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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT PERFORMANCE AUDIT REPORT

SINGAPORE FIRST SEWERAGE PROJECT (Loan 547-SI)

May 28, 1975

Operations Evaluation Department



## PREFACE

This paper reports on a performance audit of the first project supported by the Bank Group entirely devoted to sewerage: the First Singapore Sewerage Project assisted by Loan 547-SI signed July 3, 1968 and fully disbursed in December 1973. Prepared with the aid of a Project Completion Report completed by the responsible regional projects department in November 1974 and a visit to Singapore in December 1974, it provides an independent review of the extent to which the objectives described in the official project documents and in the Bank's files were achieved, a discussion of deviations, and an assessment of the Bank's performance in the handling of the project.

The assistance provided by the Singapore authorities in the preparation of the report is gratefully acknowledged.

### Measures and Equivalents

m<sup>3</sup> = cubic meter  
m<sup>3</sup>d = cubic meters per day  
m<sup>3</sup>dc = cubic meter per day per capita  
Imgd = million Imperial gallons per day  
(1 Imgd = 4,546 m<sup>3</sup>d)

### Principal Abbreviations and Acronyms used

PWD : Public Works Department  
SB : Sewerage Branch, of PWD  
MOE : Ministry of Environment  
SD : Sewerage Department, of MOE  
PUB : Public Utilities Board  
HDB : Housing and Development Board  
WBSF : Water Borne Sewerage Fee  
O and M: Organization and Methods Branch of the  
Ministry of Finance

### Currency Equivalents (Singapore Dollar)

At appraisal time: US\$ 1.00 = S \$ 3.00  
Current: US\$ 1.00 = S \$ 2.48



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PROJECT BASIC DATA

IBRD LOAN NO. 547-SI

SINGAPORE SEWERAGE PROJECT

Borrower and Beneficiary: Republic of Singapore. Project carried out by the Sewerage Branch of the Public Works Department, redesignated in September 1972 Sewerage Department under the new Ministry of Environment.

Loan Amount: US\$ 6.0 million.

Amount Disbursed: US\$ 6.0 million.

Date of Loan: July 3, 1968.

Effective Date: August 30, 1968.

Closing Date: - Original June 30, 1973  
- Final December 31, 1973.

Terms of Loan: 20 years, including  $5\frac{1}{4}$  years grace period.  
Interest rate of  $6\frac{1}{4}\%$  p.a.

Fiscal Year: - up to 1968: January 1 to December 31.  
- in 1969: 15 months January 1, 1969 to March 31, 1970.  
- thereafter: April 1 to March 31.

Appraisal Report: No. TO-644a dated June 12, 1968.

Appraisal Mission: July and November 1967.

Supervision Missions: - November 1968  
- August 1969  
- November 1969  
- December 1970  
- November 1971  
- May 1972  
- February 1973  
- November 1973

Project Completion Report: dated November 1, 1974.

Total Project Cost: - Forecast: S\$ 63.37 million  
- Actual: S\$ 51.50 million

Project Completion Date: - Forecast: July 1972  
- Actual: March 1974





## SUMMARY

Loan 547-SI to the Singapore Government in 1968 for the Sewerage Branch (SB) of its Public Works Department was the first loan for sewerage only made by the Bank. The loan of US\$ 6 million was to finance 25% of SB's 1968-mid 1972 investment program for expansion and improvement of Singapore's main sewer system, including: the expansion of one sewage treatment plant at Ulu Pandan to a capacity adequate until about 1975, improvements and adjustments to the sludge treatment and disposal facilities attached to the treatment plant of Kim Chuan, the construction of main sewers and pumping stations for nine area sewerage programs in urban areas, and the improvement of the existing sewer system in the city. This sewerage program of a total estimated cost of S\$ 63.4 million, important for Singapore's housing, urban renewal and industrial programs, was planned so that 1.2 million people (about 55% of total) would be served by the main sewer system in 1972, as compared to 900,000 (47%) in 1967.

The Sewerage Branch was a branch of the Government's Public Works Department (PWD). Responsible for planning, construction and operation of the sewerage system, it was working satisfactorily and no significant change in its public service status was proposed by the Bank. To remedy organizational and accounting shortcomings and allow it to meet its increasing responsibilities, the Bank obtained commitments from the Government that SB would establish commercial accounts, parallel to its regular Government cash accounts, to serve as a management tool in its operations control, would implement programs of data collection and investigation to improve future planning, and would have its organization and staff requirements reviewed by the Organization and Methods (O and M) Branch of the Ministry of Finance. In accordance with the Bank's advice, the Government agreed to introduce changes in the sewer fees (tariffs for trade wastes, and charges based on water consumption) and to adjust fees so that in 1972 revenues would cover operating expenses, including depreciation, and thereafter produce a reasonable return to be determined after study by the Government and consultation with the Bank. Preparation and appraisal of the Loan was carried out efficiently in one year; the Loan became effective on August 30, 1968 and was closed in December 1973 six months behind original schedule.

The project was completed 20 months behind schedule, due to major delays in the initial planning and design stages by SB and its consultants and to the shortage of technical staff. Expansion of the sewer system was about 50% larger than originally planned, in terms of area sewerage programs (12 versus 9), pumping stations and length of sewer constructed; expansion of sewage treatment capacity at Ulu Pandan was that proposed by SB's consultants and half of the 54,000 m<sup>3</sup>d capacity

increase referred to in the Bank's appraisal report. Actual total cost of the project was 19% lower than estimated, due to large savings in local currency expenditures for which the original ample provisions for escalation and contingencies proved unnecessary. The Loan was fully disbursed by the end of 1973, and earlier delays in disbursements were partly due to the complex disbursement procedures which the Bank simplified after 1969.

Construction delays had minimal effects on SB's operations. No housing or urban renewal program was reported to be completed without adequate sewer service. Despite the continuous overloading of treatment capacity, sewage remained efficiently treated at Ulu Pandan plant; however, treated effluent from Kim Chuan plant since 1971 has been slightly short of meeting international standards. Total population served by the main sewer system was 1.14 million by March 1974 at project completion, that is 51% of total population.

The Government introduced in early 1970 new sewage fees based on water consumption and payable by all premises supplied with water, whether connected to sewers or not. As a result, SB's revenues doubled and yielded rates of return of over 8% p.a. in 1970-1972 and 7.2% in 1973; SB's internal cash generation replaced the Government's funds as the major source of finance for sewerage investments. Trade Waste Regulations were promulgated in 1970 in lieu of special tariffs, requiring industries to discharge, after pre-treatment if necessary, wastes compatible with normal treatment standards; enforcement of regulations by the SB has been adjusted to industries' situations and needs, and industrial pollution has not been an issue.

The SB was strengthened and functionally reorganized on the basis of the O and M study which was carried out in 1969-70. The shortage of technical personnel, general in Singapore, still persists albeit to a much lesser degree; actions taken by the Government on salary scales have remedied the situation to the extent feasible. Commercial accounts were established by the SB in 1968 and have served as a useful management tool; audits have been satisfactory. SB began, with some delay, to collect data on sewage flows and population served which were useful for planning the 2nd sewerage project now under construction (Loan 918-SI). Since September 1972, SB has been under the Ministry of Environment.

Though it was the first Bank loan for sewerage only, the Bank's performance was quite satisfactory. The project has contributed positively to the needed expansion of the sewer system and to improving the standards of living and sanitary conditions in Singapore. Bank action contributed significantly to putting SB on a strong basis for undertaking future larger projects. The Bank's flexible and understanding approach to SB's situation and problems was efficient in having all major objectives met and envisaged measures taken.

## PROJECT PERFORMANCE AUDIT

### SINGAPORE FIRST SEWERAGE PROJECT (LOAN 547-SI)

#### General

1.01 Singapore's present area of 586 km<sup>2</sup> carries a population of 2.2 million growing at about 1.8% p.a. Population is mostly concentrated in the urban area in the south-central part of the Island. Economic growth, based principally on industry, averaged about 12% p.a. in recent years. Present and future population density requires a careful planning of land and water use, and a close attention to the environmental and pollution effects of a rapid economic growth.

1.02 Until September 1972, sewerage and sanitary services were the responsibility of the Sewerage Branch (SB) of the Public Works Department (PWD). Since then, the Sewerage Department (SD) of the Ministry of Environment (MOE) has been responsible for collection and disposal of sewage and solid wastes.

#### Singapore's Sewerage System in 1967

2.01 In 1967, the main sewerage system comprised 23 pumping stations<sup>1/</sup> and about 650 km of sewers and pumping mains serving an estimated population of about 900,000 (47% of total) through some 100,000 connections; due to the high population density and system compactness, the length of pipe per capita was less than 1 linear meter. Besides, there were some 1,400 small secondary systems utilizing (under SB supervision) septic tanks or other minor facilities and serving 130-150,000 people. Wastes of the balance of 850,000 people were collected by the Department of Public Health for final disposal into the sewers.

2.02 Average dry weather sewage flows<sup>2/</sup> in the main system were 160,000 m<sup>3</sup>/d (i.e. 35.3 lmgd) in 1966, equivalent to 0.18 m<sup>3</sup>/d per capita served. Sewage was treated at two plants, Ulu Pandan (UP) and Kim Chuan (KC), employing the activated sludge process (whereby liquids - sewage - are continuously separated from most solids - sludge - by sedimentation, treated by aeration<sup>3/</sup> and sent out as effluent, while sludge is biologically digested<sup>3/</sup> and dried after retention).

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<sup>1/</sup> required by Singapore's topography.

<sup>2/</sup> Wet weather flows are not representative, due to substantial inflows of storm water.

<sup>3/</sup> Sewage is clarified and stabilized in the aeration process by contact with aerobic bacteria activated by diffused air providing the required dissolved oxygen; putrescible matters of sludge are digested by anaerobic bacteria (see Annex 1).

The UP plant, serving the western part of the city and the Jurong Industrial Estate, had a rated dry weather capacity of 109,000 m<sup>3</sup>d for sewage and 82,000 m<sup>3</sup>d for sludge, corresponding to about 400,000 and 300,000 people respectively; part of its effluent has been discharged to the Jurong River and the other part used as a source of industrial water after further treatment by the Jurong Industrial Water Plant (JIW). The KC plant, serving the eastern and northeastern part of the city, had been unsatisfactory. Due to the lack of space, it comprised only a partial sewage treatment process<sup>1/</sup> (the effluent being discharged to the Serangoon River); its primary digested sludge was treated in the Serangoon Sludge Disposal (SSD) plant, located 3 km from KC and suffering from poor KC operations and poor design of its undersized facilities. KC plant rated capacity was to reach 136,000 m<sup>3</sup>d (adequate for about 650,000 people), after completion in 1968 of an expansion project under construction in 1967.

