No.

SEWERAGE SERVICES DEPARTMENT
MINISTRY OF ENERGY, WATER, AND COMMUNICATIONS
MALAYSIA

THE STUDY ON IMPROVEMENT OF PLANNING CAPABILITY IN SEWERAGE SECTOR IN MALAYSIA

FINAL REPORT

MAIN REPORT

MARCH 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

NJS CONSULTANTS CO., LTD.
and
NIHON SUIDO CONSULTANTS CO., LTD.

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JR
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< Structure of Report >

Main Report

Manual for Reviewing/Evaluation/Prioritising of Sewerage Catchments/Projects

Exchange Rate

US Dollar (US$) 1.00

= Malaysian Ringgit (RM) 3.4575

= Japanese Yen (¥) 104.30

(As of 30 September 2008)

Source: Representative Exchange Rates for Selected Currencies for September 2008, International Monetary Fund (IMF)

PREFACE

In response to a request from the Government of Malaysia, the Government of Japan decided to conduct a study on Improvement of Planning Capability in Sewerage Sector in Malaysia and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Ikuo Miwa, Senior Chief Engineer of NJS Consultants Co., LTD. and consists of NJS Consultants Co., LTD. and Nihon Suido Consultants Co., LTD. between March, 2007 and December, 2008.

The team held discussions with the officials concerned of the Government of Malaysia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the improvement of planning capability in sewerage sector in Malaysia and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the study.

March 2009

Ariyuki Matsumoto,
Vice-President
Japan International Cooperation Agency

Mr. Ariyuki Matsumoto
Vice-President
Japan International Cooperation Agency

Letter of Transmittal

Dear Sir,

We are pleased to submit to you this Final Report on the Study on Improvement of Planning Capability in Sewerage Sector in Malaysia. This report incorporates the views and suggestions of the authorities concerned of the Government of Japan, including your Agency. It also includes the comments made on the Draft Final Report by the Sewerage Services Department, the Ministry of Energy, Water and Communications and other government agencies concerned of Malaysia.

This report contains the Study Team's findings, conclusions and recommendations derived from the three phases of the Study. The main objective of the Phase I was to conduct the sewerage sector analysis, planning capability assessment of agencies concerned and preparation of the draft Manual for reviewing/evaluation/prioritizing of catchment strategies and sewerage projects and the draft revised Guidelines for Developers Volumes 1 and 4 (concerned with sludge treatment and disposal). That of Phase II was to apply and improve the draft Manual and draft revised Guidelines, and that of the Phase III was to finalize them and make recommendations for improvement of planning capability.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure, Transport and Tourism of the Government of Japan for their valuable advice and suggestions. We would also like to express our deep appreciation to the relevant officers of the Sewerage Services Department, National Water Services Commission and Indah Water Konsortium Bhd. Sdn. of the Government of the Malaysia for their close cooperation and assistance extended to us throughout our Study.

Very truly yours,

March 2009

Ikuo Miwa
Team Leader
Study on Improvement of Planning Capability
in Sewerage Sector in Malaysia

Location Map

THE STUDY ON IMPROVEMENT OF PLANNING CAPABILITY IN SEWERAGE SECTOR IN MALAYSIA
FINAL REPORT

MAIN REPORT

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List of Abbreviations

AL	Aerated Lagoon
AS	Activated Sludge processes
ASMA	Alan Sekitar Malaysia Sdn. Bhd.
ATM	Automated teller machine
BD	Bio Drum process
BF	Bio Filter process
BS	Bio Soil process
BOD	Biochemical Oxygen Demand
BOD_5	Five Day Biochemical Oxygen Demand
B/C	Benefit / Cost (Cost Benefit Ratio)
CEO	Chief Executive Officer
COD	Chemical Oxygen Demand
COO	Chief Operation Officer
CSR	Catchment Strategy Report
CS/P	Catchment Strategy Plan
CST	Communal Septic Tank
CSTP	Centralized Sewage Treatment Plant
CSTF	Centralized Sludge Treatment Facilities
DBKK	Dewan Bandaraya Kota Kinabaru (Kota Kinabaru City Hall)
DO	Dissolved Oxygen
DOE	Derartment of Environment, Malaysia
EQA	Environmental Quality Act
FY	Fiscal Year
IBRD	International Bank for Reconstruction and Development
IWK	Indah Water Konsortium Sdn Bhd
IT	Imhoff Tank
IST	Individual Septic Tank
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JKR	Jabatan Kerja Raya (Public Works Department)
LTC	License to Contravene
MEWC	Ministry of Energy, Water and Communication
MNRE	Ministry of Natural Resources
MOF	Ministry of Finence

NPV	Net Present Value
NRW	Non-revenue Water
OD	Oxidation Ditch
O&G	Oil and Grease
O&M	Operation and Maintenance
OP	Oxidation Pond
P	Phosphorous
PE	Population Equivalent
PIU	Project Implementation Unit
RBC	Rotating Biological Contactor process
RM	Ringgit Malaysia
SCC	Sewerage Capital Contribution
SDP	Sewerage Development Plan
SI	Sub-index
SPAN	Suruhanjaya Perkhidmatan Air Negara (National Water Services Commission)
SS	Suspended Solids
SSA	Sewerages Services Act
SSD	Sewerage Service Department
STP	Sewage Treatment Plant
TF	Trickling Filter process
TOR	Terms of Reference
UASB	Upward Flow Anaerobic Sludge Blanket process
WAMCO	Water Asset Management Company
WS	Water Sector
WSIA	Water Services Industry Act
WTP	Water Treatment Plant
WQI	Water Quality Index

m^2	Square Metres
m^3	Cubic Meters
mg/L	Milligrammes per litre

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

CHAPTER 1 INTRODUCTION

In response to the official request of the Government of Malaysia, the Government of Japan has agreed to conduct the Study on Improvement of Planning Capability in Sewerage Sector in Malaysia ("the Study"), in accordance with the relevant laws and regulations of Japan.

Accordingly, the Japan International Cooperation Agency ("JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, conducted the Study in close cooperation with the relevant authorities of the Government of Malaysia during a twenty-four month period from March 2007.

The objective of the Study is to improve planning capability in sewerage sector in Malaysia.

The Study was carried out in accordance with the Scope of Work agreed upon between the Ministry of Energy, Water and Communications ("MEWC") and JICA on the 20th day of December 2006, as follows:

1) Analysis of the sewerage sector in Malaysia
2) Development of the Manual for reviewing/evaluation/prioritising of catchments strategies/plans and sewerage projects in the catchment plan
3) Revision of Guidelines for Developers
4) Trial application of the draft Manual and revised Guidelines (Vol. 1) in (2) and (3) above
5) Recommendations regarding the development of planning capability within in sewerage sector in Malaysia

The Sewerage Services Department ("SSD") on the Malaysian side of the project organised the steering committee and counterpart team and executed its role in the Study in close cooperation with the Study Team. The Study Team was in turn supported by the JICA Monitoring Committee under the general supervision of JICA headquarters.

CHAPTER 2 SECTOR ANALYSIS REPORT

2.1 Background of Water Supply and Sewerage Sector in Malaysia

(1) Water Supply Sector

Prior to the Constitutional Amendments in January 2005, water services were solely a state

matter and the State Governments established different types of water supply organisations.

As of now, some states have fully privatized or corporatized their water supply services while some states have privatized the operations and maintenance of water treatment plants. The privatization is executed through concession agreements. In addition, the water tariffs differ from state to state, and most states experience high non-revenue water (NRW).

(2) Sewerage Sector

Reliable and efficient sewerage systems contribute greatly to protecting the nation's public health, preserving its water resources, enhancing environmental quality leading to long-term sustainability of the water supply and sewerage services industry.

Indah Water Konsortium Sdn Bhd ("IWK") has been the single concessionaire and has been given the responsibility to operate and manage all public sewerage systems. SSD had been the regulatory body, governed IWK and ensured that IWK fulfill its obligations in accordance with the concession agreement. Those responsibilities will be shifted to SPAN.

(3) The Water Services Industry Reform

The Water Service Industry Bill (WSIA) and the National Water Services Commission Bill were passed by the Malaysian Parliament in May 2006. The main objectives for restructuring the industry were:

- to enable the Federal Government to assume control and regulation of water supply and sewerage services from the States;
- to ensure that water supply and sewerage services would be jointly regulated;
- to set up certifying agencies that would approve plans, certify contractors and monitor compliance with subsidiary legislation;
- to license all water industry players that treat and distribute water, and own facilities;
- to enable current concession holders to migrate to the licensing system through re-negotiation of their existing agreements with the Commission within a specific period of time (while concession holders that do not migrate forfeit their participation rights upon expiration of their concession agreement periods); and
- to set targets for service providers with respect to non-revenue water, handling of consumers, and compliance with water quality requirements, among others.

2.2 Water and Sewerage-Related Organisations and their Roles and Relationships

(1) MEWC

The Sewerage Services Department is responsible for the sewerage sector only while the Water Sector ("WS") is involved in both the sewerage and water sectors. With respect to the sewerage sector, SSD currently operates in accordance with the Sewerage Services Act 1993 (SSA 1993/Act 508). The WS, which currently is not actively involved in the sewerage sector, is expected to have a role on the future development of the sewerage industry, especially in policy settings. Though the National Water Services Commission (Suruhanjaya Perkhidmatan Air Negara in Malay or "SPAN") is also under the purview of the Minister of the MEWC, it is regarded as an independent agency with the enactment of the SPAN Act and is addressed separately later in this document.

(2) SSD

1) Roles and Organisation

The Sewerage Services Department is one of the major departments in MEWC and is responsible for planning, constructing and managing sewerage infrastructure. The department is headed by a Director General, and is comprised of three divisions, seven sections, six branch offices and four units. As of October 2008, this is only a proposed organisation structure and is still pending approval.

2) Financial Aspects

With respect to the sewerage sector, the total project budget was established in the 5-Year Malaysia Plan with amounts allocated to SSD and MEWC. The maximum total amount allocated to sewerage is RM 3,112.835 million for the term of the 9th Malaysia Plan (2006 - 2010), which includes approximately RM 1,375.027 million for the Japan Bank for International Cooperation ("JBIC") project. SSD receives JBIC funds from MEWC without loan repayments obligations where the Federal Government assumes the burden of loan repayments.

3) Sewerage Capital Contribution

SSD managed the Sewerage Capital Contribution ("SCC") Fund with the approval of MEWC. As of October 2008, the Sewerage Capital Contribution is levied on developers that connect to the existing public STP at the rate of 1% of the developed property value. After new regulations go into effect, anticipated in January 2009, the SCC will be administered and controlled by SPAN.

4) Assessment of Sewerage Planning Capabilities

The Planning Division was established in September 2006. There are still several limitations that need to be addressed for the Division to optimize performance of its functions:

(a) The Division lacks manuals specifically for the purpose of planning. Manuals provide procedures or processes that guide effective and efficient sewerage planning.
(b) There are no programmes dedicated to capacity development for planning staff.
(c) No knowledge bank for sewerage system planning exists.
(d) The Planning Division has limited staff.

(3) National Water Services Commission (SPAN)

1) Roles and Staffing

To ensure that water supply and sewerage services are jointly regulated, SPAN will approve plans, certify contractors, and monitor compliance with subsidiary legislation. Currently, the staff strength of SPAN stands at 170 compared with a target level of 190.

2) Financial Aspects

To assist SPAN in its payment of staff compensation, office expenses, utility costs, and other initial start-up costs, the Federal Government approved a seed fund amounting to RM 50 million for a period of five years. Within the first five-year period, SPAN is expected to generate enough revenue to allow self-sufficiency without further Government support. SPAN has been established as a special bureau in the Ministry of Energy, Water and Communication, and it has been authorized to establish its own fund and to borrow money outside of the Ministry budget.

License fees are expected to be the largest revenue source for the SPAN Fund. The license fee rate is equal to 1% of the previous financial year's gross license receipts. Full collection of license fees from all existing water and sewerage service entities is anticipated to sufficiently cover the cost of SPAN operations.

(4) Water Asset Management Company ("WAMCO")

1) Roles and Staffing

With the enactment of the WSIA 2006, WAMCO was established in May 2007. WAMCO is to be a facilities licensee under the provisions of the WSIA 2006. As of November 2008, the staff strength of WAMCO stands at 41.

2) Financial Aspects

Authorized capital of WAMCO is RM 1 billion. To initiate operations, the Federal Government provided WAMCO with a seed fund of about RM 100 million as paid-up capital, which is expected to be increased to RM 500 million by the year 2010. As of

October 2008, paid-up capital by the Federal Government amounted to RM 410 million. The bulk of the paid-up capital will be used for asset transfers (ownership) in addition to other initial establishment costs.

If the agreements for asset transfer are successfully executed, WAMCO would own the assets and provide all required future capital investments for the assets. WAMCO will then lease the assets to service licensees, such as state-owned or private operators. Service licensees will be required to pay the asset lease fees in exchange for forgiveness of the capital investment loans. WAMCO is expected to raise funds for its future capital investment needs from government soft loans, local capital markets (bond issuance), and the private banking sector. It is expected to obtain loans with lower interest rates and reduce the heavy burden of loan repayments that current operators face, thereby enabling the operators to focus on their operations.

(5) Indah Water Konsortium (Sewerage Services Agency)

1) Roles and Staffing

Indah Water Konsortium (IWK), a wholly-owned company of the Minister of Finance Incorporated, is Malaysia's national sewerage company and has been entrusted with the task of developing and maintaining a modern and efficient sewerage system for all Malaysians. As of December 2007, the total number of staff in the Operations and Maintenance Department was 2,095, comprising the bulk (79.6%) of IWK's total staff of 2,632. The remainder of the staff, other than the three major departments, constitutes less than 10% of the total staff number.

2) Financial Aspects

IWK is a company fully owned by the Ministry of Finance. IWK uses revenues from sewerage tariffs for its operations. IWK has O&M responsibilities that include desludging septic tanks and repair work within tariff revenue. However, in the event of large budget shortfalls, IWK may receive financial support from the Federal Government.

IWK's annual revenue has increased due to ongoing activities focused on expanding its customer base and improving loan collection. Despite these efforts, net losses have been mounting for the last six years. As a result, financial assistance from the Federal Government to IWK increased to RM 194.2 million for the 2007 fiscal year alone (refer to **Table 1**).

Table 1 Financial Assistance from the Federal Government to Indah Water Konsortium

(Unit: × Million RM)

Year	2002/5-2003/4	2003/5-2004/4	2004/5-2005/4	2005/4-2005/12	2006/1-2006/12	2007/1-2007/12
Assistance from the Federal Government	0.0	0.0	43.2	120.0	140.0	194.2

Source: JICA Study Team, based on the data provided by IWK

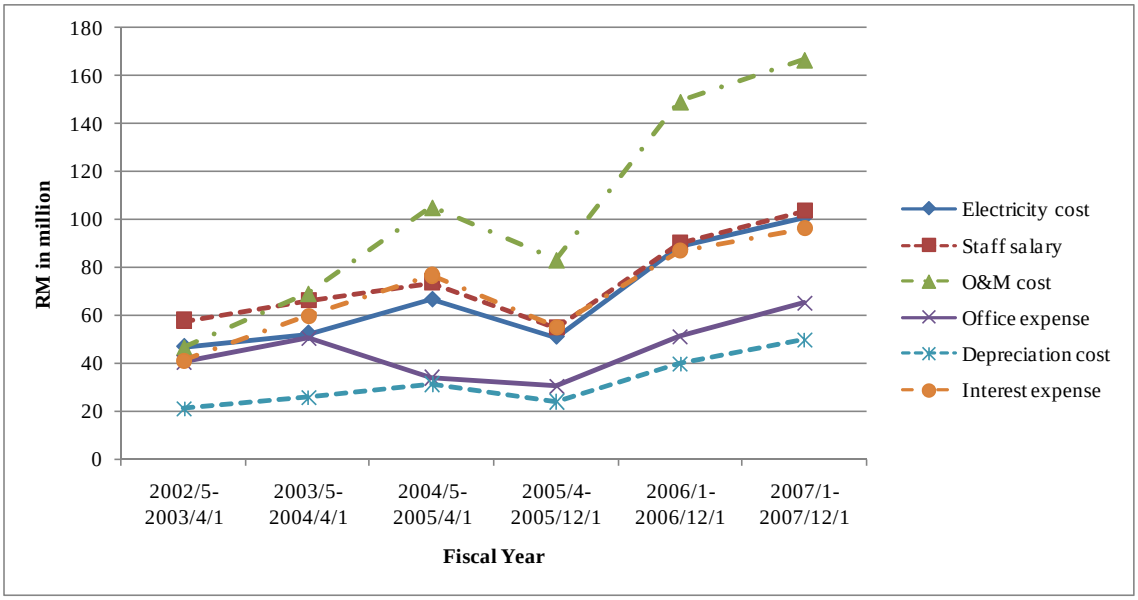


Figure 1 Changes in Major Cost Items from FY2002 to FY2007

The causes of the growing net losses are the substantial increases in O&M costs, interest expense, and electricity costs. **Figure 1** shows trends in major cost items for the last six years. O&M costs increased 258% from fiscal year 2002 to 2007.

IWK is trying to provide better operation and maintenance of the facilities by increasing the number of staff and the size of the O&M expenses to address the increasing number of sewerage facilities each year. In order to provide appropriate sewerage service for the long run, it is necessary for the operator (IWK) to plan for adequate O&M budget. The costs shall be borne by customers or by the public budget as a last resort. Securing an appropriate O&M budget is vital.

3) Management

IWK bills and collects a sewerage charge from its customers for both septic tank desludging and connecting to public sewers. Tariffs for domestic customers are set at a fixed price for each of three categories based on home values. Sewerage tariffs for domestic premises have not been changed for 12 years since January 1997.

Collection efficiency (defined as tariff collections as a percentage of total billed amount

amounts) of the sewerage charge has improved from less than 70% at the end of the 1990s to around 90% in 2007.

Table 2 shows the sewerage tariff as a percentage of monthly household income. On average, for the whole of Malaysia, 0.17% of household income is spent on sewerage tariffs. The IBRD estimates that 1% of household income is the maximum level for sewerage service household affordability. The Pan American Health Organisation puts this limit at 1.5%. The current sewerage charge in Malaysia at 0.17% of household income is around one sixth of this ceiling (1%).

Table 2 Average Monthly Tariff as a Percentage of Average Monthly Household Income

Area	Average Monthly Household Income 2004 (RM)	Average Monthly Tariff (Sewerage) 2001-07 (RM)	Ave. Monthly tariff as % of Ave. Monthly Income (Sewerage)
Malaysia	3,249	5.5	0.17%

Source: JICA Study Team based on average monthly household income data in the 1999 and 2004 Household Income Surveys from the Department of Statistics.

2.3 Water and Sewerage Sector in the Sabah State Government

Water and sewerage services in Sabah are administered by the State Ministry of Infrastructure Development. There are four departments and one agency under this Ministry: namely, the Water Department, the Public Works Department, the Railway Department, the Ports and Jetties Department, and the Sabah Port Authority. The Sabah Water Department is responsible for water while the Public Works Department is responsible for sewerage services in the State.

The Sabah Water Department is responsible for providing potable water supply throughout the State from intake, treatment, and distribution to billing and collection.

The Public Works Department (Jabatan Kerja Raya in Malay or "JKR") of Sabah is responsible for planning, design, implementation, and operation and maintenance of Sabah state roads, bridges, public sewerage facilities and government buildings.

2.4 Kota Kinabalu City Hall

Sewerage management in Kota Kinabalu is undertaken by the Kota Kinabalu City Hall (Dewan Bandaraya Kota Kinabaru in Malay or "DBKK") as one of the engineering services provided for the city and includes road, drainage, and other public facilities maintenance. The DBKK allocates the budget for sewerage services management, and the budget is not independent from other services.

The Engineering Department in DBKK is responsible for providing engineering support to DBKK and is in charge of maintenance of drains, sewerage systems, solid waste management, roads, public facilities and public buildings under its jurisdiction; plan approvals; and inspections of new structures, buildings, housing and infrastructure developments within Kota Kinabalu City.

2.5 Recommendations Based on Sector Analysis Findings

(1) Further Improvement of Sewerage Enterprise Efficiency

The new framework created by the SPAN Act and WSIA is expected to improve the efficiency of water enterprises through corporatization and by allowing comparisons among water enterprises through the use of performance indicators. To enhance efficiency in the sewerage sector, it is recommended that measures such as partial outsourcing, service contracts, and other elements that promote competition be introduced. For example, competition can be generated if several private operators reinforce their capabilities by providing outsourcing services to IWK. This, in turn, will contribute to lowering O&M costs for a large number of small STPs. The above measures notwithstanding, IWK should maintain critical O&M functions to ensure service quality.

(2) Sewerage Tariff Revision

The sewerage tariff should be changed to reflect the water consumption volume that is metered by water supply operators. It is reasonable to charge in accordance with the effluent volume of each customer, since operational costs become larger as effluent volume increases. In addition, the current level of the sewerage tariff is not sufficiently high. An increase in the sewerage tariff is required to improve and maintain service quality. The tariff increase should not be implemented all at once, but rather, in stages.

(3) Increased Public Relations Activities

One of the major causes behind the resistance to pay sewerage tariffs or to raise tariff rates is the lack of knowledge among customers concerning the role and importance of sewerage services. Therefore, continuous and effective public relations activities are indispensable to improving customer understanding of sewerage services. IWK and SSD have long been engaged in valuable public relations activities. However, additional public relations activities are recommend to raise confidence in service providers and to build the comprehension and acceptance needed to achieve full cost recovery in the future.

(4) Government Portion of Sewerage Charges to Cover Lower Tariffs for Low Income Groups

Sewerage tariffs should be set to recover necessary costs in order to prevent the degradation of long-term service quality. Poverty reduction measures should be implemented by the federal government or municipal governments, distinct from sewerage services. When the tariff reduction is implemented for low income groups, the difference between regular and discounted tariffs should be covered by the federal government or municipal governments to avoid deterioration in service caused by budget shortfalls.

(5) Setting Rules for Federal Government Subsidies to IWK

In general, sewerage services do not solely provide benefits to houses connected to public sewers. Rather, indirect beneficiaries include patients without sewerage services suffering from waterborne diseases, users of groundwater, tourism, fisheries, and the agricultural industry, among others. Within such a context, it is reasonable to expect the government to pay part of the necessary costs for sewerage services. Subsidies from the Federal Government are currently provided to IWK. It is recommended that rules governing subsidies from the Ministry of Finance to IWK be created. Establishing such rules would force stricter financial management to enhance cost savings and revenue generation.

(6) Sewerage Capital Contribution to Encourage Integration and Rationalisation

The SCC is currently paid by developers that connect to the existing public STP at the rate of 1% of the developed property value. In the interests of greater integration and rationalisation of STPs in Malaysia, the SCC should be levied on developers that construct STPs within development sites without connecting to the public sewerage system. In addition, it is recommended that the SCC fund be used as an incentive to encourage the rationalisation of STPs.

(7) Measures to Increase Public Sewer Connection

The WSIA, which established the authority of SPAN to require citizens and developers to connect to the public sewer, will contribute to increasing the number of customers utilizing the public sewerage system. Even though the legislation makes connection to the public sewer mandatory, large connection costs are a major obstacle. As a result, a revolving fund to allow installment payments of initial connection costs when septic tank users connect to the public sewer line should be established. Such an installment system will alleviate the burden of one-time connection costs on customers.

CHAPTER 3 MANUAL FOR REVIEWING/EVALUATION/ PRIORITISATION OF SEWARAGE CATCHMENTS/PROJECTS

(1) Evaluation Items and Indices for Reviewing/Evaluation/Prioritising of Sewerage Catchments/Projects.

There are many aspects—socio-economic, environmental, technical, political, and financial—to consider when sewerage projects are evaluated. From among these, eleven evaluation items were selected and measured using twenty-five indices under "without project" and "with project" scenarios, as shown in **Figure 2** and described below.

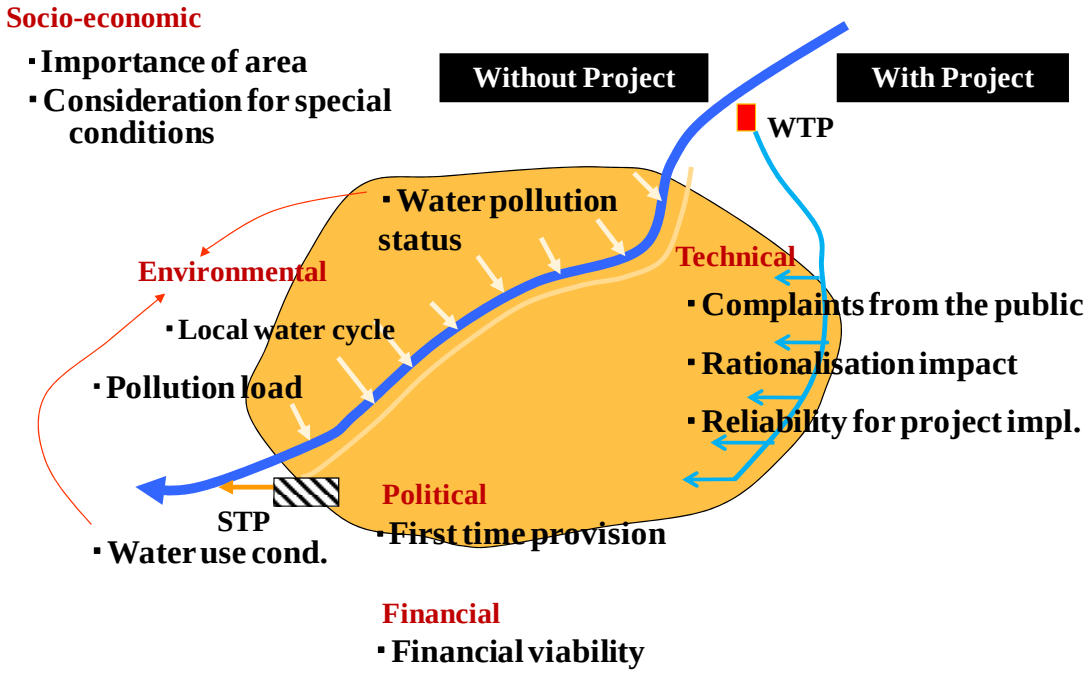


Figure 2 Evaluation Criteria for Sewerage Projects

By what indices should the respective evaluation items be measured?

1) Importance of the Area
   - Growth rate of population
   - (Planned PE per unit of sewered area)
   - Planned population
   - (Rate of commercial and industrial PE to total PE)
   - Annual hotel guests
2) Pollutant Load
   - Pollution load generated
3) Water Pollution Status of Receiving Water Body

- (Water Quality Index (WQI))
- BOD_5 SI
- NH_3-N SI

4) Complaints from the Public
   - Complaints related to existing STPs
   - No. of existing STPs
5) Water Use Condition of Receiving Water Body
   - Total water production at all downstream WTPs
   - Duration of water intake closure at all downstream WTPs
   - No. of water intakes for irrigational use
   - Recreational uses such as swimming (class II)
6) Rationalisation Impact of Existing STPs
   - Reduction of O&M manpower requirement
   - Potential connecting PE in the growth area
7) (Conservation of Local Water Cycle)
   - (Study on local water cycle)
8) First Time Works for Permanent CSTP
   - Existence of permanent CSTP
9) Reliability of Project Implementation
   - Prospective of land acquisition for STP site
10) Financial Analysis
   - NPV divided by planned PE
   - Construction cost per unit of pollution load discharged
11) Consideration for Special Conditions
   - Involvement with national projects
   - Inclusion of sludge treatment in the CSTP site
   - Extension of a discharge pipe of sewage effluent from a CSTP downstream of an intake point
   - ［Reserved］

(2) Catchment/Project

“Catchment” (or “sub-catchment”) refers to the overall plan that has been proposed for a sewerage system, while “project” refers to the implementation plan, in which part of the facility is built as laid out in the overall plan under a staged construction plan. Therefore, with the exception of facilities that small enough are to be constructed as laid out in the overall plan from the first, catchments/projects cannot be compared.

(3) Features of the Draft Manual for Reviewing/Evaluation/Prioritising of Sewerage

Catchments/Projects

The draft Manual has the following features:

1) Two weighting methods—weighting for overall balance or increased weight on special factors, such as environmental consideration, rationalisation promotion, or investment efficiency—are presented. The weighting for overall balance method is recommended as a standard for prioritising sewerage catchments/projects.

2) We propose that projects, such as island resort developments, that would be unlikely to be selected in the ordinary prioritisation process but that satisfy government policy for the acquisition of foreign currency, or projects with a high level of urgency intended to improve the natural or living environment, should be considered separately from the prioritisation process.

3) To improve the tendency that catchments/projects with higher planned PE have an advantage in the prioritisation, they are categorized into three groups based on the size of planned PE to undergo a separate prioritisation process so projects with smaller planned PE will be given a greater chance of implementation.

4) In the selection of catchments/projects for implementation, rules that require that a certain number of projects or a certain percentage of budgets be allocated to groups with low planned PE have been proposed.

5) The software developed for the prioritisation of catchments/projects can be easily customized since most values are the starting values and can be changed if necessary.

6) Although the draft Manual was developed for the purpose of setting priorities for sewerage catchments, it can also be applied to projects if the relevant data for sewage projects is given.

CHAPTER 4 REVISION OF GUIDELINES VOL. 1 PARTS B & C

Revision of Parts B and C of Guidelines Vol.1 was conducted to further improve and enhance the preparation of Sewerage Catchment Strategies. Revisions in the guideline were determined by the results of trial applications at Ipoh and Kota Kinabalu upon identification of the discrepancies within the existing Catchment Study Reports and Strategies.

Improvements or enhancements made to the revised Guidelines include the following:

(1) Summary Sheet

A summary sheet was added to describe the outline of a sewerage catchment report. The following 18 items were included in a summary sheet to provide not only catchment but also sub-catchment information.

- Title of Sewerage Catchment Strategy
- Details of STPs Planned
- Number of STPs
- Effluent Discharge Standard applied to Planned STPs
- Receiving Water Pollution Status
- Population
- PE Projection
- Connected PE
- Number of Water Intake Points
- First Works for Sewerage Provision
- Land Status on STP
- Downstream Water Use Situation (Present)
- Number of Complaints from Public on Sewerage
- BOD_5 Pollution Load
- Inclusion of Sludge Treatment
- Cost
- Project Net Present Value
- Special Considerations

(2) BOD_5 Pollution Load

The BOD_5 pollution load was introduced as an evaluation parameter to link the effect of sewerage development with catchment strategies. The following evaluation criteria were proposed.

- Total Capital Cost
- NPV
- Pollution Load Reduction
- Rationalisation Benefit
- Inclusion of Bio-solid Treatment
- Flexibility on Option
- Land Status

(3) Analytical Approach

To better analyse catchment strategies and unify the contents of a sewerage catchment strategy, an analytical approach was modified. Based on the trial studies, this analytical

approach was effective to maintain and monitor the contents of a sewerage catchment strategy.

(4) Sludge Management

To conduct quantitative analysis for sludge management, the calculation of sludge production and examples of sludge management alternatives were introduced. Trial studies indicated that sludge management alternatives were effective in quantitative evaluations and phased sludge management using sludge volume.

For sludge disposal, final disposal methods based on the characteristics of sludge either as dry bio-solid or wet sludge were introduced.

CHAPTER 5 REVISION OF GUIDELINES VOL. 4 CONCERNING SLUDGE TREATMENT AND DISPOSAL

The current version of Guidelines Vol. 4 was revised with emphasis on the following issues concerning sludge treatment and disposal:

(1) Considerations in Selection of Sludge Treatment Process

The sludge treatment process is a combination of unit processes; therefore, how to combine the unit processes, a description lacking in the existing Guidelines, is critical to facility planning. For this reason, considerations for the selection of sludge treatment processes have been added.

(2) Overall Breakdown

Overall breakdown is as follows, with an emphasis on methods to determine the number and dimensions of facilities:

- Sludge conveyance
- Sludge thickening
- Sludge digestion
- Sludge dewatering
- Sludge drying
- Sludge incineration
- Sludge reuse

(3) Introduction of Emerging Technologies

Taking into account future conditions that will be encountered in the field of sludge treatment and disposal in Malaysia, the following new technologies are introduced:

- Sludge pipeline conveyance
- Truck-mounted sludge dewatering equipment
- Sludge composting
- Sludge incineration

CHAPTER 6 RECOMMENDATIONS FOR IMPROVEMENT OF PLANNING CAPABILITY IN THE SEWERAGE SECTOR

(1) Draft Manual and Revised Guidelines

The draft Manual was prepared and applied on a trial basis to the sewerage catchments collected from the existing CSRs and LSPs as well as the report for Upper Langat Basin, while the revised Guidelines were applied in the formulation of the CSRs for Ipoh and Kota Kinabalu. In the course of such trial applications, the draft Manual and revised Guidelines were improved, but various problems were identified in the existing CSRs and LSPs. It is recommended that solutions to these problems be implemented by the Malaysian side in order to contribute to the strengthening of sewerage planning capability and to further improvements of the draft Manual and revised Guidelines.

1) The catchment strategy report must clarify the outline of each sewerage system ultimately adopted in the study.

2) DOE's water quality monitoring stations, WIPs, intake points for irrigational use and sewage effluent discharge points must be indicated on the same map during the study to allow the catchment strategy to clarify their physical relationships.

3) In most existing catchment strategy reports, the target year is set at 2020 while some reports do not reflect the results of the 2000 population census. It is strongly recommended that existing catchment strategy reports starting with areas anticipated to experience a rapid increase in population be reviewed.

4) Under the title "Population Projection", the planned PE projection only was often made with no description of planned population in the existing catchment strategy reports. The basis for the planned population must be clarified at the catchment/sub-catchment level must be clearly specified.

5) Area data on sites to be sewered is relatively disregarded in Malaysia and currently not available in many catchment strategy reports. Population and area data should always

be considered together in sewerage planning, which makes the development of new indices possible.

6) When a catchment strategy is endorsed by the relevant agencies, it is recommended that the IWK begin to arrange the existing data corresponding to the sewerage systems proposed in the study.

7) The reliability of the construction costs estimated in the reports is low since it is not clear what methods and sources were used by the consultants or planners Although the revised Guidelines recommend the collection and arrangement of construction cost data, it is important to increase the reliability of the planning content.

8) The action plan as shown in **Figure 3** has been proposed to solve the problems mentioned-above.

