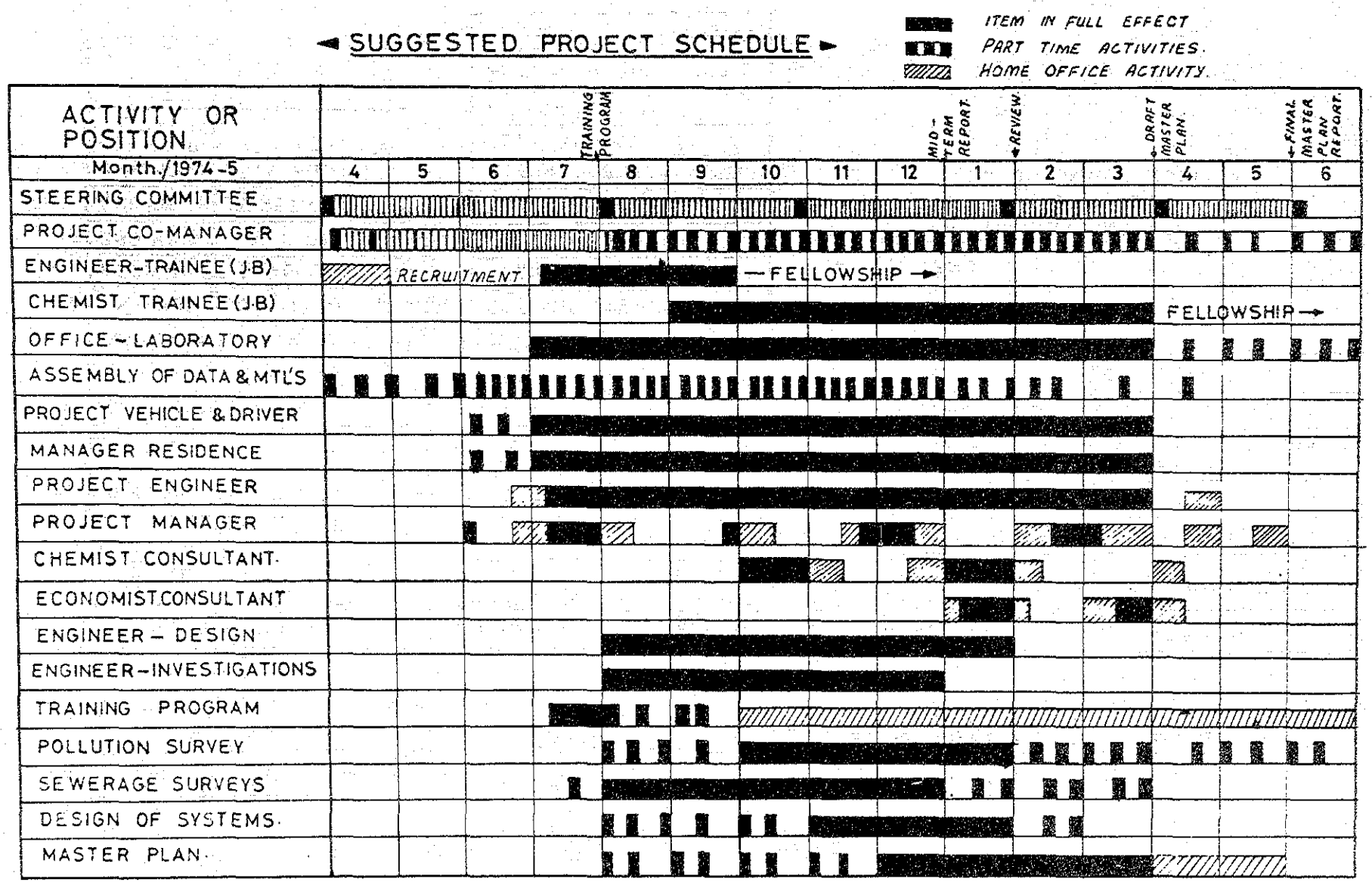
d)	Premises	12,000/-
e)	*Office & Laboratory Furnishing & Equipment	5,000/-
f)	*Expendable equipment & supplies	10,000/-
	Sub total	61,000/-
	Total	$150,000/-

4. *Estimates of new funds needed 96,000/-
(marked on items above by asterisk *)

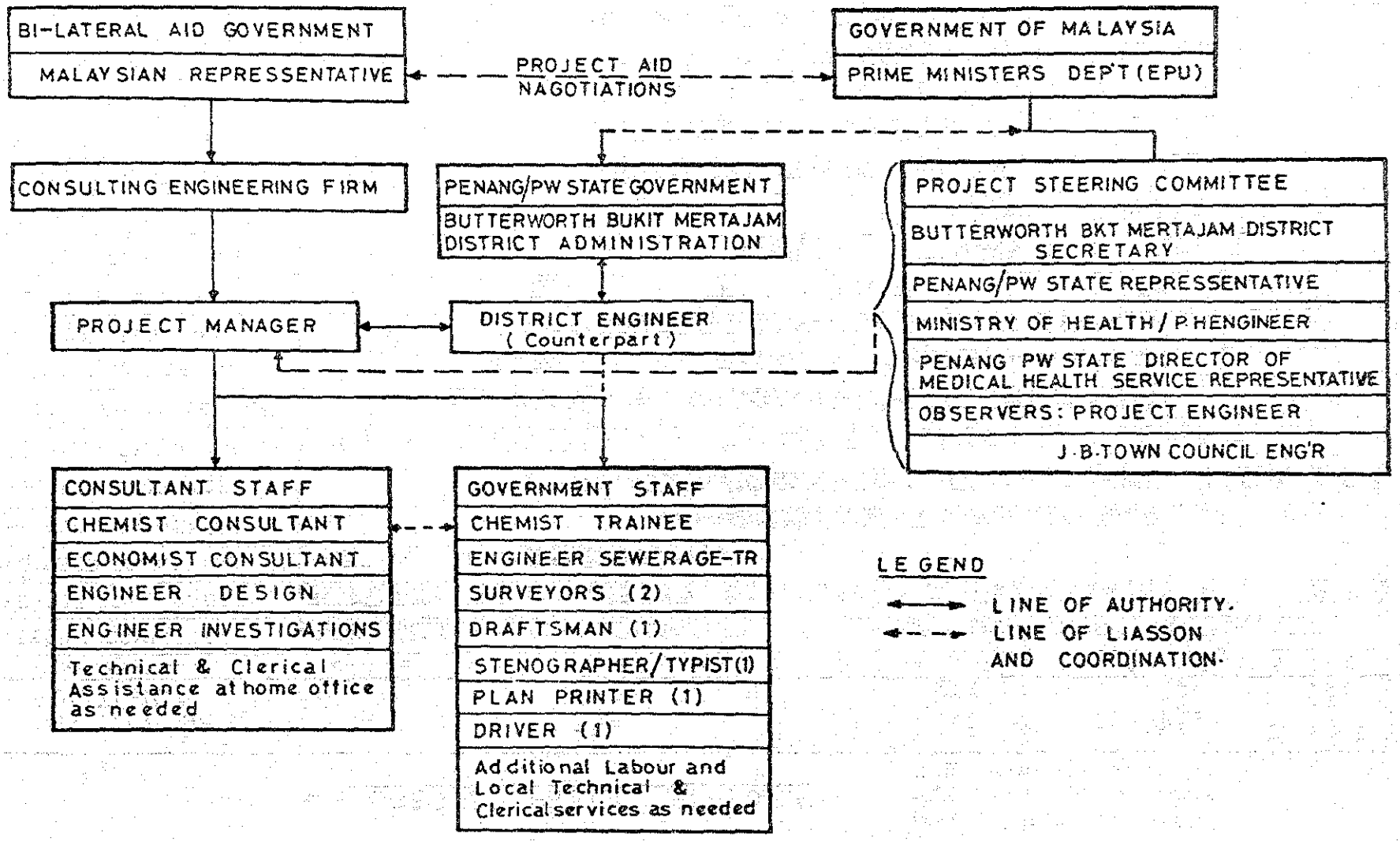
5. Fellowship Component (through bi-lateral or multi-lateral aid)