2.03 The existing sewerage system was very well maintained and well operated, notwithstanding the plant deficiencies and the general lack of flow measuring devices at pumping stations and treatment plants; as a result of SB's insufficient awareness of modern practices, measurements and records were not available for plant operation improvements and detailed planning of future expansions of a system growing rapidly more complex.

2.04 Singapore's sewerage expansion program has been geared to the urban renewal schemes and the Housing and Development Board (HDB) construction programs. HDB was about to construct throughout the city 14,400 units p.a. in high rise apartments for lower income groups during the period 1968-1971; sewerage expansion was absolutely essential to meet the needs of this housing program, as well as of the rapidly growing Jurong Industrial Estate which had been a major component of the Government's industrialization program.

#### Sewerage Branch Initial Set-up

3.01 The Sewerage Branch of PWD was under the responsibility of the Ministry of Law and National Development, also responsible for HDB, thus assuring the close coordination between SB and HDB expansion programs required particularly with respect to location, timing and lead times. The SB was responsible for the planning, design, construction, operation and maintenance of the main sewerage system, for supervision of the

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<sup>1/</sup> corresponding to the upper part of Annex I diagram; the process in the diagram's lower part has been the function of the SSD plant which does not feed back its sludge liquor but discharges it to Serangoon Harbor waters.

secondary ones, and for treatment and ultimate disposal of sewage. Administration of SB had been generally good; its major problems were personnel and accounting.

3.02 Some excess in unskilled labor force was a carryover from previous construction works done by SB itself rather than by contract. Engineers and technicians were well qualified, but insufficient in number and subject to high turnover,<sup>1/</sup> due to low salaries, government practice of long temporary appointments and attractive opportunities in the private sector; moreover staff was diverted from expansion and operation planning to substantial design tasks which could be contracted outside.

3.03 Sewerage being considered a government service rather than a public utility, SB and PWD accounts were not separately maintained and were on the cash basis customary for government operations; revenues from sewerage fees went into Government's consolidated revenue accounts, SB's operating expenditures were met by government appropriations, and capital expenditures were financed from the government development funds derived from public revenue surplus and borrowing. The principal shortcoming of the public accounting procedures was the lack of adequate information for evaluating and controlling operations and of a firm cost basis for planning expansion. Accounts were kept by the Accountant General's Office, Ministry of Finance, and satisfactorily audited by the Government's Director of Audit.

3.04 About 90% of the revenues<sup>2/</sup> for sewer service had been from the Water Borne Sewage Fee (WBSF), a flat monthly charge of S\$ 2 per sanitary fitting, established as an administrative charge unrelated to actual sewerage expenditures. Billing and collecting of the WBSF on all users connected to the main sewer system were done through the Public Utilities Board (PUB) which included it in its combined monthly bills and returned the proceeds to the Government after retaining a 5% commission<sup>3/</sup> on billings. Revenues in 1962-1965 had covered an increasing share of cash operating expenses and exceeded these in 1966 and 1967.<sup>4/</sup> Cash operating expenses had steadily declined from S\$ 0.09 per m<sup>3</sup>d of sewage treated in 1962 to S\$ 0.07 in 1966 and averaged S\$ 5 per capita served per year, which was

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<sup>1/</sup> This problem was shared also by many other public agencies.

<sup>2/</sup> Other minor revenues were derived from charges for sewer connections, fees for septic tank maintenance, and from sale of sewage sludge used as a compost.

<sup>3/</sup> to cover PUB's costs and losses due to uncollected bills. Collections have been excellent.

<sup>4/</sup> as shown by resetting SB's public accounts on a commercial accounting basis.

considered reasonable. Total net government outlays for sewerage<sup>1/</sup> during 1962-1967 averaged S\$ 9.3 million p.a., of which 95% for capital investment, and represented 5.5% of total public development expenditures.

3.05 The Government in 1967 had been considering increases and changes of sewerage fees. One change was the introduction of a Trade Waste Tariff, to be based on the volume and of characteristics of waste from commercial and industrial establishments. The second change envisaged was to relate part or all of the WBSF to the volume of water used; this was considered more equitable to the customers, and easily applicable due to PUB's computerized billing system and metering of all water use.

### Project History

4.01 Singapore's Government was focussing its 1966-1970 development plan on the industrial estate, urban renewal and housing programs. There was no practical way, other than by extending the main sewerage system, of providing the waste disposal services required for the population concentrations resulting from the housing and urban renewal programs. The long-range goal had been to provide adequate sewerage services to about 75% of the population by 1985. A sewerage project, consisting of the 1968-June 1972 sewerage expansion program, was submitted to the Bank in mid-1966 for financing; IBRD's response to the application, the first one ever made for a sewerage project, was favorable, in view of the high priority given to it by Singapore and the necessity to complement the expansion of the water supply system envisaged for Loan 503-SI.<sup>2/</sup>

4.02 The Bank sent a detailed questionnaire to PWD for working out all data (flows, engineering, operations, finances) required for appraisal, and focussed its attention during the pre-appraisal stage on three outstanding issues: a. the study of alternative methods, and design of the recommended method, of disposal for the treatment plans; b. the design and establishment of an adequate commercial accounting system for the SB; and c. the assessment of revenue requirements adequate for sewer service in Singapore.

4.03 Consultants were engaged by the PWD, and an expert provided by the Government, to resolve the issues a. and b. respectively, and reports and recommendations were made available by January 1968. Regarding the issue of sewer charges, the Bank's economic mission to Singapore in February/March 1968 was asked to assess whether on general fiscal grounds sewerage services should be charged at full cost; it reported that there was possibly a need for it since the Government would have to increase its revenues, and public services, such as sewerage, could be an appropriate source of revenues. After lengthy discussions within the Bank,

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<sup>1/</sup> capital expenditures plus cash operating deficits or minus cash operating surpluses.

<sup>2/</sup> Loan 503-SI of July 1967 included US\$ 8 million for the expansion program of water supply to Singapore, to be undertaken by the PUB.

it was sensibly decided not to insist on a specific program and time-table for increases in sewer charges since the need, if any, to increase Singapore's public revenues was relevant only to the whole taxation system and not to public services charges specifically.

#### Project Objectives and Content

5.01 The project, financed by Loan 547-SI of US\$ 6 million and scheduled to be completed by July 1972, was to comprise 95% of total sewerage investments during 1968-June 1972,<sup>1/</sup> including the following (see Annex II for details):

- (a) the improvement and expansion of the Ulu Pandan treatment plant to an average dry weather flow capacity of about 163,000 m<sup>3</sup>d (36 Imgd), adequate to serve more than 600,000 people until about 1975;
- (b) the improvement and expansion of the sludge treatment and disposal facilities at the Serangoon Sludge Disposal plant, to match the sewage treatment capacity at Kim Chuan for a tributary population of 650,000 people;
- (c) the construction of main sewers and pumping stations for nine area sewerage programs to serve new or redeveloped urban areas; and
- (d) the improvement of existing pumping stations and the extension of the system of main and minor sewers throughout the city.

The project was to contribute to the objective of serving 1.2 million people (55% of total) by 1972 and to improving the living and sanitary conditions in Singapore, especially for the lower income segments of the population which were the principal beneficiaries of the housing programs.

5.02 To remedy the organizational and accounting deficiencies of the Sewerage Branch, the Loan Agreement included suitable covenants (see Annex III) which reflected the Bank's long-term objective to have SB established on a basis broadly similar to that of a public utility with respect to its organization, procedures, finances and accounting. A commercial accounting system, parallel to the regular Government cash

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<sup>1/</sup> Sewerage investments for 1968-June 1972 not included as part of the project were works nearing completion under contracts awarded in 1967 or earlier.

accounts, was to be established and maintained by SB; SB was requested to work out and implement effective programs of flow measurements, data collection and investigations on population served, sewage flows and characteristics, and effectiveness of sewage treatment. A Government agency, the Organization and Methods (O and M) branch of the Ministry of Finance, was asked to review and report, by April 1969, on SB's organization, procedures and staff requirements. Gradual actions aiming at SB's financial viability were to be taken according to the following schedule:

- a. improve before January 1970 the sewer fees structure by establishing Trade Waste Tariffs and introducing into the WBSF charges based on metered water consumption;
- b. study, before the end of 1971, the effects of the first fee changes and propose; in consultation with the Bank, an appropriate rate of return to be earned by SB as well as the nature and timing of any further fee revisions required to achieve this return;
- c. adjust the sewer fees so that, in 1972 at the latest, revenues cover all operating expenses (including adequate depreciation), and thereafter yield the previously proposed annual return on the value of SB's net fixed sewerage assets in operation.

#### Project Implementation and Achievements

6.01 The project was completed in March 1974, about 20 months behind the July 1972 target; the most critical component was the Ulu Pandan treatment plant where additional secondary digesters were commissioned in early 1974. Most delays originated from the initial planning and design stages due to the longer-than-expected time required by the SB and its engineering consultants (JD and DM Watson, UK and Singapore) to gear up for the very substantial increase in the sewerage construction program represented by the project. Another important contributing factor was the shortage, up to 1973, of engineering and technical staff.<sup>1/</sup> Also, in 1970 and 1971, the Development Planning Committee of the Ministry of Finance was slow in approving detailed proposals for some area sewerage programs; this bottleneck was removed in 1972 on the introduction of a revised simplified procedure for approval of infrastructure components in the development schemes. Finally, periodic shortages of cement and

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<sup>1/</sup> which affected not only SB, but also other Government Departments and agencies, due to the rapid economic growth of Singapore in the years 1969-1973.



other construction materials as well as shortage of skilled labor, due to the accelerated construction activity in Singapore, contributed also to the delays; these shortages were, however, tackled reasonably well by the SB/SD.

6.02 The Government took steps in 1972 to remove, to the extent possible, the shortage of technical personnel. To attract and retain engineers, salary scales were revised upwards and titles upgraded. The SD was allowed to request new posts and create some of them; it recruited engineers from abroad (e.g. Hong Kong and Sri Lanka). In addition, SD began to make larger use of outside consultants; three consulting firms are presently employed.

6.03 The effects of the construction delays on SB's operations were not evaluated quantitatively, but did not appear to Bank's supervision missions to be serious. HDB's activities, dependent on completion of the area sewerage programs, have not been affected apparently because they too experienced delays in completion of the housing programs.