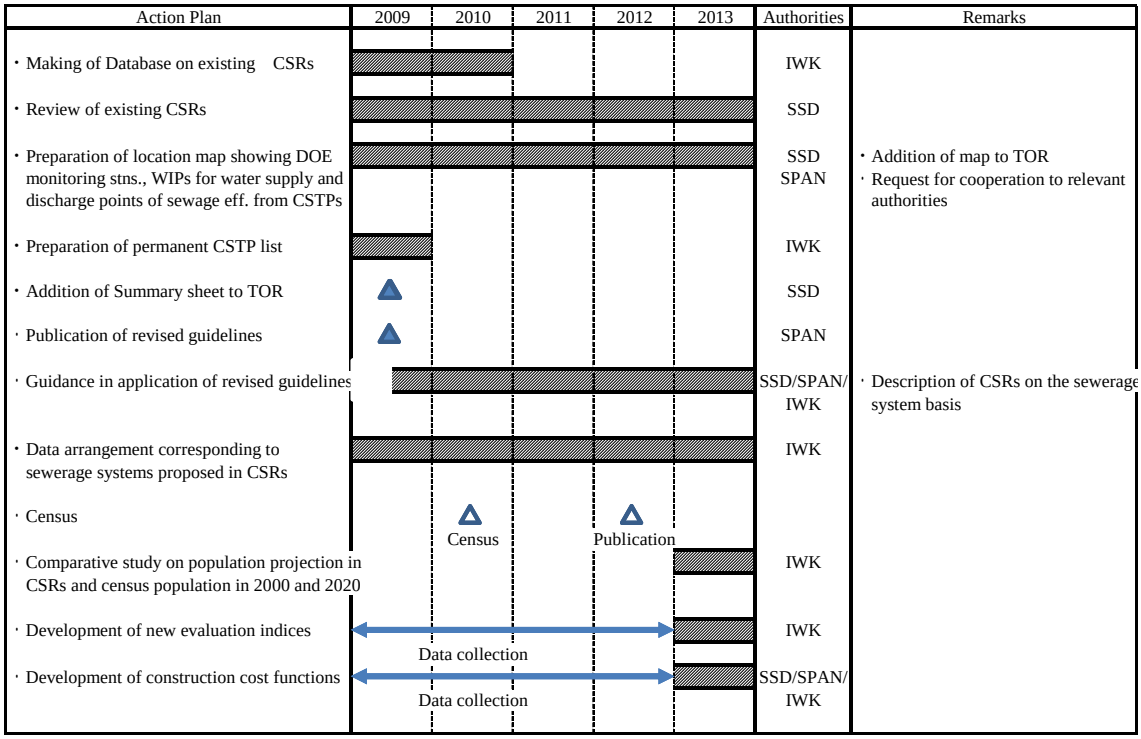


Figure 3 Action Plan for the Improvement of Planning Capability

(2) Building Institutional Capacity

A thorough analysis of the relevant organisations, including needs assessments for human and other resources, activities such as staff development, curriculum design, research and development (R&D) support, upgrading facilities, educational training, and enhancing managerial systems and skills, should be implemented.

The above initiative concerns a detailed capacity needs assessment for the sewerage sector.

The initiative should analyse not only technical but also management, legal and socio-economic knowledge gaps of agencies or institutions in the field of integrated water management. This initiative could represent a first step towards a comprehensive capacity building strategy in the Malaysian water sector.

(3) National Sewerage Development Plan and Supplementary National Sludge Management Plan

To facilitate the sewerage industry's future planning direction, it is recommended that a National Sewerage Development Plan (NSDP) that clearly defines and advocates timely "practical implementation" be developed. This document is expected to define the areas that should be sewered in the short term and middle and long term plans to meet stipulated targets and indicators. The plan indicators must be numerical targets and should be feasible and sustainable.

Similarly, the methodology for final disposal of sludge is a critical issue related to the NSMP that urgently needs to be addressed.

(4) National Sewerage Information System

The National Sewerage Information System is a vital asset for efficient and effective sewerage planning and decision making. Improvement of planning capability can only be achieved among others if relevant quantitative and qualitative information on the wastewater situation is available in a timely manner.

It is recommended that this National Sewerage Information System include population projections, mapped data showing water resource availability, the assimilative capacity of receiving waters, and problem area inventories, among others.

(5) The Green Approach

Environmental concerns and technological advances will be required in the Malaysian sewerage industries, and the Green Approach—an indication of a promising effort to ensure procurement of ecological materials and methods to work together for a sustainable recycling-based society—will also be highlighted in future sewerage system planning.

It is recommended that sewerage system plans with a view to ensuring the effects of environmental preservation be carried out at the present time to allow the early establishment of a sustainable recycling-based society. Furthermore it is important to measure and monitor environmental management efficiency through quantitative assessment parameters.

(6) Improvement of Planning Capability in Each Organisation

With the current reformation of the water sector, clear definitions of policies and the sewerage industry's directions are still required. Nevertheless, the enactment of the SPAN and WSIA Act more clearly distinguishes between the functions of institution involved.

1) Planning Section, Planning and Development Division, SSD

- Appointment of SSD officers and staff to participate in the IWK's internal training programmes
- Temporary transfer of SSD staff to the Planning and Engineering Department of IWK for at least three years

2) Catchment Planning & Control Division, Sewerage Regulatory Department, SPAN

- The current personnel assignments have been carefully thought out and are appropriate. Henceforth it will be very important to monitor the individual need for capacity building to match the progress of on-the-job training in the field.
- In addition to in-house on-the-job training, external programmes will be required to meet SPAN's detailed responsibilities. These are currently being discussed in the MEWC. An intra-committee with other SPAN divisions should be established to discuss ways to evolve programmes for capacity improvement.

3) IWK

- IWK should hold a regular meeting with staff in charge of sewerage planning from all the regional offices to discuss actual catchment strategy reports and communicate minimum requirement to the consultants.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background

In response to the official request of the Government of Malaysia, the Government of Japan has agreed to conduct the Study on Improvement of Planning Capability in Sewerage Sector in Malaysia ("the Study"), in accordance with the relevant laws and regulations of Japan.

Accordingly, the Japan International Cooperation Agency ("JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, conducted the Study in close cooperation with the relevant authorities of the Government of Malaysia for a period of twenty-four months from March 2007.

This document sets forth the Scope of Work with regard to the Study.

1.2 Objective of the Study

The objective of the Study is to improve planning capability in the sewerage sector of Malaysia.

1.3 Scope of the Study

(1) Analysis of Sewerage Sector in Malaysia

1) Legislative/Institutional Frameworks

- Suruhanjaya Perkhidmatan Air Negara (SPAN) Act 2006 and Water Services Industry Act 2006 (hereinafter referred to New acts)
- Clarification of the division of the roles between SPAN and SSD, Indah Water Konsortium Sdn. Bhd. (IWK), local authorities, developers
- Issues of SPAN and SSD, other related organisations on new acts
- Capacity assessments of SSD, in particular planning capability, and SPAN, IWK, local authorities
- Financial management analysis including operation & maintenance cost
- Catchment strategies/plans
- Guideline for developers
- Other related legislations/organisations

2) Existing Sewerage Systems, Including Networks, Treatment Facilities and Sludge Management

3) Other Related Data and Information for Sewerage Sector
4) Related Data and Information for Water Pollution

(2) Formulation of Manual for Reviewing/Evaluation/Prioritising of Catchment Strategies/Plans and Sewerage Projects in the Catchment Plan

1) Review of existing reviewing/evaluation/prioritising system
2) Formulating draft manual fur the use of the authorities concerned to evaluate/review/prioritise catchment strategies/plans and sewerage projects in the catchment plans including the consideration of prioritisation and centralization and mechanism/procedure on private and governmental sectors investment in sewerage development.(after the trial application mentioned in IV, this manual will be finalized.)

(3) Revision of "Guidelines for Developers"

1) Overall review of Guideline vol.1, including the consideration of prioritisation and centralization, and mechanism/procedure on private and governmental sectors investment in sewerage development, and appropriate sludge management.
2) Formulation of draft revised Guideline vol. 1 for trial application (after the trial application mentioned in IV, it will be finalized)
3) Revision of Guideline vol. 4 to incorporate appropriate sludge processing

(4) Trial Application of the Draft Manual/Revised Guideline (Vol. 1) mentioned in II and III

1) Select/confirm the model areas for trial application
2) Analysis of existing catchment plan/strategy and/or relevant plans in the model areas
3) Analysis of present conditions in model areas
4) Carrying out environmental and social considerations study according to JICA guidelines for environmental and social considerations (Initial Environmental Examination (lEE) level)
5) Revision of existing catchment strategy/plan in the model area by using draft revised Guideline Vol. l.
6) Formulation of new catchment plan in model area by using the draft revised Guideline Vol. 1.
7) Trial use of the draft manual for reviewing/evaluating/prioritising the new/revised catchment strategies/plans
8) Finalizing the manual/revised Guideline (Vol. l) based on the trial results

(5) Recommendations on planning capability development of sewerage sector in Malaysia

1.4 Formation of the Study

1.4.1 General

The Study was carried out in accordance with the Scope of Work agreed upon between the MEWC and JICA on the 20th day of December 2006. The Sewerage Services Department （"SSD"） organised the steering committee and counterpart team, and carried out the Study in close cooperation with the Study Team. The overall set-up for the implementation of the Study is as shown in **Figure 1.1**.

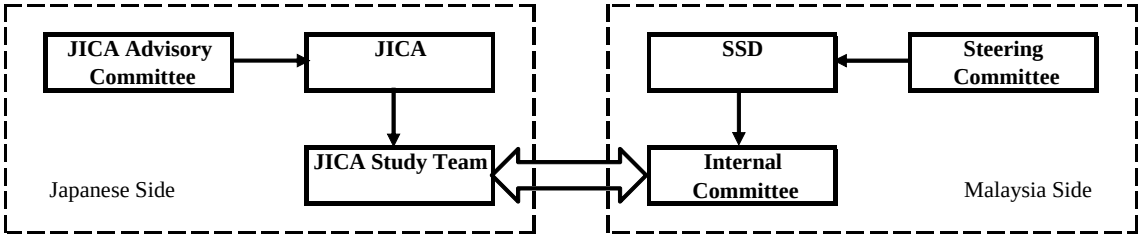


Figure 1.4.1 Implementation Set-up of the Study

1.4.2 Implementation Set-up of the Japanese Side

The implementation set-up of the Japanese side consisted of the Study Team and the Advisory Committee under the general supervision of the JICA headquarters.

The composition of the JICA Advisory Committee is shown below.

Ms. Hiroko Kamata	Chairperson	Institute for International Cooperation, JICA
Mr. Osamu Fujiki	Member	Head, Water Quality Control Department, National Institute for Land and Infrastructure Management (NILIM)

The composition of the Study Team is shown below.

Mr. Ikuo Miwa	Team leader, sewerage policy and legislation	NJS

	& institutions	
Mr. Tadao Funamoto	Sector analysis and capacity development	NJS
Mr. Tetsuo Wada	Sewerage planning, evaluation and environmental & social considerations	NSC
Mr. Daizo Iwata	Financial programmeming, organisation and business management	NSC
Mr. Satoshi Oniki	Project coordination	NJS
Mr. Atsushi Toyama	Project coordination	NJS

NJS: NJS Consultants Co., Ltd.

NSC: Nihon Suido Consultants Co., Ltd

1.4.3 Implementation Set-up of the Malaysian Side

The implementation set-up of the Malaysian side consisted of SSD, SPAN and IWK counterpart personnel and the Steering Committee for the Study composed of representatives from the relevant authorities. Overall coordination of the Steering Committee was handled by the SSD.

The Steering Committee was organised by the following representatives of relevant authorities.

Tn Hj. Mohd Akhir Bin Md Jiwa	Director General, Sewerage Services Department (SSD), MEWC
Dr. Haji Md Nasir Bin Md Noh	Director General, Department of Irrigation and Drainage (DID)
Mr. Lee Choong Min	Director General, Department of Environment (DOE)
Ir. Md Redzuan b. Husin	Senior Engineer, Economic Planning Unit (EPU)
Mr. Nor hashim Baron	Catchment Planning & Control Division, SPAN
Ir. Dorai Narayana	Head, Planning Services Section, IWK
Mr. Jack Lo	Engineer, Kota Kinabalu City Hall (DBKK)
Ms. Noriko Suzuki	Chief Representative, JICA Malaysia Office

The Internal Committee consisted of the following representatives from relevant authorities:

Tn Hj. Mohd Akhir Bin Md Jiwa	Director General, Sewerage Services Department (SSD), MEWC

Tn Hj. Ahmad Nazari Bin Hj. Md. Nor	Director, Planning Division, SSD
Mr. Mustafa Kanmal Bin Yed	Assistant Director, Planning Division, SSD
Ir. Mohd Shukri Bin Abdul Razik	Director, Catchment Planning & Control Division, SPAN
Mr. Nor hashim Baron	Catchment Planning & Control Division, SPAN
Mr. Dorai Narayana	Head, Planning Services Section, IWK

CHAPTER 2

SECTOR ANALYSIS REPORT

CHAPTER 2 SECTOR ANALYSIS REPORT

2.1 Background of Water Supply and Sewerage Sectors in Malaysia

2.1.1 Water Supply Sector

Prior to the Constitutional Amendments in January 2005, water services were solely a state matter, and the state governments established different types of water supply organisations. The types of water supply organisations are as shown in **Table 2.1.1**. However, in the Special sitting of Parliament in January 2005, Parliament approved the amendments to the Ninth Schedule to transfer water supplies and services (excluding water resources) from the State List to the Concurrent List (except for Sabah and Sarawak). It also amended the Tenth Schedule whereby revenue from water supplies and services, which was assigned to the States, would now be assigned to the Federal Government, again with the exception of Sabah and Sarawak.

These amendments received Royal Assent on February 4, 2005 and were published in the Gazette on February 10, 2005. The date of enforcement was fixed on March 21, 2005. With the approved amendments, the Federal Government was seen to regulate the water services industry in terms of licensing and regulating water operators. The ownership and control of rivers and canals and water still remain with the States.

As of now, some states have fully privatized or corporatized their water supply services while some states have privatized the operation and maintenance of water treatment plants. The privatization is executed through concession agreements. In addition, the water tariffs differ from state to state, and most states experience high non-revenue water (NRW).

Table 2.1.1 Types of Water Supply Organisations in Malaysia before January 2005

Types	Water Supply Areas
1 State Public Works Department	Kedah, Perlis, Sarawak (excluding Kuching, Sibu and Northern Sarawak)
2 State Water Supply Department	Negeri Sembilan, Sabah, Pahang, Labuan
3 State Water Supply Board	Melaka, Perak, Kuching, Sibu
4 Corporatized Company	Terengganu, Laku (covering Miri, Bintulu, Limbang in Sarawak
5 Privatized Company	Penang, Kelantan, Johor, Selangor (including Kuala Lumpur and Putrajaya)

2.1.2 Sewerage Sector

Sewage has been identified by the Malaysian Department of Environment (DOE) as one of the major pollutants of water bodies. Cities, towns and other urban centres are major polluters of the aquatic environment with sewage and municipal wastewater, industrial effluent and polluted surface runoffs. Reliable and efficient sewerage systems contribute greatly to protecting the

nation's public health, preserving its water resources, enhancing environmental quality leading to long-term sustainability of the water supply and sewerage services industry.

The Sewerage Services Department (SSD) was established in March 1994 under the Ministry of Housing and Local Government after the establishment of the Sewerage Services Act of 1993 and privatization of sewerage services in West Malaysia. The nation's sewerage privatization project involved the transfer of thousands of treatment plants and other facilities from 145 local authorities (at the time of signing the concession agreement) to the Federal Government. Indah Water Konsortium Sdn Bhd (IWK) became the single concessionaire and was given the responsibility to operate and manage all public sewerage systems. SSD as the regulatory body, governs IWK and ensures that IWK fulfils its obligations in accordance with the concession agreement.

In 2004, major changes took place with the restructuring of the Malaysian Cabinet. The function of water services (water and sewerage) was transferred to the newly established Ministry of Energy, Water and Communications (MEWC). Previously, water services were under the purview of the Ministry of Public Works while sewerage services were under the Ministry of Housing and Local Government. Currently, MEWC regulates and supervises all the national utility sectors, namely energy, water, sewerage and telecommunications.

2.1.3 Water Services Industry Reform

The Water Service Industry Bill and the National Water Services Commission Bill were passed by the Malaysian Parliament in May 2006. With passage of the bills, the Water Services Industry Act (WSIA 2006/Act 655) and Suruhanjaya Perkhidmatan Air Nasional Act (SPAN Act/Act 654) were enacted into law, and this signalled the start of the water services industry reform.

The main purposes for the restructuring of the industry were:

- to enable the Federal Government to assume control and regulation of water supply and sewerage services from the States;
- to ensure that water supply and sewerage services would be jointly regulated;
- to set up certifying agencies that would approve plans, certify contractors and monitor compliance with subsidiary legislation;
- to license all water industry players that treat and distribute water, and own facilities;
- to enable current concession holders to migrate to the licensing system through re-negotiation of their existing agreements with the Commission within a specific period of time (while concession holders that do not migrate forfeit their participation rights upon expiration of their concession agreement periods); and
- to set targets for service providers with respect to non-revenue water, handling of

consumers, and compliance with water quality requirements, among others.

The WSIA 2006 also offered possible resolution to certain critical issues for the sewerage industry such as billing and collection, refusal of individual septic tank desludging service and the maintenance of private sewage treatment plants. In the foreseeable future, three different forms of entities may emerge in this sector: (i) the water and sewerage services company, (ii) water (only) services company and (iii) sewerage (only) services company.

2.1.4 Water and Sewerage-related Organisations and their Roles and Relationships

With the recent restructuring of the industry (after WSIA and SPAN Acts), the roles of the organisations involved in water and sewerage were further redefined. A summary of the key roles is shown in **Table 2.1.2**.

Table 2.1.2 Key Roles of Water and Sewerage-related Organisations

Organisations	Key roles	Role description
Ministry of Energy, Water and Communication (MEWC) 1. WSS 2. SSD (Sewerage Services Department - JPP) 3. SPAN	1. Policy matters 2. Project implementation matters 3. Regulatory matters	1. Develops holistic water policy for the country. Sets general policy directions. 2. Manages all government-funded capital projects. 3. Regulates the whole water industry based on the policy directions set out by the Federal Government.
State Governments	Water basin matters	Manages existing water basins with the view to protecting the quality of raw water and identifying new water basins when and where required.
WAMCO (Water Asset Management Company - PAAB)	Funding and facility management matters	Raises funds for the takeover of all existing assets and implementation of new assets. Intent to own all the assets but with transfer to occur in stages and based on viability.
IWK	National sewerage concessionaire	Operations and maintenance of sewerage facilities within control area. Provision of technical advisory to Government related agencies, eg; SSD, SPAN and etc
Other agencies (Typically Government and Non Governmental agencies that are involved in the water and sewerage industry within their capacities as facility managers or service providers, such as Syabas, Syarikat Air Kelantan, SAJ, and etc)	Operation and maintenance of water and sewerage facilities	Operation and maintenance of water and/or sewerage facilities within respective control areas and stipulated agreements.

2.2 Ministry of Energy, Water and Communications (MEWC)

(1) Roles

The focus on the role of MEWC in this Study is confined solely to the Sewerage Services Department (SSD) and the Water Sector (WS). SSD is responsible for the sewerage sector only while WS is involved in both the sewerage and water sectors. With reference to the sewerage sector, SSD currently operates in accordance with the Sewerage Services Act 1993 (SSA 1993/Act 508). The WS, which currently is not actively involved in the sewerage sector, is expected to have a role on the future development of the sewerage industry, especially in policy settings. Though SPAN is also under the purview of the Minister of MEWC, it is regarded as an independent agency with the enactment of the SPAN Act and is addressed separately later in this document.

(2) Organisation of MEWC

The organisation chart of MEWC is shown as **Figure 2.2.1**.

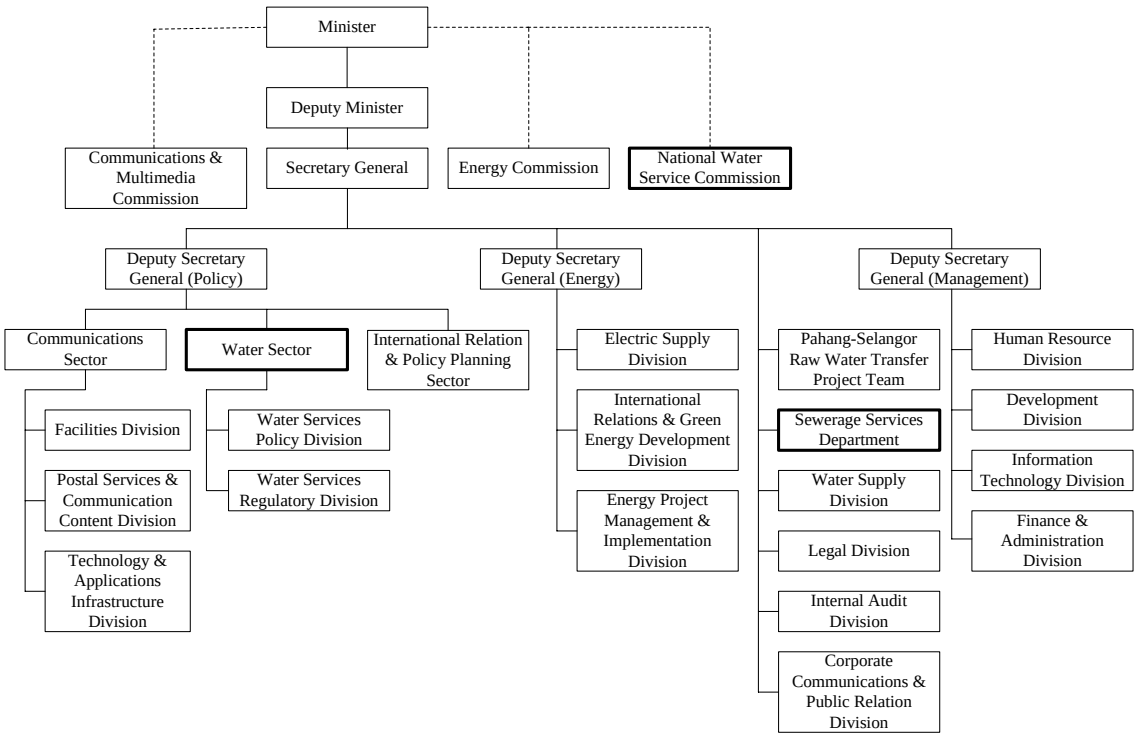


Figure 2.2.1 Organisation Structure of the Ministry of Energy, Water and Communications (As of October 2008)

2.2.1 Sewerage Services Department (SSD)

(1) Roles

The Sewerage Services Department is one of the major departments in MEWC and is responsible for planning, constructing and managing sewerage infrastructure. The department

is headed by a Director General, and is comprised of three divisions, seven sections, six branch offices and four units, as shown in the **Figure 2.2.2** (Please note that this is only a proposed organisation structure and was still pending approval by the Public Services Department as of November 2008).

As of August 2008, SSD had filled a total of 132 staff positions of the 219 planned positions. This was due to the current transition of functions between SSD and SPAN and budget limitations. Thus, SSD relies heavily on IWK's assistance in carrying out the planning and project implementation tasks, among others. This reliance on IWK is also attributed to the existence of vast amounts of accumulated information, data, knowledge and experience within IWK as the national sewerage concessionaire. It is pertinent to note this issue when considering the improvement of national sewerage planning.

(2) Organisation of SSD

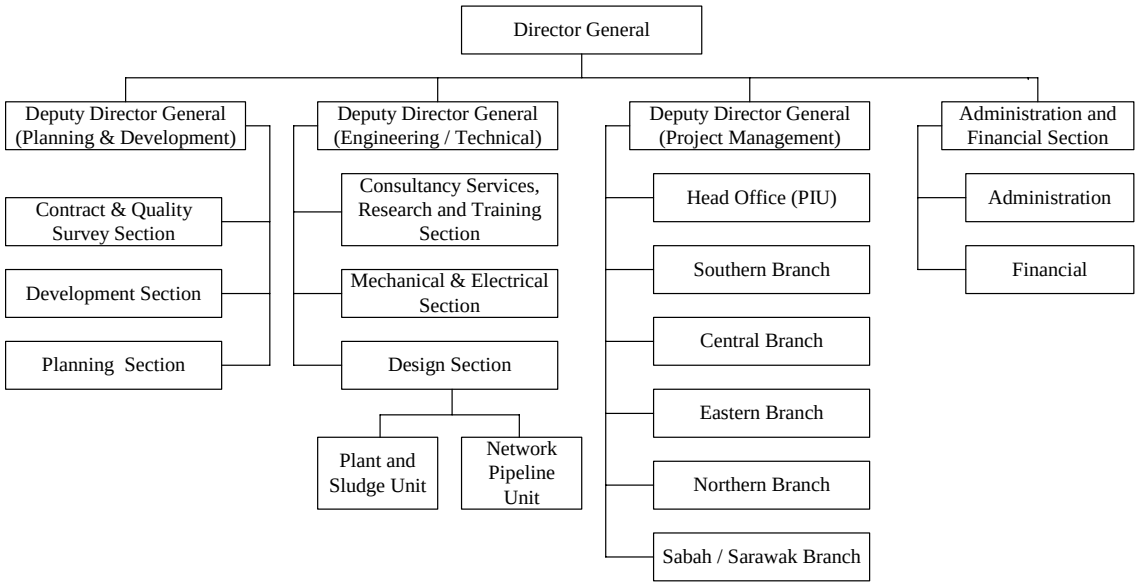


Figure 2.2.2 Proposed Organisation Structure of the Sewerage Services Department (As of November 2008)

The scope of the responsibilities of SSD's respective divisions and its sections, branch offices or units is as follows:

1) Planning and Development Division

The Planning and Development Division is headed by a Deputy Director General and is responsible for the planning and development of sewerage infrastructure. This division is also in charge of reviewing the catchment strategies/plans that have been previously carried out by the Planning Service Section of IWK, in addition to initiating the preparation of new catchment strategies/plans.

In this context, this division has started to conduct and manage the preparation of the

following five catchment strategies/plans: (i) Iskandar (Wilayah Penbangunan Iskandar (WPI), Johor; (ii) Upper Langat, Selangor; (iii) Cameron Highland, Tapah, Pahang; (iv) Pulau Pinang Barat Dan Selatan, Pulau Pinang; and (v) Lower Kerayong, Kuala Lumpur.

This division's functions are distributed and carried out by three main sections. They are the:

(a) Planning Section;
(b) Development Section; and
(c) Contract and Quantity Survey Section

(a) Planning Section

The Planning Section is comprised of two units with the following responsibilities:

i) Research and Strategic Units

- To verify all the national sewerage catchment studies
- To facilitate the appointment of project management consultants, project consultants and land surveyors
- To arrange the implementation of national sewerage projects
- To deal with state authorities, town and city planning department and local authorities within the capacity of a government advisory committee member
- To manage and facilitate the preparation of the national sewerage master plan
- To prepare the yearly expenditure and creation of the Malaysia Plan for sewerage projects
- To facilitate the preparation of all sewerage projects' EIA and approvals from DOE
- To review all short-term and long-term national sewerage systems

ii) Asset, Land and GIS Management Unit

- To manage all land acquisition activities under the 1960 Land Acquisition Act and National Land Ordinances
- To manage the reservation of plant site with all land departments and municipalities within the nation
- To manage the temporary leasing of plant sites that have not been utilized
- To update the Department's records of assets, such as plants, pump stations, networks and sewerage reserves
- To establish a computerized sewerage asset database
- To manage community awareness programmes with regards to importance of sewerage systems
- To manage all sewerage information system within a database

- To review SSD's policy development and asset management procedures

(b) Development Section

This section's responsibilities are as follows:

- To identify needs and importance of new sewerage projects development based on Sewerage Catchment Studies and request for upgrading of existing sewerage systems
- To prepare, verify and update the appropriations estimates of the Five-Year Malaysia Plan
- To prepare, verify and update yearly appropriations estimates
- To prepare, verify and update the appropriations estimates of the Five-Year Malaysia Plan (midterm review)
- To prepare and update financial and physical development reports
- To verify cash flow and project costs
- To facilitate the review of any alterations to the scope of development projects
- To plan and facilitate all studies related to planning and design for the purposes of seeking and identifying improvements
- To facilitate each request for upgrading of plants and networks to ensure compliance to policies and procedures set by SSD
- To streamline coordination meetings and monitoring of new projects at the stage of construction
- To facilitate between relevant contractors, consultants, departments and divisions for solutions to technical, social and environmental problems
- To manage and provide briefings and explanations to SSD staff, government agencies, and local authorities related to planning and implementation of sewerage projects under SSD's purview

(c) Contract and Quantity Survey Section

This section is comprised of two units with the following responsibilities:

i) Cost and Procurement Unit

- To study and analyse the construction and operations and maintenance costs of sewerage projects
- To prepare initial project cost estimates and a feasibility study for a "Sewerage Cost Information Centre" for existing cost data to be prepared as a reference material
- To serve as a reference centre for the implementation of sewerage projects
- To manage the processes for tender procurement and requests for proposal

- To align quantity surveys, work specifications, tender documents, and contract documents
- To appoint consultants
- To evaluate requests for proposal and bid books A (20 million RM or more) and B (less than 20 million RM)
- To appoint quantity surveyors, administer contract claims and negotiate contract costs

ii) Administration and Contract Monitoring Unit

- To carry out cost negotiations and prepare contract terms and evaluation reports
- To monitor compliance with terms of contract during project implementation

2) Engineering Services Division

The division is headed by a Deputy Director General, and its functions are distributed among and carried out by three main sections. They are the:

(a) Consultancy Services, Research and Training Section;
(b) Mechanical and Electrical Section; and
(c) Design Section

(a) Consultancy Services, Research and Training Section

This section's responsibilities are as follows:

- To provide technical advisory to the Ministry with respect to the creation, implementation, monitoring and evaluation of sewerage services industry policy.
- To advice the Ministry on technical aspects of planning, supervision and facilitation of policy implementation mechanisms and programmes related to the sewerage industry
- To coordinate and facilitate two way communications between various parties within the local and international sewerage industry
- To advise the Ministry in preparing implementation mechanisms and monitoring of sewerage development projects
- To provide technical advisory to the Ministry in organising the restructuring of the sewerage services industry through enforcement of WASIA Act and Methodology & Licensing Rules, SPAN operation strengthening and the establishment of subsidiary laws

- To provide technical input to the Ministry in setting the sewerage industry's way forward and the takeover of sewerage services management in Kelantan, Johor Bharu and Pasir Gudang
- To advise and provide technical input in the study of sewerage tariff setting mechanisms by SPAN as requested from time to time by licensees
- To assist the Ministry in monitoring development and the level of enforcement of IPA 2006 Act by SPAN, especially within the sewerage sector
- To represent the Department in International Seminars and Symposiums, which requires specific explanation and expertise regarding the design and construction of sewage treatment plants and sewerage systems
- To identify appropriate courses and trainings for officers and staff to improve their skill and knowledge
- To identify and create technical training modules related to the sewerage industry and coordination with accreditation agencies
- To facilitate and prepare the evaluation panel's term of reference for acknowledgement of courses/trainings for the sewerage industry
- To facilitate and create PTK examination questions for SSD's "closed jobs" (technical jobs) including technicians, assistant technicians and Engineer Grade J41
- To facilitate PTK courses together with KTAK's Human Resources Division for Management Officers and SSD Professionals (closed jobs) for J44 and above
- To prepare and implement technical training programmes for all levels of SSD staff
- To plan, facilitate and prepare monthly reports and SSD bulletins
- To manage, facilitate and complete departmental annual statistics report and sewerage sector annual report
- To facilitate and prepare concise and accurate answers to questions raised in Parliament and the National Assembly within the time allocated
- To facilitate the timely updating of the SSD website
- To facilitate, distribute and monitor departmental IT equipment and merchandise
- To facilitate and monitor complaints received relating to sewerage systems and SSD development projects
- To facilitate and establish networks and communication with all Education Institutions and Universities in preparation for training modules and expertise in sewerage

(b) Mechanical and Electrical Section

This section's responsibilities are as follows:

- To design an M&E services system
- To manage tender quotation processes and M&E services procurement
- To supervise, facilitate and monitor all construction activities
- To manage M&E testing and commissioning services
- To facilitate and monitor all operation and maintenance of plants given to operators
- To review technical proposals including changes to design and equipment forwarded by suppliers, contractors and plant operators

(c) Design Section

This section comprises of tow units with the following responsibilities:

i) Network Pipeline Design Unit

Pre-Construction stage for in-house designed sewerage projects

- To receive and review project briefs from SSD's Planning Division; prepare preliminary and detailed designs, detailed calculations and detailed design confirmations; and prepare of design drawings and specifications for tender table documents and contract documents
- To prepare project cost estimates and manage tender calling and tender evaluations in cooperation with the Contract and Quantity Survey Division
- To prepare design manuals, specifications and standard drawings for SSD projects
- To manage the Resource Centre and provide infrastructure for the Design Division (Hardware and Software)
- To carry out design audits during construction, to ensure that work on site is carried out in compliance with designs and specifications as highlighted in contract documents
- To prepare "as built" drawings and ensure that drawings may be completed within three months upon issuance of the "Certificate of Practical Completion" by SSD
- Administration of all types of documents, including design reports, design calculations and technical reports related to national sewerage projects, to ensure that the documents are recorded, stored, controlled and easily accessible

Pre-Construction stage for sewerage projects designed by consulting engineer/PMC

- To prepare Term of Reference ("TOR") for appointment of surveyors and consulting engineers (for projects that require consultancy services for either design or construction supervision or both).