Assistant Engineer-Sewerage-12 months	25,000/-
Chemist-Aquatro biology + chemistry - 6 months	15,000/-
Project Co-Manager-Sewerage Mgt., - 6 months	15,000/-
Sub total	$55,000/-

◄ SUGGESTED PROJECT SCHEDULE ►



MANAGEMENT STRUCTURE



ANNEX - 1

ORGANIZATION OF THE PROJECT

A. General Responsibilities

1. The Government will be represented by the Steering Committee to consist of:-

(a) One Representative of the Ministry of Health
(Chief, P. H. Engineer, E. H. & Engineering Section)

(b) One Representative of the Butterworth-Bukit Mertajam District Administration.

(c) One Representative of the State Govt., of Penang/Province Wellesley.

(d) The State Director of Medical of Health Services or his representative.

The Consultant's Project Engineer will be an observer at meetings of the Committee.

2. The Steering Committee will be responsible for the execution of the project and the realization of its objectives as described in Part II of this document.

3. The Government shall provide to the project the National project personnel, land, buildings, equipment and other required services and facilities.

4. The Consultant undertakes to carry out the study in accordance with the terms of this document and in accordance with the conditions established by his Government. (Bi-Lateral aid). The representative of the Bi-Lateral Aid Government in Kuala Lumpur will assist as needed in accordance with the terms to be laid down in an interchange of letters between Governments which shall constitute the formal aid agreement.

B. Participation of the Government

5. The Government shall provide to the project the services, equipment and facilities in the quantities and at the times specified in the Work Plan. Budgetary provision - either in kind or in cash - for the Governments participation so specified shall be set forth in the Project Budgets.

6. The Consultant will assign a project manager as specified in this document who will be primarily responsible for project implementation.

7. The estimated cost of items included in the Government Contribution as detailed in the project budget, shall be based on the best information available at the time of drafting of this project proposal. It is understood that price fluctuations during the period of execution and other factors may necessitate an adjustment of said contribution in monetary terms; the latter shall at all times be determined by the value of the services, equipment and facilities required for the proper execution of the project.

8. Within the given number of man-months of personnel services described in the Work Plan minor adjustments of individual assignments of project personnel provided by the Government may be made by Government in Consultation with the Consultant Project Manager, if it is found to be in the best interests of the project.

9. The Government will continue to pay the local salaries and appropriate allowances of national project personnel during periods of absence for training.

10. The Government shall defray any customs duties and other charges related to the clearance of project equipment, its transportations, handling, storage and related expenses within Malaysia. It shall be responsible forsake custody of the equipment, its installation and maintenance, insurance, and replacement if necessary, after delivery to the project site. The Government shall assist the consultant in expeditious and timely customs clearance for all items imported for use on the project.

11. The Government shall make available to the project-subject to existing security provisions - any published and unpublished reports, maps, records and other data which are considered necessary by the Project Engineer to the Implementation of the project.

12. The Government shall provide a suitable residence, furnished, for use of the project engineer and family and consultant staff; and shall arrange for suitable housing accommodation for other project staff at reasonable rental.

13. The Government will within Government regulations provide a suitable vehicle and driver for use of Consultant staff.

14. Any services and facilities specified in the Work Plan which are to be provided to the project by Government by means of a contributions in cash shall be set forth in the project budget. Payment of this amount shall be made in local currency to the Project Engineer.

C. Participation by Bi-Lateral Aid Government

15. The Bi-Lateral Aid Government will be represented by its High Commissioner in Malaysia. (or the equivalent)

16. The Government will be represented by the Prime Ministers Department (EPU) in matters relating to inter-governmental agreement for implementation of the project and by the Steering Committee in relation to project execution.

17. The Bi-Lateral Aid Government will utilize the services of an approved Consultant for the technical execution of the project and the Consultant will be represented by the Project Manager.

18. The Consultant will assign and/or hire such staff necessary for execution of the project as outlined in the Work Plan.

19. Equipment and materials imported by the consultant for use on the project may be agreement be purchased by Government for continued use at a price not to exceed the cost price paid by the Consultant. Equipment not purchased shall upon completion of the project be exported by the consultant without restriction of any kind by Government.

D. Facilities, Privileges and Immunities

Consultant Personnel (excepting Malaysian residents or nationals)

20. The Consultant Personnel shall:

a) Be immune from legal process in respect to all acts performed by them in their official capacity in the execution of the project;

b) Be immune from National Service Obligations;

c) Be immune together with their spouses and relatives dependent on them from immigration restrictions;

d) Be accorded the privileges of bringing into the country reasonable amounts of foreign currency for the purpose of the project or for personal use of such personnel, and of withdrawing any such amounts brought into the country, or, in accordance with the relevant foreign exchange regulations, such amounts as may be earned therein by such personnel in the execution of the project;

e) Be accorded together with their spouses and relatives dependent on them the same repatriation facilities in the event of international crises as diplomatic envoys.