6.04 The project description in the Loan Agreement and the List of Goods had been purposely left flexible as to the number and locations of the area sewerage programs, so that changes and adjustments to HDB's programs could be made during construction. In 1969 and 1970, SB proposed, and the Bank agreed, to include in the project four new area sewerage programs<sup>1/</sup> (Annex II). Expansion of the sewer system between 1967 and 1974 and the contribution of the project were the following:

Expansion of Sewer System and Project Contribution

	By Dec. 1967	By March 1974	<u>Increases due to</u>			<u>Project Contribution</u>	
			<u>HDB<sup>a/</sup></u>	<u>Private<sup>b/</sup></u>	<u>SB</u>	<u>Actual</u>	<u>Forecast</u>
Total Sewers Length (km)	625	866	51	158	97	71	37+
Main pumping stations, #	9	25	-	-	16	9 <sup>c/</sup>	7
Secondary pumping stations, #	14	28	-	-	14	4	2
Treatment plant capacity (000 m <sup>3</sup> /d)	191	272	-	-	81	27	54

a/ sewers, mainly mains, constructed by HDB within its housing schemes.

b/ minor sewers constructed by private developers.

c/ including four stations partially constructed under the Project.

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<sup>1/</sup> The first program - Toa Payoh satellite town - was contracted before signing of the Loan Agreement and was not part of the project. See Annex II.

6.05 Comparison between forecast and actual expansions of Ulu Pandan<sup>1/</sup> treatment capacity requires some qualification. The sewerage project financed by Loan 547-SI under audit achieved the 27,000 m<sup>3</sup>d expansion corresponding to the initial stages recommended by SB's consultants<sup>2/</sup>, and the further expansion by 27,000 m<sup>3</sup>d in a final stage is being constructed under a continuing project financed by a second loan (Loan 918-SI of 1973). Despite some uncertainty about the scope of the project<sup>2/</sup>, the appraisal report for Loan 547-SI stated explicitly that Ulu Pandan capacity would expand by 54,000 m<sup>3</sup>d under the first project; actual expansion of U.P. capacity was thus half that planned for in the appraisal report.

#### Disbursements

7.01 Actual disbursements lagged far behind the appraisal estimates in the first two years (see Annex IV), due mainly to the delays in the initial stages of construction. Disbursements began picking up after FY 1970 and reached 90% of forecasts by the original closing date of June 1973. The closing date was extended by six months to December 1973, and the loan was fully disbursed before that date.

7.02 Some delays in disbursements were due to the complex, if not cumbersome, procedures imposed on SB before submitting disbursement applications to the Bank. The Bank agreed in 1969 to simplify these procedures and to expedite disbursements thereafter<sup>3/</sup>. Also, an unusually large number of contracts had to be processed by SB for Bank approval, due probably to Bank's initial desire to control SB's tendering procedures

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<sup>1/</sup> Sewage treatment capacity at Kim Chuan was increased by 54,000 m<sup>3</sup>d by SB in June 1968 as foreseen.

<sup>2/</sup> SB's engineering consultants recommended in their feasibility study (dated January 1968) to expand UP in three stages; the first two stages, to be implemented in 1968-1972, were to comprise an expansion by 27,000 m<sup>3</sup>d at a total estimated cost of S\$ 6.98 million (of which S\$ 4.0 million during 1968-1971), and the further expansion by 27,000 m<sup>3</sup>d would be undertaken in a third stage to start in 1973. It is difficult to decide which stages were originally included in the project, since the appraisal report estimated the total cost of UP 54,000 m<sup>3</sup>d expansion at S\$ 4.0 million and thus cannot be reconciled nor compared with the consultants' report.

<sup>3/</sup> SB was originally required to submit, as evidence for reimbursement, the contractors' receipts of payment, and to compute the foreign exchange component of each construction contract. Because of delays in receiving the contractors' receipts and the large number of sewer construction contracts, the Bank agreed to accept Government's certificates of payment as evidence for reimbursement and to apply standard percentages to compute the foreign exchange components of all routine sewer contracts.

closely;<sup>1/</sup> Bank was efficient in reducing any further delays in contract approval and awards.<sup>2/</sup>

### Project Costs

8.01 Large savings occurred in local and total costs of the project, as shown in the following table (see Annex V for details):

<u>Project Cost: Forecast/Actual (S\$ million)</u>							
		<u>Sewerage Schemes</u>	<u>Miscel. Extensions</u>	<u>Treatment Plants</u>	<u>Consulting Services</u>	<u>Contingencies</u>	<u>Total</u>
<u>Forecast:</u>	L.C.	20.34	8.20	7.76	0.20	7.27	43.77
	F.X.	8.90	2.83	3.94	0.80	3.13	19.60
	Total	29.24	11.03	11.70	1.00	10.40	63.37
<u>Actual:</u>	L.C.	18.94	4.64	7.39	0.28	-	31.25
	F.X.	10.84	2.40	5.34	1.67	-	20.25
	Total	29.78	7.04	12.73	1.95	-	51.50
<u>Percentage Increases</u>							
(Decrease) in:	L.C.	(7)	(43)	(5)	40		(29) <sup>a/</sup>
	Total	2	(36)	9	95		(19)

<sup>a/</sup> Decrease in L.C. was 14% if compared to L.C. forecasts before contingencies.

8.02 The ample provision for escalation and contingencies (20% of estimates) proved wholly unnecessary for the local currency expenditures; all local cost components (except consulting) were lower than estimated, in particular the costs of miscellaneous extensions of sewer services. On the other hand, the provision was fully utilized for the foreign currency costs which were 3% larger than forecast; increases were due mainly to larger foreign exchange costs in the expansion of the treatment

<sup>1/</sup> According to a supplementary letter, all contracts above S\$ 300,000 for civil works and S\$ 150,000 for machinery and equipment required prior Bank approval. These limits were raised in the 2nd project to S\$ 500,000 and 300,000 respectively, which will have, according to SD, lower effect than expected due to inflation and increases in costs since 1968.

<sup>2/</sup> By December 1972, some 150 contracts had been submitted to the Bank for approval. In 1972, the average time between receipt of tendering documents and Bank's reply was less than four days, and the average time from the date of SB's letter to the date of Bank's reply was 14 days. Only five contracts required more than three weeks for approval.

plants and in consulting services.<sup>1/</sup> Unit costs of sewer construction averaged S\$ 507,000 per km, against some S\$ 790,000 estimated; the substantial savings enabled a much larger amount of sewer construction under the project. The final List of Goods (Annex IV) reflects the actual distribution of foreign exchange costs between the major project components.

### SB and Project Operations

9.01 Bank supervision missions estimated that the effects of construction delays and shortcomings on SB's operations were not serious; they recognized that critical operational items such as treatment and pumping elements were overloaded, and that SB gave priority attention to their improvement.

9.02 In 1967, treatment capacity at Kim Chuan was substantially overloaded and, as a result, KC effluents were of poor quality and highly active; expansion of KC capacity by 54,000 m<sup>3</sup>d in 1968 permitted dramatic improvements in its effluent quality which met international standards<sup>2/</sup> in 1968-1970. Treatment capacity of UP was overloaded in 1970 and thereafter; however, due to its treatment process, UP effluent quality consistently met international standards, and further improved in 1973 after UP capacity expansion. Also, KC capacity became progressively fully loaded after 1970, and KC effluents in 1971-1973 did not meet international and SB norms.<sup>2/</sup> (see Annex VI and Chart I). The lower efficiency of KC treatment process is illustrated further by comparing the unit costs: operating costs per m<sup>3</sup> treated have been, after 1967, higher in KC plant than in UP plant (see Annex VI).

9.03 Average contribution of population served was fairly constant at about 0.23 m<sup>3</sup>dc. Overloading of treatment capacities has remained manageable, mainly because population served by the main sewerage system expanded slowly. Total population served at home by the main system is estimated at 1.14 million<sup>3/</sup> by March 1974 (completion date of the project), that is about 51% of Singapore's total population, as compared to 1.2 million and 55% appraisal targets set for July 1972.

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<sup>1/</sup> The first loan financed the feasibility study of one Sewerage Program that is part of the second sewerage project.

<sup>2/</sup> Basic quality indicators are: the quantity of Suspended Solids (SS) in mg/l, and the 5-day-Biological Oxygen Demand at 20°C (BOD) in mg/l, measuring respectively the purity and activity of the effluents. International standards recommend maximum of 30 and 20 mg/l respectively for the SS and the BOD. The BOD of KC effluent averaged 25, 22 and 25 mg/l in 1971, 1972 and 1973 respectively.

<sup>3/</sup> The 1.23 million figure given in Annex VI is the population equivalent of all users served by the main system, including commercial and industrial users.

9.04 On the other hand, the population served by small secondary systems (septic tanks or minor plants) under SB's control increased from 132,000 in 1967 to 210,000 in March 1974, so that the share of total population served at home by facilities operated or supervised by the SB increased from 52% in 1967 to 60% by March 1974. Of the total 1.35 million population served by SD, about 1 million were living in HDB estates.

### Financial Performance

10.01 The appraisal report assumed a 48% increase in average charges in 1972 to result from the introduction of Trade Waste Tariffs and revisions to the WBSF, in order to cover all operating expenses as required by the Loan Agreement. The Government reviewed in 1969 the existing sewage fees, promulgated Trade Waste Regulations, and introduced new sewage fees based on water consumption effective March 1970, which more than doubled SB's gross annual revenues. As a result, the Sewerage Branch earned a rate of return of over 8% annually in 1970/71 through 1972/73 and 7.2% in 1973/74, as compared to 0% rate of return forecast. These financial developments, detailed in Annexes VII, VIII and IX which compare SB's forecast and actual Income Statements, Balance Sheets and Cash Flow Statements respectively, are summarized in the following table:

<u>S\$ million</u>	<u>Appraisal Forecasts (Jan. 1968-Dec. 1973)</u>	<u>Actual (Jan. 1968-March 1974)</u>
Operating Revenues	49.1	101.2
Operating Expenses after Depreciation	61.3	63.9
Operating Surplus (Deficit)	(12.2)	37.3
Operating Ratio after Depreciation	125%	63%
Rate of Return: Before 1970/71	-	-
1970/71	-	8.8%
1971/72	-	8.4%
1972/73	0.1%	8.6%
1973/74	-	7.2%

10.02 Total capital expenditures of SB during the period 1968-1973 were close to forecasts; non-project expenditures balanced the savings on project costs. IBRD loan financed about one-fourth of total expenditures, as forecast; net Government contribution was negligible and was replaced by SB's internal cash generation as the source of funds complementary to the Bank loan, as shown in the following table:

<u>S\$ million</u>	<u>1968-1973 Financing Plan of the Sewerage Department</u>			
<u>Applications of Funds</u>	<u>Appraisal Forecast</u>		<u>Actual (1968-March 1974)</u>	
1st Sewerage Project	63.4		51.5	
Other Capital Expenditures	13.5		24.6 <sup>a/</sup>	
Total Capital Expenditures	<u>76.9</u>		<u>76.1</u>	
Net Increase (Decrease) in Current Assets	(0.4)		2.6	
Total Applications	<u>76.5</u>		<u>78.7</u>	
<u>Sources of Funds</u>		<u>%</u>		<u>%</u>
Net Internal Cash Generation	10.9	14	60.2 <sup>b/</sup>	76
IBRD Loan	18.0	24	17.8 <sup>c/</sup>	23
Government contributions	47.6		10.9	
Less: Capital Repayments by SB	-		10.2	
Net Government contribution	<u>47.6</u>	<u>62</u>	<u>0.7</u>	<u>1</u>
Total Sources	<u>76.5</u>	<u>100</u>	<u>78.7</u>	<u>100</u>

a/ includes S\$ 3.6 million in 1973/74 for the 2nd sewerage project.

b/ after debt service of S\$ 3.5 million, compared to S\$ 4.2 million forecast.

c/ includes S\$ 0.38 million in 1973/74 from Loan 918-SI for the 2nd project.