- To verify tender documents, needs statements, and request for proposal documents
- To manage, coordinate and review project design inputs for outsourced national sewerage projects built via conventional, design and build, or turnkey methods
- To prepare reports and comments related designs by Consultants in the pre-contract stage
- To manage technical aspects of projects such as surveys, EIA studies, and SIA, among others
- To prepare reports and comments related designs by Consultants in the pre-contract stage
- To provide technical assistance related to design for issues that arise during the construction stage
- To carry out design audit during construction to ensure that work on site is carried out in compliance with designs and specifications as highlighted in contract documents

ii) Plant and Sludge Design Unit

Pre-Construction stage for in-house designed sewerage projects

- To receive and review project briefs from SSD's Planning Division and manage all matters related to land acquisition and appointment of surveyors
- To prepare preliminary and detailed designs, detailed calculations and detailed design confirmation and to prepare design drawings and specifications for tender table documents and contract documents
- To prepare project cost estimates and manage tender calling and tender evaluations in cooperation with the Contract and Quantity Survey Division
- To serve as the tender/request for proposal committee member and secretariat of the Consultant Technology and Cost Evaluation Committee
- To prepare design manuals, specifications and standard drawings for SSD projects
- To manage the Resource Centre and provide infrastructure for the Design Division (Hardware and Software)
- To conduct design audits during construction to ensure that work on site is carried out in compliance with designs and specifications as highlighted in contract documents
- To prepare "as built" drawings and ensure that drawings may be completed within three months upon issuance of the "Certificate of Practical Completion" by SSD

- Administration of all types of documents, including design reports, design calculations and technical reports related to national sewerage projects, to ensure that the documents are recorded, stored, controlled and easily accessible

Pre-Construction stage for sewerage projects designed by consulting engineer/PMC

- To prepare Term of Reference ("TOR") for appointment of surveyors and consulting engineers (for projects that require consultancy services for either design or construction supervision or both)
- To serve as the secretariat of Consultant Technology and Cost Evaluation Committee for appointment of consultants and to review terms of agreement for consultant appointments prior to execution of agreement by senior management
- To verify tender documents, needs statements and request for proposal documents
- To manage, coordinate and review project design inputs for outsourced national sewerage projects built via conventional, design and build, or turnkey methods
- To prepare reports and comments related designs by Consultants in the pre-contract stage
- To provide tender briefings during site visits, conduct technical assessments of participating contractors, and prepare technical assessment reports for review by the Tender Procurement Committee
- To manage technical aspects of projects such as survey, EIA studies, and SIA, among others
- To manage payments to consultants, surveyors, and others during the pre-tender stage
- To provide technical assistance related to design for issues that arise during the construction stage
- To conduct design audits during construction to ensure that work on site is carried out in compliance with designs and specifications as highlighted in contract documents

3) Project Management Division

This is division is headed by a Deputy Director General and is responsible for all matters related to project implementation. Division functions are distributed among and conducted by five other branch offices, as distinct from the Head Office. The branch offices are as shown in **Figure 2.2.3**.

Figure 2.2.3 Jurisdiction of SSD Regional Offices

(a) Head Office
(b) Southern Office
(c) Central Office
(d) Northern Office
(e) Eastern Office
(f) Sabah/Sarawak Office

(a) Head Office

- To plan and manage programmes for rationalisation, refurbishment, sewage treatment plant upgrades and connection to public sewerage networks
- To facilitate, manage, monitor and control the sewerage project implementation programme for territorial development projects and Malaysia Plan projects in Sabah and Sarawak

The following duties are also common to southern, central, northern, eastern regional offices:

- To establish a quality management system to ensure that construction meets tender specifications and completion dates
- To systematically manage cost, expenditures and cash flow for project implementation
- Obtain authorization for pre-payments interim payments for project implementation
- To conduct technical and quality audits in combination with contract compliance audits
- To prepare documents confirming delays and extensions, completion, and remediation
- To test and commission completed sewerage systems

- To facilitate and manage the receipt, takeover and surrender of sewerage system projects certified and surrendered to asset management company
- To monitor and maintain sewerage system asset inventory within the following categories: under construction, completed construction, planned construction, planned rationalisation, planned upgrade, refurbishment required, and connection to public sewerage network via computerized recording system
- To handle issues, complaints, and grievances from residents with regards to sewerage system project implementation

(b) Southern Office

- To coordinate with HQ in providing technical input related to requirements for rationalisation, refurbishment, sewage treatment plant upgrades and connection to public sewerage networks for the states of Melaka, Negeri Sembilan and Johor
- To facilitate, manage, monitor and control the sewerage project implementation programme of Malaysia Plan projects in Melaka, Negeri Sembilan and Johor

(c) Central Office

- To coordinate with HQ in providing technical input related to requirements for rationalisation, refurbishment, sewage treatment plant upgrades and connection to public sewerage networks for the states of Selangor, Federal Territories Kuala Lumpur, Putrajaya and Labuan
- To facilitate, manage, monitor and control the sewerage project implementation programme of Malaysia Plan projects in Selangor, Federal Territories Kuala Lumpur, Putrajaya and Labuan

(d) Northern Office

- To coordinate with HQ in providing technical input related to requirements of rationalisation, refurbishment, sewage treatment plant upgrades and connection to public sewerage networks for the states of Penang, Perak, Kedah and Perlis
- To facilitate, manage, monitor and control the sewerage project implementation programme of Malaysia Plan projects in Penang, Perak, Kedah and Perlis

(e) Eastern Office

- To coordinate with HQ in providing technical inputs related to requirements of rationalisation, refurbishment, sewage treatment plant upgrades and connection to public sewerage networks for the states of Terengganu, Kelantan and Pahang

- To facilitate, manage, monitor and control the sewerage project implementation programme of Malaysia Plan projects in Terengganu, Kelantan and Pahang

(f) Sabah/Sarawak Office

- To verify loan applications for sewerage project implementation as proposed by Sabah and Sarawak State Governments
- To verify loan drawdown applications as proposed by Sabah and Sarawak State Governments
- To prepare, verify and update Five-Year Malaysia Plan appropriations verification (midterm review)
- To prepare, verify and update the annual appropriations verification (midterm review)
- To monitor physical and financial progress of implementation by Sabah and Sarawak State Governments
- To prepare and update physical and financial progress of development
- To facilitate verification of any changes to scopes of work of development projects
- To serve as the technical committee member for sewerage projects to be implemented

4) Administration and Finance Section

This section is directly under the purview of the Director General and is expected to handle all matters related to the department's administration and financial needs. Its functions are distributed between and carried out by two sub-sections. They are the:

(a) Administration Sub-section; and
(b) Finance Sub-section

(a) Administration Sub-section

This sub-section is comprised of two units with the following responsibilities:

i) Human Resources Unit

- To manage issues related to staffing and services
- To manage and enforce the department's rules and regulations
- To study, conduct and manage the department's staff training to improve the Department's performance and capabilities
- To study and analise the suitability of officer appointments
- To manage and facilitate department personnel involvement in conferences, seminars and courses conducted by the Ministry or the private sector
- To manage induction course and department's job promotion

- To implement and manage issues related to the Human Resources Development panel
- To plan and manage training to improve performance and capabilities
- To manage issues related to management efficiency and administration, as well as department counselling services

ii) Management and Administration Unit

- To manage departmental records, files, letters and utility bills
- To supervise departmental building cleaning, security, maintenance and logistical services
- To manage departmental building and store rental
- To manage government loan facilities such as housing, vehicle and computer loans
- To manage departmental purchase and maintenance of vehicles, furniture and equipment
- To plan, supervise and support the department's quality programme
- To facilitate responses and report to Cabinet and important meeting memoranda and notes
- To manage and facilitate official functions and official visits of foreign and local delegates
- To manage departmental annual reports, brochures, pamphlets, books, magazines, journals, CDs, and audio visuals, among others

(b) Finance Sub-section

This sub-section is comprised of two units with the following responsibilities:

i) Payment Management Unit

- To manage departmental expenditures
- To process claims
- To manage procurement
- To maintain and verify expenditure records and financial reports
- To manage departmental payroll
- To manage inventory and asset disposal processes
- To support budget preparation

ii) Revenue and Development Unit

- To manage development expenditure receipts and payments from Government appropriations sources and concession company
- To manage revenue receipts of various income
- To manage interim payments of related projects

- To monitor performance of development expenditures to ensure achievement of intended objectives
- To support working paper preparation for budget and development projects

(3) Financial Aspects

The fiscal year of the Government of Malaysia starts in January and ends in December. The budget of the Ministry is closed on the 31st of December every year. **Table 2.2.1** shows the budget of MEWC for the last three years. This table covers only the figures from the year 2004 because SSD was under the Ministry of Housing and Local Government until the year 2003. The operating budget is used for the general office activities, including staff salaries, office rental fees, utility costs for office buildings, and office equipment. On the other hand, the development budget is used for the implementation of projects, such as new capital project construction and upgrading and refurbishment of existing sewage treatment facilities.

Approximately 54% to 58% of the total development budgets (appropriations) from 2004 to 2006 were allocated to the Water Supply Division. Approximately 22% to 34% of this was allocated to SSD while 11% to 12.5% was allocated to the Sabah Electricity Board. The rest of the development budget (7% to 8%) was allocated to the Communications, Energy, Information Technology, and Water Services divisions.

Table 2.2.1 Annual Budget and Expenditures of MEWC

(Unit: ×1,000 RM)

			2004	2005	2006
MEWC	Operating expenses	Appropriations	82,291	68,299	72,401
		Expenditure	72,999	65,453	72,457
	Development expenses	Appropriations	1,764,286	2,054,925	2,876,785
		Expenditure	1,001,467	1,693,374	2,478,200

Source: Annual Report 2005 & 2006, The Ministry of Energy, Water and Communications
Notes: On March 2004, water supply and sewerage services were transferred from the Min. of Public Works and Min. of Housing and Local Government.

With respect to the sewerage sector, the total project budget (development expenses) was set in the Five-Year Malaysia Plan and the appropriations were made to SSD and MEWC. The ceiling on total sewerage appropriations is RM 3,112.835 million for the period of the 9th Malaysia Plan (2006-2010), which includes the JBIC project (approximately RM 1,375.027 million). Part of the development expenses have been secured for the sewerage project in Sabah and Sarawak states, and the disbursement was initiated in 2008. With respect to Sabah and Sarawak, financial support from the Federal government must be provided in the form of loans, since the state government bears responsibility for sewerage service.

Table 2.2.2 shows the annual expenditures for the last three years by SSD for operations and development. In 2006, operating expenditures were RM 4.5 million for staff salaries, RM 2.5 million for office rental fees, and RM 0.7 million for office utility charges and equipment costs.

Table 2.2.2 Annual SSD Expenditures

(Unit: ×1,000 RM)

		2004	2005	2006
SSD	Operating expenses	4,043	8,215	9,452
	Development expenses	377,328	426,819	991,608

Source: Annual Report 2005 & 2006, Ministry of Energy, Water and Communications.

Figure 2.2.4 shows changes in development expenses for the JBIC fund and the non-JBIC fund. With respect to the JBIC fund, SSD receives the budget from MEWC without loan repayment obligations where the Federal Government bears the burden of loan repayments. The Project Management Division engages in the implementation of JBIC-funded and non-JBIC funded projects. Non-JBIC projects cover four components: i) the construction of sewage treatment plants and sewerage pipe networks, ii) the refurbishment and upgrading of existing sewage treatment plants, iii) the acquisition of land to be used as sites for sewerage systems, and iv) carrying out other related work such as investigations and studies.

The reimbursement for JBIC-funded construction projects has been carried out since 2004, contributing to the expansion of capital expenditures for sewerage infrastructure improvement in Malaysia.

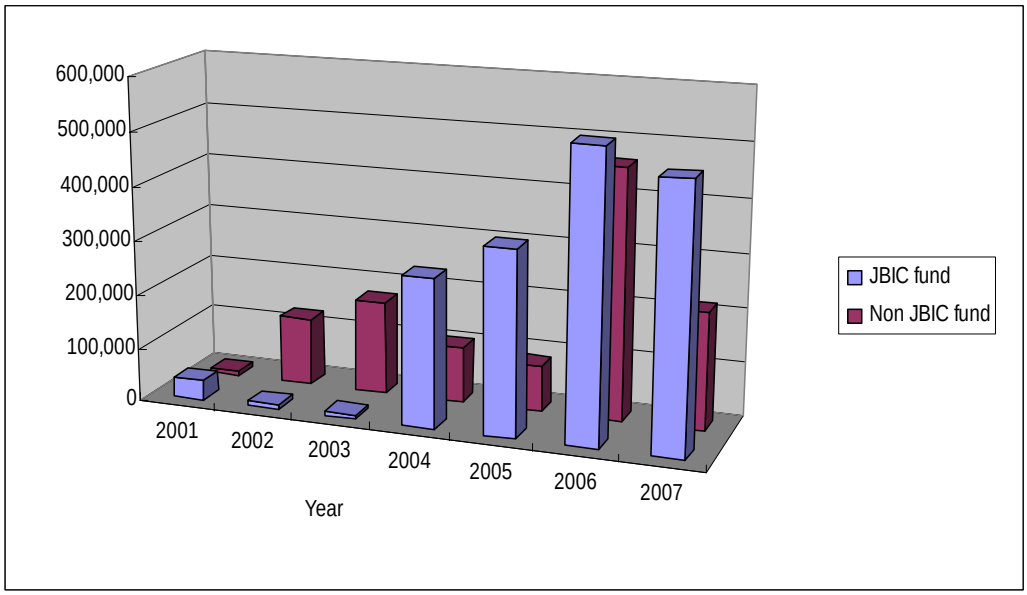


Figure 2.2.4 Changes in Development Expenses

(4) Sewerage Capital Contribution

In addition to budget amounts from MEWC, SSD controlled the Sewerage Capital Contribution (SCC) Fund with the approval of MEWC. SSD is responsible for receiving, withdrawing, and monitoring the SCC Fund by the time it is changed by new regulations concerning the SCC based on WSIA.

As of October 2008, the Sewerage Capital Contribution is levied on developers that connect to the existing public STP at the rate of 1% of their developed property value (after September 1999). Under the present SCC system, the property value to calculate the SCC is set according to the following three methods: 1) checking the property value described on the Sales and Purchase Agreement (S&P) between the developer and its customer, 2) referring to the land and building valuation report for the developed area prepared by the valuation company (referred to as "Valuation Company"), or 3) using twice the land value described on the Sales and Purchase Agreement only for land trades for future building construction. Developers pay the SCC to the regional SSD office at the time the "Recommendation of Certificate of Fitness" is delivered to the local authority (municipality) upon successful testing and commissioning of the sewerage system during the final inspection by SSD.

The SCC Funds are kept in the Trust Account. As of October 30, 2008, the balance of the Trust Account was around RM 551.7 million, as shown in **Table 2.2.3**. Part of the SCC Fund is secured in fixed deposit accounts (RM 285.5 million as of October 2008). The balance of the Trust Account, at RM 266.2 million, can be used with fewer approval procedures than those for fixed deposits. Note that RM 212.6 million of this account has already been allocated for future projects. The residual amount, which can be allocated to other projects, is RM 53.6 million as of the end of October 2008. The SCC Fund is intended to be spent mainly to carry out projects or work in areas where the SCC has been collected. The SCC Fund is also intended to be utilized for upgrading and rationalisation work by coordinating with developers who are to construct and deliver their developments' sewerage systems. However, this amount may be utilized to engage in small projects, such as refurbishment of STP or construction of sludge facilities, since the annual amount of the SCC is too small to cover even one construction project. The SCC Fund is regarded as quite limited for purposes of rationalisation or sewerage system integration projects.

Before 1999, the SCC would have been paid by a developer that constructed an STP within its own premises at a rate of 1.65% of the property value, thereby preventing an increase in the number of small sized STPs. Nevertheless, the SCC rate was suspended by the Cabinet and changed to the present rate and system on September 1999.

Table 2.2.3 Receipts and Payments of the Trust Account

(Unit: ×1,000 RM)

Year	SCC Receipts	Interest on Fixed Deposits	SCC Payments	Balance
1998	94,841	1,777	922	95,696
1999	58,678	5,457	3,242	60,893
2000	18,493	4,689	201	22,981
2001	24,112	5,268	453	28,927
2002	23,274	6,808	1,550	28,532
2003	30,156	6,303	142	36,317
2004	37,922	5,938	0	43,860
2005	44,378	5,670	6,556	43,492
2006	46,460	8,443	0	54,903
2007	72,913	9,624	0	82,537
2008 (30/Oct.)	69,144	4,441	20,060	53,525
Total	520,371	64,418	33,126	551,663

Source: SSD

Note: SCC (Sewerage Capital Contribution). A portion of SCC receipts must be placed in Fixed Deposit Accounts. The total amount of Fixed Deposits as of Oct 30 2008 is RM 285.5 million.

As mentioned in the WSIA, put into force in January 2008, the Sewerage Capital Contribution Fund is to be administered by SPAN independent of the SPAN Fund. However, as of October 2008, the Sewerage Capital Contribution is still being collected by the regional SSD office during a transitional period. After new regulations go into effect, scheduled in January 2009, the SCC will be levied and controlled by SPAN. Furthermore, several changes to the present SCC system are expected to be introduced as described in the WSIA. Anticipated SCC changes indicated in the WSIA are as follows;

(a) The SCC will be charged for sewage treatment work without a sludge processing facility or standby power generator
(b) The SCC will also be charged for a septic tank or communal septic tank that requires an off-site sludge processing facility

Even after the migration of the SCC from SSD to SPAN, implementation of projects utilizing the SCC fund will be handled by SSD, which plays the primary role in project implementation according to SPAN. SPAN will assume control of the SCC Fund, for instance, by checking the balance of the Fund. The Catchment Planning & Control Division, Sewerage Regulatory Department, and SPAN will be responsible for controlling the SCC Fund.

The current SCC system has no remaining incentives for developers to plan and to proceed with rationalisation or integration of STP. With the recent restructuring of the sewerage sector, it is important to systematize and rationalise the SCC for sewerage facilities.

(5) Management and Services

1) Approval and Acquisition Services

In 2005, SSD accepted 25,210 applications for the approval of new sewerage systems and released 3,782 Certificates of Fitness for Occupation of buildings.

2) Sewerage Appeal Case Management

All sewerage appeal cases to obtain approval for the usage of individual septic tanks or exemption/reduction of payment or contribution for usage or central sewerage system are to be ruled on by a special committee at the department level and by MEWC. In 2005, Appeal Committee meetings at the Ministry level had been held four times, and department level meetings had been held eight times. The activity summary is shown in **Tables 2.2.4 and 2.2.5**.

Table 2.2.4 Appeal Committee at Ministry Level

Appeal Cases		Approved	Rejected	No. of Cases
Appeal on the use of Individual Septic Tank (IST)	New case	1	5	6
	Re-appeal case	1		1
	Postponed case			
Appeal on Exemption of Sewerage Capital Contribution (SCC)	New case			
	Re-appeal case		1	1
	Postponed case			
	Total			

Source: MEWC Annual Report 2005

Table 2.2.5 Appeal Committee at Department Level

Appeal Cases		Approved	Rejected	*1	No. of Cases
Appeal on the use of Individual Septic Tank (IST)	New case	11	18	1	30
	Re-appeal case	1	7	2	10
	Postponed case	2	2		4
Appeal on Exemption of Sewerage Capital Contribution (SCC)	New case		3		3
	Re-appeal case	1	1		1
	Postponed case	1			1
	Total	16	30	3	49

Source: MEWC Annual Report 2005 *1: Taken from main meeting

3) SSD Client Charter

To improve the delivery of sewerage services and projects in terms of response time and quality, SSD has charted the following commitments in planning, implementation and regulation. These are shown in **Table 2.2.6**.

Table 2.2.6 SSD Client Charter on Service Quality and Response Time

Type of service	Processing time
Processing of applications for sewerage licenses	Within 30 days
Release of sewerage licenses after payment of license fee	In 14 days
Processing of sewerage proposal plans after payment of license fee	Within 14 days
Release of support letter for Certificate of Fitness for Occupation (CFO) to the local authority	14 days after complete application for final inspection is received
Complaints on sewerage charges, services and contractors	Received in one working day
Action on complaints on sewerage charges, services and contractors	• Within 14 days from the date received • Will be monitored until solved
Checking and certification of all project progress payment claims	Within 30 days
Decision on submission of complete appeal applications related to central sewerage system and capital contribution payment	Within 60 days (2 months)
Decision on submission of complete applications to obtain approval for utilization of sewerage product not used to treat sewage	Within 30 days (1 month)
Decision on submission of complete applications to obtain approval for utilization of sewerage product used to treat sewage	Within 90 days (3 months)

(6) Assessment on Sewerage Planning Capabilities

Planning management in SSD is an area that had been neglected before the establishment of the Planning Division in September 2006. Sewerage planning was previously undertaken by IWK with the support of SSD Regional Offices. In 2007 the Planning Division started to operate officially. However, there are still several limitations that need to be addressed for the Division to optimally perform its functions.

- The Division lacks manuals specifically for the purpose of planning. Manuals provide procedures or processes that guide effective and efficient sewerage planning. Manuals also take into consideration industry benchmarks and best practices while tailing practices to suit local conditions.
- There are no programmes dedicated to capacity development for planning staff. As mentioned, the Planning Division is still quite new. Therefore, a training needs assessment to identify training gaps should be a priority for the division. Then, a short-term and long-term training plan can be prepared to address perceived and actual planning capacity inadequacies related to SSD's mandate.
- No knowledge bank for sewerage system planning exists. Actual functions and responsibilities related to sewerage planning have always been handled by IWK and SSD regional offices, and experience within the Division is only now being built up. Since the Division is currently conducting and managing the preparation of five catchment strategies/plans, it presents a good opportunity to start developing and retaining expertise along these lines. In the meantime, it would be best to tap or utilize the existing expertise available in IWK and SSD regional offices.
- The Planning Division has limited staff. Of nine planned staff including one director, only six positions have been filled. It appears that even in the event that the three

remaining staff positions were filled, the Division would still be insufficiently staffed to deliver satisfactory planning services nationwide. In considering recruitment, selection and placement (RSP) of staff, strategic planning skills and technical planning expertise should be considered.

2.2.2 Water Sector (WS)

The Water Sector within MEWC is comprised of two divisions: the Water Services Policy Division and the Water Regulatory Division. The Water Sector plays an important role as the advising agency to the minister and as the ministry representative on all matters pertaining to the water and sewerage industry. Its current staff strength is 25 and the sector's main functions or responsibilities are as follows:

- To study, plan and endorse policies and strategies for the development of national water supply and sewerage services infrastructure
- To study, plan and confirm policies and regulations related to the SPAN Act and Water Services Act
- To manage appropriations for the development of national water supply and sewerage services
- To coordinate, monitor and review the implementation of projects
- To report, announce and communicate to the public with respect to water supply and sewerage projects
- To function as the secretariat, coordinator and member of selected committee meetings

(1) Water Services Policy Division

To plan, formulate, review, update, monitor and coordinate all aspects related to policies and water service programmes and project with the intention of providing effective services to consumers and in accordance with approved standards.

(2) Water Services Regulatory Division

To plan, coordinate, implement and regulate SPAN together with licensing activity for the development of effective and efficient water services and the safeguarding of consumer interests.

2.2.3 National Water Services Commission (SPAN)

(1) Roles

In addition to the functions mandated under the water supply and sewerage services laws, SPAN has the following important functions:

- To advise the Minister on all matters related to the national policy objectives of the water supply and sewerage service laws and to implement and promote the national policy objectives
- To implement and enforce the water supply and sewerage services laws and to consider and recommend reforms to water supply and sewerage services laws
- To ensure the productivity of the water supply services and sewerage services industry and the monitoring of operator compliance with stipulated service standards, contractual obligations and relevant laws and guidelines
- To increase concerted efforts towards improving the operational efficiency of the industry and in particular the reduction of non-revenue water through short-term, medium term and long term programmes
- To advise the Minister on fair and efficient mechanisms for determination of tariffs that are fair to both consumers and licensees, and to implement tariffs that have been established through appropriate mechanisms and tools
- To ensure that national development goals pertaining to coverage, supply and access to water supply services and sewerage services are achieved
- To ensure long-term sustainability of the quality of water and sewerage services through continued capital works development
- To formulate and implement a plan so that all reasonable demands for sewerage services are satisfied and in consultation with the relevant authorities, and to prepare a sewerage catchment plan formulating the policy and general proposal with respect to the development of any new sewerage system and measures of improvement of any existing sewerage system
- To carry out any function conferred upon it under any other written law
- To advise the Minister generally on matters relating to water supply services and sewerage services

(2) Organisation

The organisation structure for SPAN is shown in **Figure 2.2.5.**

Ten SPAN Committee Members including the Chief Executive Officer and the Executive Director of the Water Regulatory Department had been assigned by the beginning of August 2007. Currently, the staff strength of SPAN stands at 170 while its target figure is 190.

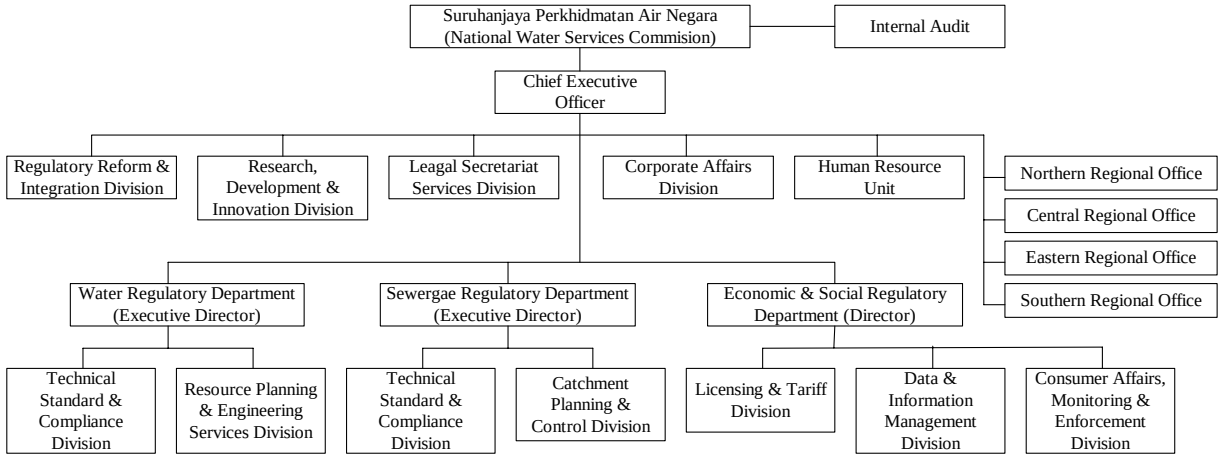


Figure 2.2.5 Organisation Structure of SPAN

(3) Power of the Commission

The Commission shall have the power to do all things necessary or expedient for or in connection with the performance of its functions under the water supply and sewerage services laws, such as the following:

- To utilize all the property of the Commission, movable and immovable, in such manner as the Commission may think expedient, including the raising of loans by mortgaging such property
- To impose fees or charges for services rendered by the Commission
- To appoint such agents, experts or consultants as it deems fit to assist the Commission in the performance of its functions
- To grant loans and scholarships to employees of the Commission for such purposes as may be approved by the Minister
- To formulate and implement human resource development and funding and cooperation programmes for the proper and effective performance of the functions of the Commission
- To cooperate with any corporate body or government agency for the purpose of performing the Commission's functions

(4) Financial Aspects

To assist SPAN in its payment of staff compensation, office expenses, utility costs, and other initial start-up costs, excluding project implementation costs, the Federal Government approved a seed fund amounting to RM 50 million for a period of five years and to be drawn down as required. Within the first five-year period, SPAN is expected to generate sufficient income/revenue to allow self-sufficiency without further Government support. In the interim, RM 20 million has been provided to SPAN.

The SPAN Act (Laws of Malaysia Act 654, Suruhanjaya Perkhidmatan Air Negara Act 2006) establishes the financial system of SPAN in “Part V Finance”. The following is a

summary of the financial system described in the Act.

- "Suruhanjaya Perkhidmatan Air Negara Fund" (SPAN Fund) shall be established and controlled by SPAN.
- The SPAN Fund shall consist of the following major revenues: (i) budget set by Parliament on an intermittent basis; (ii) license, permits, and other fees and administrative charges; (iii) income from investment; (iv) revenues from sale, disposal, lease or hire etc. of assets of SPAN; (v) revenues from consultancy and advisory services, etc.; and (vi) loans, and others.
- If revenue from license fees or any other fees/charges exceed the financial requirements of SPAN, amounts in excess shall be paid into the Federal Consolidation Fund.
- The Water Industry Fund and the Sewerage Capital Contribution Fund are administered by SPAN independently of and not to be combined with the SPAN Fund.
- The SPAN Fund is expected to be used for the following purposes: (i) remuneration, allowances etc. of committee members and staff of SPAN; (ii) procurement and services, including engagement of consultants; (iii) purchasing or leasing equipment, machinery, material, land, buildings etc.; and (iv) repayment of loan and interest, and others.
- SPAN must conserve the Fund by securing all revenue required to meet all the necessary expenses.
- Annual expenditures of SPAN authorized by the Minister are withdrawn from the SPAN Fund.
- Before September 1st of every year, SPAN submits expenditures estimates for the next year to the Minister.
- The Minister reports authorized expenditure amounts to SPAN before January 1st, the first day of the financial year.
- SPAN is allowed to submit supplementary estimates of its expenditures to the Minister.
- SPAN may borrow money occasionally with the approval of the Minister and with the agreement of the Minister of Finance.
- SPAN must have the approval of the Minister and agreement of the Minister of Finance before executing contracts with amounts exceeding RM 10 million.
- The financial year of SPAN begins on January 1st and ends December 31st.
- SPAN reports the statement of accounts (balance sheet, income and expenditure, etc.) and statement of activities of the year soon after the end of each financial year.
- SPAN sends a copy of the statement of accounts certified by the auditors and the auditors' report to the Minister, which the Minister submits to both Houses of Parliament.

SPAN has been established as a special bureau in the Ministry of Energy, Water and Communication, and it is authorized to have its own Fund and to borrow money from outside the budget of the Ministry. Nevertheless, SPAN is required to obtain the approval of the Minister for its annual budget estimate, loans, and large contracts, etc.

Based on the WSIA, there are major two types of licenses required to obtain for owners or operators of water businesses: the individual license and the class license. The individual license targets owners of public water supply system, owners of public sewerage system, or operators of these systems. The class license is intended for owners of private water supply system or private sewerage system, or operators of these systems. Both of the licenses are subject to renewal every three years. Furthermore, individual licenses can be broken down into service and facility categories. The facility license grants authority to owners of public water supply or public sewerage systems. Service licenses provide authority to entities that provide any water supply services or sewerage services by utilizing the public water supply or sewerage system.

License fees are expected to be the largest revenue source for the SPAN Fund. The license fee rate is described in the "Water Services Industry (Licensing) Regulations 2007" and is equal to 1% of the previous financial year's gross facility and service license receipts. Full collection of license fees from all existing water and sewerage service entities is anticipated to sufficiently cover the cost of SPAN operations. However, this may generate difficulties for several water operators experiencing operating losses. It is important for SPAN to verify in detail the financing program in the license applicant's business plans.

1) Water Industry Fund

The Water Industry Fund, a new concept in Malaysia, is in the process of being established and, as of October 2008, had not yet been launched. SPAN will prepare new regulations for establishing the Water Industry Fund. The Fund is charged for the individual licensees as described in the "Water Services Industry (Licensing) Regulations 2007". Purposes of the Water Industry Fund are described in Part XII, Clause 171, WSIA, as follows:

- To protect and preserve watercourses and water catchment areas
- To ensure sustainability of water supply from the watercourses
- To improve water quality of the watercourses
- To provide water and sewerage services in rural developments
- To serve other such purposes as may be determined by the Minister

It is anticipated that the Fund shall be used for investigation or coordination related to inter-state watercourse matters, since, in some areas, several water supply licensees may exist in a single watercourse. According to SPAN, the anticipated amount of the Water Industry Fund is limited and not enough to make capital investments for project implementation; therefore, it will be utilized for watercourse or river pollution studies, etc.

According to SPAN, amounts to be charged for the Water Industry Fund are computed by multiplying some percentage by the total revenue of water supply licensees. This amount will be charged in addition to license fees to SPAN. The rate for the Water Industry Fund, that is percentage of total revenue, has not been decided as of October 2008.

Based on the WSIA, SPAN shall administer the Water Industry Fund by opening the account for the Fund and reporting activities using the Fund to the Ministry. SPAN will be required to send the certified accounting documents of the Fund to the Minister at the end of financial year.

The Water Industry Fund is regarded as a limited amount in terms of capital investment, but is one of the important funds to be utilized for watercourse preservation to ensure sustainable usage and water quality improvement, especially focused on inter-state or inter-operator matters related to water supply services. Effective and efficient use of funds is strongly desired.

2) Business Plan

Individual licensees are required to submit a 30-year business plan and three-year annual rolling plans to SPAN to obtain approval. Business plans will be reviewed for viability when SPAN considers the renewal of the license. According to the "Explanatory Note on the Enforcement of the Water Service Industry Act 2006 (ACT 655)" issued by SPAN, the business plan is expected to include the following topics:

- Roadmap towards full cost recovery
- Water demand forecast
- Water supply projection with programme for capital investment
- Expected tariff increases
- Plans to conserve water and the environment
- Plans to integrate with sewerage services

Annual rolling plans (three years) will be utilized by SPAN to monitor and regulate the water supply and sewerage licensees through several performance indicators. SPAN is currently preparing the business plan format, which will indicate detailed content to be included. The business plan is intended to be submitted by water supply and sewerage companies when they apply for the individual license. Proposed business plans will be approved, rejected or require revision. After approval, individual licensees have the duty to carry out activities following business plans from the 1st year or be subject to penalties.

SPAN indicates that management target is full cost recovery, especially for water supply companies. Full cost in this context includes O&M and costs of capital. SPAN also encourages the sewerage sector to realize full cost recovery in the long term. To achieve this purpose, each individual licensee is expected to consider the planned tariff increases. These basic directions are considered appropriate for sustainable service provision.

3) Tariff Review and Joint Billing of Water Supply and Sewerage Services

According to the "Explanatory Note on the Enforcement of the Water Service Industry Act 2006 (ACT 655)" by SPAN, the following policies are clearly described regarding tariff

review:

- A primary focus to restructure the water services industry is the need to consider full cost recovery to secure long term sustainability
- Tariff reviews from licensees will be based on applications that need to be substantiated by each licensee
- There will be no automatic tariff increase, and licensees will have to meet certain performance indicators before applications are considered by SPAN
- The Ministry, in cooperation with SPAN, will conduct tariff reviews in the future, taking into consideration the following aspects:
  - Level of efficiency achieved by the operator
  - Operating effectiveness of the operator
  - Progress of continuous improvement programmes of the operator (e.g., NRW, bill collection)
  - Level of capital expenditures
  - Lease rental charges by WAMCO

Full cost recovery is described as one of the major directions of water service management by SPAN. It is considered appropriate even though the realization of full cost recovery takes time, especially for sewerage services.

Joint billing of water supply and sewerage is also expressed in the Explanatory Note by SPAN. According to the Note, joint billing is expected to be implemented beginning with Penang, Johor and Labuan. However, this is still under consideration as of October 2008. Joint billing is planned only for customers who connect to the public sewerage system and excludes customers with individual septic tanks. Raising the collection efficiency of sewerage tariffs is one of the most important tasks to be tackled and introduction of joint billing is recognized as a valuable step towards improvement. Successful introduction of joint billing in these three areas will have significance as the joint billing would be introduced into the other states.

In order to plan the tariff increase, licensees must apply with substantial evidence and meet the specified performance indicators. This is considered reasonable because operators must try to improve their management efficiency and service levels to apply for tariff increases. This will help to reduce customer dissatisfaction caused by tariff increases without satisfactory service provision to the customers.