21. All Consultant personnel shall enjoy inviolability for all papers and documents relating to the project.

22. The Government shall either exempt from, or bear the cost of, any taxes, duties, fees or levies which it may impose on the Consultant in respect of:-

a) The salaries and wages earned by such personnel in the execution of the project;

b) Any equipment, materials and supplies brought into the country for the purposes of the project or which, after having been brought into the country, may be subsequently withdrawn therefrom;

c) Any substantial quantities of equipment, materials and supplies obtained locally for the execution of the project, such as, for example, petrol and spare parts for the operation and maintenance of equipment as specified in the Work Plan.

d) Any property brought or purchased locally, including one privately owned automobile for the Project Engineer and household effects and furnishings used while in residence for personal use or consumption, or which after having been brought into the country or purchased therein, may subsequently be withdrawn therefrom upon departure.

e) The privileges and immunities of the Consultant and its personnel referred to above, may be waived by the Bi-lateral Aid Country's diplomatic representative where in his opinion the immunity would impede the course of justice and can be waived without prejudice to the successful completion of the project.

f) The Bi-lateral Aid Countries representative shall provide the Government with the list of personnel to whom the privileges and immunities enumerated above shall apply.

Note: As there is a possibility of coordinating the work of the Consultant with a similar feasibility study on another Malaysian town it may be possible to arrange for savings both to Government and the Consultant in respect to such items as special laboratory equipment, items for personnel use of consultant personnel to be imported (Automobile?) etc. Also timing of various work tasks might be staggered to utilize the same personnel or to avoid extra visits by specialist consultants. These matters can however be easily adjusted as and when necessary.

Scope of Work の例

SCOPE OF WORK

FOR

THE SEWERAGE AND DRAINAGE SYSTEM PROJECT IN BUTTERWORTH/BUKIT MERTAJAM METROPOLITAN AREA IN MALAYSIA

I. INTRODUCTION

In response to the request made by the Government of Malaysia for technical cooperation in conducting a study necessary for preparing Master Plan and a Feasibility Study on the Sewerage and Drainage System Project in Butterworth/Bukit Mertajam Metoropolitan Area, the Government of Japan agreed to offer the service of Japanese expert team for the studies to be carried out in the project site and the transfer of knowledge to the Counterpart who appointed by the Government of Malaysia, in accordance with laws and regulation in force in Japan. The Japan International Cooperation Agency (JICA), the official agency responsible for implementation of technical cooperation programmes of the Government of Japan, will carry out the studies in close cooperation with the authorities concerned of the Government of Malaysia.

II. OBJECTIVE OF THE STUDY

The Government of Japan conducted the Preliminary Survey on the Sewerage and drainage System Project in Butterworth/Bukit Mertajam Metoropolitan Area in May, 1976. Based on the results of this Survey, JICA will carry out the study for preparing the Master Plan and the Feasibility study on the first priority project which will be selected by the Government of Malaysia, from among the projects recommended by the Master Plan Study.

III. CONTENTS OF THE STUDY

1. Master Plan Study

1-1. Data collection and analysis

(details of data and materials are as in Annex Sheet (A))

1-2. Establishment of the target year for planning

1-3. Definition of survey area for planning and population to be served

1-4. Designation of sewerage system, drainage system and treatment process (including industrial waste)

1-5. Required facilities

1-6. Construction method and materials

1-7. Availability of construction materials and manpower for construction, operation and maintenance

1-8. Rough estimation of costs for construction, operation and maintenance

1-9. Implementation programme

1-10. Rough estimation of benefits

1-11. Costs and benefits analysis

1-12. Studies of organization, operation and managements plans

1-13. Priority of the project

1-14. Revision and supplementation

2. Feasibility Study

2-1. Definition of project area

2-2. Study on industrial waste

2-3. Required facilities

2-4. Layouts of the facilities

2-5. Construction schedule

2-6. Study of construction materials and labour force and study of construction ability of local contractors

2-7. Studies of administration ability for construction

2-8. Estimation of construction, operation and maintenance costs

2-9. Estimation of benefits

2-10. Economic and financial analyses

2-11. Studies of organization, operation and management plan

2-12. Environmental assessment

IV. REPORTS

JICA will prepare and submit the following reports to the Government of Malaysia in the course of the Master Plan Study and the Feasibility Study.

1. Inception Report
   - copies
   - at the beginning of the field survey of the Master Plan Study

2. Progress Report
   - copies
   - at the end of the field survey of the Master Plan Study

3. Interim Report
   - copies respectively
   - within 4 months (for Master Plan Study) and 5 months (for Feasibility Study) after the completion of the field survey of the studies
   - The Government of Malaysia will provide JICA with its comments within one month after the receipt of the Interim Report respectively.

4. Draft Final Report
   - copies respectively
   - within 3 months after the receipt of the comments on the Interim Report respectively
   - The Government of Malaysia will provide JICA with its comments within one month after the receipt of the Draft Final Report of the Master Plan Study

5. Final Report
   - copies respectively
   - within 3 months after the receipt of the Comments on the Draft Final Report of the Master Plan Study
   - within 2 months after the completion of the explanation on the Draft Final Report of the Feasibility Study to the Government of Malaysia

V. UNDERTAKINGS OF THE GOVERNMENT OF MALAYSIA

The Government of Malaysia agrees,

1. To provide the Study Team with the data and information concerned for the study (annex sheet A)
2. To exempt the Team from taxed and duties for materials, equipment and personal effects brought into Malaysia by the Team that it normally extends to Colombo Plan expert
3. To appoint counterpart personnel (officials/engineers) to the Team during the survey period
4. To provide the Team with suitable office and laboratory space with necessary equipment for the studies
5. To make arrangements for the Team to bring the data and materials concerning the study to Japan

VI. UNDERTAKINGS OF THE GOVERNMENT OF JAPAN

The Government of Japan agrees,

1. To transfer the knowledge of the Malaysian counterpart personnels during the field survey
2. To provide the materials and equipments necessary for the studies which are not provided by the Government of Malaysia.

ANNEX (A)

Data and materials to be provided by the Government.

1. Population
   a. Population (total; age-group) and its Annual Change (in Malaysia; In other cities)
   b. Population (total; age-group) by the Administrative District and its Annual change ... Province Wellesley, Butterworth, Bukit Mertajam
   c. Population and Density by District
   d. Daytime Population by District

2. Industry
   a. Employed Persons by Sectors of Industry and their Change
   b. Kind and Size of Industries
   c. Water Consumption by Industries
   d. Distribution Map of Major Factories
   e. List of Major Factories
      Area, Number of Employee, Main Product, Raw Material, Production Method, Yearly or Monthly Shipment, Water Consumption. (Total, Process, Daily or Seasonal Change, etc.), Quantity and Quality of Wastewater (Total, Process, Daily, Seasonal Change), Wastewater treatment Facilities (Specification and Effect) etc.