### Sewage Fees

11.01 In accordance with the advice of the Bank and its first supervision missions, the Ministry of Finance worked out in 1969 several revisions of the WBSF and, despite its concern about possible social reactions, introduced, effective March 1970, a WBSF based on metered water consumption (S. cents 4.4 and 11.0 per m<sup>3</sup> for domestic and trade consumers respectively) in addition to the then existing rate of S\$ 2.0 per month per sanitary fitting (Annex X). The level and structure of new fees were determined on the assumption that they would be paid only by premises with sanitary fittings and that total SB revenues would cover its operating costs by 1972 as required by the Loan Agreement (para 5.02). Actually, it was decided that all premises supplied with water by PUB would pay the new fees, whether connected to the sewer systems or not; the Ministry of Finance justified this decision on the ground that unconnected premises would be connected soon with the expansion foreseen and these premises should contribute to the costs incurred by the Government on open water courses receiving their discharges. Sewerage revenues in 1970/71 almost doubled over the fifteen-month fiscal 1969/70 and SB began earning an 8% rate of return. The Bank considered that no further tariff study was

necessary. By mid-1973, 25% of domestic,<sup>1/</sup> and 44% of non-domestic, premises paying the WBSF were not connected to the sewer systems, and contributed in 1973/74 some S\$ 4.8 million - i.e. 20% - to SD's total revenues.

11.02 In compliance with the Loan Agreement and Bank's requests, the Government worked out also in 1969 Trade Waste Regulations, in place of special tariffs, requiring industries to discharge their wastes, after preliminary treatment if necessary, so that they conform to the specifications imposed therein on discharges into sewers and water streams; content specifications for discharges into sewers were determined so that trade wastes would meet normal treatment standards and not require additional treatment costs. The Bank advised the Government to establish a system of penalties to be levied on those establishments which would exceed the maximum allowances for waste characteristics, and Trade Waste Regulations and penalties were promulgated in mid-1970. Since SB's finances had improved beyond expectations and trade wastes meeting the regulations did not involve additional treatment costs, the levy of trade waste tariffs over and above the S. cents 11 per m<sup>3</sup> of consumed water was considered unnecessary by the Bank which therefore considered that the covenant had been complied with. The SB continued after 1970 to study various measures to improve trade waste control regulations and their enforcement, and adopted a flexible approach, consistent with the Government's industrialization policy, regarding enhancement of penalties for default.

11.03 Presently, new plants are required to submit to SD their wastes plans, and if necessary to hire consultants for design of pre-treatment facilities to be approved and maintained by the SD. About 70% of all industrial establishments are within sewered areas; about one-third of these have pre-treatment plants and comply fully with requirements, another third are temporarily allowed to discharge into the sewers until completion of their pre-treatment works, and the last third are required to discharge in water courses outside the sewers. Among the establishments outside the sewered areas, 10% carry out a full treatment of their trade wastes. Therefore, 26% of all industrial establishments<sup>2/</sup> presently comply with the regulations.

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<sup>1/</sup> These domestic premises are essentially concentrated in poorer and rural areas.

<sup>2/</sup> i.e. one-third of 70% plus 10% of 30%.

### Institutional Development

12.01 A major tool in SB's reorganization and strengthening was the Organization and Methods (O and M) report (para. 5.02). The first part of the report, completed in May 1969, recommended the functional division of SB into three sections:<sup>1/</sup> Planning and Design, Operations and Maintenance, and Construction; SB reorganization accordingly was practically completed by the end of 1970.<sup>2/</sup> The Bank insisted that further study of SB's staff requirements be made by O and M; such study, made in November 1969 but left incomplete, was resumed under Bank's pressure and completed in March 1971. As a result of this delay and the persisting shortage of engineering and technical staff in Singapore, SB suffered from the lack of staff, albeit to a decreasing degree. Measures taken in 1973 by the Government and SD (para. 6.02) contributed to improve greatly the staff situation which is presently manageable. Despite difficulties in implementing its staffing recommendations, the O and M report was instrumental in the recognition by the Government of the staffing and other operational needs of SB, which had been seen before as an ordinary administration.<sup>3/</sup>

12.02 The SB has maintained since 1968 commercial accounts parallel to its Government cash accounts. SB's accounts have been satisfactory and have served as a useful management tool for effective control and evaluation of SB's operations. Minor improvements required under the 2nd Loan (918-SI), such as codification of accounting procedures into an Accounting Manual, were recently made. SB's accounts have been audited by the Auditor General of Singapore and audits have been satisfactory, despite minor delays in their completion.

12.03 Programs of flow measurements and data collection and investigation, as requested by the Loan Agreement (para. 5.02), received low priority initially, and progress by the end of 1969 was small. In 1970 however, SB started to install, improve or replace, as necessary, flow measurement devices in all pumping stations and to collect data in respect of population served, sewage flow patterns and characteristics,

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<sup>1/</sup> A fourth section, for Pollution Control and Water Reclamation, was later established.

<sup>2/</sup> except for the recommendation that SB's head be placed in a higher grade than the Section heads and be relieved of direct responsibility for construction. Implementation of this recommendation was requested under the 2nd Loan.

<sup>3/</sup> It is likely that, in the absence of Bank involvement and O and M report, the SB would have continued to expand because of the pressure and needs for more sewer services; planning and continuity of its expansion would probably have received less attention.



and sewage treatment effectiveness, which proved useful for planning the 2nd sewerage project. Reliable data on population served have been available since mid-1973; further improvements, however, are apparently desirable.

12.04 Coordination with HDB and the Economic Development Board improved considerably after 1968 and has been very good on matters relating to sewerage; SB has been consulted in time to be able to plan and carry out the sewerage works required, even in cases of HDB plan modifications. Planning and coordination have been firmer and more consistent since completion in 1971/72 of a long-range Sewerage Master Plan worked out by SB with the active assistance of a WHO consultant paid out of UNDP funds.<sup>1/</sup>

12.05 The organizational changes consequent to the transfer in September 1972 of sewerage operations from PWD to MOE have had little effect on the administration and staff of SD. The SB was given in June 1971 the responsibility to operate the Jurong Industrial Water plant which supplies treated sewage effluent (from Ulu Pandan) to industries for washing, cooling and other purposes; this plant, which provides about 5.5 million m<sup>3</sup> annually (equivalent to 15,000 m<sup>3</sup>d), has contributed to SB's operating surplus by some S\$ 100,000 p.a.

#### IBRD's Performance

13.01 The Bank's approach and attitude, in dealing with Singapore's first sewerage project, proved to be efficient, and issues raised were relevant. The Bank considered sewerage to be a public service, and it did not question SB's administrative status, nor did it impose financial and tariff targets which might have proved unattainable or unacceptable. In view of the urgent need for sewer expansion, the Bank did not press for a firm project content, and trusted SB's ability to build up the project and expand the sewer system according to actual developments and circumstances. The Bank nevertheless insisted rightly on the need for reorganization of SB's procedures and accounts and for solving SB's technical staff problem. During project implementation, the Bank remained open and understanding to SB's problems and difficulties, and modified effectively its initial disbursement procedures which were unnecessarily complex. Finally, acceptance by the Bank that SB's organization and staff requirements be reviewed by another Government service, rather than by

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<sup>1/</sup> The Bank was effective in supporting SB's request to extend the consultant's two-year contract beyond August 1972. Long-range plans of the Sewerage Master Plan are based on a general "Singapore Land Use Concept Plan" which was developed also with UNDP assistance.

a management consultant, was probably the best way to insure full acceptance and efficient implementation of the necessary recommendations.

13.02       Acceptable treatment standards could be maintained due to SD's satisfactory operations, despite overloading of treatment facilities; SD may have some difficulties to keep such standards in 1975/76 until shortage of capacity is alleviated by the completion of treatment plant expansions under the 2nd sewerage project. More attention could usefully have been given to treatment capacity planning and consultants design during appraisal, and to the need to accelerate or revise the expansions of the overloaded treatment plants during supervision; unexplained discrepancies between consultants' and Bank's expansion targets and the Bank's concentration on financial and institutional objectives may explain why it did not occur. Targets for population served were not entirely met, most probably because the data used for planning overestimated slightly the population served in 1967. Finally, the unexpectedly large increases in sewer charges promulgated in 1970, which may raise some questions, appear justified retrospectively since they were well accepted by the public and since sewer charges should not need upward revisions during some years to come.