2.3 Water Asset Management Company (WAMCO)

(1) Roles

With the enactment of the WSIA 2006, WAMCO (Water Asset Management Company) was established in May 2007. WAMCO is to be a facilities licensee under the provisions of the WSIA 2006. Its main responsibilities are as follows:

- To construct, refurbish, improve, upgrade, maintain and repair water supply and sewerage systems and all other assets in relation to the systems, in accordance with Section 35 of the Water Services Industry Act 2006 ("Act 655").
- To source and obtain competitive financing for the development of water supply and sewerage infrastructures.
- To assist SPAN in its efforts to restructure the nation's water industry towards achieving the Government's vision for efficient and high quality water supply and sewerage services.

To achieve the above, it is envisaged that WAMCO will raise funds via Government loan sor private financial instruments. This is expected to be feasible as WAMCO is 100% owned by the Ministry of Finance, and this would help to secure long term loans with low interest. There is a possibility that government guarantees would be made available to accommodate funding needs.

To carry out its functions, WAMCO is expected to be awarded a facility license by SPAN, which can only be obtained upon WAMCO owning at least one asset.

(2) Organisation and Staffing

As of November 2008, the staff strength of WAMCO stands at 41. Its organisation structure is as highlighted in **Figure 2.3.1**.

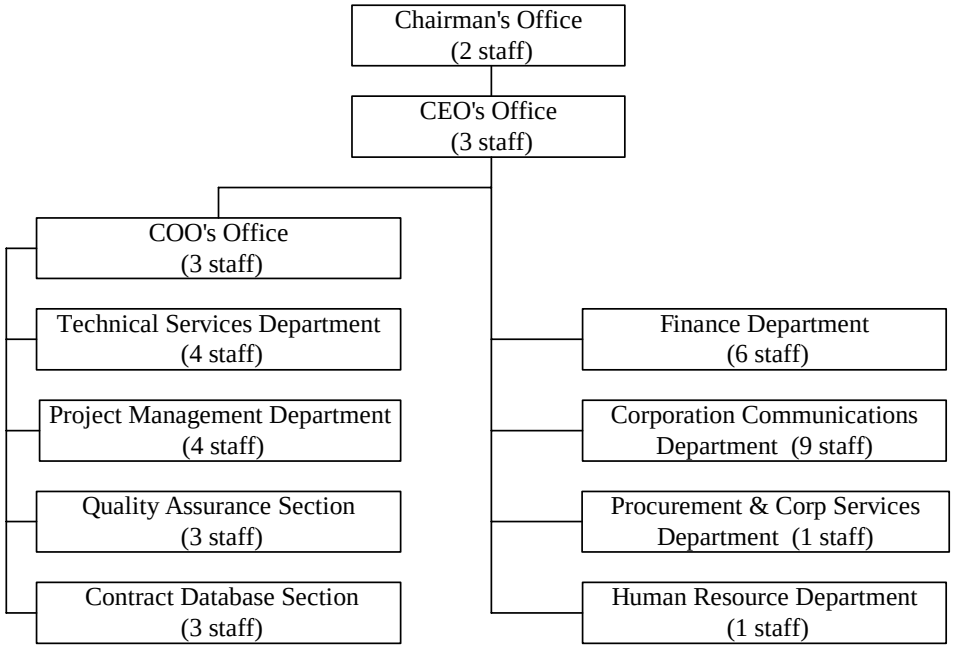


Figure 2.3.1 Organisation Structure of WAMCO

(3) Financial Aspects

Authorized capital of WAMCO is RM 1 billion. To initiate operations, the Federal Government provided WAMCO with a seed fund of about RM 100 million as paid-up capital, which is expected to be increased to RM 500 million by the year 2010. As of October 2008, paid-up capital by the Federal Government amounted to RM 410 million. The bulk of the paid-up capital will be used for asset transfers (ownership) in addition to other initial establishment costs. Since all water supply assets are state government owned, if the state government is in debt to the Federal Government or other agencies, WAMCO may either negotiate to write off the debts in return for transfer of asset ownership or compensate them for the difference if the debt is not equivalent to present asset value. In meeting its objectives, WAMCO works on a full cost recovery model.

WAMCO is engaged in productive discussions with water supply operators and state governments in almost all of the states in the peninsula of Malaysia to enter into an agreement to transfer the ownership of their water supply facilities. Federal government has not yet decided whether WAMCO holds sewerage assets or not. As of October 2008, negotiations to transfer the water supply facilities were still on-going and the contracts were anticipated to be signed soon for three states: Negri Sembilan, Melaka, and Johor. Based on this progress, WAMCO presented the facility license application with the business plan to SPAN in October 2008.

If the agreements for asset transfer are successfully executed, WAMCO would own the assets and will provide all required future capital investments for the assets. WAMCO will then lease the assets to service licensees, such as state-owned or private operators. Service licensees will be required to pay the asset lease fees in exchange for forgiveness of the capital investment loans. The amount of lease fees shall be described in each lease agreement between WAMCO and the water operator.

WAMCO is expected to raise funds for its future capital investment needs from government soft loans, local capital markets (bond issuance), and the private banking sector. It is expected to obtain loans with lower interest rates and reduce the heavy burden of loan repayments that current operators face, thereby enabling the operators to focus on their operations. Loans will be paid back by WAMCO using the lease fees from service licensees.

2.4 Water Supply Services Agencies

One of the main objectives of restructuring the water sector is to create a structure that ensures the long-term sustainability of the water supply and sewerage services industry.

The positive financial outlook of water supply agencies is the key to ensure the sustainability of the industry.

Table 2.4.1 shows the revenues and expenditures of water supply organisations over five years (2001 to 2005). Johor, which privatized its entire utility, recognized large positive balances of revenue over expenditures. On the other hand, Selangor, which contracted three water treatment concessionaires and one distribution concessionaire shows a large negative balance. Kedah, Perak, Pulau Pinang, Kelantan, had generated relatively large balances of revenue over expenditures. In Kedah, the State Public Works Department is responsible for distribution and regulates the two private operators. In Perak, the State Water Supply Board retains distribution of water while controlling two private operators. In Terengganu, the water supply entity was corporatized in July 1999 and is wholly owned by the state government.

Table 2.4.1 Revenue and Operating Expenditures of Water Supply Organisations

(Unit: ×Million RM)

States		2001	2002	2003	2004	2005
Kedah	Revenue	133.1	148.5	157.9	166.1	163.1
	Expense	97.7	117.1	111.8	122.7	129.0
	Balance	35.4	31.4	46.1	43.4	34.1
Sarawak*1	Revenue	19.9	22.0	26.3	25.8	25.4
	Expense	30.3	26.2	28.5	36.4	36.6
	Balance	-10.4	-4.2	-2.2	-10.6	-11.1
Labuan	Revenue	9.7	9.6	9.7	10.6	11.0
	Expense	16.1	16.6	16.7	17.2	18.0
	Balance	-6.4	-7.0	-7.0	-6.6	-7.0
Perlis	Revenue	10.5	12.7	12.9	14.9	12.8
	Expense	12.3	13.7	13.7	13.8	18.6
	Balance	-1.8	-1.0	-0.8	1.1	-5.8
Pahang	Revenue	96.1	98.7	105.7	97.7	103.8
	Expense	102.8	109.3	118.9	133.7	149.1
	Balance	-6.7	-10.6	-13.2	-36.0	-45.3
N.Sembilan	Revenue	77.3	99.6	130.0	154.4	163.5
	Expense	61.2	72.8	122.3	127.5	114.4
	Balance	16.1	26.8	7.7	26.9	49.1
Sabah	Revenue	51.7	75.9	124.4	217.8	255.8
	Expense	175.3	200.9	160.3	195.0	295.3
	Balance	-123.6	-125.0	-35.9	22.8	-39.5
Perak	Revenue	186.1	207.6	210.2	220.3	231.5
	Expense	167.6	168.3	170.3	176.0	185.5
	Balance	18.5	39.3	39.9	44.3	46.0
Melaka	Revenue	94.3	105.5	107.9	117.2	115.8
	Expense	68.6	77.8	79.8	111.7	113.2
	Balance	25.7	27.7	28.1	5.5	2.6
Kuching	Revenue	57.5	62.8	66.6	72.2	75.6
	Expense	53.8	55.7	60.0	61.6	61.6
	Balance	3.7	7.1	6.6	10.6	14.0
Sibu	Revenue	18.6	19.5	21.0	22.3	23.9
	Expense	18.4	21.2	22.2	22.7	24.0
	Balance	0.2	-1.7	-1.2	-0.4	-0.1
P. Pinang	Revenue	163.3	168.0	163.8	170.4	173.4
	Expense	104.1	107.5	112.9	120.0	129.8
	Balance	59.2	60.5	50.9	50.4	43.6
Terengganu	Revenue	74.0	80.7	77.4	80.1	80.8
	Expense	38.8	45.6	47.0	49.8	81.8
	Balance	35.2	35.1	30.4	30.3	-1.0
Selangor*2	Revenue	733.9	861.4	1,008.4	1,084.0	1,417.6
	Expense	1,495.2	1,310.5	1,714.7	1,840.3	1,510.9
	Balance	-761.3	-449.1	-706.3	-756.3	-93.3
Johor	Revenue	416.4	382.4	428.9	497.6	610.1
	Expense	251.4	270.7	293.5	390.7	460.7
	Balance	165.0	111.7	135.4	106.9	149.4
Kelantan	Revenue	41.5	45.7	46.7	52.5	57.6
	Expense	30.5	34.2	35.6	39.0	42.7
	Balance	11.0	11.5	11.1	13.5	14.9
LAKU	Revenue	43.3	46.7	49.6	51.9	53.2
	Expense	40.7	40.3	41.9	43.8	44.7
	Balance	2.6	6.4	7.7	8.1	8.5
TOTAL	Revenue	2,227.2	2,447.3	2,747.4	3,055.8	3,575.0
	Expense	2,764.8	2,688.4	3,150.1	3,501.9	3,415.8
	Balance	-537.6	-241.1	-402.7	-446.1	159.2

Source: Malaysia Water Industry Guide, 2003 and 2005, published by The Malaysian Water Association

Notes: *1. Excluding LAKU, Kuching and Sibu,

*2. Including Wilayah Persekutuan, Kuala Lumpur and Putrajaya

Table 2.4.2 depicts important financial and managerial indicators of all water supply organisations in Malaysia. The unit production cost is the actual cost to produce one m3 of treated water. The average price of water is the actual revenue from selling the one m3 of treated water. If the unit production cost is more than the average price of water, it is almost impossible to generate a profit. Labuan and Sarawak fell into this condition and experienced massive negative balances. Selangor is characterized by a higher unit production cost (RM 1.11/m^3) and a high non-revenue water ratio (38.4%). These factors have caused massive negative balances every year. In Selangor, these factors, in combination with having the highest number of connections (1.48 million), have caused the deficit to become remarkably large compared with all of the water supply organisations in Malaysia.

Table 2.4.2 Domestic and Industrial Water Rates (2005)

States	Average water tariff (2007) (RM/m^3)*4		Total number of connections	Non-revenue water *5	Unit production cost *6	Average price of water *7
	Domestic	Industrial		(%)	(RM/m^3)	(RM/m^3)
Kedah	0.53	1.20	439,336	42.8	0.36	0.80
Sarawak*1	0.56	1.19	121,813	10.1	0.57	0.44
Labuan	0.90	0.90	12,436	24.0	1.32	1.06
Perlis	0.57	1.30	63,499	36.3	0.55	0.60
Pahang	0.57	1.45	303,209	49.6	0.58	0.80
N.Sembilan	0.68	1.59	322,130	53.0	0.49	1.49
Sabah	0.90	0.90	197,574	57.1	1.10	2.22
Perak	0.73	1.60	595,856	30.6	0.53	0.96
Melaka	0.72	1.47	206,687	28.8	0.78	1.12
Kuching	0.62	1.06	115,023	32.0	0.53	0.96
Sibu	0.62	1.06	46,903	27.2	0.74	1.01
P. Pinang	0.31	0.94	430,659	19.4	0.43	0.72
Terengganu	0.52	1.15	207,780	34.7	0.53	0.80
Selangor*2	0.77	2.27	1,483,000	38.4	1.11	1.69
Johor	0.90	2.93	811,874	35.5	0.93	1.91
Kelantan	0.55	1.25	154,445	40.0	0.43	0.96
LAKU*3	-	-	71,192	18.5	0.65	0.95
TOTAL	-	-	5,585,724	-	-	-
AVERAGE	0.65	1.32	-	37.7	0.79	1.32

Source: Malaysia Water Industry Guide 2006, published by The Malaysian Water Association

Notes: *1. Excluding LAKU, Kuching & Sibu, *2. Including Wilayah Persekutuan, Kuala Lumpur & Putrajaya, *3. LAKU applied several different rates for distinct coverage areas.

*4. Average water tariff for domestic use applies to the first 35 m^3, and industrial use applies to the first 500 m^3. Tariff tables apply to the progressive block rate for all of the states in Malaysia excluding two states, Sabah and Labuan. Sabah and Labuan utilize the tariff tables of constant volumetric rate.

*5. NRW equals (water production volume – billed water volume) divided by water production volume.

*6. Unit production cost is defined as the necessary cost to generate 1m^3 of water supply.

*7. Average price of water equals total revenue divided by total billed water volume.

Kedah suffers from a high NRW ratio (42.8%), but unit production cost is very low (RM 0.36/m^3). Therefore, in this case, it is possible to generate large positive balances. It can be said that Kelantan is under the same management situation. Perak, Melaka, Pulau Pinang, and LAKU, on the other hand, have succeeded to lower NRW ratio and lower unit

production cost. However, in Johor, the water supply organisation had a relatively higher unit production cost (RM 0.93/m^3), but it was able to contain the NRW ratio (35.5%), and it charged relatively higher tariffs for domestic customer (RM 0.90/m^3) and much higher tariffs for industrial customers (RM 2.93/m^3). As a result, the water supply organisation in Johor was able to generate a huge positive balance. It should be noted that Johor and Perak have a similar number of connections, but Johor obtained almost three times the revenue of Perak. Some reasons for this disparity include the difference in composition between domestic and non-domestic customers and the differing average water tariffs for the industrial customers.

Table 2.4.3 shows the states that suffer from continuous losses of water supply management in terms of annual revenues minus annual operating expenditures based on the data in **Table 2.4.1**. Some anticipated solutions for these six states are described below. Analysis is based on the data from the Malaysia Water Industry Guide. Detailed analysis should be conducted based on precise and sufficient information and data for each responsible water supply authority.

(1) Sarawak

As shown in the operating ratio (1.45), total O&M costs are much higher than total revenue. Unit production costs (RM 0.57/m^3) were held lower than the national average (RM 0.79/m^3). Water tariffs as a share of household income (0.61%) is considered low at present. Therefore, the average price of water (water tariff) should be raised high enough to cover at least O&M costs. Staff per 1,000 connections (8.9) is considered higher than the applicable level. Labor productivity should be increased to reduce O&M costs.

Table 2.4.3 Characteristics of Water Supply Enterprises in Six States (2005)

States	Average water tariff (2007) (RM/m^3) domestic/ industrial	NRW (%)	Unit production cost (RM/m^3)	Average price of water (RM/m^3)	Ave. price of water / unit production cost	Operating ratio (total O&M cost / total revenue)	Staff / 1,000 connec-tions	Water tariff / household income (%) *1
Sarawak	0.56 / 1.19	10.1	0.57	0.44	0.77	1.45	8.9	0.61
Labuan	0.90 / 0.90	24.0	1.32	1.06	0.80	1.63	13.4	-
Perlis	0.57 / 1.30	36.3	0.55	0.60	1.09	1.45	2.0	0.74
Pahang	0.57 / 1.45	49.6	0.58	0.80	1.38	1.44	5.1	0.60
Sabah	0.90 / 0.90	57.1	1.10	2.22	2.02	1.15	6.7	1.56
Selangor	0.77 / 2.27	38.4	1.11	1.69	1.52	1.07	1.5	0.57
National Ave.	0.65 / 1.32	37.7	0.79	1.32	1.67	0.96	-	0.61

Source: Malaysia Water Industry Guide 2006 published by The Malaysian Water Association

Note: *1. Average tariff data is calculated by utilizing the Malaysia Water Industry Guide 2006. Average household income (2004) is sourced from Department of Statistics – Household Income Surveys.

(2) Labuan

Since the unit production cost (RM 1.32/m^3) belongs to the highest group, the average price

of water is only 80% of the unit production cost. As a result, the operating ratio (1.63) shows that total O&M costs are much more than total revenue. Staff per 1,000 connections (13.4) indicates that labor productivity is in the lowest group. In order to ensure the sustainability of services, labor productivity must be improved and costs must be saved before tariff increases can be considered.

(3) Perlis

First, NRW (36.3%) needs be reduced through ongoing efforts. Second, as shown in the operating ratio (1.45), total O&M costs are 45% more than total revenue. Nevertheless, unit production costs (RM 0.55/m^3) are lower than the national average. Cost saving seems difficult in this case. On the other hand, the average price of water (RM 0.60/m^3) is less than half that of the national average (RM 1.32/m^3). The monthly water tariff is only 0.74% of the household income. The tariff raise needs to be considered in detailed prior to implementation.

(4) Pahang

The NRW ratio is high (49.6%). Half of the treated water did not generate any revenue. Reduction of the NRW is one of the important problems to be tackled first. The average price of water (RM 0.80/m^3) has been kept down to moderate levels. As a result, the operating ratio (1.44) indicates that O&M costs are much greater than revenue. Reduction of the NRW ratio should be achieved before a tariff revision plan is considered. The water tariff as a share of household income (0.60%) shows that the tariff is not high compared to household income.

(5) Sabah

The NRW ratio (57.1%) is the highest of all the states in Malaysia and remains a serious problem to be addressed. Unit production costs (RM 1.10/m^3) are higher than the national average (RM 0.79/m^3). Staff per 1,000 connections (6.7) show that labor productivity is not high. Cost savings measures in addition to labor productivity improvements need to be implemented by water supply enterprises at the beginning. Once this occurs, tariff increases for industrial, not domestic, customers may be considered. Water tariffs for domestic customers are higher than those in other states in Malaysia as a percentage of household income (1.56%).

(6) Selangor

The NRW (38.4%) must be reduced through ongoing efforts. The operating ratio (1.07) shows that O&M costs are slightly greater than revenue. Unit production costs (RM 1.11/m^3) are relatively high. Tariff revisions were already conducted in 2006. NRW reduction and cost saving should be considered and implemented. Water tariffs as a share of household income are 0.57%. Because of high average household income, the share is

lower than the national average (0.61%) despite a higher tariff. When the next tariff revision is conducted, impact to low income groups need to be considered in detail.

Preliminary analyses are only provided here for states showing clear annual losses in recent years. By conducting detailed analysis based on precise data even states with annual profits may need to consider tariff revision. It is strongly recommended that the water supply authority of each state shall itself conduct the detailed cost analysis and water tariff planning as is requested in business plans.

2.5 Indah Water Konsortium (Sewerage Services Agency)

(1) Roles

Indah Water Konsortium (IWK), a wholly-owned company of the Minister of Finance Incorporated, is Malaysia's national sewerage company and has been entrusted with the task of developing and maintaining a modern and efficient sewerage system for all Malaysians.

In 1994, the Federal Government awarded the company with a concession for nationwide sewerage services, previously under the responsibility of local authorities. Since then, IWK has taken over the sewerage services from all local authorities except those within the States of Kelantan, Sabah, Sarawak and Dewan Bandaraya Johor Baru.

The IWK has been currently operating in 86 out of 96 local authorities in Peninsular Malaysia, including the Federal Territories of Kuala Lumpur, Putrajaya and Labuan.

The responsibilities of IWK are as follows:

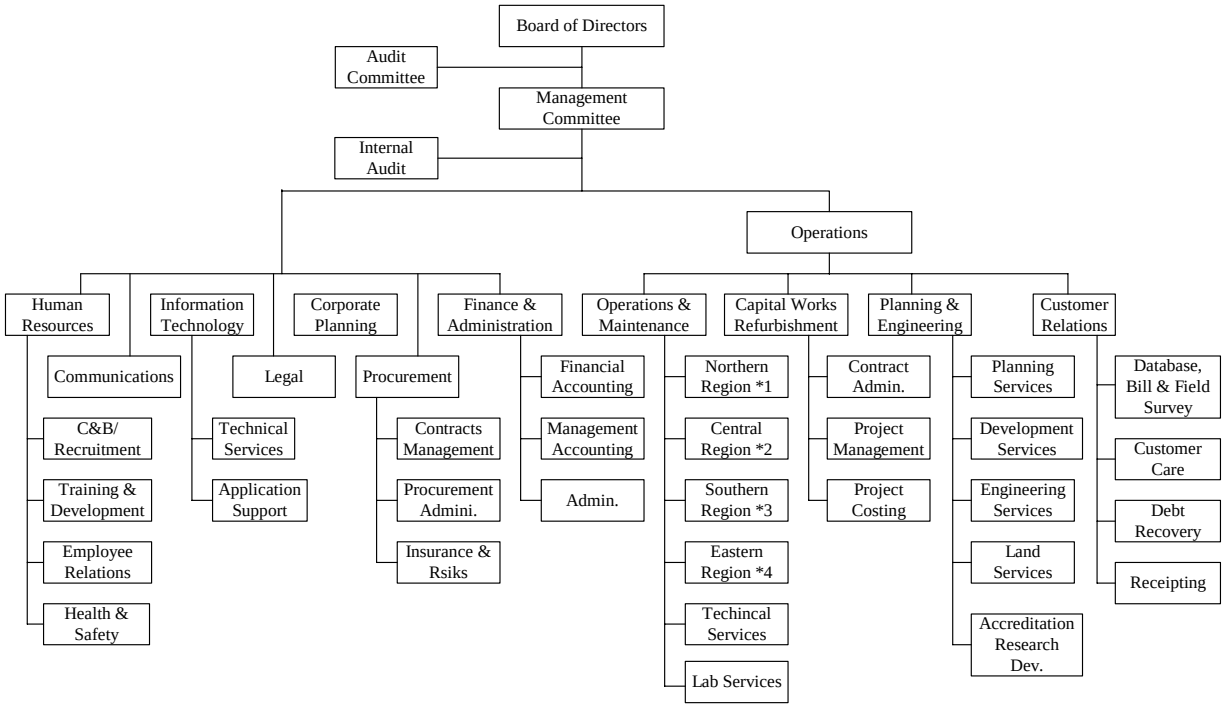
(a) Operate and maintain public sewerage systems
(b) Refurbish and upgrade existing public treatment plants and sewers to ensure acceptable performance
(c) Provide septic tank desludging services in a scheduled manner for customers
(d) Assist the SSD on sewerage planning and development for which IWK is paid a fee
(e) Assist the SSD in conducting sewerage projects and project management for which IWK is paid a fee
(f) Operate only within local authority operational areas

(2) Organisation

The organisation structure of IWK is shown in **Figure 2.5.1**.

There are three major departments within IWK that are of interest with respect to the sewerage industry: Operation and maintenance, Capital Works and Refurbishment, and Planning and Engineering. Other departments within IWK provide a supporting role to

these three departments.



Notes: *1. Three offices in Pulau Pinang, Perak, & Kedah *2. Offices in Kuala Lumpur & Selangor

*3. Three offices in N. Sembilan, Melaka, & Johor, *4. Two offices in Pahang & Terengganu

Figure 2.5.1 Organisation Structure of Indah Water Konsortium Sdn. Bhd (As of Oct. 2008)

1) Operations and Maintenance Department

The Operations and Maintenance Department is responsible for the operation and maintenance of the public sewerage system and the provision of the septic tank desludging services in order to ensure compliance of treatment plant performance with environmental standards.

2) Capital Works and Refurbishment Department

The Capital Works and Refurbishment Department is responsible for the design, tendering, and construction supervision of capital works projects, sludge management projects, networks and private connection, and refurbishment projects. As much as they are responsible for implementation of IWK's internal projects, a vast amount of their resources are deployed in assisting SSD with their project management of capital works for which IWK is reimbursed with a project management fee.

3) Planning and Engineering Department

The Planning and Engineering Department is responsible for the development of strategies

and policies for the operations and maintenance of sewerage system to meet standards of customer service and to comply with regulatory requirements in addition to creating a reliable database of treatment plants operated by IWK. IWK's Planning & Engineering Department also provides supporting services for SSD, which include preparation of catchment strategies/plans (CS/Ps) and in the form of "Developer Services" such as evaluation of CS/Ps and development plans.

(3) Staffing

As of December 2007 and as shown in **Table 2.5.1**, the total number of staff members in the Operations and Maintenance Department was 2,095, comprising the bulk (79.6%) of IWK's total staff of 2,632. The rest of the staff, other than the three major departments mentioned, constitutes less than 10% of the total staff number.

Table 2.5.1 Number of Staff of IWK and Major Departments (Last Five Years)

As of December	2003	2004	2005	2006	2007
Operations and Maintenance Dept.	1,528	1,674	1,781	2,000	2,095
Capital Works and Refurbishment Dept.	77	85	85	82	76
Planning and Engineering Dept.	174	175	183	194	208
Sub-total	1,779	1,934	2,049	2,276	2,379
IWK as a whole	1,999	2,163	2,289	2,535	2,632

Source: IWK, 2008

In order to alleviate the lack of operations and maintenance personnel, the staff number of the Operations and Maintenance Department increased by 37.1% from 2003 to 2007 (refer to **Table 2.5.2**). In other words, for the past five years, Department staffing has been increased at an average rate of 8.21% per annum. For the same period, the number of sewage treatment plant has increased at an average rate of 3.70% per annum. The annual percentage increase of O&M staff is thus higher compared to percentage increases in the number of STPs. Similarly, this has also exceeded the percentage increases in sewer network length, at 7.70%, and ISTs desludged by IWK, at 4.02%. These O&M staff increases have been necessary to overcome the shortage of O&M staff in IWK compared to the large number of sewerage facilities being operated and managed.

Table 2.5.2 Number of O&M Staff , STPs, and Sewerage Facilities

As at Dec	2003	2004	2005	2006	2007	Increase from 2003 to 2007 (%)	Annual % of increase
No. of staff, O&M Department, IWK	1,528	1,674	1,781	2,000	2,095	37.1	8.21
No. of STPs	7,520	7,904	8,220	8,459	8,697	15.7	3.70
No. of pump stations	448	510	562	601	640	42.9	9.33

As at Dec	2003	2004	2005	2006	2007	Increase from 2003 to 2007 (%)	Annual % of increase
Length of sewerage network maintained by IWK (km)	12,707	14,149	15,060	16,034	17,097	34.5	7.70
No. of individual septic tank desludged by IWK	135,744	152,339	158,936	150,954	158,922	17.1	4.02

Source: JICA Study Team, based on data provided by IWK

(4) Financial Aspects

IWK is a company fully owned by the Ministry of Finance. IWK uses revenues from sewerage tariffs for both customers connected to public sewerage systems and septic tank users. IWK has O&M responsibilities that include desludging septic tanks and repair work within tariff revenue. However, in the event of large budget shortfalls, IWK may receive financial support from the Federal Government.

IWK is externally audited on an annual basis. IWK's accounting system follows the Industrial Financial System on an accrual-basis. The corporate accounting system implemented by IWK is regarded as appropriate for analyzing the financial situations of the water supply and/or sewerage companies.

As indicated in **Table 2.5.3**, IWK's annual revenue has increased due to ongoing activities focused on expanding its customer base and improving loan collections. Despite these efforts, net losses have been mounting for the last six years. As a result, financial assistance from the Federal Government to IWK increased to RM 194.2 million for the 2007 fiscal year alone (refer to **Table 2.5.4**).

Table 2.5.3 Revenue and Expenditures of Indah Water Konsortium (2002 - 2007)

(Unit: ×Million RM)

Period *1	2002/5-2003/4	2003/5-2004/4	2004/5-2005/4	2005/4-2005/12	2006/1-2006/12	2007/1-2007/12
Operating revenue						
1. Sewerage tariff	254.6	274.1	310.5	201.0	354.6	370.8
2. Other revenue	14.7	17.4	14.6	11.4	33.2	45.2
Total	**269.3**	**291.5**	**325.1**	**212.4**	**387.8**	**416.0**
Operating expenditures						
3. Electricity costs	46.9	52.5	66.5	51.0	88.8	100.6
4. Staff salaries	57.6	66.0	73.7	54.8	90.0	103.3
5. Operations & maintenance costs	46.5	69.0	104.9	83.0	149.0	166.5
6. Office expenses	40.4	50.5	34.3	30.7	51.2	65.0
7. Depreciation costs	21.2	25.6	31.5	24.1	39.8	49.8
8. Others	48.9	0.2	72.1	35.3	55.5	51.0
Total	**261.5**	**263.8**	**383.0**	**278.9**	**474.3**	**536.2**
Income from operations	**7.8**	**27.7**	**-57.9**	**-66.5**	**-86.5**	**-120.2**
9. Interest expenses	41.2	59.8	76.7	55.2	86.8	96.2
Net profit	**-33.4**	**-32.1**	**-134.6**	**-121.7**	**-173.3**	**-216.4**

Source: JICA Study Team, based on data provided by IWK

Notes: *1. IWK's accounting year end changed from April to December in 2005. Therefore, 2005 results are for an eight-month period only ending December 31, 2005.

Table 2.5.4 Financial Assistance by Federal Government to Indah Water Konsortium

(Unit: ×Million RM)

Year	2002/5-2003/4	2003/5-2004/4	2004/5-2005/4	2005/4-2005/12	2006/1-2006/12	2007/1-2007/12
Assistance from the Federal Government	0.0	0.0	43.2	120.0	140.0	194.2

Source: JICA Study Team, based on data provided by IWK

The causes of increasing net losses are the substantial increases in O&M costs, interest expense, and electricity costs. **Figure 2.5.2** shows trends in major cost items for the last six years. Figures for fiscal year 2005 (May 2005 to December 2005) are adjusted from eight months to 12 months. O&M costs increased at 258% from fiscal year 2002 to 2007. Interest expenses and electricity cost increased at an additional 134% and 115%, respectively during the same period.

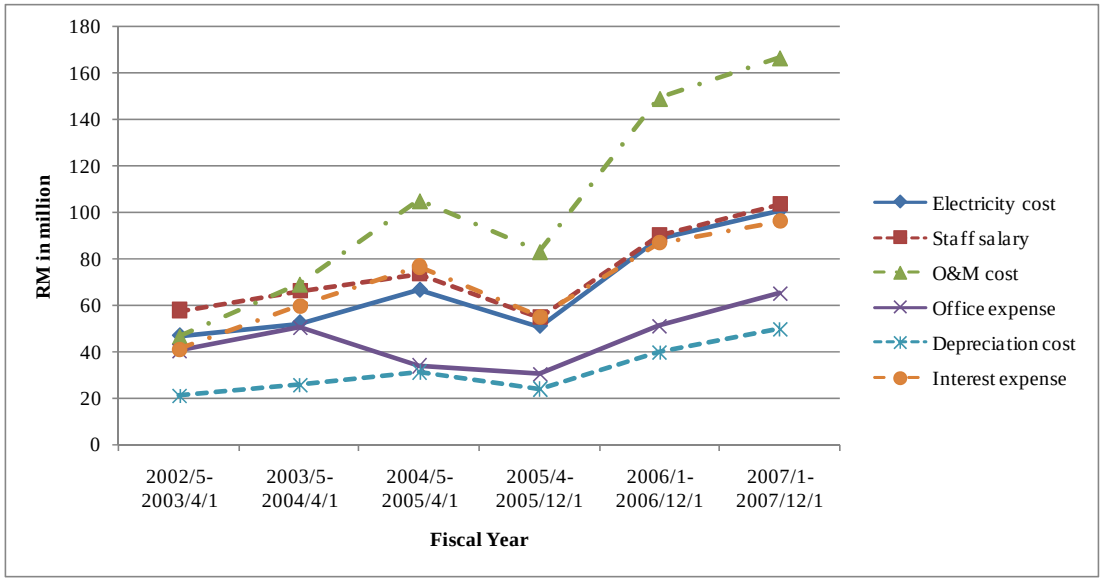


Figure 2.5.2 Changes of Major Cost Items from FY2002 to FY2007

Table 2.5.5 makes clear the following points: (i) approximately RM 35 million per annum on average was uncollected and added to the allowance for doubtful accounts, (ii) depreciation costs were recorded for future facilities renovations, (iii) as a whole, increasing net losses generated by annual operations were compensated for by increased federal government financial assistance and government support loans.

Financial and managerial indicators shown in **Table 2.5.6**, are based on the income statement, balance sheet, and other IWK sources of information.

The operating ratio shows the profitability of the company by examining the size of annual operating expenditures to generate one unit of operating revenue. IWK generated income from operations until the fiscal year 2003, but incurred losses after 2004. The profitability of IWK is getting worse, judging from performance over the last five years, where profit

margin is also used to indicate profitability.

Table 2.5.5 Balance Sheet of Indah Water Konsortium (2002 - 2007)

(Unit: ×Million RM)

Year *1	Apr-03	Apr-04	Apr-05	Dec-05	Dec-06	Dec-07
Current Assets	436.2	424.9	420.8	493.1	554.1	631.6
Cash & bank deposits	335.0	274.8	242.4	310.3	357.1	439.9
Accounts receivable	366.6	415.0	511.2	552.4	618.1	628.5
Allowance for doubtful accounts	-271.1	-271.3	-343.4	-378.5	-433.9	-447.8
Other current assets	5.7	6.4	10.6	8.9	12.8	11.0
Fixed Assets	535.1	564.2	562.5	564.9	560.0	533.8
Buildings	0.2	0.3	0.6	0.6	0.7	3.9
Plant and equipment	473.2	544.6	613.8	631.0	679.5	767.1
Construction in progress	153.8	135.1	104.4	111.3	95.3	40.1
Accumulated depreciation	-116.2	-139.9	-170.4	-192.1	-229.6	-277.3
Other fixed assets	24.1	24.1	14.1	14.1	14.1	0.0
Total assets	**971.3**	**989.1**	**983.3**	**1,058.0**	**1,114.1**	**1,165.4**
Liabilities	1,240.8	1,290.7	1,376.2	1,454.8	1,544.2	1,622.0
Accounts payable	153.3	140.3	145.9	167.9	167.5	149.2
Government support loans	1,087.5	1,150.4	1,230.3	1,286.9	1,376.7	1,472.8
Equities	-269.5	-301.6	-392.9	-396.8	-430.1	-456.6
Issued capital	100.0	100.0	100.0	100.0	100.0	100.0
Accumulated losses	-369.5	-401.6	-492.9	-496.8	-530.1	-556.6
Total liabilities & equities	**971.3**	**989.1**	**983.3**	**1,058.0**	**1,114.1**	**1.165.4**

Source: JICA Study Team, based on data provided by IWK

Notes: *1. IWK's accounting year end changed from April to December in 2005. Therefore, 2005 results are for an eight-month period only ending December 31, 2005.