3. Land Use
   a. Existing Land Use Map
      . residential
      . commercial
      . industrial
      . recreational
      . open space
      . others
   b. Existing Road Network (in map)
   c. Type of Houses in the project area
   d. Present Distribution of Floor Space by Use and District

e. Location of Main Buildings (office, hotel, school, medical institution and other public buildings)

4. City Planning

a. Future Population

b. Future Employed Persons by Sector of Industry

c. Future Demand of Land by Use

d. Land Use Plan

e. Networks of Road and Railway

f. Future Development Plan

. new town

. re-development plan

5. Investigation of the Present Wastewater Treatment Facilities, Sewerage and Drainage System

a. Historical Development of the Systems

b. Role and Function expected for the Systems

c. the Existing Facilities (Domestic, Human Excreta, Industrial etc.)

d. Current State of influent and effluent Wastewater

e. Current State of Maintenance

f. the Organization

g. Management and the Sewer Service Charge

h. Master Plan prepared by WHO Expert

6. Investigation of Natural Water Courses

a. Meteorological Observation

. temperature

. precipitation, intensity of rainfall

. direction and velocity of wind

. relative humidity

. quantity of evaporation

b. River and Canal

. water usage

. water level

. water velocity and quantity

. water quality

c. Channel (small drainage system)

. quantity and quality

d. Sea, Coastal, Tidal

. usage

. tide, current direction and velocity

. water quality

. bathymetry, hydrography and benthic conditions

e. Ground Water

. usage

. level of ground water

. water quality

7. Related Maps and Drawings

a. Topographical Map of the Administrative Districts and the Project District (scale; 1/25,000, 1/10,000 + 1/2,500)

b. Drawing of the Existing System

. drainage system including rivers and canals, polders

. pumping station

. sewerage system and treatment facilities

8. Micellaneous

a. Laws and Regulations concerning

. city planning

. building code

. water supply and its source (distribution network)

. water quality standards

. water pollution control

. regulations on plant effluent discharge

. others

b. Statistics on Occurrence of Communicable Diseases (water-borne epidemical diseases)

c. Statistical Year Book of Malaysia, Penang and Province of Wellesley

9. Others

a. The third Malaysia Plan

b. Development Plans for the Project area

c. Other related materials

フィージビリティ調査報告書内容の例

1. 被調査国：マレイシア国
2. 調査対象地域：バタワース・ブキットメルタジャム地区
3. 調査期間：１９７７年４月～１９７８年３月
4. 調査目的：下水道フィージビリティ調査

ここに示す調査報告書作成の内容は、下水道計画フィージビリティスタディで必要と考えられる項目について、その概要を述べたものである。

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OUTLINE
OF
FEASIBILITY STUDY REPORT

1. Outline of Feasibility Study

According to the Terms of Reference for the Feasibility Study, the report shall include preliminary engineering and feasibility study for the First Stage programme to be implemented in the first five years of the Project, from 1981 through 1985. The study will comprise detailed field investigations, surveys and technical analyses of alternative plans and schemes for the various elements, and pertinent legal, managerial, economic and financial matters as proposed for implementation of the First Stage programme within the Master Plan.

For sewerage system, possible alternative plans shall be prepared so that the Government of Malaysia can select the most suitable system for the First Stage programme areas. For the purpose of identification of the most feasible plan to achieve the desired results, the analyses shall be made to (a) cost estimates for construction, operation and maintenance, (b) sewer charges and revenues, and (c) users' ability and willingness in compliance with the sewer charge.

The stormwater drainage programme for the First Stage programme shall include rehabilitation of existing drains, widening of sections and provision of new side ditches, and provision of stormwater reservoris.

For the convenience, the report may be divided into two separated volumes, one for preliminary engineering and feasibility studies and the other for preliminary engineering drawings and maps and, if necessary, tabulations.

2. Proposed Outline of Report

The report will consist of five parts and appendices as shown below:

Part I - Introduction
Part II - Summary
Part III - Sewerage
Part Iv - Drainage
Part V - Other Recommendations
Appendices

An outline of each chapter is described in the succeeding sections.

Letter of Transmittal

References to the appropriate paragraph of the Terms of Reference under which the report is to be prepared and the number of volumes involved.

Table of Contents

This will include a list of tables, figures, drawings and appendices. Also, the various chapters and sections of the report itself, a list of abbreviations, glossary, and a list of other reports to be submitted under this project.

Part I - Introduction

This will include the full terms of reference of the study; a section covering important background information, which will give a picture of existing situations in general but particularly of the water supply and sewerage services. More descriptive background material, if pertinent, will be included in an Appendix.

Part II - Summary

The summary will be written for the top decision-makers who will not be able to read the full report. Thus, it will present in a concise manner all the important findings established in the study, the proposed solutions, an outline of the elements of works proposed under the First Stage programme, costs and benefits implications and main recommendations, including a time-table for implementation and possible method of financing. In this connexion, the decision-makers would be interested to know what number and group of population will be served, for what period and at what cost and what sorts of benefit will be gained. Cross referencing will be used as much as possible so that the reader will be able to refer further detail easily if so desires.

For convenience, this part may be divided into three Sections namely; sewerage, drainage and other recommendations.

Part III - Sewerage

This part may consist of 11 chapters as described in the following:

Chapter 1 - Method of Approach and Investigations Carried Out under the Study

Chapter 2 - Areas and Population Served by the First Stage Programme for Sewerage

Chapter 3 - Sewage Flow Quantities and Qualities

Chapter 4 - Effluent Standards, Treatment Requirements and Method of Disposal

Chapter 5 - Design Criteria

Chapter 6 - Alternative Systems and Description of Proposed First Stage Programme

Chapter 7 - Cost Estimates and Capital Investment Programme

Chapter 8 - Cost Estimates for Operation and Maintenance

Chapter 9 - Organizational, Managerial, Legal and Financial Considerations

Chapter 10- Financial Planning

Chapter 11- Benefits of the Project

(a) Chapter 1 - Method of Approaches and Investigations

This chapter will describe the way of conducting the studies, the use of the national counterpart staff, what field investigations were carried out and the main findings. As necessary, reference will be made to more elaborate descriptions in the Appendices.

This chapter will also discuss combined vs. separate or partially separate sewerage systems with advantages and disadvantages as applicable in the particular cases, if necessary. Financial recommendations on the adopted system will be made accordingly in this chapter.

(b) Chapter 2 - Areas and Population Served by the First Stage Programme for Sewerage

This chapter will give an analysis of population trends including past, present and projected future growth. Population will also be classified according to income and housing

conditions, if enough data are available. A breakdown of population according to types of districts will also be presented. Any information which is a part of the Master Plan Report should not be repeated here, but summary will be presented with a reference to the Master Plan Report.

(c) Chapter 3 - Sewage Flow Quantities and Qualities

Domestic sewage quantities on a per capita basis will be analyzed based on the actual measurements done under the project, domestic water consumption and any other relevant information as applicable. The analysis should include average daily flows, peak and minimum flows and other fluctuation trends. It will also provide a forecast of future trends in domestic sewage flows.