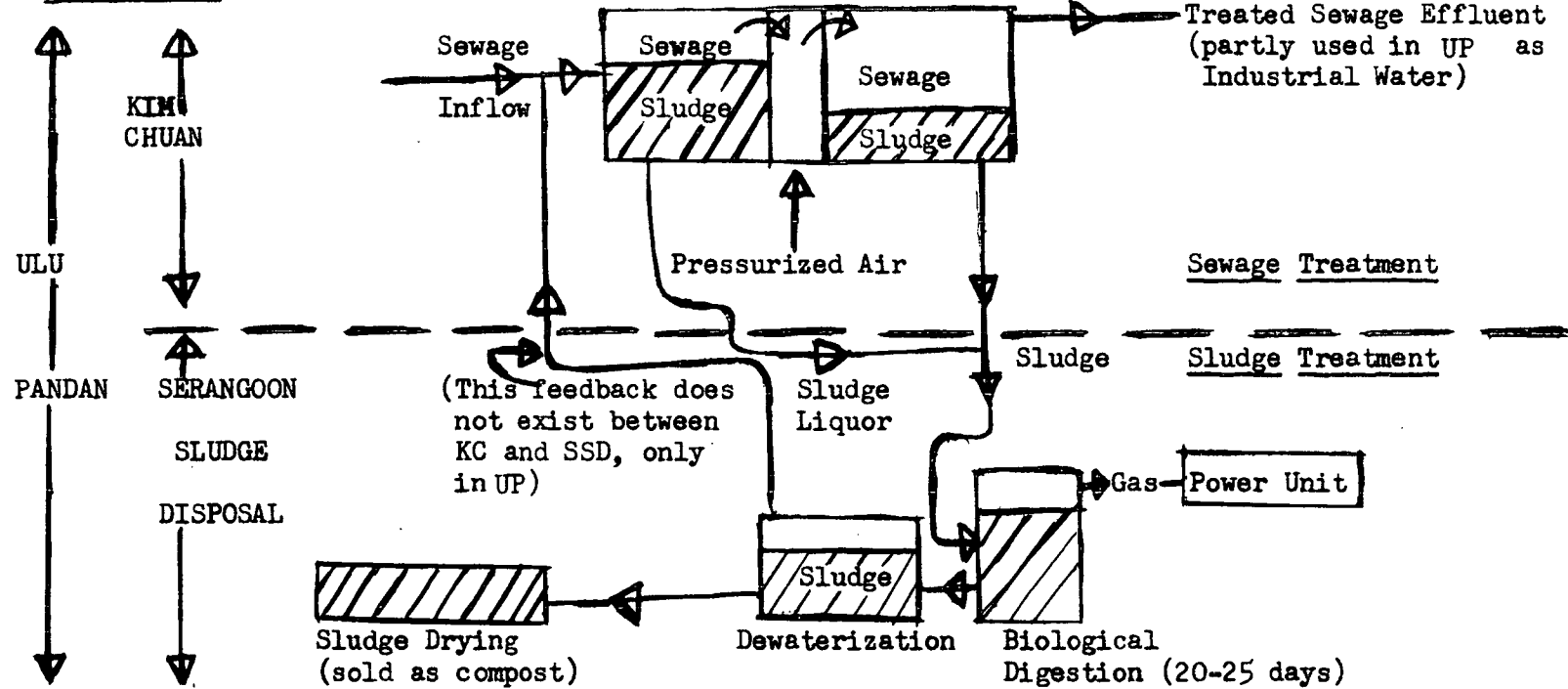
13.03       The Bank decided after the third supervision mission to increase the interval between missions from 6 to 12 months because it was satisfied with SD's achievements in carrying out the project and meeting the loan commitments; this change, which had no negative effects, kept supervision costs low for this efficient borrower and seems wise in retrospect.

#### Conclusion

14.01       Loan 547-SI of US\$ 6 million made in 1968 contributed importantly to the much needed expansion of Singapore's sewer system and sewage treatment capacity. Most project physical achievements reached expectations; shortfalls with respect to population served and treatment capacity were not critical. Despite delays in completion due to SB's initial difficulty in adjusting itself to the size of the project, project implementation was smooth and efficient. The project has contributed positively to improving the standard of living and sanitary conditions in Singapore. Other major benefits of the project were to help reorganize and strengthen the Sewerage Department for undertaking future larger sewerage projects, and to put sewerage services on a solid financial basis contributing substantial amounts to public revenues. The Bank's performance with its first sewerage project was good, due to its restrained and flexible approach to the problems of such a public service.

# "Activated Sludge" Process

## Scope of Plants Operations:



## ANNEX II

### Description of Works as Planned and as Executed

<u>A - Area Sewerage Programs</u>	<u>Appraisal Report</u> (Additional people served)	<u>Actual Works</u>	<u>Reasons for Variations</u>
1. Toa Payoh (Satellite Town - HDB)	2.13 km of main sewers	Nil	Contracted out before loan signing - outside project
2. Jurong Sewerage (HDB, Jurong Industrial Estate, Private Housing)	1 pumping station, force mains and 3.05 km of main sewers (50,000 people)	1 pumping station (capacity 4.6 Imgd), force mains and 6.22 km of sewers	Larger than expected expansion of sewerage system in Jurong Industrial Estate and area
3. Pasir Panjang	7.1 km of sewers (10,000 people)	2.51 km of sewers	Part of original works contracted out prior to loan signing <sup>b/</sup>
4. Urban Renewal South (HDB - Urban Renewal)	1 pumping station, and 3.66 km of sewers (20 - 30,000 people)	1 pumping station (capacity 26.6 Imgd) and 2.07 km of sewers	Laying of sewers adjusted to delays in Urban Renewal programs due to resettlement and clearance programs <sup>b/</sup>
5. Urban Renewal North (HDB - Urban Renewal)	1 pumping station, 1 temporary pump, force mains and 4.57 km of main sewers (40-50,000 people)	1 temporary pump, 2.32 km of main sewers, and partial completion of the pumping station <sup>b/</sup>	
6. Kallang Basin (HDB)	1 pumping station and 1 temporary pump (for flows averaging 9 Imgd), force mains and 8.23 km of main sewers (n.a.)	1 pumping station (capacity 32 Imgd), 1 temporary pump, force mains and 7.01 km of main sewers	
7. Telok Blangah (HDB)	1 pumping station, force mains and main sewers (n.a.)	1.71 km of main sewers	The program was rescheduled <sup>b/</sup>
8. Serangoon	1 small pumping station (0.7 Imgd), force mains and 6.4 km of sewers (15,000 people)	1 pumping station (capacity 2.2 Imgd), force mains and 13.32 km of sewers	
9. Kampong Tiong Bahu (HDB)	1 pumping station, force mains and main sewers (n.a.)	1 pumping station	Major part constructed prior to loan signing

ANNEX II (continued)

<u>A - Area Sewerage Programs</u>	<u>Appraisal Report</u> (Additional people served)	<u>Actual Works</u>	<u>Reasons for Variations</u>
10. Thomson Area	Not included originally (n.a.)	9.60 km of sew- ers and civil works for 2 pumping sta- tions <sup>a/</sup>	Additional scheme
11. Upper Changi Estate	Not included originally (14,000 people)	0.93 km of sew- ers, civil works for 1 pumping station <sup>a/</sup>	"
12. Queenstown Neighbor- hood	Not included originally (n.a.)	1 temporary pump, and 1.71 km of sewers	"
13. East Coast Reclamation	Not included originally (n.a.)	1 temporary pump, and 4.15 km of sewers	"
<u>B - Treatment Works</u>			
1. Ulu Pandan Plant	Increase plant capacity from 109 to 164,000 m <sup>3</sup> d to serve populations of 600,000 (from 400,000 in 1968)	Sewer treatment capacity increased by 27,000 up to 136,000 m <sup>3</sup> d. Sludge treatment capacity increased by 82,000 up to 164,000 m <sup>3</sup> d	Inconsistency between consultants feasibility study and IBRD apprai- sal report. See text of report
2. Kim Chuan Sewage Treatment Plant, and Serangoon Sludge Disposal plant	Preliminary plans, to be firmed up by consultants studies, comprised minor modifications at Kim Chuan and extensions to SSD drying beds	(i) Modification and enlargement of inlet works at Kim Chuan; (ii) Workers quarters (57), sludge drying beds (60), 1 settling tank and 2 pumping stations at SSD plant	
<u>C. - Miscellaneous Improvements and Extensions</u>			
1. Improvements to existing pumping stations	As required by expe- rience and operations	New pumps to 1 pumping station	
2. Extensions to Main sewers	Extensions expected each year 1968-June 1972	8.64 km of main sewers	
3. Extensions to minor sewers	"	10.53 km of minor sewers	

<sup>a/</sup> Civil works of the pumping stations were completed and financed under the first project; pumps and equipment are being installed and financed under the ongoing **second sewerage project**.

<sup>b/</sup> The remaining sewers planned under these schemes are being constructed under the ongoing second sewerage project.

### ANNEX III

#### Selected Covenants and Supplementary Letters to the Loan Agreement

##### Section 5.02 (a)

###### Requirements:

Employ consultants and contractors acceptable to the Borrower and the Bank.

###### Fulfillment:

Complied with. SB presently employs three consulting firms for sewer design.

##### Sections 5.03/5.05 (a)

###### Requirements:

Establish and maintain sound accounting procedures and data collection system.

###### Fulfillment:

Commercial accounting system established and used as of 1968.

##### Section 5.04 (b)

###### Requirements:

Prepare a long-term plan of SB organization to assure SB's sound expansion.

###### Fulfillment:

Complied with through the O and M report (see below).

##### Sections 5.05 (b) and (c)

###### Requirements:

Install dependable flow measurement devices to collect and analyse adequate information on population served, sewage flows and characteristics and sewage treatment. Use said information for expansion planning and improvements of sewerage system.

###### Fulfillment:

Little progress before 1970. Measures taken in 1970 onwards. All pumping stations presently equipped with flow measurement devices; surveys carried out since 1973 on population served.

### ANNEX III (continued)

#### Section 5.07

##### Requirements:

SB's accounts be audited at least once a year by auditor acceptable to the Bank.

##### Fulfillment:

SB's accounts audited by the Auditor General of Singapore.

#### Section 5.08 (a)

##### Requirements:

Adjust sewer charges and tariffs so as to cover all operating expenses (including adequate depreciation) by revenues not later than 1972 and thereafter earn a reasonable annual return on net fixed assets. Carry out before end of 1971 a study to determine the rate of such return and consequently required changes in rates.

##### Fulfillment:

New sewer charges and tariffs made effective March 1970. Revenues doubled in 1970 onwards; actual rate of return of over 8 percent in 1970-1972 and over 7 percent in 1973. After establishment of new fees in 1970, further study considered unnecessary.

#### Section 5.08 (c)

##### Requirements:

Introduce before January 1, 1970: (i) a Trade Waste Tariff for industrial/commercial wastes; and (ii) revisions in the existing Sewage Fees such that charges be partially or totally based on water consumption.

##### Fulfillment:

Fees based on water consumption made effective March 1970. Trade Waste Regulations promulgated mid-1970; trade waste tariffs considered unnecessary.

#### Supplementary Letters

##### (a) Procurement:

##### Requirements:

All contracts above US\$100,000 for civil works and US\$50,000 for machinery and equipment require prior Bank approval.