Table 2.5.6 Financial and Managerial Indicators of IWK

Period *1	Unit	2002/5-2003/4	2003/5-2004/4	2004/5-2005/4	2005/4-2005/12	2006/1-2006/12	2007/1-2007/12
Operating ratio *2	%	97.1	90.5	117.8	131.3	122.3	128.9
Profit margin *3	%	2.9	9.5	-17.8	-31.3	-22.3	-28.9
Equity ratio *4	%	-21.7	-23.4	-28.5	-27.3	-27.9	-28.2
Return on assets *5	%	-3.4	-3.2	-13.7	-17.3	-15.6	-18.6
Accounts receivable to sales revenue ratio *6	%	144.0	151.4	164.6	183.2	174.3	169.5
O&M and capital costs recovery ratio *7	%	84.1	84.7	67.5	60.2	63.2	58.6
O&M cost recovery ratio *8	%	106.0	115.1	88.3	78.9	81.6	76.2
O&M costs per served customer *9	RM/ month	10.6	9.5	12.3	12.4	12.9	14.7
O&M and capital costs per served customer *10	RM/ month	13.4	12.9	16.0	16.3	16.7	19.1
Collected tariff amounts per customer *11	RM/ month	8.2	8.7	7.4	7.8	8.5	10.2

Source: JICA Study Team, based on data provided by IWK

Notes:

*1. *1. IWK's accounting year end changed from April to December in 2005. Therefore, 2005 results are for an eight-month

period only ending December 31, 2005. If necessary for calculating indicators, data from the Income Statement table has been adjusted from eight to 12 months.

*2. Operating ratio = total operating expenditures / total operating revenue. Total operating expenditures include depreciation costs.

*3. Profit margin = operating income before interest / total operating revenues

*4. Equity ratio = equity / total liabilities

*5. Return on assets = net profit / total assets

*6. Accounts receivable to sales revenue ratio = accounts receivable / sales revenue. Sales revenue is operating revenue that does not reflect the collection rate.

*7. O&M and capital costs recovery ratio = sewerage tariff revenue / (total operating expenditures + interest expenses). Sewerage tariff revenue is the annual billed amount.

*8. O&M cost recovery ratio = sewerage tariff revenue / (total operating expenditures - depreciation costs). Sewerage tariff revenue is the annual billed amount.

*9. O&M cost per served customer = (total operating expenditures - depreciation costs) / total number of domestic customers

*10. O&M and capital costs per served customer = (total operating expenditures + interest expenses) / total number of domestic customers

*11. Collected tariff amount per customer = collected tariff amount / total number of customers

The equity ratio is used to measure the ability to pay off liabilities with equity. Because of accumulated losses, the equity ratio is negative. This indicates that IWK is not able to pay off liabilities without external budget injections. Return on assets measures the profitability of company assets. For sewerage companies, this indicator often shows a negative number. In IWK's case, the indicator has been worsening, reflecting the increase in net losses during the period under review.

The accounts receivable to sales revenue ratio expresses the relative amount of payments from sales to be collected the following year against total annual sales. A figure greater than 100% for this indicator suggests that IWK holds more amounts to be collected next year than actual sales for the year. This is caused by massive uncollected bills and the practice of billing domestic customers every six months Shortening of the billing cycle, as well as an improved collection rate would improve this indicator.

The O&M cost recovery ratio expresses billed sewerage tariffs as a percentage of O&M costs. Until fiscal year 2003, billed sewerage tariff amounts covered O&M costs. However, after May 2004, billed amounts could not cover necessary costs. The O&M and capital costs recovery ratio also expresses billed tariff amounts as a percentage of O&M and capital costs. Sewerage tariffs were not able to cover both O&M and capital costs. Furthermore, the indicator worsened after fiscal year 2004.

O&M cost per served customer shows the total O&M costs for each customer when dividing the total costs by customer. If every customer bears this amount per month, O&M costs for the year should be covered by tariff revenue. In 2007, O&M costs per served customer were RM 14.7 per month. It should be noted that, under the present system, customers were categorized according to domestic, commercial, industrial, and government premises. Commercial, industrial, and governmental premises are charged higher rates than those in the domestic category. The number reflected is an average for all customers. The O&M and capital costs per served customer metric represent the appropriations of

O&M costs and capital costs to each customer. RM 19.1 per month from all customers is enough to cover both O&M and capital costs for IWK assets.

IWK is trying to provide better operation and maintenance of the facilities by increasing the number of staff and O&M costs to cater to the increasing number of sewerage facilities each year. In order to provide appropriate sewerage service for the long run, it is necessary for the operator (IWK) to plan an adequate O&M budget. The costs shall be borne by customers or by the public budget as a last resort. Securing an appropriate O&M budget is vital.

Collected tariff amounts per customer expresses the actual average tariff revenue per customer. Types of customers include domestic, commercial, industrial, and governmental. The collected amount of tariffs per customer is RM 10.2 per month. The gap between this amount (RM 10.2/month) and O&M costs per served customer (RM 14.7/month) is the shortage of revenue per customer to maintain the present level of O&M. The gap between this amount (RM 10.2/month) and O&M and capital costs per served customer (RM 19.1/month) is the shortage of revenue per customer to cover the present level of O&M plus facility renovation by IWK.

(5) Effluent-Related License Fees

Based on regulations in the Environmental Quality Act, 1974, IWK is charged with an effluent-related license fee for sewage treatment plants operated by IWK, since they are in contravention of several water quality standards. Effluent-related license fees, or the "license-to–contravene" (LTC) fee, is charged in accordance with the volume of BOD_5 and/or oil and grease (O&G) that exceed limits specified in the Environmental Quality Act, 1974. Calculation formulae of LTC fees for BOD_5 and O&G for sewerage are as follows:

BOD_5

$$\frac{\text{Flow} \times 365\text{days} \times \text{Concentration of } BOD_5}{10^6} = BOD_5 \text{ (ton)}$$

$$\text{LTC fee for Std A} = BOD_5 \text{ (ton)} \times \text{RM 100/ton}$$

$$\text{LTC fee for Std B} = BOD_5 \text{ (ton)} \times \text{RM 10/ton}$$

O&G

$$\frac{\text{Flow} \times 365\text{days} \times \text{Concentration of O\&G}}{10^3} = \text{O\&G (kg)}$$

$$\text{LTC fee for Std A} = \text{O\&G (kg)} \times \text{RM 100/kg}$$

$$\text{LTC fee for Std B} = \text{O\&G (kg)} \times \text{RM 10/kg}$$

Note: Flow is calculated based on ultimate PE for the STP.

Data to calculate the LTC fee is taken at the highest recorded concentration of contaminants. The effluent data is gathered by IWK and samples are analised by IWK's certified

laboratories. The effluent data were obtained based on the routines/scheduled sampling to be conducted for the certain plants. BOD_5 and O&G for the effluent samples were taken over a 12-month period for the each sewage treatment plant.

The total amount of LTC fees on IWK for the period May 1st, 1999 to December 31st, 2006 (seven years) was approximately 2.1 billion RM. Most of the LTC fee was charged for oil and grease, since the unit LTC fee for O&G, computed by kilogram, was much greater than that of BOD_5. However, IWK has been exempted from the payment of LTC fees in accordance with the EQA clause. Clause 23 (1) of the Environmental Quality (Sewage and Industrial Effluent) Regulation 1979 specified as follows:

"If the Director-General is satisfied that research on effluent disposal or treatment of a kind or scale is likely to benefit the cause of environmental protection is or is planned to be carried out at any licensed premises, he may, with the approval of the Minister, wholly or partly waive any effluent-related amount payable by virtue or regulation 22(3)."

IWK has been provided with justification for total exemption of LTC fees because it is undertaking the research on effluent disposal, research on treatment, and is contributing to environmental protection.

(6) Management

1) Sewerage Tariff Billing and Collection

The IWK bills and collects a sewerage charge from its customers for both septic tank desludging and for connecting to public sewers. The tariff tables for four categories of customers—domestic, commercial, industrial, and government premises—are shown in **Table 2.5.7**, **Table 2.5.8**, **Table 2.5.9**, **and Table 2.5.10**. With respect to tariff setting, IWK participated in the preparation of the draft tariff table, and the first draft was changed based on discussions in MEWC and EPU. EPU has the final decision authority on the sewerage tariff. After this, the sewerage tariff table is approved by the Cabinet and published in the name of MEWC. There are no fixed or regular periods between tariff revisions. The concepts of tariff setting are as follows:

- To maintain a low rate for domestic premises
- To establish cross-subsidies for domestic premises by setting higher rates for commercial, governmental and industrial premises
- To provide exemptions for charitable organisations

Tariffs for domestic customers (**Table 2.5.7**) are set at constant price for three categories based on home values. Domestic premises also include government quarters used exclusively by Government servants with quarters broken into classes—A to I—corresponding to various grades. The majority of domestic customers are charged RM 6.00/month (septic tank) or RM 8.00/month (connected). Bills are prepared by a

subsidiary of Post Malaysia and sent through the post office to customers twice a year for each six-month charge. Customers can pay for the sewerage bill at the 17 IWK offices around the country by cash or check. They can also pay at post offices, and using bank methods, such as over-the-counter, ATM, internet banking, and credit card, among others.

Table 2.5.7 Sewerage Tariff for Domestic Premises

Type of premises	Septic tank	Connected
Houses with annual values more than RM 600.00 and government quarters in Grades A, B, C, D & E	RM 6.00/month Payment for six months	RM 8.00/month Payment for six months
Low-cost houses with annual values less than RM 600.00 and government quarters for civil servants in Grades F, G, H & I.	RM 2.00/month Payment for six months	RM 2.00/month Payment for six months
Houses located on land in zones classified as villages, new villages or estates by the relevant state authority	RM 3.00/month Payment for six months	RM 3.00/month Payment for six months

Source: IWK

Table 2.5.8 Sewerage Tariff for Industrial Premises

Type of premises	Septic tank	Connected
Industrial premises based on head-count/number of users	RM 2.00/person Monthly bill	RM 2.50/person Monthly bill

Source: IWK

Table 2.5.9 Sewerage Tariff for Commercial Premises

Monthly basic charge			
Band	Annual value (RM)*1	Basic charge (RM)	
		Connected	Septic tank
1	0 - 2,000	8.00	7.00
2	2,001 - 5,000	14.00	8.00
3	5,001 - 10,000	20.00	14.00
4	10,001 - 20,000	26.00	19.00
5	20,001 - 30,000	29.00	21.00
6	30,001 - 40,000	32.00	23.00
7	40,001 - 50,000	35.00	25.00
8	50,001 - 60,000	38.00	27.00
9	60,001 - 70,000	41.00	29.00
10	70,001 - 80,000	44.00	31.00
11	80,001 - 90,000	47.00	33.00
12	90,001 - 100,000	50.00	35.00
13	100,001 - 200,000	180.00	120.00
14	200,001 - 400,000	495.00	330.00
15	400,001 - 600,000	522.00	348.00
16	600,001 - 800,000	1,980.00	1,320.00
17	800,001 - 1,000,000	2,160.00	1,440.00
18	1,000,001 - 3,000,000	4,320.00	2,880.00
19	3,000,001 - 5,000,000	8,800.00	5,400.00
20	5,000,001 - 7,000,000	9,200.00	6,000.00
21	More than 7,000,001	9,600.00	6,600.00
Monthly excess charge *2			
Water usage		Excess charge	
Up to 100 m^3		No charge	
More than 100 m^3		30 sen / m^3	
More than 200 m^3		45 sen / m^3	

Source: IWK

Note: *1. Estimate of yearly rental charges for the premises

*2. Monthly excess charge, which is calculated based on water usage, is an additional charge to the monthly basic charge

In **Table 2.5.10**, government premises are those owned and occupied by any government department, local authority, or statutory body established by Federal or State law or by a court of law. For Commercial premises, annual values are determined through estimates of annual rental charges for the premises.

Table 2.5.10 Sewerage Tariff for Government Premises

Monthly basic charge		**Monthly excess charge**	
Sewerage services	Basic charge (RM)	Water usage	Excess charge
Connected	40.00	Up to 100 m^3	No charge
Septic tank	25.00	More than 100 m^3	45 sen / m^3
		More than 200 m^3	95 sen / m^3

Source: IWK

Sewerage tariffs for domestic premises have not been changed for 12 years since January 1997. For other premises, some tariff revisions have been made. The latest revision for commercial and government premises was implemented on August 1st, 2004. Major changes are as follows:

- Some bands for commercial premises were narrowed, and the number of bands was increased from 10 to 21.
- The number of tiers for the excess water charge for commercial premises was revised from two to three. The tier for consumption over 100 m3 was divided into two tiers: (i) 00 m3 to 200 m3 and (ii) over 200 m3. Before August 2004, the charge for the greater than 100 m3 tier was 45 sen/m3. After August 2004, the charge for the first tier (100-200 m3) was 30 sen/m3 and that of the second (greater than 200 m3) was 45 sen/m3.
- The excess water charge for government premises was raised.

Collection efficiency (defined as tariff collections as a percentage of total billed amount) of the sewerage charge has improved over the last eight years, as shown in **Figure 2.5.3**. Collection efficiency improved from less than 70% at the end of the 1990s to around 90% in the 2007. The right side of **Figure 2.5.3** shows the composition of sewerage tariffs collected in the 2007. Around 47% of collected tariffs come from domestic customers and 34%, 16% and 3% come from commercial, governmental, and industrial customers, respectively. **Table 2.5.11** delineates the collection efficiency for each category of customers. Collection efficiency for industrial customers is the best, followed by governmental and domestic customers. The commercial customers are lowest among these categories, which improved at 85.6% in the year 2007.

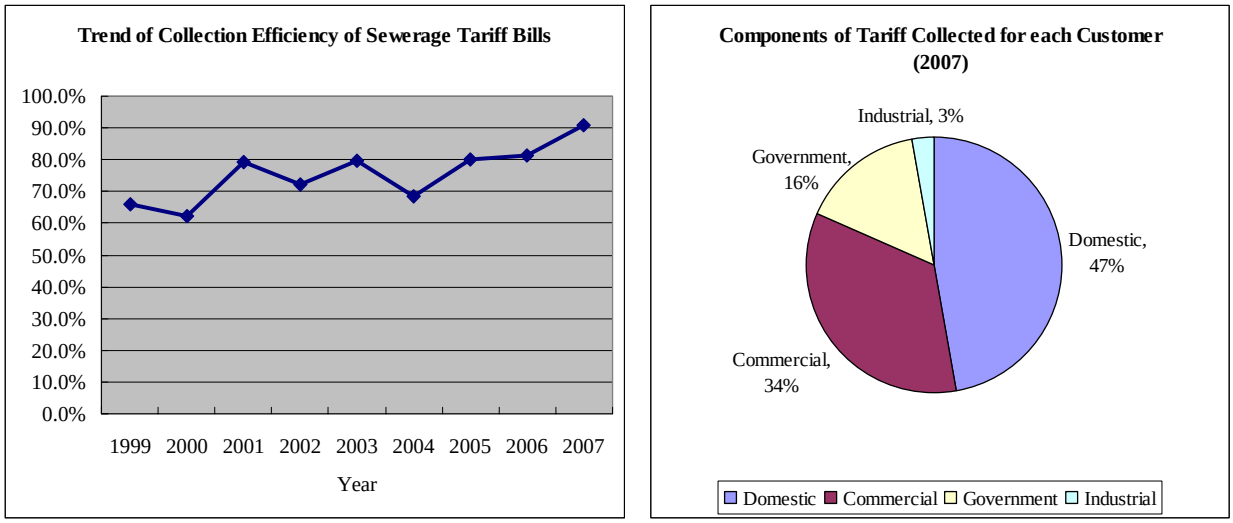


Figure 2.5.3 Collection Efficiency of Sewerage Bills and Components of Collected Tariffs

Table 2.5.11 Collection Efficiency of Sewerage Bills

(Unit: ×Million RM)

Year		1999/5 -2000/4	2000/5 -2001/4	2001/5 -2002/4	2002/5 -2003/4	2003/5 -2004/4	2004/5 -2005/4	2005/5 -2005/12	2006/1 -2006/12	2007/1 -2007/12
Domestic	Billed	73.9	88.7	101.8	113.6	128.2	149.9	86.8	164.9	174.0
	Collected	38.1	43.4	69.1	73.9	85.2	79.5	56.8	125.3	159.4
	Ratio (%)	51.6	48.9	67.9	65.1	66.5	53.0	65.4	76.0	91.6
Commercial	Billed	70.2	72.7	77.5	98.7	96.7	102.3	77	124.1	135.4
	Collected	52.7	48.7	69	74.3	87.1	83.4	61.6	105.3	115.9
	Ratio (%)	75.1	67.0	89.0	75.3	90.1	81.5	80.0	84.9	85.6
Government	Billed	13	15.9	20.5	35.9	41.2	50.8	32.2	58.6	53.8
	Collected	10	15.2	16.9	28.3	37.6	40.9	36.3	48.2	52.9
	Ratio (%)	76.9	95.6	82.4	78.8	91.3	80.5	112.7	82.3	98.3
Industrial[*1]	Billed	6.0	8.4	6.7	6.4	8.0	7.5	5.0	7.0	7.6
	Collected	6.9	7.9	8.4	7.7	8.2	8.5	5.9	9.1	9.3
	Ratio (%)	115.0	94.0	125.4	120.3	102.5	113.3	118.0	130.0	122.4
TOTAL	Billed	163.1	185.7	206.5	254.6	274.1	310.5	201.0	354.6	370.8
	Collected	107.7	115.2	163.4	184.2	218.1	212.3	160.6	287.9	337.5
	Ratio (%)	**66.0**	**62.0**	**79.1**	**72.3**	**79.6**	**68.4**	**79.9**	**81.2**	**91.0**

Source: IWK

Note: *1. For most of the years, collections exceed billed amounts in the industrial customer category. This is because some billed amounts for industrial customers were counted in the commercial category due to data input errors while collected amounts were correctly classified as industrial.

The number of customers for each category is shown in **Table 2.5.12**, where the total number of all customers has increased significantly; nevertheless, distribution of customers across categories has not changed much. In 2007, 91.6% of customers belonged to the domestic category, 7.9% to the commercial category, and government and industrial customers constituted 0.4% and 0.1%, respectively. As was shown in **Figure 2.5.3**, commercial, governmental, and industrial customers contributed a larger share (53%) in tariff revenue to IWK, though the number of customers amounts to only 8.4% of the total.

Table 2.5.12 Number of Customers by Category (last 10 years)

(Unit: ×1,000 RM)

Year	Type of customer									
	Domestic		Commercial		Government premises		Industrial		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
1998	1,026.057	90.2	103.656	9.1	2.931	0.3	4.206	0.4	1,136.850	100.0
1999	1,166.497	90.8	110.454	8.6	4.783	0.4	2.390	0.2	1,284.124	100.0
2000	1,287.499	91.0	118.527	8.4	6.587	0.5	2.179	0.1	1,414.792	100.0
2001	1,526.263	90.8	143.651	8.5	8.508	0.5	2.526	0.2	1,680.948	100.0
2002	1,708.380	90.8	159.432	8.5	9.449	0.5	3.373	0.2	1,880.634	100.0
2003	1,899.113	90.7	180.018	8.6	10.545	0.5	3.840	0.2	2,093.516	100.0
2004	2,170.818	90.8	204.241	8.5	11.111	0.5	4.224	0.2	2,390.394	100.0
2005	2,328.669	90.9	215.679	8.4	11.604	0.5	4.982	0.2	2,560.934	100.0
2006	2,549.449	90.8	240.926	8.5	13.331	0.5	4.596	0.2	2,808.302	100.0
2007	2,521.573	91.6	217.191	7.9	11.009	0.4	4.038	0.1	2,753.811	100.0

Source: IWK

The larger tariff revenue from commercial, industrial, and governmental customers was due to the higher tariffs per customer for these categories. **Table 2.5.13** utilizes data for total billed sewerage tariff amounts and the number of customers per category over the last seven fiscal years. On average, government customers pay the highest tariffs, followed by industrial customers, commercial customers, and lastly, domestic customer, who pay the lowest tariffs. It should be noted that this order does not necessarily correspond with the order of the sewerage tariff per unit of treated sewage volume, since the three categories (commercial, government, and industrial) cover entities of various size.

Table 2.5.13 Average Sewerage Tariff Billed by Customer Category

Item	Type of customer			
	Domestic	Commercial	Government	Industrial
Average tariff billed (RM/month)	5.5	46.1	334.9	158.6

Note: Calculated by JICA Study Team, based on the data provided by IWK

Table 2.5.14 shows sewerage tariffs as a percentage of monthly household income, using data from **Table 2.5.13**. In Selangor State, sewerage tariff amounts are the lowest at 0.11% of household income. The highest is 0.30% in Kelantan. On average, for the whole of Malaysia, 0.17% of household income is spent on sewerage tariffs. The IBRD "Project Appraisal Manual" estimates that 1% of household income is the maximum level for sewerage service household affordability. The Pan American Health Organisation also recommends that total water supply and sewerage charges should be less than 5% of household income, with 3.5% for water supply and 1.5% for sewerage. The current sewerage charge in Peninsular Malaysia at 0.17% of household income is around one sixth of this ceiling (1%) set by an international organisation. For reference, total monthly water supply and sewerage tariffs are 0.78% of the average household income for Malaysia, which

is one sixth of the ceiling (5%).

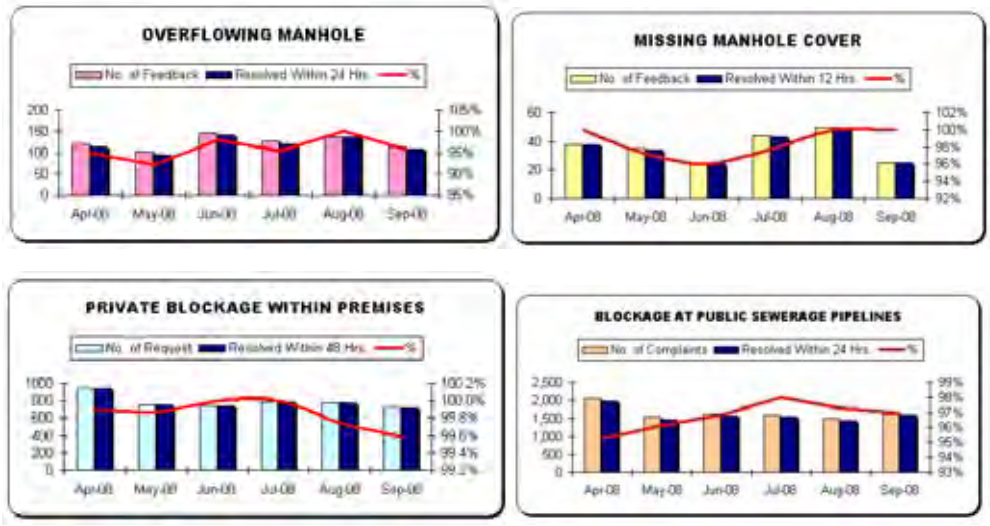
Table 2.5.14 Average Monthly Tariff as a Percentage of Average Monthly Household Income

No.	State	Average monthly household income 2004 (RM)	Ave. monthly tariff (sewerage) (RM) average 2001-07	Monthly tariff as % of ave. monthly income (Sewerage)	Ave. monthly tariff (water supply) (RM)	Monthly tariff as % of ave. monthly income (water supply)
1	Kedah	2,126	5.5	0.26		0.79
2	Perak	2,207	5.5	0.25		0.74
3	Perlis	2,046	5.5	0.27		0.74
4	Pulau Pinang	3,531	5.5	0.16		0.28
5	Melaka	2,792	5.5	0.20		0.65
6	Negeri Sembilan	2,886	5.5	0.19		0.47
7	Selangor	5,175	5.5	0.11		0.57
8	Johor	3,076	5.5	0.18		0.77
9	Kelantan	1,829	5.5	0.30		0.76
10	Pahang	2,410	5.5	0.23		0.60
11	Terengganu	1,984	5.5	0.28		0.75
12	Sabah	2,487	-	-		1.56
13	Sarawak	2,725	-	-		0.61
	Malaysia	3,249	5.5	0.17%		0.61

Source: JICA Study Team, based on average monthly household income data in the 1999 and 2004 Household Income Surveys from the Department of Statistics and average monthly tariff (water supply) data from the Malaysia Water Industry Guide 2006s.

2) Public Service Performance

IWK strives to provide efficient and environmentally-sound sewerage services to all customers. These services are monitored and evaluated to facilitate continuous improvement. The performance of typical activities is shown in **Figure 2.5.4**.



Source: http://www.iwk.com.my/f-customer-service.htm

Figure 2.5.4 Public Performance of IWK

2.6 Other Sewerage Service Operators in the Peninsula

Sewerage service operators other than IWK in the Peninsula undertake the operation and maintenance of sewerage facilities in Kelantan State, and Johor Bahru City and PBT Pasir Gudang in Johor State.

2.6.1 Kelantan State

At present, IWK does not cover any sewerage facilities in the State of Kelantan and has little information on their present status as well as SSD. The local authorities are reportedly responsible for the operation and maintenance of sewerage facilities. The sewage tariff differs from that of IWK but details are unknown.

2.6.2 Johor Bahru City and PBT Pasir Gudang

In the State of Johor, the operation and maintenance of sewerage facilities fall under the services of IWK. However, this is not the case for Johor Bahru City (MBJB) and PBT Pasir Gudang where the sewerage systems have not been taken over by SSD, according to the Draft Final Report on "Sewerage Catchment Study for Wilayah Perbangunan Iskandar (WPI), Johor Darul Ta'Zim" issued in May 2008. The report indicates that there are 82 public STPs with a total design PE of 537,770, 225 private STPs (387,028 PE), 37,950 ISTs (200,580 PE) and 17,344 substandard systems (87,313 PE) in Johor Bahru City Centre Catchment, and 32 public STPs (329,014 PE), 42 private STPs (73,245 PE), 6,918 ISTs (81,195 PE) and 4,460 substandard systems (21,045 PE) in Eastern Gate Catchment, in which PBT Pasir Gudang belongs to Sg. Kim Kim Sub-catchment.

However, any information on the organisation responsible for operation and maintenance of sewerage facilities was not included in the Report, and both SSD and IWK have little information. The operation and maintenance of sewerage facilities are reportedly undertaken by private contractors, and the sewage tariff differs from that of IWK, but details are unknown.

2.7 Water and Sewerage Sectors in the Sabah State Government

(1) Overview

Sabah State is the second largest among Malaysia's thirteen states after Sarawak. The area of the state is 76,115 km^2 with an official population of 2.5 million (2000) and an estimated population of 3.4 million in 2007. The Head of the Sabah State is Yang di-Pertua Negeri (State Governor) who is a political appointee (by the Federal Government). The Chief

Minister is the head of the State Cabinet and also heads the Chief Minister's Department. There are ten state Ministries, each headed by State Cabinet Ministers.

The State is comprised of five administrative divisions, which are divided into 24 districts: (i) West Coast Division (7,588 km^2): Kota Belud, Kota Kinabalu, Papar, Penampang, Ranau, Tuaran; (ii) Interior Division (18,298 km^2): Beaufort, Nabawan, Keningau, Kuala Penyu, sipitang, Tambunan, Tawau; (iii) Kudat Division (4,623 km^2): Kota Marudu, Kudat, Pitus; (iv) Sandakan Division (28,205 km^2): Beluran, Kinabatangan, Sandakan, Tongod; and (v) Tawau Division (14,905 km^2): Kunak, Lahad Datu, Semporna, Tawau.

Each of these districts is administered by a local authority. There are 22 local authorities in Sabah, and they are classified into four types: (i) District Councils covering 18 local authorities, (ii) City Hall covering Kota Kinabalu, (iii) Municipal Councils covering Tawau and Sandakan and (iv) Town Board covering Kudat.

(2) Organisation

Water and sewerage services in Sabah are administered by the State Ministry of Infrastructure Development. The organisation structure of the Ministry is shown in **Figure 2.7.1**.

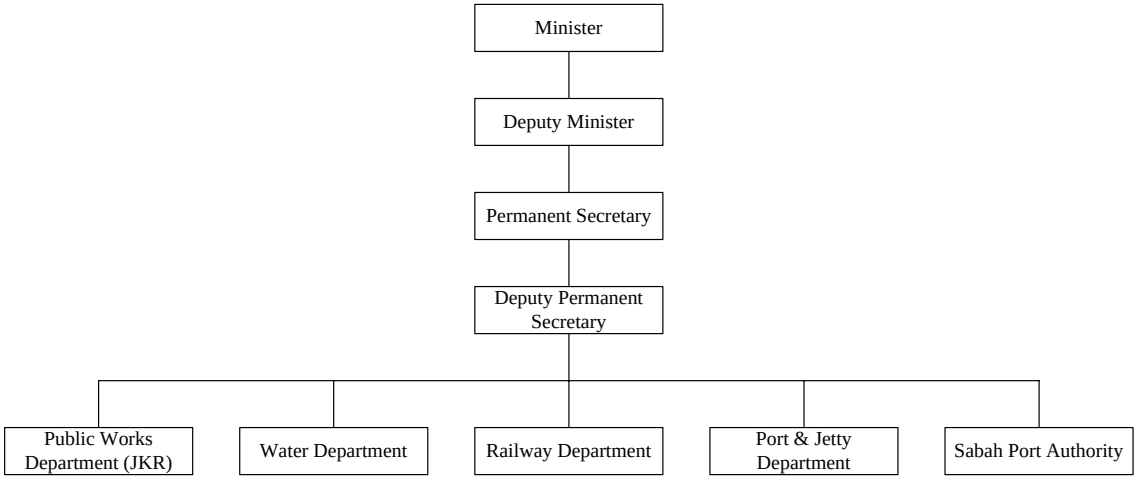


Figure 2.7.1 Organisation of the Sabah State Ministry of Infrastructure Development

There are four departments and one agency under this Ministry: namely, the Water Department, the Public Works Department, the Railway Department, the Ports and Jetties Department, and the Sabah Port Authority. The Sabah Water Department is responsible for water while the Public Works Department is responsible for sewerage services in the State.

1) Sabah Water Department

The Sabah Water Department was established on January 1st, 1988 after the approval of all amendments to the Water Supply Ordinance 1961 by the State Assembly in April 1987. The amendments involved the change of responsibility for water from the Director of Public Works to the Director of Water Department in Section 2, Water Supply Ordinance 1961, as well as the nullification of Sabah Water Authority Enactment 1981. Before January 1st, 1988, the Hydraulic Section of the Public Works Department was responsible for the handling of water supply in Sabah. The Sabah Water Department functions in accordance to the Water Supply Ordinance 1961 (Sabah No. 16 of 1961).

The Sabah Water Department is responsible for providing potable water supply throughout the State from intake, treatment, and distribution to billing and collection. Its key functions include:

- Planning, designing and implementation of new water supply development projects to meet future water demand
- Operation and maintenance of existing water supply
- Provision of advisory services on technical matters relating to water supply to other state government departments and agencies, and local authorities

2) Sabah Public Works Department (JKR Sabah)

JKR Sabah is responsible for planning, design, implementation, and operation and maintenance of Sabah state roads, bridges, public sewerage facilities and government buildings.

The District Offices are the executing arms of JKR Sabah. The District Engineers have the added responsibility for the operation and maintenance of all sewerage systems under their jurisdiction apart from their core responsibility of construction supervision and the operation and maintenance of public works and services such as state roads, government buildings, and bridges, among others.

The Sewerage Branch was recently set up (end of 2005) within JKR for the sole purpose of providing sewerage services for the State of Sabah. The organisation chart of the Sewerage Branch within the JKR headquarters is shown in **Figure 2.7.3**.

The organisation structure of JKR is shown in **Figure 2.7.2**.