Other sewage flows will also be analyzed and forecast covering infiltration, industrial wastes, commercial and institutional discharges. Sources of major industrial, commercial and institutional discharges, if they are located within the area, will be identified on a drawing and a table will be provided showing quantities and expected qualities. Quality of expected sewage discharges to be provided will include, for example, BOD, suspended solids, pH, chlorides and sulphates for sewage components.

(d) Chapter 4 - Effluent Standards, Treatment Requirements and Method of Disposal

Brief description will be made as to effluent standards, treatment requirements and method of disposal studied in the Master Plan, as well as the studies to cope with the first stage conditions and recommendations made for the First Stage, until the completion of the econd Stage programme, with additional engineering and economic analyses to select the best suitable alternative.

(e) Chapter 5 - Design Criteria

This chapter will present design criteria studied in the Master Plan relating to the First Stage programme, and discussions on application of these criteria to the preliminary engineering design, taking into account the local conditions of the First Stage programme areas. If necessary, adjustment of the design criteria will be made for those developed in the Master Plan to fit the First Stage programme.

(f) Chapter 6 - Alternative Systems and Description of Proposed First Stage Programme

This chapter will present layouts of different routing of alternative major collection systems and sites of disposal, thus showing the number of pumping stations needed, possible difficulties in siting such pumping stations and street conditions which may influence decision on routing.

The alternatives will analyze also whether the topographic situation might lend itself to the use of pressure systems in some areas, or whether more than one site of disposal might be more economical. Full justification will be presented in this regard. If any of the above has been well covered in the Master Plan Report, this chapter will only present a summary and the conclusion with reference to the details in the appropriate sections of the Report.

Reference will be made to the alternative methods of treatment considered and analyzed in Chapter 4 and to the adoption of separate or combined sewerage system analyzed in Chapter 1.

(g) Chapter 7 - Cost Estimates and Capital Investment Programme

This chapter will describe cost estimating procedures, including construction methods to cope with the different conditions in soil, depth and width of trench, size, etc. Further to be discussed will be traffic conditions of streets and whether open excavation or tunneling should be used for deeper sewers. Cost estimation and investment programme for the recommended programme will be made on the basis of the study results mentioned above.

(h) Chapter 8 - Cost Estimates for Operation and Maintenance

Operation and maintenance for the sewerage system will include inspection, measurement of rate of flow, cleaning, repaires, supervision, protection of sewers and pumping stations and also treatment plants. All costs accruing to the system will be estimated on the basis of the proposed facilities expressed in mid-1977 price levels in the area.

(i) Chapter 9 - Organizational, Managerial and Legal Aspects

This chapter will recommend on the subjects, which will be on the basis of those established in Master Plan Report but with some amendment to suit the First Stage programme, with analysis of the existing conditions. Major items to be discussed in this chapter will be:

- Alternative financing methods, including evaluation of alternative financial measures, taking into account the present situation, and the extent of the staged programme.

- Recommendations for financing methods, including charges for sewerage service, to enable the sewerage organization to meet various expenses accruing to the First Stage programme, with necessary tabulations.

(j) Chapter 10 - Financial Planning

Based on the capital investment programme developed under Chapter 7 above, and based on the organization established and the revenue collection or tariff system recommended in Chapter 9 above, the following financial statements and forecasts will be prepared for the duration of the First Stage programme implementation and eight years beyond.

. Cost of operation and maintenance.

. Income and expenditure forecasts.

. Source of funds and application of funds, i.e., cash recources and cash requirements, or what is known as cash flow statement.

As a part of the financial analysis, calculation will show the rate of return on net fixed assets.

(k) Chapter 11 - Benefits of the Project

This chapter will present, in a brief narrative form, economic benefits to be derived from the sewerage programme for the First Stage programme, including increase in land values, improvement of health conditions, etc., with intangible associated benefits manifested through a more pleasant community environment, abatement of flood damage, and greater potential for tourism.

Part IV - Drainage

This part may consist of seven chapters as mentioned below:

Chapter 1 - Method of Approach and Investigations

Chapter 2 - Design Criteria

Chapter 3 - Preliminary Engineering Analyses and Recommendations

Chapter 4 - Cost Estimates and Capital Investment Programme

Chapter 5 - Operation and Maintenance

Chapter 6 - Organization and Financing

Chapter 7 - Benefits of the Project

(a) Chapter 1 - Method of Approach and Investigations Carried Out Under This Study

This chapter will have a description of studies, field surveys, and investigations conducted, covering the following subjects:

. Method of approach for selecting the priority areas, including discussion of the selection of priority areas for drainage implementation and rehabilitation programme for the First Stage programme, together with assessment of alternative drainage plans considered.

. Brief description of investigations carried out by this project, including existing drainage and flood protection facilities, effects of present system, impact of drainage system on environment, and flow rates of major drains in the First Stage programme area.

(b) Chapter 2 - Design Criteria

This chapter briefs the design criteria developed in the Master Plan and their adoption to the First Stage programme, taking into account the local conditions in each of drainage basins.

(c) Chapter 3 - Preliminary Engineering Analyses and Recommendations

This chapter will describe the possible alternative drainage plans, including drains, storage system to reduce peak discharge rate, and diversion drains to the sea. Major drains will be provided with profiles in appropriate scale, indicating size and gradient of channels, together with necessary structural details.

(d) Chapter 4 - Cost Estimates and Capital Investment Programme

This chapter will cover the followings:

- General description of methods of construction relating to the drainage, including suggested width of excavation, sheeting, masonry, soil deposit, etc., with necessary drawings and dimensions.

- Cost estimating procedures for component and total costs at 1977 price levels, including costs of materials, labour, engineering, and overhead and profit of contractor.

- Description of procedures for estimating unit costs for all drainage facilities, including masonry, concrete, excavation, backfilling, dewatering, etc.

- Costs of open channels, pipe laying, and appurtenances, on the basis of 1977 price levels.

- Breakdown of all costs into local and foreign currency portions, considering the availability of materials and equipment necessary for drainage construction and rehabilitation.

- Capital investment programme for open channels, closed conduits, and appurtenances of the system, in accordance with the assigned priority of construction. Tabulations as needed.

(e) Chapter 5 - Operation and Maintenance

This chapter will discuss the causes of clogging of conduits and methods of cleaning and inspection, with necessary drawings. Also, estimates of all operation and maintenance costs will be made for the drainage system recommended, including routine jobs and preventive maintenance.

(f) Chapter 6 - Organization and Financing

Description will be made for recommended organization and financing of the project. Care should be given on whether the drainage system will be managed by the same agency as that for sewerage system. If the construction of the drainage system is included in the project, necessary financial analysis will be made accordingly.

(g) Chapter 7 - Benefits of the Project

Description will be made for the major benefits resulting from the improvement by decreasing physical damage to buildings and facilities, the loss of income for business, and evacuation, care and rehabilitation of inundation victims, either tangible or intangible, together with other expected individual, local and general health sanitation benefits.