##### Fulfillment:

Complied with, but experience showed arrangements heavy and complex (more than 150 contracts approved).

### ANNEX III (continued)

#### Supplementary Letters

##### (b) Development:

###### Requirements:

Consider the sewer capital costs and construction times involved in major housing and urban renewal programs when appraising such programs. Insure coordination of HDB and EDB<sup>1/</sup> development programs with those of Sewerage Branch.

###### Fulfillment:

**Coordination** with HDB and EDB very good since project inception. Long-range Sewerage Master Plan developed since mid-1970 in conjunction with a general Land Use Plan.

##### (c) Organization:

###### Requirements:

The Organization and Methods Branch of the Ministry of Finance will conduct, and complete by April 30, 1982, an appraisal of SB's functions and staff to identify required practicable changes in activities, structure and procedures and to determine staff requirements for the most effective use of personnel and consultants. Recommendations and their implementation be discussed with the Bank.

###### Fulfillment:

First part of O and M report issued in May 1962, with recommendations for SB's reorganization and procedures. Second part on SB staff requirements issued incomplete in November 1969 and completed in March 1971. Recommendations of the first part implemented by end 1970. Overall labor shortages have slowed down implementation of second part report.

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<sup>1/</sup> HDB: Housing Development Board.  
EDB: Economic Development Board.



ANNEX IV

Loan Disbursements

Cumulative Disbursements Schedule

<u>IBRD FY</u>	<u>Forecast/Actual</u>					
	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Forecast (US\$ million)	0.89	2.32	3.98	5.31	6.00	-
Actual (US\$ million)	0.20	1.07	2.07	3.80	5.40	6.00
Actual/Forecast, in %	22.00	46.00	52.00	72.00	90.00	100.00

Allocation of Proceeds of Loan

<u>Category of Goods</u>	<u>Amount (US\$ equivalent)</u>	
	<u>Original</u>	<u>Final</u>
1. Treatment plants	1,300,000	1,486,000
2. Area Sewerage Programs/Sewers	3,500,000	4,019,000
3. Consulting Services	300,000	425,000
4. Unallocated	900,000	-
TOTAL	6,000,000	6,000,000

# ANNEX V

## Total Project Cost - Estimates and Actual (\$ million)

	<u>Length of Sewers (kms)</u>		<u>Cost Estimates</u>			<u>Actual Cost</u>		
	<u>Forecast</u>	<u>Actual</u>	<u>L.C.</u>	<u>F.X.</u>	<u>Total</u>	<u>L.C.</u>	<u>F.X.</u>	<u>Total</u>
<b>A. <u>Sewerage Schemes</u></b>								
1. Toa Payoh	2.13	-	.61	.16	.77	-	-	-
2. <b>Jurong</b>	3.05	6.22	2.72	.96	3.68	2.51	1.51	4.02
3. Pasir Panjang	7.10	2.51	.64	.16	.80	.21	.14	.35
4. Urban Renewal S	5.66	2.07	2.46	1.20	3.66	1.10	.43	1.53
5. Urban Renewal N	4.57	2.82	3.33	1.84	5.17	2.34	1.15	3.49
6. Kallang Basin	8.23	7.01	5.56	2.60	8.16	5.12	3.75	8.87
7. Telok Blangah	n.a.	1.71	1.82	.68	2.50	.46	.23	.69
8. Serangoon	6.40	13.32	3.04	1.16	4.20	2.63	1.38	4.01
9. Kampong T. Bahm	n.a.	-	.15	.15	.30	.01	.02	.03
10. Thomson Area	N.A.	9.60				2.82	1.34	4.16
11. Upper <b>Changi</b>	N.A.	0.93				.39	.21	.60
12. Queenstown	N.A.	1.71				.37	.18	.55
13. East Coast	N.A.	4.15				.27	.51	1.48
Sub-total A	36.74	52.05	20.34	8.90	29.24	18.94	10.84	29.78
<b>B. <u>Treatment Works</u></b>								
1. Ulu Pandan Plant			1.96	2.04	4.00	3.19	2.57	5.76
2. Kim Chuan and SSD			<u>5.80</u>	<u>1.90</u>	<u>7.70</u>	<u>4.20</u>	<u>2.77</u>	<u>6.97</u>
Sub-total B			7.76	3.94	11.70	7.39	5.34	12.73
<b>C. <u>Miscellaneous Improvements and Extensions</u></b>								
1. To Existing Stations			.06	.74	.80	.29	.44	.73
2. To Main Sewers	n.a.	8.64	4.81	1.22	6.03	3.21	1.35	4.56
3. To Minor Sewers	<u>n.a.</u>	<u>10.53</u>	<u>3.33</u>	<u>.87</u>	<u>4.20</u>	<u>1.14</u>	<u>.51</u>	<u>1.75</u>
Sub-total C	n.a.	19.17	8.20	2.83	11.03	4.64	2.40	7.04
<b>D. <u>Unallocated Contingencies (20 %)</u></b>			7.27	3.13	10.40	-	-	-
<b>E. <u>Consulting Services</u></b>			.20	.80	1.00	.23	1.67	1.95
<b>TOTAL PROJECT</b>	n.a.	<u>71.22</u>	<u>43.77</u>	<u>19.60</u>	<u>63.37</u>	<u>31.25</u>	<u>20.25</u>	<u>51.50</u>
Non-Project Expenditures			1.70	1.50	3.20	n.a.	n.a.	21.06
<b>Total Capital Expenditures</b>			45.47	21.10	66.57	n.a.	n.a.	<u>72.56</u>

(Forecast 1968-June 1972)

(1968-March 1974)

**ANNEX VI:**

**Main Sewerage System Sewage Flows: Treatment Capacity and Indicators**

<b><u>Forecasts:</u></b>	<b><u>1966<sup>a/</sup></u></b>	<b><u>1967</u></b>	<b><u>1968</u></b>	<b><u>1969</u></b>	<b><u>1970</u></b>	<b><u>1971</u></b>	<b><u>1972</u></b>	<b><u>1973</u></b>
Dry weather treatment capacity (000m <sup>3</sup> d)	191	191	245	245	245	245	300	300
Dry weather sewage flows:								
Basis for planning	160	190	205	221	238	255	280	302
Dry weather sewage flows:								
Forecast range	-	170-200	180-215	190-240	200-260	210-275	225-300	240-330
Estimated population equivalent served (million)	0.90	0.98	1.06	1.16	1.25	1.37	1.47	1.58

**Actual:**

Dry weather treatment capacity (000 m <sup>3</sup> d)	191	191	245	245	245	245	245	272
Annual average of daily flow treated (000 m <sup>3</sup> d)	188	206	219	243	243	241	253	282
Maximum daily flow treated (000 m <sup>3</sup> d)	263	306	300	308	320	341	346	402
Minimum daily flow treated (000 m <sup>3</sup> d)	147	153	172	187	179	194	174	215
Estimated population equivalent served (million)	0.90	0.95	1.00	1.03	1.06	1.08	1.12	1.23
Average daily flow per capita (m <sup>3</sup> dc)	.21	.22	.22	.24	.23	.22	.23	.23
Ulu Pandan treatment capacity (000 m <sup>3</sup> d)	109	109	109	109	109	109	109	136
Annual average of daily flow treated (000 m <sup>3</sup> d)		95		106	120	119	125	143
Minimum/maximum of daily flow treated (000 m <sup>3</sup> d)		75/130				90/165		110/185

**Effectiveness of Treatment Indicators<sup>b/</sup>**

Ulu Pandan Effluent: Suspended Solids (mg/l)	14.4	13.8	26.6	19.1	22.0	26.0	21.0
Bio Oxygen demand (mg/l)	13.3	11.5	22.6	14.8	16.5	14.0	13.4
Kim Chuan) -- Suspended solids (mg/l)	39.3	17.8	13.3	17.2	27.7	26.0	25.0
and SSD ) Bio Oxygen demand (mg/l)	88.5	20.9	20.0	18.4	24.7	22.2	24.7

**Sewage Treatment Operating Costs :**

	<u>1967</u>		<u>1971</u>		<u>1973</u>	
	<u>UP</u>	<u>KC</u>	<u>UP</u>	<u>KC</u>	<u>UP</u>	<u>KC</u>
Total operating costs (\$000)	571.6	415.6	666.8	799.7	1,035.7	1,027.5
Total flows treated (million m <sup>3</sup> )	34.6	40.7	42.8	45.3	52.3	50.6
Estimated population served (000)	450	500	475	600	540	685
Unit cost of treatment (\$/000 m <sup>3</sup> )	16.5	10.2	15.6	17.6	19.8	20.3
Cost per capita served (\$/cap.)	1.27	0.83	1.40	1.33	1.92	1.50

a/ Actual data.

b/ Maximum limits recommended by International Agencies for Suspended Solids (SS) and Bio Oxygen Demand (5-day BOD at 20°C) are 30 and 20 mg/l respectively.