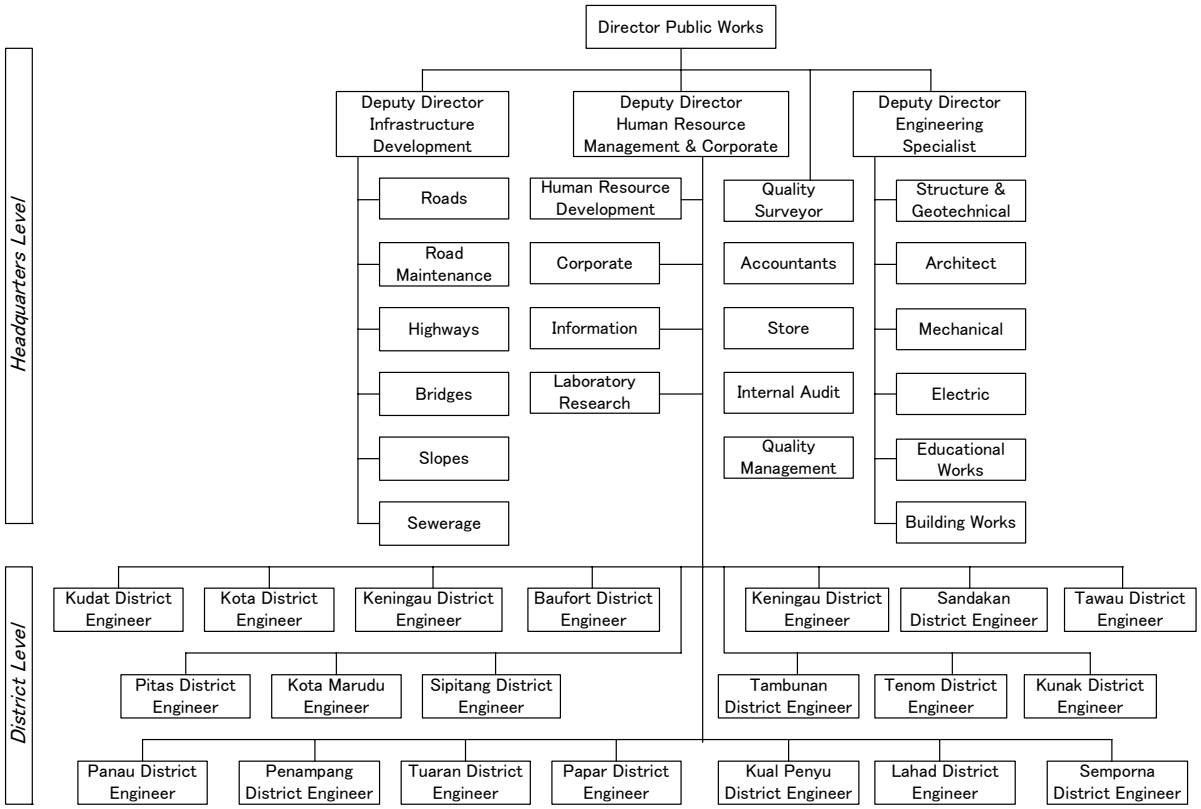


Figure 2.7.2 Organisation of Public Works Department (JKR)

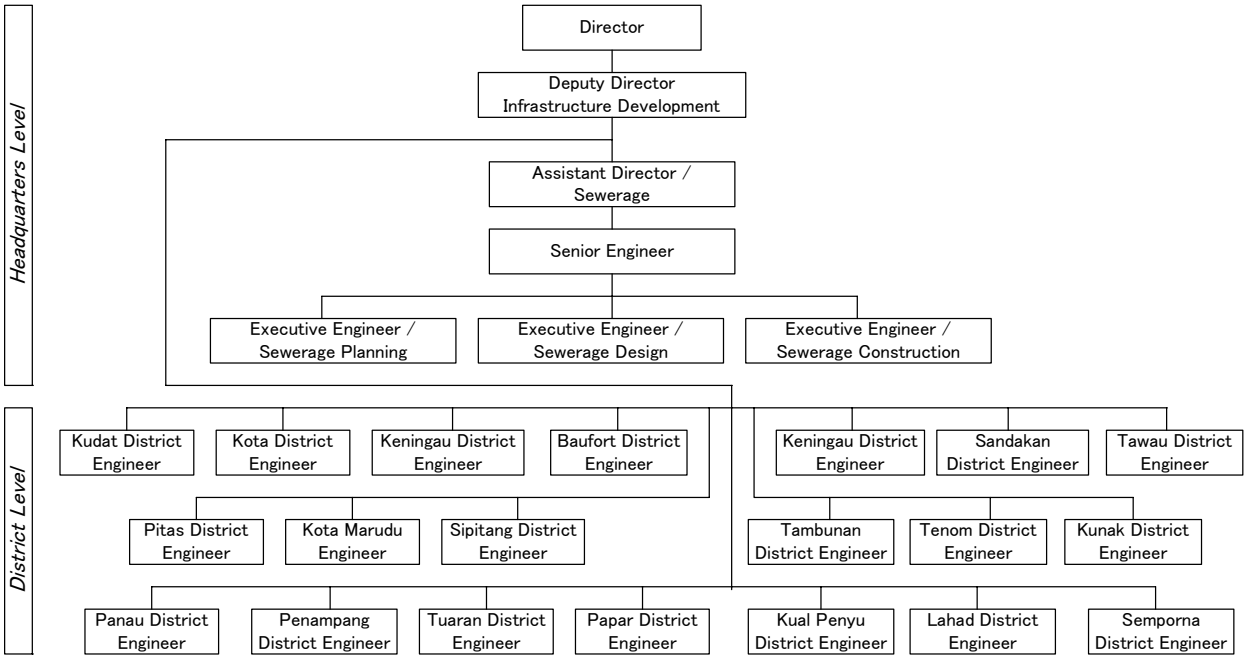


Figure 2.7.3 Organisation of the Sewerage Branch

The responsibilities for planning, construction and maintenance of public sewerage facilities are split between the Sewerage Branch and JKR District Offices. Planning and construction is the responsibility of the Sewerage Branch at the headquarters level while O&M falls within the responsibility of various JKR District Engineers.

The Sewerage Branch has the following responsibilities for sewerage services in Sabah: (i) planning, investigation, design and implementation of public sewerage schemes; (ii) providing technical advice to the district engineers on the operation and maintenance of public sewerage schemes, and (iii) providing technical advice to district engineers and local authorities on sewerage proposals submitted by the private developers.

(3) Staffing

The existing staffing within the Sewerage Branch of JKR seems inadequate to undertake the management of sewerage services in Sabah. Similarly, at the district level, the number of staff is also inadequate for proper operations and management of the sewerage facilities. The focus at the district level is mostly on public roads, bridges and buildings, and, as such, sewerage is of low priority in terms of manpower and financial resource appropriations. Generally, most of the routine operation and maintenance and emergency repairs are outsourced to local contractors. **Table 2.7.1** shows typical staffing at JKR district offices for sewerage facilities operation and maintenance.

Table 2.7.1 Typical Sewerage O&M Staffing at JKR District Offices and JKR District Staff Assigned to Sewerage Facilities O&M

No.	District	Technical Assistants/ Technicians	Specialised Workers	General Workers
1	Papar	1	2	2
2	Kudat	3	-	6
3	Kota Belud	2	2	2
4	Tawau	1	-	10
5	Lahad Datu	1	-	4
6	Sandakan	-	2	11
7	Kota Marudu	2	3	-
8	Tuaran	1	5	3
9	Ranau	2	3	2
10	Tenom	1	-	-
11	Keningau	1	-	6

(4) Management and Services

Sewerage services in the towns in Sabah are officially under the responsibility of the various local authorities in accordance with relevant state legislation, Public Health Ordinance 1960, and the Local Government Ordinance 1961. However, in reality, the actual administration of public sewerage facilities in the local authority areas is undertaken largely by Jabatan

Kerja Raya (JKR) Sabah (Public Works Department Sabah) on behalf of the local authorities, except for the City of Kota Kinabalu.

Due to limited manpower and technical and financial resources, the local authorities in Sabah have signed individual agreements with JKR Sabah for JKR to plan, implement, operate and maintain the sewerage systems in their respective areas and, in turn, JKR is to be reimbursed by the local authorities for this service yearly at an agreed amount as specified in these agreements. JKR is the implementing agency for these sewerage infrastructure projects.

According to the agreements between JKR and the local authorities, JKR is required to hand over the sewerage systems to the local authorities for operation and maintenance upon completion or as and when they are capable of taking it back. So far, only Kota Kinabalu City Hall (DBKK) and Penampang District have taken back the operation and maintenance of the sewerage facilities in their districts.

In most local authority areas, JKR is responsible for the planning, implementation, operation and maintenance of the centralized sewerage systems that are implemented by JKR. All other sewerage systems (mostly constructed by developers) handed over to the local authorities are under the jurisdiction of the local authorities. Individual septic tanks are maintained by the respective owners while private developments with individual treatment units are maintained by the property management.

There are a number of coordination issues related to the present arrangement in managing sewerage services especially in municipalities and towns where both JKR and the local authorities manage sewerage services. Key issues include:

- The problem of who is the appropriate authority to see, or go to, for developers and the general public for matters related to submitting proposals or presenting complaints.
- The JKR is the technical authority responsible for the vetting and approval of sewerage proposals in development plan submissions for all districts, but the final approval of these plans lies with the local authorities.
- There are no standard guidelines on sewerage plans and document submission, since the requirements of the local authorities may differ from those of JKR, an issue that impacts the approval process.
- There is a lack of coordination and integration in planning for new sewerage developments in municipalities and districts, since both JKR and the local authorities have overlapping functions related to sewerage, and most local authorities do not have long term sewerage master plans for their areas.

(5) Status of Sewerage Infrastructure in Sabah

The sewerage infrastructure in Sabah is generally underdeveloped and poorly maintained as was the case in West Malaysia up to 1995 before the privatization of sewerage services there.

Sewerage master plans were prepared in the 1980's and 1990's for Kota Kinabalu, Sandakan, Tawau, Kudat, Kota Belud, Papar, Keningau and Semporna. The urban areas of Kota Kinabalu, Sandakan and Tawau are sewered to waste stabilization lagoons built in the early 1980's and 1990's. The southern catchment of Sandakan Town is sewered to a marine outfall. The central oxidation ponds constructed in the 1980's serving the small towns of Lahad Datu, Keningau, Tuaran and Kota Marudu Township are still in operation except for Lahad Datu, which is overloaded, and is due for expansion. The other sewerage systems, not mentioned above, under JKR management are mostly septic tanks for government buildings and quarters.

The other areas in these towns and the other municipalities and districts in Sabah are served by individual septic tanks, pour flush latrines, and small sewage treatment plants serving individual developments/buildings. These facilities are not maintained by JKR.

JKR has implemented the Phase 1 Papar and Semporna Sewerage Schemes and will implement 18 sewerage development projects and five sewerage refurbishment/upgrading projects costing RM273 million under the 9th Malaysia Plan. In this connection, the State Government has recently (mid-July 2007) awarded a major contract of over RM180 million to Rastamas-Salcon JV to undertake the Kota Kinabalu Integrated Sewerage Scheme. This project will be funded with a grant to the State from the Federal Government and will be implemented by the Sewerage Branch of JKR under the Ministry of Infrastructure Development.

(6) Financial Aspects

As previously mentioned, sewerage services in Sabah State are officially the responsibility of the local authorities. But because the local authorities have limited staff as well as resources, individual agreements were made with JKR to plan, construct, operate and maintain the sewerage facilities, mainly centralized sewerage systems. Local authorities are required to pay the service charges specified in the individual agreement to the state government. In addition, the agreement also calls for cost recovery for capital investment and O&M from payments by the local authorities. However, the actual payments were short of the required amounts, thereby increasing the total amount due to the State Government (from the local authorities) of more than RM 112 million as of 1999.

This prompted the State Cabinet cancel these debts on December 5, 1999 and changed the charges on local authorities from covering capital costs and O&M costs to covering only the O&M costs after January 2000. These charges are now paid directly to the State Government. JKR Sabah receives its annual budget appropriations from the State

government. JKR budget appropriations for 2005 are shown in **Table 2.7.2**.

Table 2.7.2 Approved JKR Budget Appropriations (2005)

Item	Appropriations (RM)	%
Staff Salary and allowances	78,700,000	-
Administration cost	3,869,030	-
Building	20,350,010	24.8
Road & port	28,957,570	35.3
Engineering	2,700,010	3.3
Sewerage (O&M)	3,700,000	4.5
General services	26,358,040	32.1
TOTAL	164,634,660	100.0

Source: Annual Report 2005, JKR

Operation and maintenance costs for sewerage are only 4.5% of the total JKR budget (minus salaries, allowances, and administrative costs). The costs are allocated to each JKR district office, which manages the sewerage operation and maintenance work. **Table 2.7.3** shows appropriations for sewerage O&M costs to each JKR district office and actual expenditures for 2005.

The O&M costs include electricity costs, equipment costs, repair costs, car rental costs, temporary staff salaries and overtime salaries of regular staff, among others. Regular staff salaries are not included in the above O&M costs, since they are included within JKR staff salaries. O&M budget requirements to properly maintain the sewerage facilities are much higher. For example, Lahad Datu district in Sabah State, which was allocated RM 120,000 per year as the O&M budget for sewerage, had requested an O&M budget of RM 749,000 per year, six times that of the actual budget appropriations.

Table 2.7.3 Appropriations and Actual Sewerage O&M Expenditures, JKR (2005)

(Unit: RM)

District	Appropriations from State Govt.	Initial appropriations to district	Additional appropriations	Actual expenditure
Papar	-	80,000	100,673	180,673
Tuaran	-	80,000	0	80,000
Kota Belud	-	200,000	0	200,000
Ranau	-	80,000	0	80,000
Kudat	-	200,000	47,116	247,116
Kota Marudu	-	80,000	118,835	198,835
Sandankan	-	400,000	108,140	508,140
Beaufort	-	200,000	162,250	362,250
Keningau	-	200,000	165,000	365,000
Tambunan	-	80,000	0	80,000
Tenom	-	80,000	0	80,000
Tawau	-	400,000	126,000	526,000
Lahad Datu	-	120,000	222,081	342,081
Kunak	-	80,000	34,800	114,800
Semporna	-	80,000	0	80,000
TOTAL	3,700,000	2,360,000	1,084,895	3,444,895

Source: Jabatan Kerja Raya (JKR)

Capital costs of sewerage facilities are funded by the state government and loans from the federal government. When the State funds for capital expenditures are fully utilized, federal funds are then used.

Sewerage tariffs, referred to as "Sewerage Rates" by most local authorities in Sabah State, are set, billed, and collected by each local authority. The sewerage rate is calculated by the following formula:

Sewerage Rate (RM) = Ratable Value (RM) × Sewerage Rate (%)

This formula is common for all the customers, including commercial, industrial, and governmental customers. Ratable value is the appraised value of the residence/building assessed by each local authority. Sewerage rates are set at 4% to 7% of ratable value depending on each local authority and as advised by the State Government.

At present, no capital contribution charges for sewerage (for new sewerage facilities built by developers) are collected except within Kota Kinabalu and Sandakan by the respective local authorities.

(7) Draft Sewerage Enactment

A draft Sewerage Enactment prepared by the Sabah Ministry of Infrastructure Development is currently being reviewed by the State Attorney General. This proposed Sewerage Enactment will bring sewerage services for all local authority areas in Sabah under a Sewerage Services Council to be set up within the State JKR under the Ministry of Infrastructure Development. It is anticipated that this Sewerage Snactment will soon be introduced to the Sabah State Assembly.

Under this proposed Sewerage Enactment, a Sewerage Council will be set-up as the regulatory and policy-making body to oversee the sewerage sector in Sabah. The Draft Sewerage Enactment is a confidential document and was not available for review.

It is anticipated that the implementation, operation and maintenance of sewerage services in Kota Kinabalu City, currently under DBKK authority, may be taken over by the Sewerage Council in the State JKR if the proposed Sewerage Enactment comes into law.

2.8 Kota Kinabalu City Hall

(1) Overview

Kota Kinabalu is the capital city of Sabah State and is the seat for the Sabah State Legislative Assembly and the state government where almost all of their ministries and

agencies are based. Most of the federal government agencies and departments are also located in Kota Kinabalu.

The city is administered by Kota Kinabalu City Hall (Dewan Bandaraya Kota Kinabalu/DBKK). The city obtained city status on February 2, 2000 and, prior to this, was administered by Majlis Perbandaran Kota Kinabalu (Kota Kinabalu Municipal Council). The city is defined by the borders of the district and formerly the municipality, of Kota Kinabalu. With a total area of 351 square kilometers, it is the smallest but most populous district in Sabah. The urban population is approximately 700,000 (2007).

DBKK is responsible for providing urban services as required by Kota Kinabalu City Hall Enactment 1996. DBKK also administers the Local Government Ordinance (LGO) 1961.

The provision of sewerage services in Kota Kinabalu by DBKK is governed by the following legislations: (i) Public Health Ordinance 1960; (ii) Municipal and Urban Authorities Ordinance (Cap. 162); and (iii) Kota Kinabalu Municipal Council (Sewerage) By-Laws, 1960.

(2) Organisation

Kota Kinabalu City is administered by DBKK and is headed by a mayor who is appointed by the Chief Minister of Sabah. DBKK is a department under the Chief Minister's Office. The organisation structure of DBKK is depicted in **Figure 2.8.1**.

Sewerage services for Kota Kinabalu City are provided by the Engineering Department of DBKK. The organisation structure of DBKK's engineering department is depicted in **Figure 2.8.2**.

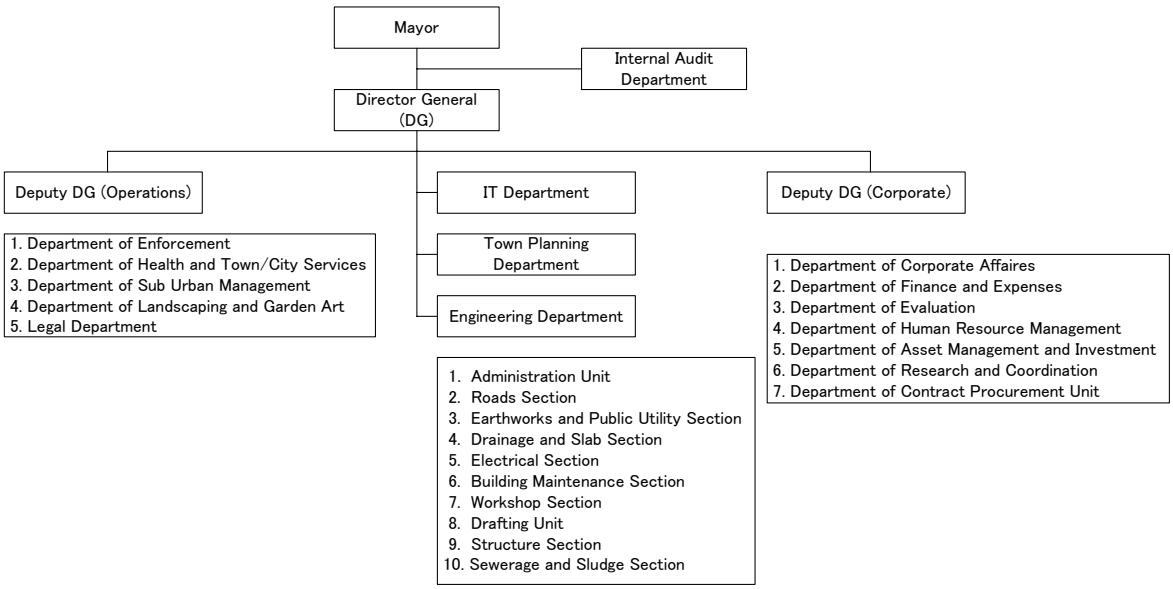


Figure 2.8.1 Organisation Structure of DBKK

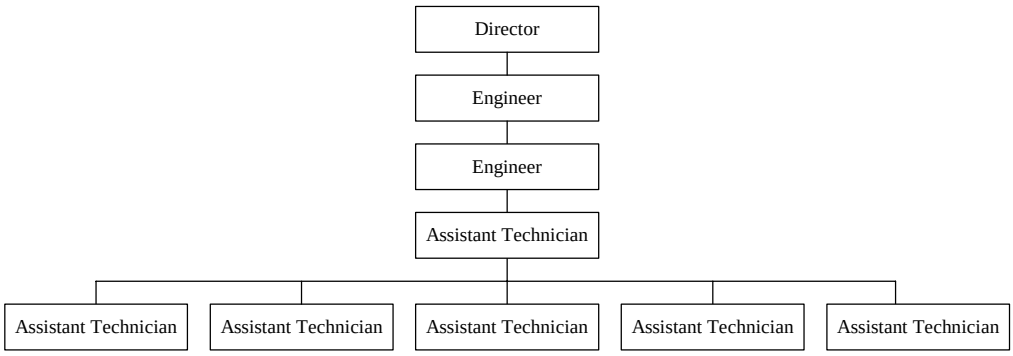


Figure 2.8.2 Organisation Structure of DBKK Engineering Department

The Department is headed by a director and assisted by a senior engineer and engineer. The Sewerage and Solid Waste Section is a section within the Engineering Department, and a senior technician and four assistant technicians support the sewerage and solid waste section. This section is responsible for the city's sewerage and solid waste planning, engineering, management and operations. A total of 48 sewage treatment plants in Kota Kinabalu City (total PE = 300,000) and a sewer network of approximately 180 km are managed by this section.

(3) Staffing

The Engineering Department in DBKK is responsible for providing engineering support to DBKK and is in charge of maintenance of drains, sewerage systems, solid waste management, roads, public facilities and public buildings under its jurisdiction, plan approvals, and inspections of new structures, buildings, housing and infrastructure developments within Kota Kinabalu City. It has 168 staff members across a number of technical divisions and support units.

(4) Management

The Sewerage Master Plan for Kota Kinabalu was prepared in 1981, and only the first phase of the plan was implemented in the mid-1980s. DBKK is developing a draft sewerage master plan for the northern, central and southern catchments. This draft master plan serves only as a guide, since the physical sewerage system has not been fully constructed. Sewerage planning for Kota Kinabalu is also guided by Majlis Perbandaran Kota Kinabalu's document "Directions for the Design of Sewers and Sewage Treatment Plant". DBKK also uses the "Sewerage Guidelines" issued by the Sewerage Services Department and Malaysian Sewerage Standards – MS 1228 (Code of Practice for Design and Installation of Sewerage Systems) as a standard reference for the detailed planning and design of sewerage systems.

DBKK requires that all new developments within the City Hall's jurisdiction construct sewerage systems to connect to the public central sewerage system where a "Sewerage Capital Contribution" must be paid. Where the public central sewerage system is not available, then small sewage treatment plants serving that development may be accepted. Developments with a total PE below 150 are allowed to use individual septic tanks. Developments such as flats and condominiums must operate and maintain sewerage treatment system through their management corporations.

Figure 2.8.3 shows current sewerage facilities in Kota Kinabalu.

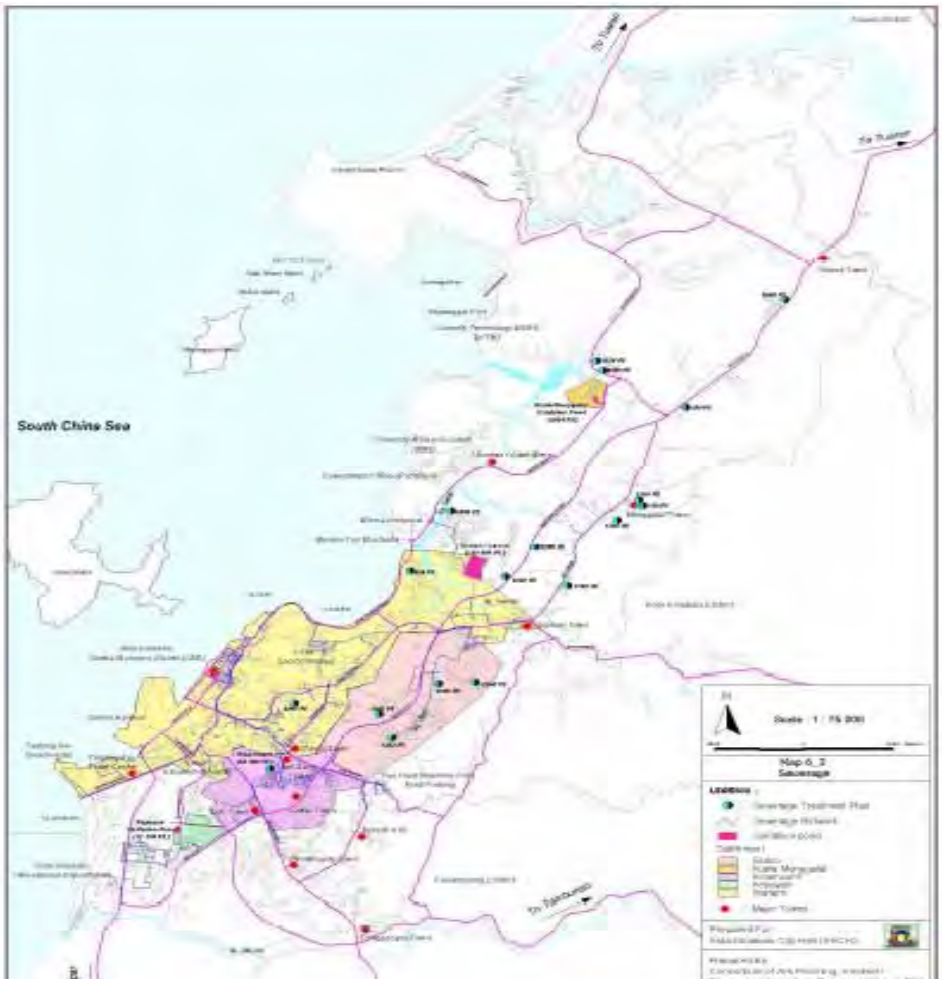


Figure 2.8.3 Current Sewerage System in DBKK

Table 2.8.1 shows the list of sewage treatment plants managed by DBKK, design P.E., location and working conditions. A total of 300,000 PE are sewered to 48 plants through 180 kilometers of public sewers. Although 33 plants are listed in good working condition, it has been observed based on random site visits that overall housekeeping and maintenance is generally poor, and it is unlikely that most plants meet effluent standards. Most plants require major refurbishment to raise performance to operational requirements. The operation and maintenance of the entire Kota Kinabalu City Sewerage System (network, pump station and sewage treatment plants) are contracted to two O&M contractors.

However, O&M contracts are limited to emergency clearance of sewer blockages, routine inspection, maintenance and housekeeping of only working sewage treatment plants and pumping stations. Therefore, many facilities are inadequately operated and maintained.

Table 2.8.1 Operational Status of Sewage Treatment Plants under DBK

No.	Status of Sewage Treatment Plant	Unit		Area	Location	STP(PE)
1	Bad condition	1	A	42	Kian Yap Industrial	500
2	Bad condition	2	A	53	Taman Nelly	4,160
3	Bad condition	3	A	55	Taman B.D.C	5,000
4	Bad condition	4	A	62	Taman Kolombong	600
5	Bad condition	5	A	72	Taman Judy	200
6	Bad condition	6	A	73	Seri Kemajuan I & II	400
7	Bad condition	7	A	74	Taman Syn Fah	270
8	Bad condition	8	A	82	Taman Tobobon	500
9	Bad condition	9	A	84	Teluk Likas	270
10	Bad condition	10	A	90	Tmn Khidmat No. 3	2,100
11	Bad condition	11	A	99	Taman Keramat, Jalan Tuaran	3,000
12	Bad condition	12	B	70	Austral Ph11,13& 14, K'pyn. Ridge	1,420
13	Not running	1	A	40	Putra Jaya	8,600
14	Not running	2	A	104	Taman Bunga Raja Ph.IA & IIA	2,346
15	Not running	3	A	89	Tmn. View Point	1,000
16	Decent working condition	1	A	80	Taman Sepanggar	2,000
17	Decent working condition	2	B		Kepayan Oxidation pond	11,500
18	Decent working condition	3	A	141	Taman Kurnia Jaya Likas	450
19	Decent working condition	4	A	70	Sinar Light Industrial	384
20	Decent working condition	5	A	114	Taman Seri Baru Menggatal	2,310
21	Decent working condition	6	A	126	Taman Permai Ph.1, Menggatal	3,150
22	Decent working condition	7	A		Inanam Oxidation pond	120,000
23	Decent working condition	8	A		Kuala Menggatal Oxidation	3,000
24	Good working condition	1	A	43	Taman Delta 5.5	600
25	Good working condition	2	A	52	Kolombong Industrial	1,692
26	Good working condition	3	A	57	Sedco No. 1	5,000
27	Good working condition	4	A	64	Taman Dai Ming Baru	1,800
28	Good working condition	5	A	71	Daita Development	1,244
29	Good working condition	6	A	76	Wijaya Park	1,000
30	Good working condition	7	A	78	Menggatal New Township	1,500
31	Good working condition	8	A	86	Kingfisher Park Ph. I & II	1,200
32	Good working condition	9	A	95	Taman Kemajuan LCH	1,158
33	Good working condition	10	A	97	Taman Ria Ph. 1, Ring Road	1,342
34	Good working condition	11	A	111	Hiong Tiong Industrial Centre	1,000
35	Good working condition	12	A	123	Taman Indah Permai Shophouses	8,300
36	Good working condition	13	A	130	Taman Mensiang Menggatal	186
37	Good working condition	14	A	131	Taman Seri Pulutan	1,500
38	Good working condition	15	A	137	Taman King Fisher Phase II	6,590
39	Good working condition	16	A	143	Taman Kingfisher 3	550
40	Good working condition	17	A	144	Tmn Seri Indah Kuala Menggatal	900
41	Good working condition	18	A	145	Taman Bakti Ikhlas Menggatal	3,500
42	Good working condition	19	A	146	Tmn Seri Borneo Off Jln Lintas	1,260
43	Good working condition	20	A	151	Tmn Harmoni Inanam Laut	330
44	Good working condition	21	A	156	Tmn Industry Warisan Inanam	3,700
45	Good working condition	22	B	68	Kepayan Ridge Ph.9	5,682
46	Good working condition	23	B	71	LCH Phase 18 & 19	6,000
47	Good working condition	24	B	111	Kinamount STP	65,000
48	Good working condition	25	A	136	Taman Inanam Laut	5000
I	Bad condition	12				
II	Not running	3				
III	Decent working condition	8				
IV	Good working condition	25				
		48				

A: O&M service company for northern catchment
B: O&M service company for central and southern catchments

(5) Financial Aspects

Sewerage management in Kota Kinabalu is undertaken by the Kota Kinabalu City Hall (DBKK) as one of the engineering services provided for the city and includes road, drainage, and other public facilities maintenance. The DBKK allocates the budget for sewerage services management, and the budget is not independent from other services. Capital costs are funded by the State budget and/or the federal budget. The revenue and expenditures for DBKK for the six-year period from 2002 to 2007 are shown in **Table 2.8.2**.

Table 2.8.2 Revenue and Expenditures of DBKK

(Unit: ×Million RM)

Year	2002	2003	2004	2005	2006	2007
1. Operating revenue	53.6	64.4	62.7	73.1	76.5	74.2
2. Grant for capital investment, etc	0.0	4.6	5.8	0.0	0.0	0
3. Other revenue	8.2	3.8	3.2	1.5	3.5	4
Total revenue (1. to 3.)	**61.8**	**72.8**	**71.7**	**74.6**	**80.0**	**78.2**
4. Operating expenses	52.8	58.4	60.4	66.8	74.3	74.1
5. Capital investment by grant, etc.	0.0	4.6	5.5	0	0.3	0
6. Other expenses	7.7	3.3	2.1	3.4	3.6	4.8
Total expenditures (4. to 6.)	**60.5**	**66.3**	**68.0**	**70.2**	**78.2**	**78.9**

Source: Prepared by JICA Study Team, based on the Audit Report of DBKK, for the year 2002 to 2007.

Property assessment taxes contributed more than 70% of the total revenue while sewerage revenue contributed 7% of the total revenue. These are the two major revenue sources. On the other hand, salary and allowances account for around 45% of total expenditures. DBKK expends around 20% of total expenditures for operation and maintenance costs for public utilities including sewerage services.

Table 2.8.3 DBKK Sewerage Services-related Revenue and Expenditures

(Unit: ×1,000 RM)

Year	Revenue			Expenditures					Balance
	Sewerage rate	Capital contribution	Total	Salary	Electricity	Water	Repair & maintenance	Total	
2000	4,554.2	1,271.6	5,825.8	157.8	539.4	0.0	2,689.1	3,386.3	2,439.5
2001	4,920.4	393.5	5,313.9	168.5	507.7	0.0	2,603.9	3,280.1	2,033.8
2002	6,027.0	170.7	6,197.7	186.5	495.8	0.8	2,491.2	3,174.3	3,023.4
2003	6,121.7	2,364.0	8,485.7	201.2	418.7	5.7	2,648.4	3,274.0	5,211.7
2004	5,656.9	2,164.7	7,821.6	211.1	574.1	2.0	2,434.8	3,222.0	4,599.6
2005	7,110.0	1,580.1	8,690.1	236.4	448.7	56.7	2,455.4	3,197.2	5,492.9
2006	9,413.5	2,858.9	12,272.4	252.5	395.1	4.8	2,476.9	3,129.3	9,143.1
2007	2,947.2	2,315.0	5,262.2	351.9	641.5	9.8	2,533.2	3,536.4	1,725.8

Source: DBKK

Table 2.8.3 summarises the revenue and expenditures of DBKK's sewerage services. Repair and maintenance costs cover the O&M contract payments to the two sewerage O&M contractors. The above table shows that revenue from sewerage is more than the actual

expenditure for operation and maintenance of sewerage facilities. It should be noted that it does not indicate the point at which sewerage services generate a profit. If DBKK provides sufficient operation and maintenance of sewerage services, expenditures may exceed sewerage revenue. At present, revenue received from sewerage fees and capital contributions are also allocated to other DBKK expenses. Sewerage capital contributions are collected from developers of new property/building development. The capital contribution system is different from that of Peninsular Malaysia under SSD. There are 40 categories of sewerage capital contribution rates, including residential and commercial building categories. **Table 2.8.4** shows representative examples of sewerage capital contribution rates.

In Kota Kinabalu City, sewerage tariffs, called the "sewerage rate" in Sabah State, are calculated by the following formula:

Sewerage Rate (RM) = Ratable Value (RM) × Sewerage Rate (%)

This formula is common for all the customers, including commercial, industrial, and government customers. Ratable value is the appraised value of the residence or building assessed by DBKK. Sewerage rates (%) have been set at 1% since January 1st, 2007 in response to strong demands from customers to lower sewerage rates. Until the end of 2006, the sewerage rate was 7%.

Table 2.8.4 Typical Sewerage Capital Contribution Rates in DBKK

No.	Type of building	Rate of contribution
(A)	RESIDENTIAL	RM 2,000 /unit of residential house/flat
(B)	COMMERCIAL	Followings are representative examples.
1	Restaurant/Café	RM 4,000 /1,000 square feet (sq.ft)
2	Shop/Showroom/Supermarket	RM 3,000 /1,000 sq.ft
3	Office	RM 2,000 /1,000 sq.ft
4	Hotel/Motel/Lodging House (excluding restaurant)	RM 1,000 /room
5	General Industry	RM 2,000 /1,000 sq.ft
6	Primary School including Cafeteria etc.	RM 10 /person
7	Hospital including other utilities rooms	RM 1,000 /bed
8	Government Building/Courts of Law	RM 500 /1,000 sq. ft

Source: DBKK

As shown in **Table 2.8.5**, the billed amount for private customers (Domestic, Commercial, and Industry) was RM 18.9/month per customer until the end of 2006. This was reduced effective January 1st, 2007 to RM 3.5/month. For comparison, billed sewerage tariffs in West Malaysia (IWK area of operation) were estimated at RM 8.8/month per customer (for domestic, commercial, and industrial customers) in 2006.

Figure 2.8.4 shows sewerage rate collection trends by DBKK. Collection efficiency was calculated by dividing total annual collections by the total annual billed amount based on

data provided by DBKK. Average collection efficiency over the last seven years was 65.9% with collection rates improving since 2004.

Table 2.8.5 Estimated Billed Sewerage Rate per Customer

	Unit	Private	State Govt.	Federal Govt.	Total
Number of customers (2007)	No.	39,737	169	3,103	43,009
Total billed (2006)	RM	8,998,989.6	1,342,376.0	1,334,878.0	11,676,243.6
Total collections (2007)	RM	1,682,798.9	307,715.4	298,154.5	2,288,668.8
Monthly billed rate (2006)	RM/month	18.9	661.9	35.8	22.6
Monthly billed rate (2007)	RM/month	3.5	151.7	8.0	4.4

Source: JICA Study Team, based on data provided by DBKK

Notes: Number of customers in 2007 was used to calculate monthly billed rate for both 2006 and 2007 based on data availability.

The sewerage bill, which is combined with the property assessment bill, is prepared by DBKK and sent to each customer every three months. Customers can pay at the DBKK office, community centres, post offices, Telecom Malaysia, the Public Works Department, water supply companies, or private banks. If customer arrears accumulate to large amounts, DBKK may resort to resolution by a court. However, the total arrears for both sewerage and general rates have accumulated to around RM 30 million (including interest).