Part V - Other Recommendations

This part will describe various recommendations relating to sewerage and sanitation measures as defined in the items of Terms of Reference, prepared by the Government of Malaysia. This will consist of four chapter as follows:

Chapter 1 - Improvement Measures for Bucket and Septic tank systems.

Chapter 2 - Interception of Various Flows

Chapter 3 - Methods of Charging for Industrial Wastes and Septic Tanks

Chapter 4 - General Recommendations for Pre-treatment of Existing Industrial Wastes

(a) Chapter 1 - Improvement Measures for Bucket and Septic Tank Systems

Recommendations will be made for improving the operation of conservancy (bucket) and septic tank systems, currently practiced in the project area, including the possible alternative plans to select the most cost effective human excreta disposal system in the area. The alternative plans will cover cost estimates and the impact on the environment, together with necessary economic analyses for each of the plans.

Although the methods for the studies will be determined after all the related surveys are completed and preliminary engineering studies made, it is presumed that the studies may include the proposal to switch the current bucket system to the more sanitary and low cost spetic tank system, either for an individual household or several households, depending upon the local conditions. Another study may be that for alternative collection and disposal methods for sludge from the tanks by more sanitary means.

(b) Chapter 2 - Interception of Various Flows

Since the First Stage programme area may include areas wherein the sewerage system will not readily become available due to topographical or other reasons, and sullage waters from the areas will find their way to nearby drains and finally inflow to rivers causing significant water pollution, it may be necessary, as an interim measure, to collect such sullage waters to the sewerage system through open drains. Because the proposed sewerage is principally separate system, the amount of the sullage waters into sewers should be limited to the reasonable level and the diluted mixed sullage water during storm rain will be discharged to the nearby waterways through appropriate outlet facilities.

(c) Chapter 3 - Methods of Charging for Industrial Wastes

On the basis of studies made under the project and also available information obtained during the course of the project, a study will be made for alternative charging methods for handling industrial wastewaters.

(d) Chapter 4 - General Recommendations for Pre-treatment of Existing Industrial Wastes

This chapter covers a study of alternative means of industrial wastes disposal, either raw or pretreated, to determine the best suitable process for the sewerage system, including prediction of future quantities and components of industrial wastewaters and influence of the wastewaters to sewer materials and treatment processes recommended.

Appendices

More descriptive background material, if pertinent, will be included in appendices.

3. Outline of Preliminary Engineering Drawings

This volume, to be prepared separately from the main report, will include all the maps and drawings prepared for preliminary engineering purposes, in appropriate scales and, if necessary, some of them will be in colour. Major items to be included are as follows:

(a) Location maps of project area.
(b) General maps for sewerage and drainage programme.
(c) City planning maps.
(d) Topographic maps of the first stage programme area.
(e) Population distribution map in the first stage area.
(f) Housing and industrial development programmes.
(g) Map showing existing drainage system.
(h) Map showing existing septic tank system.
(i) Trunk sewer plans and profiles.
(j) Layout of treatment plants.
(k) Drainage plans and profiles.
(l) Structural detail of sewers and appurtenance.
(m) Structural detail of pumping stations.
(n) Structural detail of treatment facilities.
(o) Structural detail of toilet system.
(p) Tables of discharge calculation for sewers.
(q) Tables of discharge calculation for drains.

In addition to the above, any maps and drawings necessary may be included.

参　考　文　献

参考文献としては、下水道計画のフィージビリティスタディの標準要領の作成にあたって参考にしたものと、フィージビリティスタディを実施する場合に参考となる主要な文献を示す。

参　考　文　献

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(2) 「下水道維持管理指針」日本下水道協会（１９７６）

(3) 「流域別下水道整備総合計画調査方針と解説」日本下水道協会（５２年版）

(4) 「下水道と財政」日本都市センター（４８年版）

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(6) "Glossary of Water and Wastewater Control Engineering," APHA, ASCE, AWWA, WPCF, USA (1969).

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(9) "Federal Guidelines, Design, Operation and Maintenance of Wastewater Treatment Facilities," Department of the Interior, Federal Water Quality Administration (Sept. 1970).

(10) "Quality of Environment in Japan," Environment Agency, Japan (1977).

(11) "Jakarta Sewerage and Sanitation Project," Nihon Suido Consultants Co., Ltd., Japan (1977), under WHO/UNDP.
Volume I - Summary Report
Volume II - Master Plan Report
Volume III - Preliminary Engineering and Feasibility Report
Volume IV - Master Plan and Preliminary Engineering Drawings
Volume V - Appendices
Volume VI - Institutional Studies
Volume VII - Immediate Programme for Sanitation
Volume VIII - National Guidelines

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(14) "Feasibility Study for Sewerage and Drainage System Project, Butterworth/Bukit Mertajam Metropolitan Area, Malaysia," Japan International Cooperation Agency (1979).

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(20) "Eligibility Requirements Under Special Funds Loans," ADB, August 1975.

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略　　語

本標準要領に用いられている略語と、下水道フィージビリティスタディ報告書作成にあたって用いられると考えられる略語のうち主要なものを示す。

COMMON ABBREVIATIONS

1. Linear Measure

millimetre	mm	inch	in.
centimetre	cm	foot	ft
decimetre	dm	yard	yd
metre	m	mile	mi
kilometre	km		

2. Square of Surface Measure

square millimetre	mm^2	square inch	sq in.
square centimetre	cm^2	square foot	sq ft
square decimetre	dm^2	square yard	sq yd
square metre	m^2	square mile	sq mi
square kilometre	km^2	acre (do not abbreviate)	
are	a		
hectare	ha		

3. Cubic or Solid Measure

cubic millimetre	mm^3	cubic inch	cu in.
cubic centimetre	cm^3	cubic foot	cu ft
cubic decimetre	dm^3	cubic yard	cu yd
cubic metre	m^3		

4. Weight

milligramme	mg	ounce	oz
centigramme	cg	pound	lb
gramme	g	hundredweight	cwt
kilogramme	kg		
metric ton	t		

5. Capacity

centilitre	cl	point	pt
decilitre	dl	quart	qt
litre	l	gallon	gal
hectolitre	hl	Imperial gallon	Igal
kilolitre	kl		

6. Velocity

kilometres per hour	km/h
miles per hour	mi/h
revolutions per minute	rpm
metres per second	m/sec
metres per minute	m/min
metres per hour	m/h

7. Time

hour	h	minute	min
second	sec	day	d

8. Flow Rate

cubic metres per second	m^3/sec	cubic feet per second	cu ft/sec
cubic metres per day	m^3/d	barrels per day	bpd
litres per second	l/sec	million gallons daily	mgd