## SINGAPORE SEWERAGE PROJECT

## Income Statements

	1968		1969/70 <sup>/1</sup>		1970/71		1971/72		1972/73		1973/74	
	Appraisal	Actual	Appraisal	Actual	Appraisal	Actual	Appraisal	Actual	Appraisal	Actual	Appraisal	Actual
	Report	Jan-Dec 68	Report	Jan 69-Mar 70 (15 months)	Report	Apr 70-Mar 71	Report	Apr 71-Mar 72	Report	Apr 72-Mar 73	Report	Apr 73-Mar 74
-----S\$ 000-----												
REVENUES												
Water Borne Sewage Fees:												
Non-Government Properties	4,675	5,170	5,075	7,694	5,475	14,693	5,875	16,601	9,287	18,531	9,879	19,645
Government Properties	523	523	542	683	562	2,745	583	2,199	895	1,921	931	1,764
Sub-total	5,198	5,693	5,617	8,377	6,037	17,438	6,458	18,800	10,182	20,452	10,810	21,409
Less PUB's Commission	-	-	-	385	-	240	-	240	-	240	-	240
Net Water Borne Sewage Fees	5,198	5,693	5,617	7,992	6,037	17,198	6,458	18,560	10,182	20,212	10,810	21,169
Sale of Industrial Water	-	-	-	-	-	-	-	313	-	404	-	447
Connection Fees (Mandatory)	150	169	150	208	150	106	150	67	150	52	150	56
Special Sewer Connections	375	424	375	556	375	358	375	678	375	1,237	375	891
Septic Tank Maintenance Fees	260	259	260	386	260	244	260	333	260	298	260	277
Sludge Sales & Miscellaneous	20	218	20	355	20	422	20	461	20	564	20	830
TOTAL REVENUE	6,003	6,763	6,422	9,507 <sup>/2</sup>	6,842	18,328	7,263	20,412	10,987 <sup>/3</sup>	22,767	11,615 <sup>/3</sup>	23,670
OPERATING COSTS												
Salaries & Allowances	1,840	1,240	1,936	1,442	2,040	1,103	2,191	2,151	2,406	2,450	2,526	3,171
Contribution to Provident Fund	223	148	217	236	210	205	210	293	210	378	210	541
Wages	1,400	1,415	1,400	1,713	1,400	1,078	1,400	1,290	1,400	1,554	1,400	1,809
Materials & Supplies	250	164	260	278	280	202	280	471	280	389	280	465
Repairs & Maintenance by Contractors	300	331	320	365	340	268	360	391	380	498	400	617
Fuel & Utilities	840	866	840	1,281	850	1,114	860	1,076	900	1,292	910	1,772
Transportation & Traveling	65	53	70	56	75	47	80	53	85	60	90	65
Overhead	246	596	258	667	271	639	285	223	299	115	314	129
Others	50	159	50	224	50	160	50	42	50	38	50	42
TOTAL OPERATING COST	5,214	4,972	5,351	6,262	5,516	4,816	5,716	5,990	6,010	6,774	6,180	8,611
Surplus before Depreciation	789	1,791	1,071	3,245	1,326	13,512	1,547	14,422	4,977	15,993	5,435	15,059
Depreciation	3,896	2,956	4,117	4,637	4,370	3,820	4,646	4,284	4,876	4,660	5,374	5,087
Surplus (deficit) after Depreciation	(3,107)	(1,165)	(3,046)	(1,392)	(3,044)	9,692	(3,099)	10,138	101	11,333	61	9,972
Interest on Loans <sup>/4</sup>	-	29	-	296	-	321	-	556	-	862	563	1,154
Other Non-operating Expenses	-	-	-	-	-	120	-	486	-	576	-	(55)
Net Surplus (deficit)	(3,107)	(1,194)	(3,046)	(1,688)	(3,044)	9,251	(3,099)	9,096	101	9,895	( 502)	8,873
Operating Ratio before Depreciation	87%	74%	83%	66%	81%	26%	79%	29%	55%	30%	53%	36%
Operating Ratio after Depreciation	152%	117%	147%	115%	144%	47%	143%	50%	99%	50%	100%	58%
Rate of Return	-	-	-	-	-	8.8%	-	8.4%	0.1%	8.6%	0%	7.2%
SB's Labor Force		259		352		329		455		504		574

/1 Fiscal year changed to April-March.

/2 Excludes 585 on account of value of nightsoil treatment.

/3 Including rate increases as assumed in Annex 13 to the Appraisal Report.

/4 Appraisal estimates assumed capitalization of interest during construction.

## SINGAPORE SEWERAGE PROJECT

## Balance Sheets

	1968		1969/70 <sup>/1</sup>		1970/71 <sup>/1</sup>		1971/72 <sup>/1</sup>		1972/73 <sup>/1</sup>		1973/74 <sup>/1</sup>	
	Appraisal Report	Actual	Appraisal Report	Actual	Appraisal Report	Actual	Appraisal Report	Actual	Appraisal Report	Actual	Appraisal Report	Actual
<b>ASSETS</b>	-----S\$ 000-----											
<b>Current Assets</b>												
Accounts Receivable	320	341	320	434	330	3,232	340	5,495	350	4,028	360	5,932
Materials & Supplies	770	842	770	621	770	624	770	456	780	459	790	411
Advances & Other Accounts	-	205	-	190	-	182	-	215	-	329	-	380
Sub-Total	1,090	1,388	1,090	1,245	1,100	4,038	1,110	6,166	1,130	4,816	1,150	6,723
<b>Fixed Assets</b>												
Gross Fixed Assets in Operation	152,677	152,152	161,527	156,311	171,652	167,768	182,682	187,987	191,882	200,640	220,850	220,978
Less: Depreciation	46,923	45,826	51,040	50,463	55,410	54,345	60,056	59,759	64,932	64,419	70,306	69,506
Net Fixed Assets in Operation	105,754	106,326	110,487	105,848	116,242	113,423	122,626	128,228	126,950	136,221	150,544	151,472
Work in Progress	9,200	5,106	13,161	10,890	20,470	9,743	25,078	7,224	28,369	9,429	12,000	6,665
Sub-Total	114,954	111,432	123,648	116,738	136,712	123,166	147,704	135,452	155,319	145,650	162,544	158,137
<b>TOTAL ASSETS</b>	<u>116,044</u>	<u>112,820</u>	<u>124,738</u>	<u>117,983</u>	<u>137,812</u>	<u>127,204</u>	<u>148,814</u>	<u>141,618</u>	<u>156,449</u>	<u>150,466</u>	<u>163,694</u>	<u>164,860</u>
<b>LIABILITIES &amp; EQUITY</b>												
<b>Current Liabilities</b>												
Deposits by Contractors	200	216	200	247	210	335	220	391	220	569	220	535
Deposits by Consumers	450	546	480	552	500	449	550	433	550	667	600	895
Retention Funds & Payables	430	1,715	490	475	500	972	520	5,311	530	904	530	1,429
Sub-Total	1,080	2,477	1,170	1,274	1,210	1,756	1,290	6,135	1,300	2,140	1,350	2,859
<b>Long Term Debt</b>												
IBRD Loan	1,000	-	4,320	2,591	9,580	5,289	14,310	10,263	17,580	14,932	17,648	17,461
<b>Equity</b>												
Equity at beginning of year	109,810	108,272	113,964	110,343	119,248	114,057	127,022	120,159	133,214	125,220	137,569	133,394
Add: Government Appropriation (Deduct Capital Repayment to Govt.)	7,261	3,265	8,330	5,463	10,818	(3,149)	9,291	(5,365)	4,254 <sup>/3</sup>	(1,721)	7,629 <sup>/3</sup>	2,289
Add: Surplus (Deduct deficit) for the year	(3,107)	(1,194)	(3,046)	(1,688)	(3,044)	9,251	(3,099)	10,426 <sup>/2</sup>	101 <sup>/3</sup>	9,895	(502) <sup>/3</sup>	8,857
Equity at end of year	113,964	110,343	119,248	114,118	127,022	120,159	133,214	125,220	137,569	133,394	144,696	144,540
<b>TOTAL LIABILITIES &amp; EQUITY</b>	<u>116,044</u>	<u>112,820</u>	<u>124,738</u>	<u>117,983</u>	<u>137,812</u>	<u>127,204</u>	<u>148,814</u>	<u>141,618</u>	<u>156,449</u>	<u>150,466</u>	<u>163,694</u>	<u>164,860</u>

<sup>/1</sup> The figures for appraisal report and actuals for 1968 are as at December 31. For other years the appraisal report figures are as at December 31 and actuals as at March 31.

<sup>/2</sup> Includes 1,330 in respect of sewer fees relating to FY 1970/71 received from British Military & Sembawang Shipyard.

<sup>/3</sup> Figures amended on the basis of Annex 13 to the Appraisal Report.

SINGAPORE SEWERAGE PROJECT

Sources & Application of Funds

	1968		1969/70 <sup>1/</sup>		1970/71		1971/72		1972/73		1973/74	
	Appraisal Report Jan-Dec 68	Actual Jan-Dec 68	Appraisal Report Jan-Dec 69	Actual Jan 69-Mar 70 15 months	Appraisal Report Jan-Dec 70	Actual Apr 70-Mar 71	Appraisal Report Jan-Dec 71	Actual Apr 71-Mar 72	Appraisal Report Jan-Dec 72	Actual Apr 72-Mar 73	Appraisal Report Jan-Dec 73	Actual Apr 73-Mar 74 <sup>2/</sup>
	-----S\$ 000-----											
<u>SOURCES</u>												
Government Appropriation	7,261	3,265	8,330	5,463	10,818	-	9,291	-	4,254	-	7,629	2,169
Surplus before Depreciation	789	1,791	1,071	3,245	1,326	13,512	1,547	14,422	4,977	15,993	5,435	14,860
IBRD Loan	1,000	-	3,320	2,591	5,260	2,698	4,730	4,974	3,270	4,669	420	2,834 <sup>3/</sup>
Changes of Current Assets and/or Liabilities	<u>150</u>	<u>1,823</u>	<u>90</u>	<u>-</u>	<u>40</u>	<u>-</u>	<u>80</u>	<u>3,581</u>	<u>10</u>	<u>-</u>	<u>50</u>	<u>-</u>
TOTAL SOURCES	<u>9,200</u>	<u>6,879</u>	<u>12,811</u>	<u>11,299</u>	<u>17,444</u>	<u>16,210</u>	<u>15,648</u>	<u>22,977</u>	<u>12,511</u>	<u>20,662</u>	<u>13,534</u>	<u>19,863</u>
<u>APPLICATION</u>												
Investment												
Project	6,350	1,375	12,125	7,816	16,910	9,008	14,840	12,138	11,475	12,843	1,670	8,309
Other Capital Investments	<u>2,800</u>	<u>5,475</u>	<u>400</u>	<u>2,127</u>	<u>-</u>	<u>1,301</u>	<u>-</u>	<u>4,432</u>	<u>-</u>	<u>2,015</u>	<u>10,330</u>	<u>9,274</u> <sup>4/</sup>
Sub-Total	9,150	6,850	12,525	9,943	16,910	10,309	14,840	16,570	11,475	14,858	12,000	<u>17,583</u>
Debt Service												
Interest on Loans	50	29	286	296	524	321	798	556	1,016	862	1,162	1,154
Amortization of Loans	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>352</u>	<u>305</u>
Sub-Total	50	29	286	296	524	321	798	556	1,016	862	1,514	1,459
Other Non-operating Expenses (Net)	-	-	-	-	-	120	-	486	-	576	-	(26)
Changes of Current Assets and/or Liabilities	-	-	-	1,060	10	2,311	10	-	20	2,645	20	847
Capital Repayment to Government	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>3,149</u>	<u>-</u>	<u>5,365</u>	<u>-</u>	<u>1,721</u>	<u>-</u>	<u>-</u>
TOTAL APPLICATION	<u>9,200</u>	<u>6,879</u>	<u>12,811</u>	<u>11,299</u>	<u>17,444</u>	<u>16,210</u>	<u>15,648</u>	<u>22,977</u>	<u>12,511</u>	<u>20,662</u>	<u>13,534</u>	<u>19,863</u>
Debt Service Coverage (Times)	-	-	-	-	-	-	-	-	-	-	3.6	10.2

<sup>1/</sup> Fiscal year changed to April-March.    <sup>3/</sup> Includes 381 for the Second Sewerage Project (Loan 918-SI).