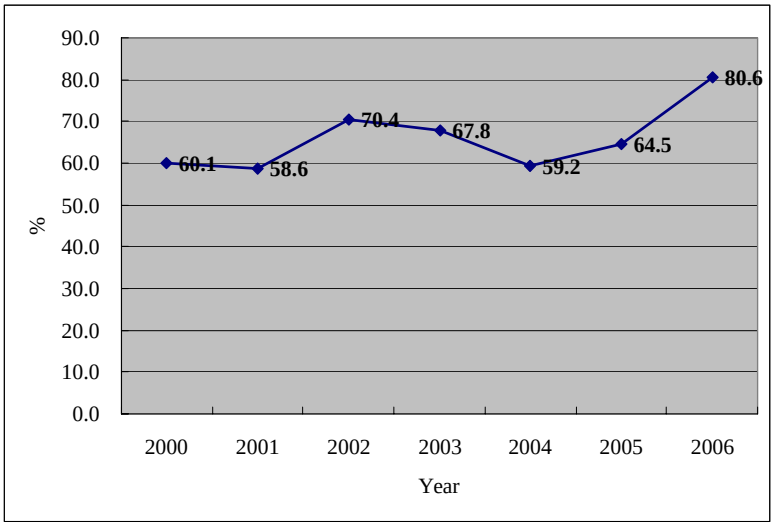


Figure 2.8.4 DBKK Sewerage Rate Collection Trends

(6) Current Developments in Sewerage Infrastructure Upgrading in Kota Kinabalu

As mentioned earlier in this report, the Sabah State Government recently (mid-July 2007) awarded a contract to manage the Kota Kinabalu Integrated Sewerage Scheme.

to Rastamas-Salcon JV.

2.9 The Future of the Sewerage Sector

The National Sewerage Development Policy envisions an industry that is managed in a holistic and sustainable manner so as to provide adequate and appropriate sewerage facilities and services that continuously protect public health, preserve national water resources and enhance that quality of the environment.

The current structure of the industry, as illustrated in **Figure 2.9.1**, shows that there are three Ministries—Energy, Water and Communications, Finance, and Natural Resources and the Environment—that have major but distinct roles in promoting and advancing the sewerage industry of Malaysia.

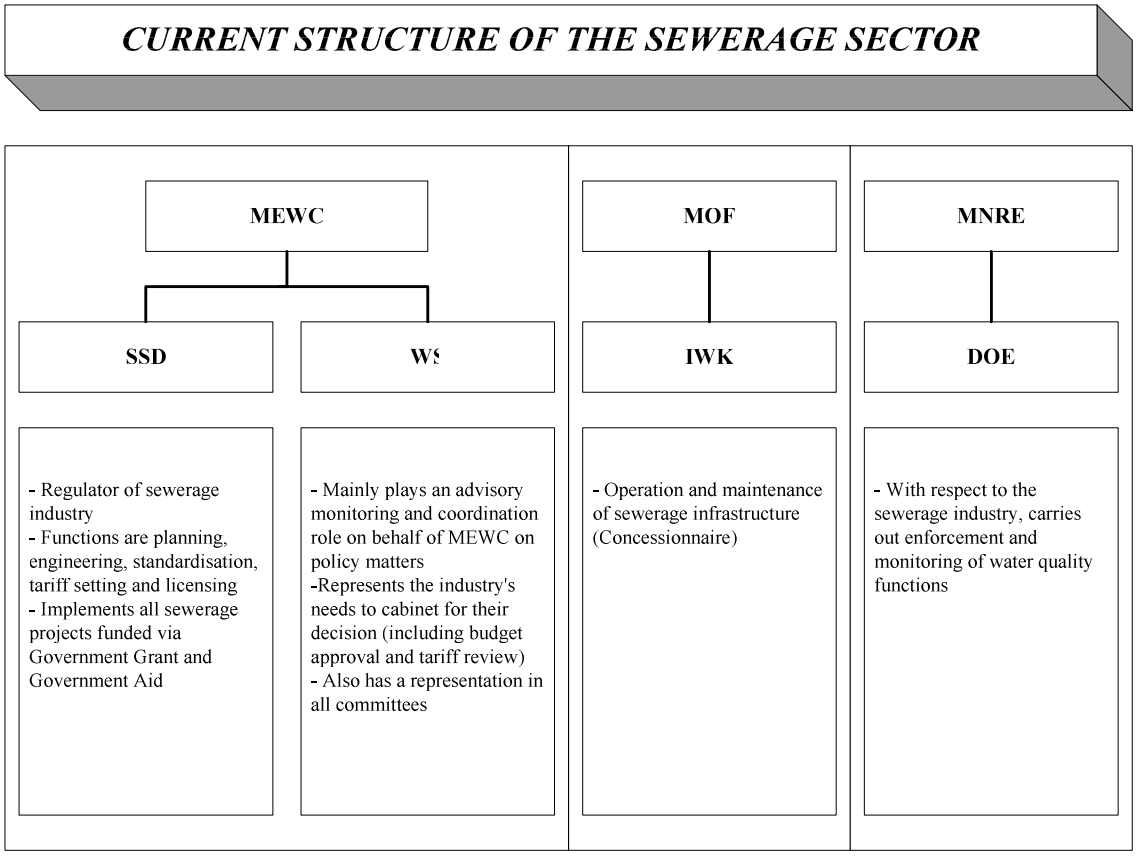


Figure 2.9.1 Current Structure of the Sewerage Sector (As of August 2007)

The implementation of sector reforms, with the enforcement of WSIA on January 2008, will provide a new impetus to the sewerage services industry, given the rationalised roles of MEWC and the MOF, as shown in **Figure 2.9.2**. MEWC will now have three departments focused on various sewerage services functions ranging from policy and policy coordination, planning, design and construction and project implementation, and regulation (tariff setting, engineering standards, licensing and enforcement of sewerage and sewerage-related laws and codes).

With the integration of water and sewerage planning, WSS is expected to take on a very active role in advisory services and coordination. This may be the reason it has membership in select

committees: to ensure that plans and programmes are managed to achieve greatest results.

It is apparent that SSD might need to eventually transfer its project planning role to SPAN and its project implementation role to WAMCO, especially for new water and sewerage infrastructures. Nevertheless, this transition may take years considering that this change will affect not only systems and processes but also the public.

The future hub of activity will be with SPAN, which is anticipated to spur focused development in the water and sewerage sector. Since it is a new entity, it may take a few years for SPAN to reach a fully operational level. Therefore, it is imperative that an organisational transition plan be implemented to put in place human and financial resources and other logistical support, including structures, systems, and processes. The end in view is that delivery of this basic service remains smooth and unhampered.

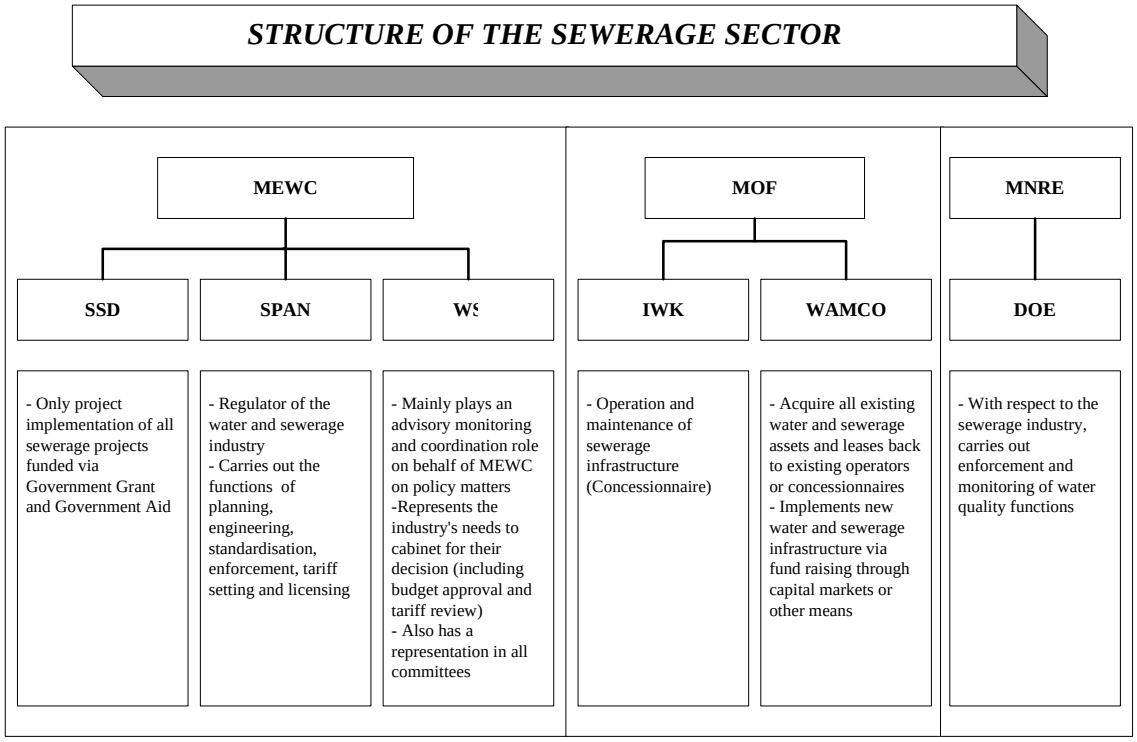


Figure 2.9.2 Structure of the Sewerage Sector after November 2007

The MOF, through IWK and WAMCO, will operate and maintain the sewerage infrastructure. In addition, WAMCO will implement new pipeline water and sewerage infrastructure projects using a variety of financial strategies. This may involve private and public partnerships, loans, or financing through the capital market, among others. The possibility of raising funds through tariff increases cannot be ruled out. These measures are aimed at achieving viable operations of water and sewerage infrastructure facilities in order to improve quality of service over the long term without the need for government intervention or subsidies.

The MNRE, through the DOE, will continue to enforce and monitor compliance with laws

pertaining to water quality, ensuring the quality of the environment for future generations of Malaysians.

All of these changes are necessary to coordinate policy implementation at the federal (central), State, and local authority levels, contributing to the achievement of sector goals and objectives.

2.10 Recommendations Based on Sector Analysis Findings

2.10.1 Further Improvement of Sewerage Enterprise Efficiency

The new framework created by the SPAN Act and WSIA is expected to improve the autonomy and efficiency of water enterprises through incorporation and by allowing comparisons among water enterprises through the use of performance indicators measuring costs, efficiency, and service quality.

IWK is currently responsible for the O&M of sewerage facilities in the majority of the Malaysian peninsula. The size of this service area allows the emergence of economies of scale. On the other hand, monopolies can lead to reductions in efficiency, since there are no comparable service providers. Therefore, it is recommended that measure to improve efficiency in the sewerage sector be introduced: partial outsourcing, service contracts, and any other elements that promote competition. For example, introducing and fostering the development of several private operators and allowing them to increase their capabilities by providing outsourcing services to IWK can create competitive conditions. This will, in turn, contribute to lowering O&M costs for a large number of small STPs (7,041 out of a total 8,459 STPs were under 5,000 PE in 2006), which comprise the majority of STPs. Examples of measure include:

- outsourcing or service contracts of O&M for small STPs;
- part time contracts for residents to perform the operations of small STPs;
- outsourcing the desludging work of CST & ST; and
- introducing competition by dividing IWK into several state-wide enterprises, thereby allowing economies of scale and comparison utilizing performance indicators.

Even in the event that the above outsourcing, service contracts, and part time contracts are implemented, IWK should identify and maintain critical O&M functions to ensure service quality. Accordingly, the tasks such as monitoring of treated water, major repairs, and replacement of facilities should be conducted by IWK. Tasks that can be outsourced include: i) STP site cleaning (sweeping STP sites, trash removal, weeds and algae removal in OP, etc), ii) minor maintenance, iii) routine operations in small STPs in keeping with the formatted checklist, and iv) water sampling and transport of samples.

The division of IWK into state-wide entities follows the basic principles of SPAN, which leads to the holistic management of water and sewerage service. In order to prevent compromising economies of scale, a detailed study should be conducted prior to making the decision to separate IWK.

2.10.2 Sewerage Tariff Revision

The sewerage tariff should be changed to reflect the water consumption volume that is metered by water supply operators. It is reasonable to charge in accordance with the effluent volume of each customer, since operational costs become larger as effluent volume increases. In keeping with a cost-based approach and to eliminate tasks associated with initial rating setting, a sewerage tariff corresponding to water consumption volume should be introduced early, in particular for industrial premises where the tariff is currently based on number of occupants

With respect to the sewerage sector, it is believed that full costs should be recovered not only from customers but also from other beneficiaries, such as tourism, fisheries, agriculture, and other sectors. There is justification for governments to share the cost of sewerage services, as is described later in **2.10.4** Government Portion of Sewerage Charges to Cover Lower Tariffs for Low Income Groups.

Nevertheless, the present level of sewerage tariffs is not high enough for relevant level. The average sewerage tariff estimated to be 0.17% of average household income as shown in **Table 2.10.1**. The IBRD and Pan American Health Organisation estimate that 1% and 1.5%, respectively, of household income is the maximum level for sewerage service household affordability. In Malaysia, the sewerage tariff as a percentage of household income (0.17%) is only one sixth of the maximum affordability level indicated by IBRD (1%) (refer to **Figure 2.10.1**).

Table 2.10.1 Average Sewerage Tariff as a Percentage of Average Household Income

Area	Average monthly household income 2004 (RM)	Ave. monthly tariff (sewerage) (RM) 2001-07	Monthly tariff as a % of ave. monthly income (sewerage)
Malaysia	3,249	5.5	0.17

Source: JICA Study Team, based on average monthly household income data in the 1999 and 2004 Household Income Surveys from the Department of Statistics

an increase in the sewerage tariff is required to improve and maintain service quality. On the other hand, it is critical to avoid a dramatic increase in the sewerage tariff by setting clear cost recovery targets (rate of recovery by year) and implementing any increases in stages.

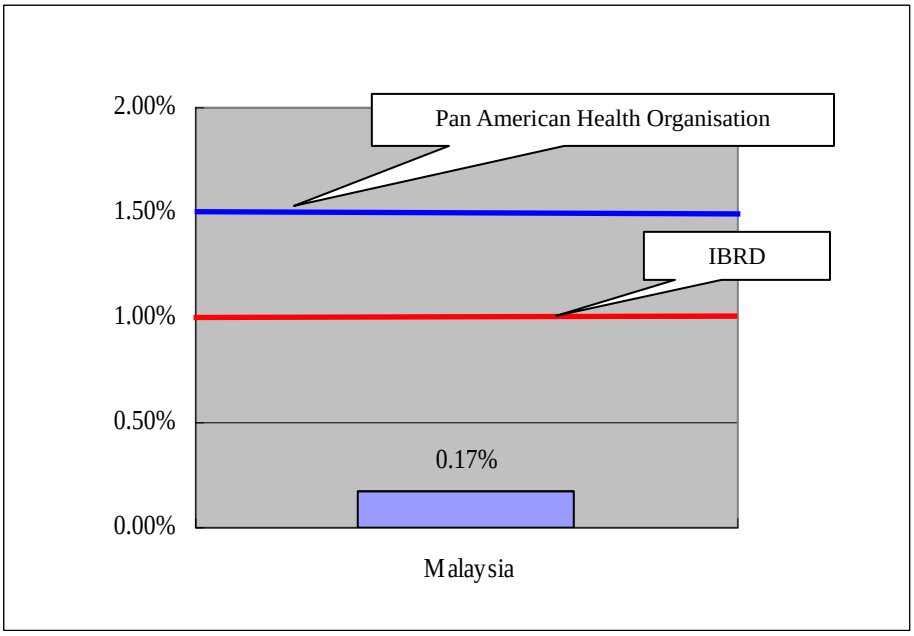


Figure 2.10.1 Sewerage Tariff as a Percentage of Ave. Household Income in Malaysia and Affordability Limits according to International Agencies

Currently, billing of sewerage charges follows a 6-month cycle.. This is regarded as one of the causes of large accounts receivables in the IWK balance sheet. Bills for sales of goods and services—even public services—should be issued as soon as possible. There are no good reasons to delay billing six months after costs for services have been incurred. Moreover, it is more difficult for customers to make large one-time payments than to pay in smaller amounts over the period. A more reasonable practice would be to bill customers every month or every two months.

2.10.3 Increased Public Relations Activities

One of the major causes behind the resistance to pay sewerage tariffs or to raise tariff rates is the lack of knowledge among customers concerning the importance of sewerage services and the present environmental and financial circumstances facing the sector. Most customers are unable to understand the role and importance of sewerage service. Generally, service providers tend to believe that customers have an adequate comprehension of the effects of sewerage service but this is more often not the case. Therefore, continuous and effective advertising or public relations activities are indispensable to improving the understanding of sewerage services by customers.

IWK and SSD have long been engaged in such advertising and public relation activities. While these initiatives have contributed positively to recent improvements in the collection status of sewerage bills, increased public relations activities are needed to raise public

confidence in service providers and to build the comprehension and acceptance needed to achieve full cost recovery in the future. It is also recommended that service providers constantly monitor the performance of public relation activities and utilize more effective methods. Major tools of public relation activities are as follows:

(a) Posters, slogans, calendars, etc. to convey a message or image
(b) Brochures, newsletters, and PR videos to introduce the activities of the enterprise
(c) Annual reports to provide detailed data and information
(d) Newspaper articles to present issues or opinions
(e) Advertising in radio, TV, and other media to generate a positive image or provide notice of emergencies
(f) Allow public access to STPs or other facilities to let citizens (including school children) understand the sewerage system
(g) Conferences or panel discussions to exchange opinions between citizens and service providers
(h) Day-to-day responses to customer claims (e.g., using a helpdesk) to provide fast and polite responses that build confidence in the service provider

Among the above major tools, face-to-face contact between service provider and citizens, such as (g) conferences or panel discussions, might not have the reach of newspaper or TV, but they provide deep and long-lasting impressions of service providers. Implementing such public relations measures is highly recommended.

2.10.4 Government Portion of Sewerage Charges to Cover Lower Tariffs for Low Income Groups

Under the current system, sewerage tariffs for domestic premises are set at lower rates for premises classified as low-cost or village housing. Sewerage tariffs should be set to recover necessary costs in order to prevent the degradation of long-term service quality with sound management. On the other hand, poverty reduction measures should be implemented by the federal government or municipal governments as distinct from sewerage services. When the tariff reduction is implemented for low income groups, the difference between regular and discounted tariffs should be covered by the by the federal government or municipal governments to avoid deterioration in service caused by budget shortfalls.

For domestic premises connected to public sewers, RM 8 per month is charged for houses with annual values greater than RM 600.00 and government quarters in grades A, B, C, D & E. RM 2 per month and RM 3 per month are charged for low cost or village houses. Amounts to be compensated by the government for each customer are equivalent to the gap between the normal and discounted rates: RM 6 and RM 5 per month, respectively.

The government portion of sewerage charges to be paid to service providers will be computed by summing the differences for all connected customers with lower tariff rates. These subsidies shall be used to cover the excess O&M costs incurred by the service provider.

2.10.5 Setting Rules for Federal Government Subsidisation of IWK

At present, sewerage tariffs are not sufficient to cover all necessary costs, including O&M and the cost of capital; therefore, subsidies from the federal government are provided to sewerage service providers. The amount of subsidies is increasing year by year as shown in **Table 2.2.15** Financial Assistance from the Federal Government to Indah Water Konsortium. It is recommended that rules or criteria governing subsidies from the Ministry of Finance to IWK be created.

In the absence of such subsidy rules, sewerage enterprises may fall into a state of heavy dependence on subsidies, and, as a result, lose motivation to improve productivity. If the rules reflect an enterprise's rights and duties with respect to profit appropriation or loss disposition, financial management responsibility and incentives to increase revenue and reduce costs can be maintained, leading to continuous improvements in productivity and efficiency.

The following are examples of rules for subsidy from the federal government to IWK:

(a) Subsidies shall cover costs of depreciation, loan repayment, and 50% of other O&M. IWK must cover other costs using tariff revenues.
(b) Subsidies shall cover costs of depreciation, loan repayment, and 25% of other O&M. IWK must cover other costs using tariff revenues.
(c) Subsidies shall cover costs of depreciation and loan repayment costs. IWK must cover other costs using tariff revenues.

The unlimited expansion of subsidies using the governmental budget is regarded as inappropriate. By establishing certain rules for providing subsidies, IWK would be compelled to conduct stricter financial management to enhance cost savings and revenue generation. On the other hand, the federal government should expand the right of IWK to set the sewerage tariff with more flexibility under SPAN's regulatory regime. It is recommended that this kind of plan will be proposed to SPAN via IWK's business plan, accompanied by a necessary plan to raise tariffs.

In general, sewerage service provides benefits not only to houses connected to sewerage pipes, but also to others, by removing dirty water from a certain area and treating sewerage. Those indirect beneficiaries include patients without sewerage services suffering from water borne diseases, users of groundwater, tourism, fisheries, the agricultural industry, and members of the public who can take walks along a clean riverside, among others. Obviously, it is impossible

to identify these beneficiaries and persuade them to pay the sewerage charge in proportion to their benefits. Therefore, it is reasonable to expect the government to pay part of the necessary costs for sewerage services using tax revenue. In other words, a certain (not unlimited) amount of subsidisation of sewerage service is recognized as the federal government's share of the sewerage charge burden and shall account for the total sewerage revenue needed to realize full cost recovery.

Furthermore, it is recommended that the ideal (long-term objective) proportion of the government's portion of sewerage charges to customer charges be determined through discussion among relevant Ministries and by considering the appropriate level of cost sharing by these two parties. As a start, subsidy rules should be set based on current circumstances with the low sewerage tariff (0.17% of average household income). In the near future, the business plan of IWK should define the ideal (long-term objective) allocation of cost sharing between customers and the government as a target and develop a staged implementation plan, including the target year.

2.10.6 Sewerage Capital Contribution to Encourage Integration and Rationalisation

It is recommended that the criteria of the sewerage capital contribution (SCC) be reviewed. The SCC is currently paid by developers that connect to the existing public STP at the rate of 1% of the developed property value. Therefore, the present SCC system encourages the construction of a developer's own STP on the development site rather than connecting to the public sewerage system. This causes the problem of a large, and still increasing, number of STPs in Malaysia that exceeds the maintenance capacity of IWK. That is why rationalisation (reducing the number) of STP is strongly desired in Malaysia. In the interests of greater integration and rationalisation of STPs in Malaysia, the SCC should be levied on developers that construct STPs within development sites without connecting to the public sewerage system.

In addition, it is recommended that the SCC fund be used as an incentive to encourage developers to reduce STPs. Incentives will be paid to developers that:

(a) connect to the existing public sewerage system if the distance to public systems is determined to be far;
(b) construct integrated STP to treat sewerage from neighbouring developments by collaborating with other developers;
(c) incorporate existing sewerage systems into new STP; or
(d) install larger sewers to connect to existing public sewers or construct larger STP for future developments following the direction of a certifying agency.

The above measures are expected to be a catalyst to encourage developers to connect to the public sewerage system and construct integrated STP. This should, therefore, contribute to

promoting the integration or rationalisation of STPs or at least slow down the pace of STP growth. After monitoring the progress and effects of rationalisation projects, it is recommended that the Ministry and SPAN discuss the relevant rate of the SCC charge and incentives to achieve the purpose.

Annual SCC collections are currently not sufficient for many construction projects in the Malaysian peninsula. It is also recommended that the SCC fund be utilized for planning, preliminary design, and cost estimation only, for integration and consolidation projects, so as to prepare for construction budget appropriations in the Five-Year Malaysia Plan.

In order to achieve revision of the SCC, it is necessary for the federal government to declare the strong political intention to utilize the SCC for integration and rationalisation of STP, since the 1.65% SCC levied on developers that construct STP was suspended in September 1999.

2.10.7 Measures to Increase Public Sewer Connection

Clauses 57 and 58 of the WSIA authorized SPAN to require premises and developers to connect to the public sewerage system. These clauses will contribute to a helpful increase in the number of customers utilizing the public sewerage system and the utilization rate of public STP. Practical regulation shall be prepared based on these Clauses. On the other hand, a revolving fund to allow instalment payments of initial connection costs when septic tank users connect to the public sewer line should be established.

Costs to connect septic tanks to the public sewer are usually the large amount. While legislation requires connection to the public sewer, initial investment costs will present the biggest obstacle. Instalment payments should, therefore, be provided to customers by establishing a revolving fund. If a septic tank user who applies for instalment payment is qualified to utilize the revolving fund, a contract will be created between the customer and relevant organisation regarding the loan amount, repayment period, and annual repayment amount, etc. Money borrowed from the revolving fund must be paid directly to of sewerage connection contractor. Customers shall make repayments to the fund on a monthly or yearly basis. This instalment system will alleviate the burden of one-time connection costs on customers.

The instalment plan should initially be introduced as a trial with a small budget and limited number of loans. After monitoring user feedback on loan repayment progress, loan amounts and conditions should be reviewed upon the next full implementation of the instalment plan. It should also be noted that there is a risk that customers would take legal action and default on their loans. Loan agreements between responsible organisations and customers must include terms that prevent this type of default.

CHAPTER 3

MANUAL FOR

REVIEWING/EVALUATION/PRIORITISING

OF SEWERAGE CATCHMENTS/PROJECTS

CHAPTER 3
MANUAL FOR REVIEWING/EVALUATION/PRIORITISING OF SEWERAGE CATCHMENTS/PROJECTS

3.1 Catchment Strategy Report

The catchment strategy report (CSR) describes a catchment strategy/plan (CS/P) for a study area, which may comprise a single or a number of catchments depending on the study area. In some cases, one catchment may be further divided into sub-catchments. The comparative study of alternatives, which are usually called "options" in the report, is conducted considering either of the following:

- On-site treatment by pour-flush latrines or individual septic tanks (though it is not the norm to consider this as an option in a strategy, some rural, low density and low growth areas will maintain existing facilities until the need for a change can be justified)
- Multi-point treatment system
- Regional treatment system
- Conveyance to adjoining sewerage catchment or a combination of these

From the above options, the option with the minimum total cost by NPV, which is the cumulative sum of discounted construction and operation and maintenance costs, is selected as the preferred option and recommended as the sewerage scheme or sewerage project of the catchment/sub-catchment. Besides minimum total cost by NPV, non-cost considerations are also taken into account.

(1) Catchment Strategy/Plan (CS/P) Formulated by the Government

Since privatization of sewerage facilities in 1993, the formulation of the catchment strategy/plan (CS/P) was commenced but it has changed with time.

In 1993, IWK concluded the concession agreement with the government of Malaysia and assumed exclusive responsibility for planning, design, construction, operation and maintenance, and billing and collection of public sewerage facilities in Malaysia. The concession agreement provided the performance goal that the connected population coverage served by sewerage shall be 70% for 48 major towns and 30% for the other 96 towns at the termination of the concession agreement. For this reason and overall planning needs, IWK had actively selected the cities and areas and formulated the CSPs every year directly or through outsourcing to the local consultants. The CSPs that were formulated by IWK would then be approved by SSD (the sewerage regulator) with the consultation of

common stakeholders. However, IWK's progress in achieving and providing sustainable sewerage services as the national sewerage concessionaire had been hindered by the low sewage charge collections.

In June 2000, the Ministry of Finance acquired IWK as a wholly owned subsidiary. Since then, the Project Implementation Unit (PIU) of SSD has been regulating IWK on the formulation of CSPs, which IWK either carried out in-house or through outsourcing to the local consultants. There was almost no change to the arrangement where IWK had been responsible for all technical aspects.

In September 2006, the Planning Division was established in SSD, and the consultancy services for the development of CSPs at five districts were awarded to five local consultants and were to be conducted under the control of the Planning Division. IWK will be playing a role as the internal technical advisor for SSD with respect to the formulation of these five CSPs, for which, IWK is allowed to charge a professional fee to SSD.

In the course of the formulation of CSRs and SLPs, the best option is usually selected. Although the Manual is expected to be applied in this step, its use would likely be limited as many of the indicators would be the same due to the limited study area. Potential projects will then be identified based on the preferred option.

(2) CSR Prepared by Private Developers

The developer is first advised to discuss all their development's sewerage requirements with IWK. The initial consultation will determine whether the proposed development site can be connected to an existing public sewerage system or whether the developer will be required to construct a dedicated treatment plant.

For the permanent sewage treatment plant or schemed development, a CSR is required for submission. Since the coverage area of the developer's development area is limited and the investment for a sewerage plan is made privately, the CSRs formulated by developers are usually simplified in comparison to those funded and prepared by the government. Although SSD issues an approval for each developer-formulated CSR under the name of the director of the regional office, the technical aspects are fully assisted by IWK.

Application of the Manual is would also be limited in this case.

IWK is now registered as the certifying agency by SPAN and will review and approve the sewerage plans of the developers and a monthly report is submitted to SPAN. Only when there is a dispute or an appeal is made will the sewerage plan will be sent to SPAN for a

decision at its own discretion.

The distinct expected outcome of a sewerage catchment strategy is that it advocates the most feasible option to provide satisfactory and sustainable sewerage infrastructure, services to the public, and conservation of the surrounding environment within a planned area. It should also provide sufficient information for planners to plan the immediate, middle term and long term needs of a planned area by addressing the present situation together with the needs and highlighting future scenarios and requirements.

To achieve the above, the CSRP should be able to provide comprehensive data for prioritisation of catchments/projects that need to be implemented and highlight the importance of its study area. To substantiate the prioritisation of planned sewerage catchments/projects and to ensure that it meets the required expectations, a standard manual for prioritisation is developed.

To ensure the effectiveness of the Manual and its utilization, the CSRP is expected to provide the data required for its application, which is based on a number of criteria as follows:

1) Importance of city or area
2) Pollution load
3) Incidence of waterborne diseases
4) Water pollution status of receiving water body
5) Complaints from the public
6) Beneficial water uses of receiving water body
7) Rationalisation impact to existing sewerage facilities
8) Conservation of local water cycle
9) First time provision of public sewerage
10) Reliability of project implementation
11) Condition of existing sewerage facilities
12) Cost
13) User affordability to pay
14) Improvement of sludge treatment
15) Consideration of special conditions

Note: The above highlighted criteria are explained in detail in the later part of this report.

3.2 Manual for Reviewing/Evaluation/Prioritising of Sewerage Catchments /Projects

3.2.1 Possible Applications of the Manual

The objective of the Manual is to review, evaluate and prioritise the sewerage catchments/catchments/projects. In actual practice, the Manual would be used to review/ evaluate/prioritise catchments/sub-catchments as well as to prioritise projects located in different catchments, as described below. The relationship among these applications is depicted in **Figure 3.2.1.**

Case 1: for reviewing/evaluating/prioritising of sewerage catchments/sub-catchments

Case 2: for reviewing/evaluating/prioritising of sewerage projects in the different catchments

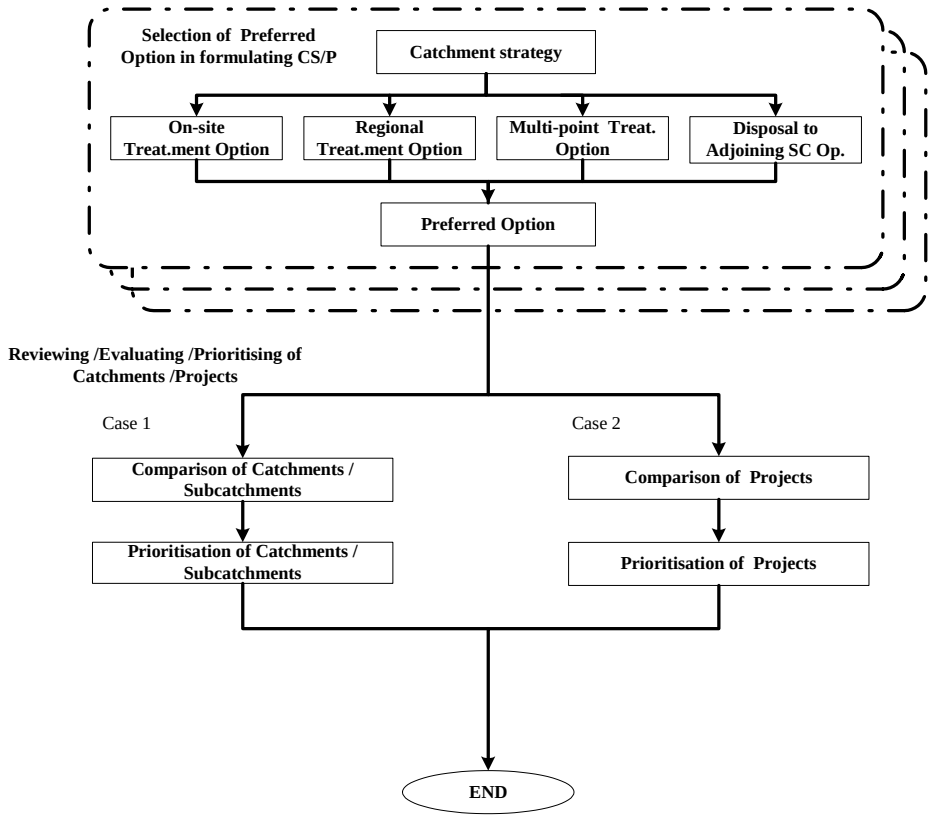


Figure 3.2.1 Application of the Manual for Reviewing/Evaluation/Prioritising of Catchments Strategies/Plans and Sewerage Projects

The "catchment" or "sub-catchment" is the planning unit set for the purpose of sewerage planning and refers to the specified area, but, when used in prioritisation, it means the overall

plan of a sewerage system proposed for such catchments/sub-catchments. When a catchment / sub-catchment have an independent sewerage system, respectively, they are treated equally in the prioritisation. It should be noted that there are some cases where the multiple sewerage systems are proposed for one catchment/sub-catchment, or one catchment/sub-catchment is finally integrated with another catchment/sub-catchment and covered by one centralized sewage treatment plant

"Project" refers to implementation of one-third or one-fourth of the overall plan for the catchment/sub-catchment under a phased construction plan. Therefore, projects and catchments/sub-catchments cannot be compared, with the exception of catchments/sub-catchments that are small enough to be fully implemented.

Although this Manual is applicable to the prioritisation of projects as well as catchments/ sub-catchment, the data at the project implementation level is required for projects, which is described last as considerations for the prioritisation of projects.
Table 3.2.1 summarises some examples of existing catchment strategy reports, of which the location of the study areas is shown in **Figure 3.2.2**.