9. Temperature

degree Centigrade	°C	degree Fahrenheit	°F

10. Miscellaneous

average	avg	diameter	dia
grammes per day per capita	g/d/cap	cubic metres per day per capita	m^3/d/cap

11. United Nations Bodies and Specialized Agencies

United Nations Development Programme	UNDP
World Health Organization	WHO
International Bank for Reconstruction and Development	IBRD
International Development Association	IDA
Asian Development Bank	ADB

12. Sewerage System

Asbestos cement pipe	ACP
Biochemical oxygen demand (5 day, 20°C)	BOD
Chemical oxygen demand	COD
Dissolved oxygen	DO
Dry weather flow	DWF
Most probable number	MPN
Hydrogen ion potential	pH
Poly vinyl chloride pipe	PVCP
Reinforced concrete pipe	RCP
Vitrified clay pipe	VCP
Suspended solids	SS

用　語　の　定　義

フィージビリティスタディ報告書作成にあたって用いられると考えられる英文用語のうち、主要なものを示す。和文の用語については日本下水道協会制定「下水道施設設計指針と解説」を参照されたい。

* Activated Sludge Process

A process for achieving biological stabilization of sewage based on use of activated sludge generated under aerobic conditions maintained by included aeration in a reaction chamber, with the effluent subsequently settled and part of the sludge returned to the reaction chamber.

* Aeration

The bringing about of intimate contact between air and a liquid by one or more of the following methods: (a) spraying the liquid in the air, (b) bubbling air through the liquid, (c) agitating the liquid to promote surface abosrption of air.

* Aerated Lagoon

A natural or artificial wastewater treatment pond in which mechanical or diffused-air aeration is used to supplement the oxygen supply.

* Aerobic

Requiring, or not destroyed by, the presence of free elemental oxygen.

* Aerobic Bacteria

Bacteria that require free elemental oxygen for their growth.

* Benefit-Cost Ratio

A theoretical economic concept, usually expressed by relating the present value of the stream of capital costs and annual expenses of the project.

* Biochemical Oxygen Demand (BOD)

The quantity of oxygen used in the biochemical oxidation of organic matter in specified time, at a specified temperature, and under specified conditions.

* Box Culvert

A culvert with a rectangular cross section.

* Branch Sewer

A sewer which receives wastewater from a relatively small area, and discharges into a main sewer serving more than one branch-sewer area.

* Coefficient

A numerical quantity, determined by experimental or analytical methods, interposed in a formula which express the relationship between two or more variables to include the effect of special conditions or to correct a theoretical relationship to one found by experiment or actual practice.

* Chlorination

The application of chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

* Coliforms

An important parameter for assessing the level of pollution in receiving waters, based on measuring the concentration of coliform bacteria, which is a rough index of the probable level of contamination by human excreta.

* Collecting System

A system of sewers and appurtenances for the collection, transportation, and pumping of sewage and industrial wastes.

* Combined Sewer

A sewer receiving both surface runoff and sanitary and/or industrial wastewater.

* Concentration Time

The period of time required for storm runoff to flow from the most remote point of a catchment or drainage area to the outlet or point under consideration. It is not constant, but varies with depth of flow and condition of channel.

* Culvert

A closed conduit for the free passage of surface drainage water under a high-way, railroad, canal, or other embankment.

* Demographic Characteristics

The vital statistics of a population, such as births, deaths, marriages, rate of growth, age distribution, literacy and levels of education, skills and/or income.

* Depreciation

The amount which must be charged against profits each year in a series which will equal the original purchase price of a given asset at the end of its useful life expectancy.

* Discount Rate

The compound rate of interest which measures the difference between two values separated by one or more successive periods of time. The rate is applied to the ultimate value to determine the present value of the series at any prior point in time.

* Design Rainfall

The rainfall estimate corresponding to an enveloping depth - duration curve for the selected frequency, often referred to as the "Design Storm".

* Discharge

As applied to a stream or conduit, the rate of flow, or volume of water flowing in the stream or conduit at a given place and within a given period of time.

* Dissolved Oxygen

The oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation. Abbreviated - DO.

* Domestic Wastewater

Wastewater derived principally from dwellings, business buildings, institutions and the like. It may or may not contain ground water, surface water or storm water. Also called sanitary sewage.

* Drainage Basin

An area from which surface runoff is carried away by a single drainage system. Also called catchment area, watershed, drainage area.

* Feasibility Study

A compilation of the economic benefits of a proposed project for comparison with engineering and other estimates of total costs to determine the relative merits of the project vis-a-vis other potential social investments.

* Force Main

A pressure pipe joining the pump discharge at a water or waste-water pumping station with a point of gravity flow.

* Gradient

The rate of change of any characteristic per unit of length or scope. The terms is usually applied to such terms as elevation, velocity, pressure.

* Head

The height of the free surface of fluid above any point in a hydraulic system; a measure of the pressure or force exerted by the fluid.

* House Connection

The pipe carrying sewage from the building to a public sewer. Also called Building Sewer and House Sewer.

* Hydraulic Gradient

The slope of the hydraulic grade line; the rate of change of pressure head; the ratio of the loss in the sum of the pressure head and position head to the flow distance. For open channels, it is the slope of the water surface and is frequently considered parallel to the invert. For closed conduits under pressure, it is the slope of the line jointing the elevations to which water would rise in pipes freely vented and under atmospheric pressure. A positive slope is usually one which drops in the direction of flow.

* Industrial Wastes

The liquid wastes from industrial processes, as distinct from domestic or sanitary wastes.

* Infiltration

(1) The flow or movement of water through the interstices or pores of a soil or other porous medium. (2) The quantity of groundwater that leaks into a pipe through joints, porous walls, or breaks. (3) The entrance of water from the ground into a gallery. (4) The absorption of liquid by the soil, either as it falls as precipitation or from a stream flowing over the surface.

* Infrastructure

The basic structures and facilities upon which the economic activities of a community or region are dependent, such as roads, railways, school systems, water and power supply and other public utilities. Sometimes referred to as Social Overhead Capital

* Initial Storm

The storm having a return period of 2 or 5 years.

* Inlet

(1) A surface connection to a drain pipe. (2) A structure at the diversion end of a conduit. (3) The upstream end of any structure through which water may flow. (4) A form of connection between the surface of the ground and a drain or sewer for the admission of surface or storm water. (5) An intake.

* Invert

The floor, bottom, or lowest portion of the internal cross section of a closed conduit. Used particularly with reference to aqueducts, sewers, tunnels, and drains. Originally, it referred to the inverted arch which was used to form the bottom of a masonry-lined sewer.

* Land Use

The culture of the land surface, which affects the social and economic conditions of a region and which determines the amount and character of the runoff and erosion. Existing or zoned

economic use of land, such as residential, industrial, farm, commercial.