<sup>2/</sup> Unaudited accounts.    <sup>4/</sup> Includes 3,561 for the Second Sewerage Project financed from Loan 918-SI.

November 1, 1974

# ANNEX X: SEWER SERVICE CHARGES AND FEES

1. Water Borne Sewage Fees

	<u>Before 1970</u>	<u>1970 Onwards</u>
a. Fixed Cost (Effective Sept. 1959):	S\$ 2 per sanitary fitting per month	
Applies to all premises connected to main sewerage system or to secondary systems which have been taken over by SB/SD.		
b. Variable Cost (Effective March 1970)		<u>Rate/m<sup>3</sup> water consumed</u>
Domestic Premises	---	4.4 S cents
Other Premises	---	11.0 S cents
Applies to all water supplied by PUB to premises whether connected to the sewer systems or not (By March 1974, the share of premises not connected to the sewer systems was 25% of all premises paying the WBSF).		
2. Septic Tank Maintenance Fees (Effective July 1967):
 

Apply only to systems which are maintained but not taken over by SB/SD.

<u>Capacity of tank (m<sup>3</sup>)</u>	<u>No Pumping</u>	<u>Single Pumping</u>	<u>Double Pumping</u>
	-----S\$ per month-----		
0- 9.1 ( 2000 gallons)	9-18	19- 32	29- 46
9.1-72.7 (16000 gallons)	24-40	40- 64	56- 88
Above 72.7	60-80	88-116	116-152
3. Connection Fees
  - a. Actual Cost plus 20% overhead charges when: connection is voluntary; connection length exceeds 30 m. (100 feet); connection diameter exceeds 23 cm. (9 inches); or connection to secondary sewer systems.
  - b. S\$ 100 per meter in other cases, with minimum of S\$ 35/connection.

## COMPOSITION OF SB TOTAL REVENUES:

in % of total revenues	<u>1968</u>	<u>1969/70</u>	<u>1970/71</u>	<u>1971/72</u>	<u>1972/73</u>
WBSF: Fittings (Fixed)	84	84	40	38	39
Water Consumption (Variable)	-	-	54	53	50
Septic Tank Maintenance Fees	4	4	1	2	1
Connection Fees	9	8	3	4	6
<u>Other</u>	<u>3</u>	<u>4</u>	<u>2</u>	<u>3</u>	<u>4</u>
Total	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>
Total Revenues (100 in 1969/70)	<u>71</u>	<u>100</u>	<u>193</u>	<u>215</u>	<u>239</u>





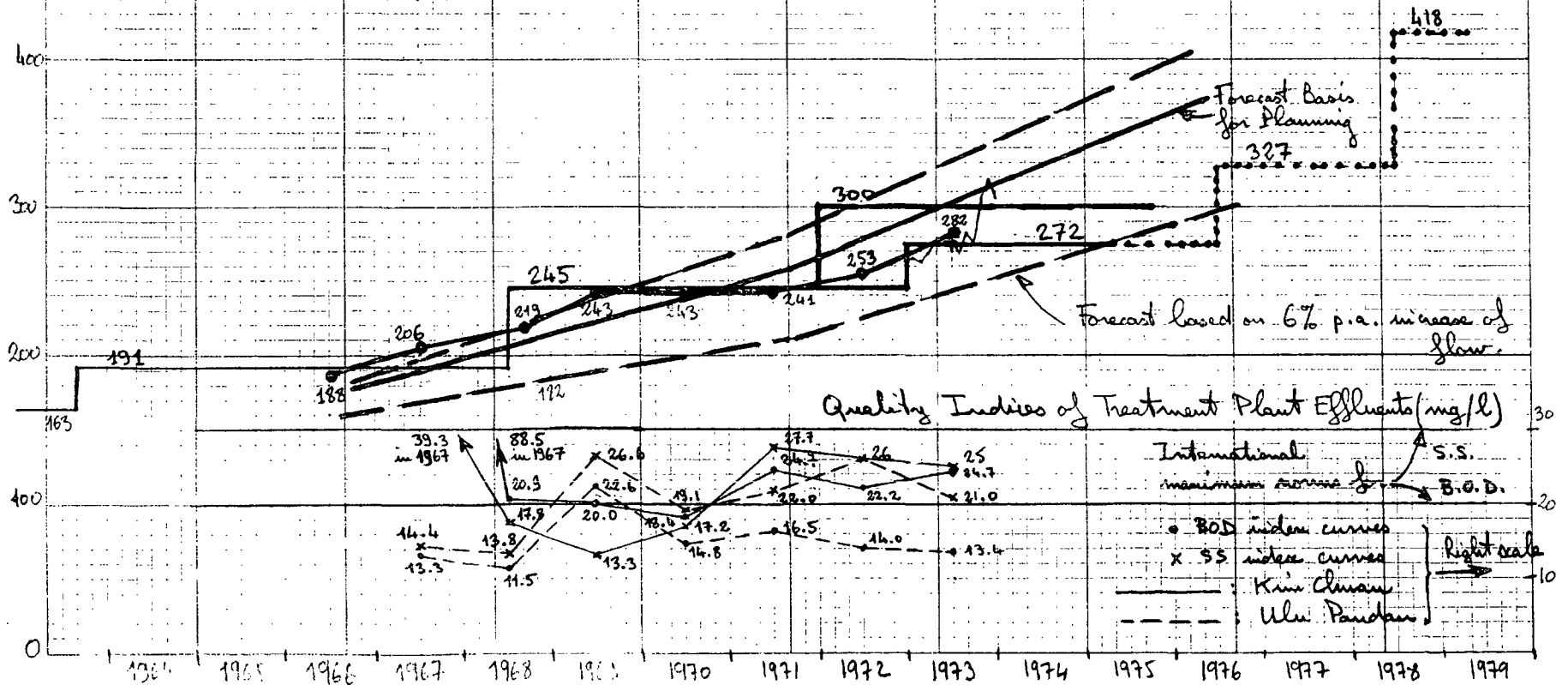
# SINGAPORE SEWERAGE PROJECT

## CHART I

### DRY WEATHER SEWAGE FLOWS AND TREATMENT CAPACITY

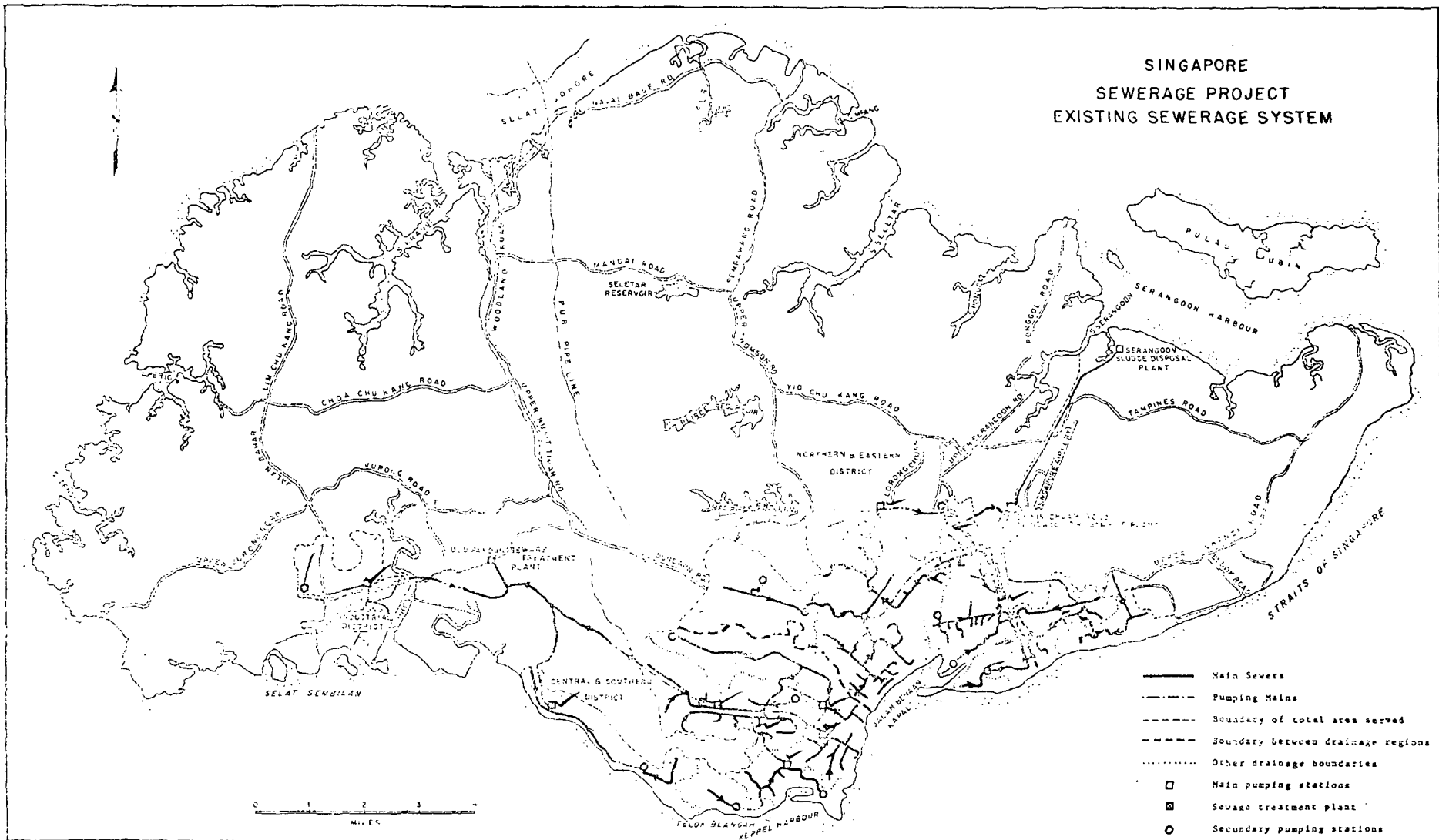
(000 m<sup>3</sup> d) (Left Scale)

- Actual Capacity
- Future Capacity
- Capacity Forecast and Flow Forecast for Planning (LOAN 547-SI).
- Annual Average of daily Flow treated.





# SINGAPORE SEWERAGE PROJECT EXISTING SEWERAGE SYSTEM



APRIL 1965

IBRD 2236R



# PROPOSED SEWERAGE PROJECT