* Pumping Station

A wastewater pumping station that lifts the wastewater to a higher elevation when the continuance of the sewer at reasonable slopes would involve excessive depths of trench, or that raises wastewater from areas too low to drain into available sewers. These stations may be equipped with pneumatic ejectors, centrifugal pumps, or other pumps.

* Main Sewer

A sewer that receives many tributary branches and serves a large territory. Also called Trunk Sewer. In small systems, a sewer to which one or more branch sewers are tributary.

* Major Storm

The storm having a return period of 100 years.

* Manhole

An opening in sewer provided for the purpose of permitting a man to enter or leave the sewer.

* Metropolitan Area

The area which was defined to be urbanized within around 20 years from the basic year.

* Micro and Macro Drainage

Storm water systems are commonly considered as divided into local/smaller conduit systems (micro-drainage), which discharge into larger conduits or systems (macro-drainage).

* Municipality

The officials governing such a community as city, town, etc.

* Outfall Sewer

A sewer which receives the sewage from a collecting system and carries it to a point of final discharge. See Pipe Outlet.

* Open Channel

Any natural or artificial waterway or conduit in which water flows with its surface exposed to the outside atmosphere.

* Outlet

Downstream opening or discharge end of pipe, culvert or canal.

* Overland Flow

The flow of water over the ground before it enters some defined channel.

* Oxidation Pond

A basin used for retention of wastewater before final disposal, in which biological oxydation of organic material is effected by natural or artificially accelerated transfer of oxygen to the water from air.

* pH

The reciprocal of the logarithm of the hydrogen-ion concentration in grams per liter of solution. Neutral water, for example, has a pH value of 7 and a hydrogen-ion concentration of 10^{-7}.

* Pipe Outlet

A pipeline which conveys the effluent from a reservoir, sewage treatment plant, or other structure to its point of discharge.

* Present Valve

The economic method which recognizes and quantifies the values of differences in time. Benefits or costs which are expected to be received or incurred at a future date are worth less than those which can be enjoyed or must be paid currently. Present value at any point in time is determined by applying a given discount rate to the ultimate value for the appropriate number of years.

* Public Sewer

All sanitary sewers, except house connections.

* Primary Treatment

(1) The first major (some times the only) treatment in wastewater treatment works, usually sedimentation. (2) The removal of a substantial amount of suspended matter but little colloidal and no dissolved matter.

* Rainfall Intensity

Amount of rainfall occuring in a unit of time, converted to its equivalent in millimeters per hour at the same rate.

* Rainfall-Intensity Curve

A curve that expresses the relation on rate of rainfall and their duration. Each curve is generally for a period of years during which time the intensities shown will not, on the average, be exceeded more than once.

* Rational Method

A method of estimating the runoff in a drainage basin at a specific point and time by means of the rational runoff formula. For each drainage area, the rainfall rate under a stated intensity-duration relationship, the fraction that will appear as runoff, and the basin area above the specific point are estimated. Their products is the flow. This method is used to estimate storm runoff in urban areas and flood flows in streams.

* Roughness Coefficient

A factor in the Chezy, Darcy-Weisbach, Hazen-Williams, Kutter, Manning, and other formulae for computing the average velocity of flow of water in the conduit or channel, which represent the effect of roughness of the confining material on the energy losses in the flowing water.

* Runoff

(1) That portion of the earth's available water supply that is transmitted through natural surface channels. (2) That part of the precipitation which runs off the surface of a drainage area and reaches a stream or other body of water or a drain or sewer.

* Runoff Coefficient

The ratio of the maximum rate of the runoff to the uniform rate

of rainfall with a duration equaling or exceeding the time of concentration which produced this rate of runoff.

* Sanitary sewer

A sewer which carries liquid and water-carried wastes from sanitary conveniences of residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground, storm and surface water which are not admitted intentionally.

* Sanitary Wastewater

(1) Domestic wastewater with storm and surface water excluded. (2) Wastewater discharging from the sanitary conveniences of dwellings (including apartment houses and hotels), office buildings, industrial plants, or institutions. (3) The water supply of a community after it has been used and discharge into a sewer. Also called sanitary sewage.

* Secondary Treatment

The treatment of wastewater by biological or chemical methods after primary treatment by sedimentation.

* Separate System

A system of sewers and drains in which sanitary wastewater and storm water are carried in separate conduits.

* Septic Tank

A settling tank in which settled sludge is in immediate contact with the wastewater flowing through the tank and the organic solids are decomposed by anaerobic bacterial action.

* Sewage

The spent water of a community. Term now being replaced in technical usage by the preferable term wastewater.

* Sewage Works

All-inclusive term for wastewater collection, pumping, treatment, and disposal facilities. Term declining in use.

* Sewer

A pipe or conduit that carries wastewater or storm water drainage.

* Sewerage

System of piping, with appurtenances, for collecting and conveying wastewater from source to discharge. Term declining in use.

* Stabilization Lagoon

A shallow pond for storage of wastewater before discharge. Such lagoons may serve only to detain and equalized wastewater composition before regulated discharge to a stream, but often they are used for biological oxidation.

* Stabilization pond

A type of oxidation pond in which biological oxidation of organic matter is effected by natural or artificially accelerated transfer of oxygen to the water from air.

* Storm Sewer

A sewer that carries storm water and surface water, street wash and other wash waters, or drainage but excludes domestic wastewater and industrial wastes. Also called storm drain.

* Storm Water

The excess water running off from the surface of a drainage area during or immediately after a period of rain. It is that portion of the rainfall and resulting surface flow that is excess of that which can be absorbed through the infiltration capacity of the surface of the area.

* Sullage

Any household waste liquids discharged from any bath, shower, lavatory, basin, floor gully, laundries or sink (not being a slop sink) but excludes faecal water and urine.

* Term

The period of time stated in the loan contract by the end of which the loan must be fully repaid.

* Tidal River

A river in which flow and water surface elevation are effected by the tides. Such effect usually occurs in the lower stretch near the mouth, where the gradient is very flat. In some streams, the effect may extend a hundred or more kilometres upstream from the mouth.

* Time Lag

(1) Referring to discharge or water level, the time elapsing between the occurrence of corresponding changes in discharge or water level at two points in a river. (2) Referring to runoff of rainfall, the time between the center of mass, or beginning, or rainfall to the peak, or center of mass, of runoff.

* Useful Life Expectancy

The period of time during which a piece of equipment of a building or other physical asset is expected to render the service or perform the function for which it is intended, at an acceptable level of efficiency, with ordinary maintenance and under operating conditions expected in the given situation. Technical and financial planning assumes that the asset will have to be replaced at the end of its expected useful life.

* Wastewater

The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In recent years, the word wastewater has taken precedence over the word sewage.