As shown in **Table 3.2.1**, the number of catchments is different in the catchment strategy reports, such as one catchment in Jinjang-Kepong and eleven catchments in Daerah Kuala Langat. A basic comparative study for the selection of options is conducted in each catchment/sub-catchment.

Table 3.2.1 Example Content of Existing Catchment Strategy Reports

Study Area	Hulu Langat District	Daerah Kuala Langat	Jinjang-Kepong
Year	1998	1999	1998
Contents	Sewerage Catchment St.	Sewerage Catchment St.	Sewerage Catchment St. & Sludge Mgt St.
Consultants	BW Perunding Sdn. Bhd.	Symonds Travers Morgan Sdn. Bhd.	Minconsult Sdn. Bhd.
Cities Involved	Kajang, Bangi	District Council + 7 mukims	Part of Kuala Lumpur city and Majlis Perbandaran Selayang
Area	1,319 ha	82,067 ha [*1]	6,860 ha
Population (2015)	1,928,798	734,674	806,750
No. of STPs	18 STPs for 6 CAs	8 STPs for 7 CAs	1 STP for 1 CA

Note: CA: catchment area, S-CA: sub-catchment area

[*1] The study area is large but there are no major urban areas in the study area where there is an immediate need for a sewerage scheme.

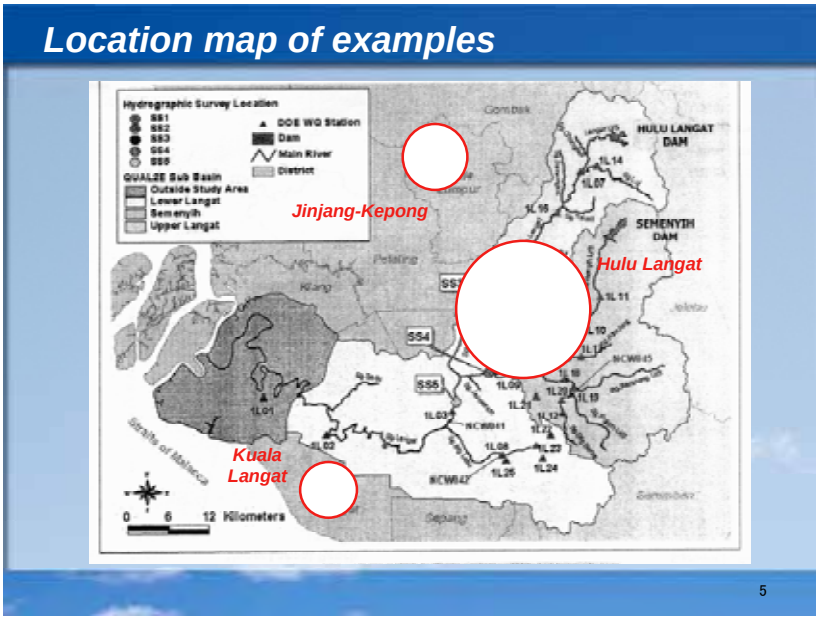


Figure 3.2.2 Location of Study Areas in Table 3.2.1

Note: The river system in **Figure 3.2.2** shows the Sg. Langat River Basin. A part of Hulu Langat District adjoining Kuala Lumpur is called Upper Langat or the model area for application of the Manual.

3.2.2 Current Status of Reviewing/Evaluation/Prioritising of Sewerage Catchments /Projects

The criteria for reviewing/evaluation/prioritising of sewerage projects adopted for the Ninth Five-Year Malaysia Plan for the period of 2006-2010 by the Sewerage Services Department ("SSD"), the Ministry of Energy, Water and Communication ("MEWC") are shown in **Table 3.2.2**.

IWK, which assists the SSD on this matter, has drawn up the following seven evaluation items for Sewerage Development Plan (SDP) implementation, although the weighting method is unknown:

1) Mitigation of public health risks
2) Protecting drinking water resources
3) Strategic interest of river system
4) Operational improvement
5) Priority for high density areas, commercial and industrial areas, areas of tourist importance
6) First-time provision of sewerage services

7) Political and strategic importance

Table 3.2.2 Ninth Malaysia Plan Sewerage Project Selection Criteria

No.	Benefit	Meaxure	Weightage
	FINANCIAL/ECONOMIC ISSUES		
1	***Strategic Importance*** Socio-economic, e.g. tourism, industry	Qualitative Assessment on Local Authority basis, refer **Table A**	10.0
2	***Promotion of Commercial and Industry Related Projects*** Bias to projects with higher level of commercial and industrial consumers	Quantitative measures based on population equivalent ratios, refer **Table B**	10.0
	SANITATION ISSUES		
3	***Mitigation of Known Public Health Problems***	Score 10.0 or 0 depending on whether Ministry of Health has reported incidence of diseases or illness which are potentially waterborne and sewage related. Also, where water quality problems and improvements are possible, which may affect health, refer **Table C**	10.0
4	***Improvement of Drinking Water Quality***	Measure of distance of protection upstream from intake for drinking water treatment plants identified in the Fourth Schedule of the Environmental Quality [Sewerage and Industrial Effluents) Regulations 1978, refer **Table D**	18.0
5	***High Density Areas First*** Bias to provision of services to higher density areas where sewage problems are more acute	Quantitative measure based on population equivalent and catchment area, refer **Table E**	10.0
6	***First Time Provision of Sewerage Services*** Bias to projects' services to consumers to be served by connected service	Quantitative measure based on population equivalent ratios, refer **Table F**	10.0
	ENVIRONMENTAL ISSUES		
7	***Alleviation of River and Coastal Pollution***	Measure according to quality of river or adjoining coastal water to b protected as defined in the Environment Quality Report 1990, refer **Table G**	17.0
8	***Operational Improvement*** Alleviation of operational nuisance/visual problems and efficiency savings	Quantitative measure based on population equivalent ratios, refer **Table H**	15.0

Table 3.2.2 Ninth Malaysia Plan Sewerage Project Selection Criteria (cont'd)

Scoring of Project Selection Criteria

Table A Strategic Importance of Local Authorities

(Abbreviated)

Table B Commercial and Industrial Projects

PE(C)	SCORE
>70%	10.0
50-70%	8.0
30-49%	5.0
10-29%	3.0
<10%	0

Where PE (C) = Population Equivalent of commercial and industrial consumers

Table C Mitigation of Known Public Health Problems

HEALTH FACTOR	SCORE
Reported incidents of illness and disease by Ministry of Health	10.0
Improvement of water quality will improve public health	5.0

Table D Improvement of Drinking Water Quality

NEAREST POINT OF PROJECT TO WATER SUPPLY INTAKE	SCORE
0 - 2 km	18.0
2 - l0 km	9.0
> 10 km	0

Table E High Concentration of Pollution

PERSON (PE) PER HECTARE	SCORE
>160 (High)	10.0
120 - 160	8.0
80 - 119 (Medium)	5.0
40 - 79	3.0
< 40 (Low)	0

Table F First-time Provision of Connected Sewerage

PE(NC)	SCORE
>70%	10.0
30-70%	5.0
<30%	0

Where PE (NC) = Population Equivalent of customers not provided with a connected service.

Table G Alleviation of River and Coastal Pollution

CLASSIFICATION	SCORE
Projects adjacent to polluted rivers(Environmental Quality Report, 2001)	17.0
Projects adjacent to any coastal areas or estuaries	10.0
Projects adjacent to any rivers (< 2 km)	5.0
None of the above	0

Table H Operational Improvement

ASPECT	SCORE
Efficiency Saving	4.0
Operational Improvement	2.0
Nuisance Removal	2.0
Visual Improvement	2.0

Note: Obtain a total score by adding the scores for each aspect

3.2.3 Considerations for Preparation of the Manual

In preparing the Manual for the purpose of reviewing/evaluation/prioritising of sewerage catchments/projects, consideration was given to the following:

1) To minimize additional surveys for prioritisation of sewerage catchments/projects
2) To consider how to update the data used in the catchment strategy report
3) To make scoring clear and systematic so that the results will not vary, depending on the appraisers
4) To systematize the arrangement of the necessary data for prioritisation of sewerage catchments/projects, with the use of the summary sheet of each catchment strategy report

3.2.4 Methodology for Reviewing/Evaluation/Prioritising of Sewerage Catchments/ Projects

The reviewing/evaluation/prioritising of sewerage catchments/projects were studied in accordance with the following steps:

1) To study the content of existing sewerage catchment strategy reports
2) To investigate possible application cases of the Manual

3) To list possible evaluation items
4) To identify indicators representing respective evaluation items
5) To investigate the availability of indicators
6) To review the importance of each evaluation item
7) To select evaluation items and indicators
8) To develop a scoring system
9) To consider weighting among evaluation items

3.3 Possible Evaluation Items and Indicators

It is necessary to consider various items for evaluation, from the need to the benefits derived from sewerage provision, in order to make a reasonable judgment based on a comprehensive consideration of each relevant factor.

Duncan Mara, for example suggests consideration of (i) projected total population, (ii) population density, (iii) failure of on-site sanitation systems, (iv) industrial pollution, (v) cost, (vi) tourist impact, (vii) environment impact, (viii) affordability, (ix) economies of scale, (x) institutional capacity, and (xi) health benefits as evaluation items for catchment/project selection.
Source: Duncan Mara, "Low-cost Sewerage", John Wily & Sons, pp.20-25, 1996

In addition, taking into account the current situation of the sewerage sector in Malaysia, attention should be paid to the rationalisation of existing sewerage facilities and improvement of sludge treatment.

Possible evaluation items are as follows (see **Figure 3.3.1**):

1) Importance of city or area
2) Pollution load
3) Incidence of waterborne diseases
4) Water pollution status of receiving water body
5) Complaints from the public
6) Beneficial water uses of receiving water body
7) Rationalisation impact of existing sewerage facilities
8) Conservation of local water cycle
9) First-time provision of public sewerage

10) Reliability of project implementation

11) Conditions of existing sewerage facilities

12) Cost

13) User affordability to pay

14) Improvement of sludge treatment

15) Consideration of special conditions

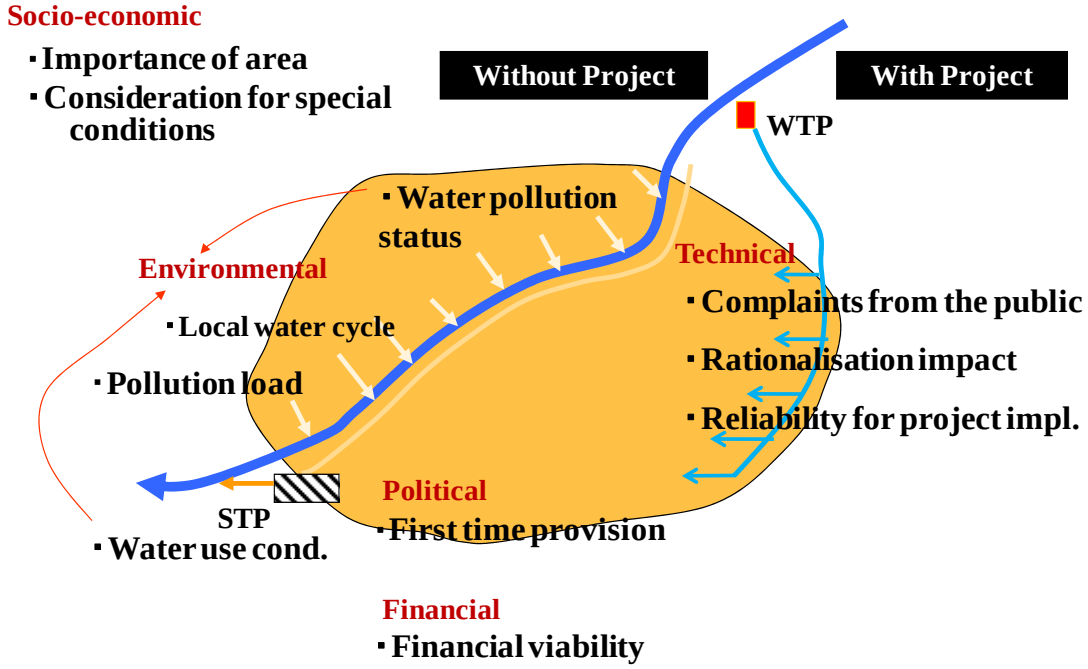


Figure 3.3.1 Possible Evaluation Items

The first problem is the type of data that represents the evaluation items. If existing statistical data is available for evaluation purposes, and if such data is easily obtainable and quantifiable, the later stages of prioritising sewerage catchments/projects become more transparent. The second problem is to what level of detail such data is available. If the statistical data is available at a national level, such data is basically accumulated in steps from the municipal, to the state, and finally to the national level. Typically, however, national level publications provide state level data, but not municipal level data, with the exception of area and population. In such cases, the data must be collected directly from the city/town offices involved.

3.3.1 Importance of City/Area

(1) Development Potential of City/ Area

According to the census of Malaysia conducted in 2000, the total population increased to 22.198 million from 17.563 million in 1991 with an annual growth rate of approximately 2.6%, which was almost equal to that of the period from 1980 to 1991. However, there are significant differences in the growth rate of state populations. For example, Selangor registers the highest at 6.2%, followed by Sabah at 4.0%, the Federal Territory of Labuan at 3.0%, Johor at 2.5%, Perlis at 0.8%, Kelantan at 1.0%, and Perak, with the lowest, at 0.6%.
Source: Department of Statistics, Malaysia, Yearbook of Statistics 1998, pp.23-27

Also, at a city level, there are significant differences in urban population growth. **Table 3.3.1**, Top 15 Urban Centre Population in 1991 and 2000, shows trends in urban population growth over ten years. Subang Jaya (with a growth rate of 21.2%), Shah Alam (7.8%) and Kota Kinabalu (7.5%) were among the top 11 growth centres in 2000, while Kota Bahru (0.8%), Kuala Trengganu (1.3%), Georgetown (-2.1%) and Kuantan (4.0%) dropped out of the top 11 in 2000. It should be noted that Kuala Lumpur (1.5%) and Petaling Jaya (2.4%), which are fairly well developed, exhibit slow growth while Klang (6.1%), Subang Jaya, Ampang Jaya (5.7%), and Shah Alam surrounding KL and PJ show a sharp growth as these townships have land still available for development.

Table 3.3.1 Top 15 Urban Centre Population in 1991 and 2000

	2000		1991	
	Urban Areas	Total	Urban Areas	Total
1	D. B. Kuala Lumpur	1,305,792	D. B. Kuala Lumpur	1,145,342
2	M. B. Johor Bahru	642,944	M. B. Ipoh	468,841
3	M. P. Klang	626,699	M. B. Johor Bahru	441,703
4	M. B. Ipoh	536,832	M. P. Klang	368,379
5	M. P. Ampang Jaya (d)	478,613	M. P. Petaling Jaya	350,995
6	M. P. Subang Jaya (e)(g)	447,183	M. P. Ampang Jaya (d)	290,452
7	M. P. Petaling Jaya	432,619	Kuching	277,905
8	Kuching	422,240	M. P. Kota Bharu	234,581
9	M. P. Shah Alam (f)	314,440	M. P. Kuala Terengganu	228,119
10	D. B. Kota Kinabalu	306,920	Georgetown	219,603
11	M. P. Seremban	290,709	M. P. Kuantan	202,445
12	M. P. Kuantan	288,727	M.P.Taiping	200,324
13	Sandakan	276,791	M. P. Seremban	193,237
14	M. P. Kuala Terengganu	255,518	Alor Setar	164,444
15	M. P. Kota Bharu	251,801	D. B. Kota Kinabalu	160,184

Source: Department of Statistics, Malaysia, Yearbook of Statistics 2006, pp.31-35

Such growth rates of urban centre population are identified as one of the indicators showing the importance of city or area.

There is another possible index showing the importance of city or area, which is the number of houses in residential development projects. Such data, however, have been thoroughly checked and used for population projections, tabulating development status (existing, under construction and under application), expected commissioning time and land use (residential, commercial, industrial, etc.). Therefore, it is believed that this data has already been reflected in the growth of populations in the existing catchment strategy reports.

(2) Urban Population Size

The cities are categorized into the national capital, state capitals and others, which are further classified based on the urban population size. The capital or state capital is the centre of administration and represents each state, which again, requires special considerations in addition to urban population size.

The urban centres in Malaysia are classified based on population size as shown in **Table 3.3.2**.

Table 3.3.2 Classification of Urban Centres in Malaysia Based on Population Size in 2000

State	Urban Areas (×1000)							
	×≥500	500>×≥150	150>×≥75	75>×≥50	50>×≥25	25>×≥10	×<10	Total
Johor	1	0	5	2	5	9	1	23
Kedah	0	2	1	0	2	3	0	8
Kelantan	0	1	0	0	1	8	0	10
Melaka	0	1	0	0	4	8	0	13
N. Sembilan	0	1	0	1	1	3	0	6
Pahang	0	1	0	0	5	4	0	10
Perak	1	1	0	1	6	9	0	18
Perlis	0	0	0	1	0	1	0	2
Pulau Pinang	0	2	4	1	2	5	0	14
Sabah	0	3	0	3	3	6	0	15
Sarawak	0	3	1	0	1	5	0	10
Selangor	1	7	1	2	6	14	0	31
Terengganu	0	1	0	2	0	4	0	7
W. P. Kuala Lumpur	1	0	0	0	0	0	0	1
W. P. Labuan	0	0	0	1	0	0	0	1
Malaysia	4	23	12	14	36	79	1	169

Source: Department of Statistics, Malaysia, Yearbook of Statistics 2006, pp.31-35

(3) Commercial and Industrial City/Area

The indicators representative of a commercial and industrial city or area are industrial

product value, commercial sales value and population by industry. Since such data will be difficult if not impossible to secure for all cities or areas, the percentage of the commercial and industrial design PE (population equivalent) to the total design PE as shown in Catchment Strategy Reports is adopted as an index for this purpose.

In general, the following methods are used for the projection of population equivalent (PE):

1) Census Population Growth Rate Method
   In this method, the annual average population growth rate between the latest and previous census is calculated and applied to the current population in the census area to be included within the study area. The projected population is then converted to the design PE using a conversion factor of 1.10 to 1.25. It should be noted that the design PE by use cannot be obtained using this method.
2) Land Use Method
   The design PE is projected at five-year intervals with the calculation sheet using the form in **Table 3.3.3** by predicting future land use patterns by block and multiplying the per ha design PE to each block.

Table 3.3.3 Calculation Sheet Used for PE Projection by Land Use Method

Block Name	Dominant Land Use	Total PE	Development Status				Planning Period				Ultimate PE
			E	UC	PA	UDV	2000	2005	-----	2020	
A	Commercial										
B	Residential										
C	Industrial										

E: Existing UC: Under Construction PA: Pending Approval UDV: Undeveloped

In the CSR for Taiping and Kuala Kangsar, comparisons of design PEs projected by both census population growth rate and land use methods have been made. The latter method results in 1.1 to 3.3 times the design PE than the former in all cases in Larut and Matang, Kerian and Kuala Kangsar with the exception of one sub-catchment. The design PE is fixed by using the intermediate value closest to the value resulting from the land use method. Comparing results from different methods can reduce the incidence of population projection overestimation to some extent.

The residential PE equals the population and, by clarifying the design PE by land use, it is possible to compare it with the design population of the structure plan at five-year intervals, as well as to verify the reasonableness of population projection through the comparison of residential and non-residential design PEs.

However, fewer than half of the existing 24 CSR and SLPs provide population by land use, and, for this reason, commercial and industrial design PE ratio could not be used as an index in this study. Design PE by land use should be indicated in future CSRs and SLPs.

(4) Tourism City/Area

The tourism sector has maintained its position as the second largest foreign exchange earner in Malaysia since 2000 when international arrivals totaled 10.2 million and tourism receipts RM 17.3 billion. By 2006, the number of international tourists had increased to 17.55 million while receipts grew to RM 36.27 billion.
Source: The Ministry of Tourism

The number of hotel guests by locality in 2005 is indicated in **Appendix 3-A**. **Figure 3.3.2** shows localities with annual hotel guests of 100,000 or more. (It should be noted that Kuala Lumpur, with 7.24 million domestic hotel guests and 7.89 million from overseas for a total of 15.13 million, is excluded from **Figure 3.3.2**.).

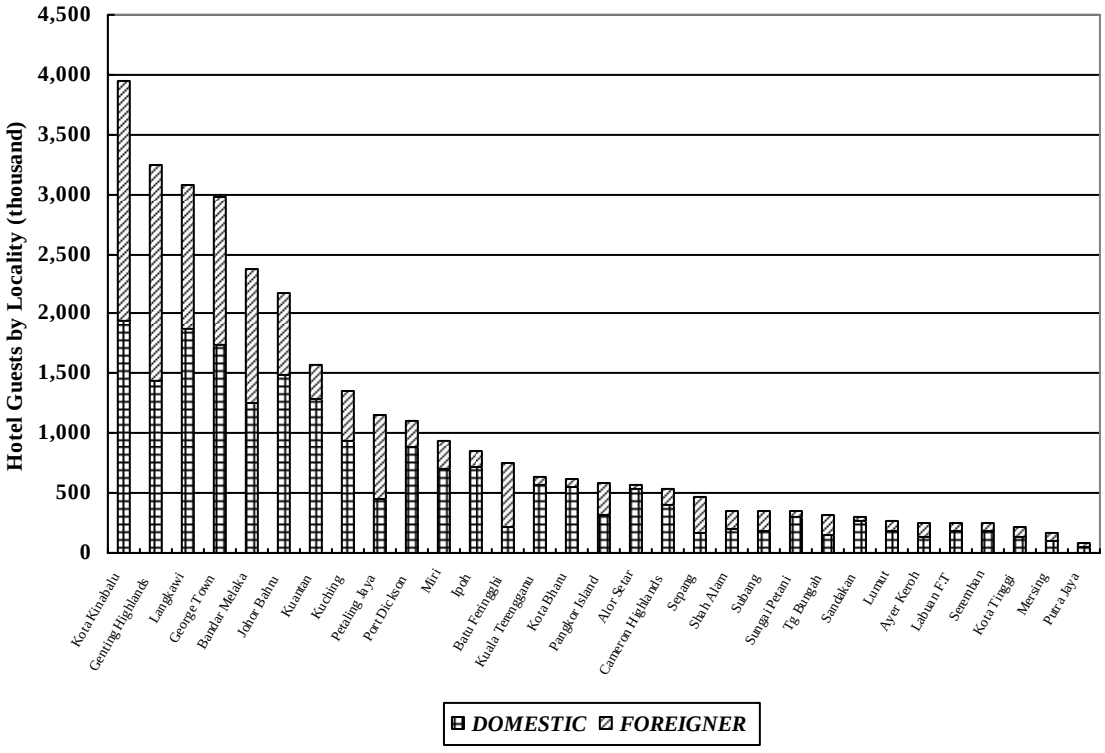


Figure 3.3.2 Hotel Guests by Locality (Based on Appendix 3-A)

Tourism should be analised according to distribution of domestic and overseas guests and attributes like beach resort, highland resort or administrative core city, and so on.

3.3.2 Pollution Loads

(1) Pollution Loads

Pollution load signify the quantity of sewage entering a river or water body. There are two possible indicators: (1) total domestic pollution load generated and (2) total pollution load removed. Total pollution load discharged—calculated by deducting total pollution load removed from total domestic pollution load generated—has been significantly reduced through the adoption of conventional activated sludge processes and recent moves to high treatment efficiency in Malaysia. As a result, total domestic pollution load generated and total pollution load removed are highly correlated and total domestic pollution load generated can represent pollution load.

Some portion of pollution load generated is currently removed by the existing STPs and ISTs (shown in "C" in **Figure 3.3.3**). In relation to this, two ideas on total domestic pollution load generated emerge: (1) the concept excluding the pollution load that is currently deducted from the pollution load generated (shown in "B" in **Figure 3.3.3**) and (2) the concept including pollution load that is currently deducted (shown in "A" in **Figure 3.3.3**). In the case of the latter, it is observed that "B" becomes negative, or the currently connected PE to existing STPs exceeds the design PE, especially in the rapidly-developed areas in the metropolitan region. Therefore, Type "A" pollution load generated is recommended for adoption.

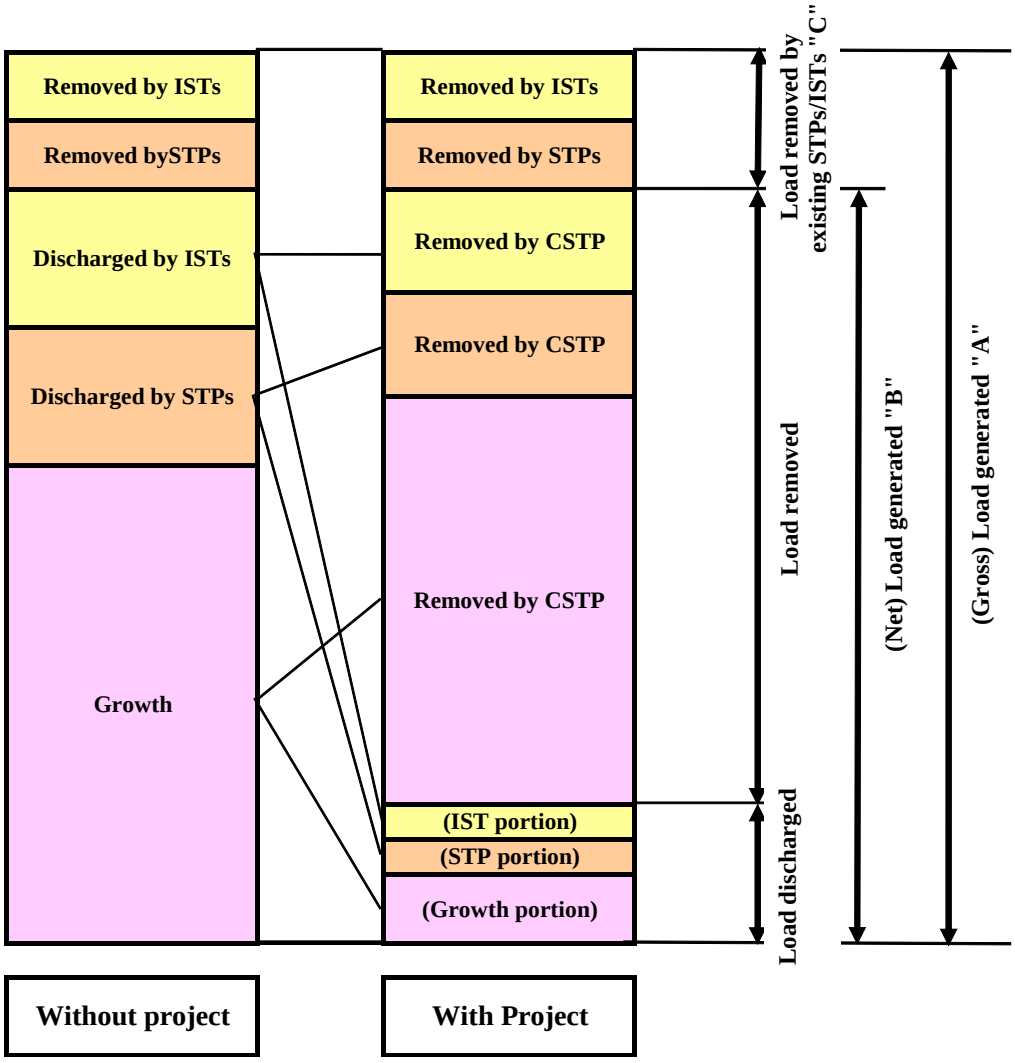


Figure 3.3.3 Definition of Pollution Loads

(2) Water Quality of Sewage Effluent from STPs by Treatment Process

In Malaysia, developers of private housing with more than 30 units have been required to provide a sewerage system with an STP since 1980, though in practice this may not be mandatory. The communal septic tanks (CST) and Imhoff tanks (IT) were popular in earlier days, but, recently, a variety of treatment processes with high treatment efficiency have been adopted

The water quality of sewage effluent from STPs under IWK's O&M is summarised by treatment process as shown in **Figure 3.3.4** and **Table 3.3.4**. "AS" is the general term of eight activated sludge processes such as active extended aeration (AB), activated sludge (AS), extended aeration (EA), Hi Kleen (HK), intermittently decanted extended aeration

(IDEA), oxidation ditch (OD), sewage aerated treatment system (SATS), and sequential batch reactor (SBR). The sewage treatment by the processes of activated sludge, trickling filter, aerated lagoon and bio drum are stable with high removal efficiency while communal septic tank, bio solids and upward anaerobic sludge blanket processes are not stable with low removal efficiency.

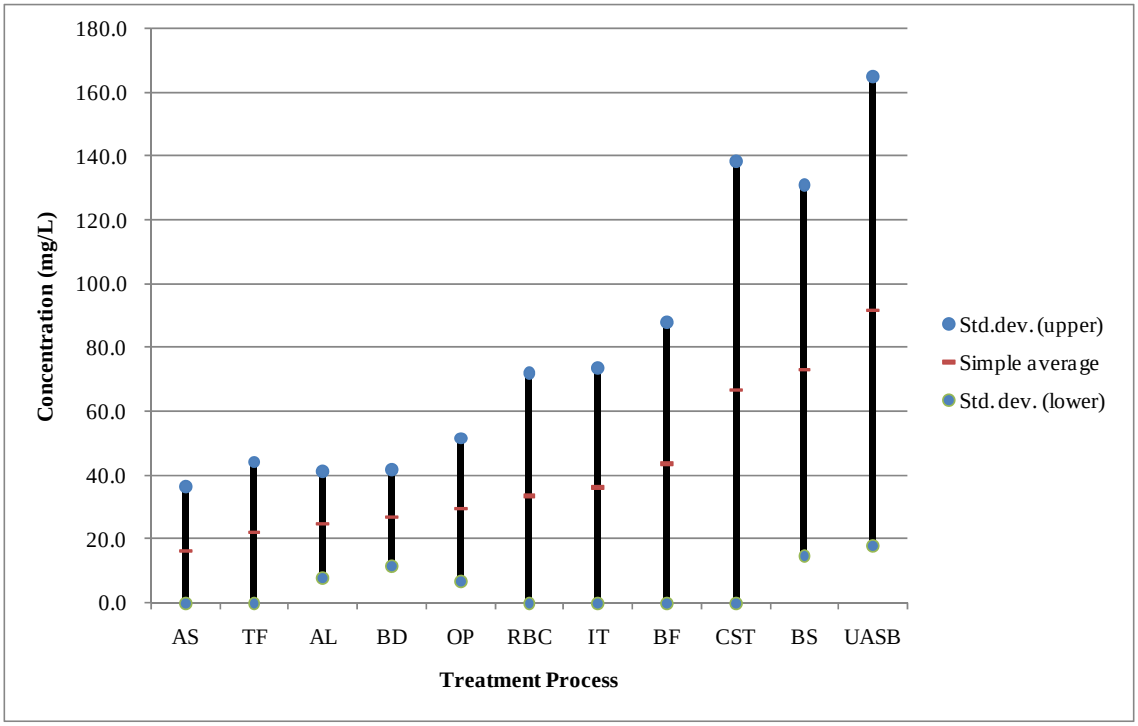


Figure 3.3.4 Water Quality of Sewage Effluent from STPs under IWK's O&M

Figure 3.3.5 and **Figure 3.3.6** show the cumulative frequency curve of sewage effluent BOD_5 and NH_3-N from STPs under IWK's O&M, which were prepared based on the histogram of all the data by treatment process.

For example, for BOD_5, which has an average of 16.2 mg/L, 78% of the data comply with the sewage effluent Standard A (20 mg/L) and 95 % of the data with Standard B (50 mg/L). The only other treatment processes where more than 50% of the data exceed Standard A are the trickling filter and rotating biological contactor (see **Figure 3.3.5**).

Table 3.3.4 Water Quality of Sewage Effluent from STPs under IWK O&M

Treatment Process		BOD_5	COD	NH_3-N	O&G	SS
Aerated Lagoon (AL)	Average	24.6	90.1	17.7	6.0	43.4
	Std. dev.	16.7	47.7	10.5	4.9	28.8
	Data points	1934	1,934	1,933	537	1,933
Activated Sludge (AS)	Average	16.2	65.0	16.2	4.8	27.3
	Std. dev.	20.1	53.4	12.9	4.9	29.5
	Data points	44,191	44,177	43,988	9,433	44,184
Bio Drum (BD)	Average	26.7	81.1	21.8	2.5	32.7
	Std. dev.	15.1	43.2	6.7	1.4	18.5
	Data points	204	204	204	112	204
Bio Filter (BF)	Average	43.5	120.5	25.9	10.5	46.6
	Std. dev.	44.2	86.7	13.6	9.9	43.9
	Data points	933	932	913	292	936
Bio Soil (BS)	Average	72.9	183.5	32.5	13.2	63.8
	Std. dev.	58.0	112.0	16.7	12.9	51.9
	Data points	197	197	19	77	197
Communal Septic Tank (CST)	Average	66.5	158.9	28.3	7.9	54.5
	Std. dev.	71.9	133.3	37.8	30.6	66.8
	Data points	1,419	1,404	1,164	890	1,419
Imhoff Tank (IT)	Average	36.1	99.2	26.2	6.2	34.0
	Std. dev.	37.3	82.1	16.1	6.5	35.1
	Data points	4,658	4,650	4,404	1,828	4,642
Oxidation Pond (OP)	Average	29.3	105.7	16.5	5.5	50.4
	Std. dev.	22.2	59.1	10.0	4.3	33.0
	Data points	4,503	4,502	4,502	1,224	4,501
Rotating Biological Contactor (RBC)	Average	33.3	100.1	17.8	5.9	37.3
	Std. dev.	38.7	87.8	14.1	5.7	38.4
	Data points	258	258	259	76	257
Trickling Filter (TF)	Average	22.0	68.0	15.0	3.0	29.0
	Std. dev.	22.1	55.7	11.9	3.7	31.6
	Data points	268	267	265	137	268
Upward Flow Anaerobic Sludge Blanket (UASB)	Average	91.5	228.8	31.9	10.9	82.5
	Std. dev.	73.4	157.6	16.8	7.0	64.5
	Data points	54	58	57	14	60

Source: Calculated by the JICA Study Team based on water quality data provided by IWK

But, with respect to NH_3-N, there is no treatment process in which the compliance ratio with Standard A (10 mg/L) exceeds 50%. The trickling filter, oxidation pond, activated sludge, aerated lagoon and rotating biological contactor processes meet Standard B (20 mg/L) with compliance ratios of 57% to 73% (see **Figure 3.3.6**).

The average concentration of BOD_5 in each treatment process is rounded up to the nearest unit of ten and used for the calculation of BOD_5 load discharged from existing STPs.

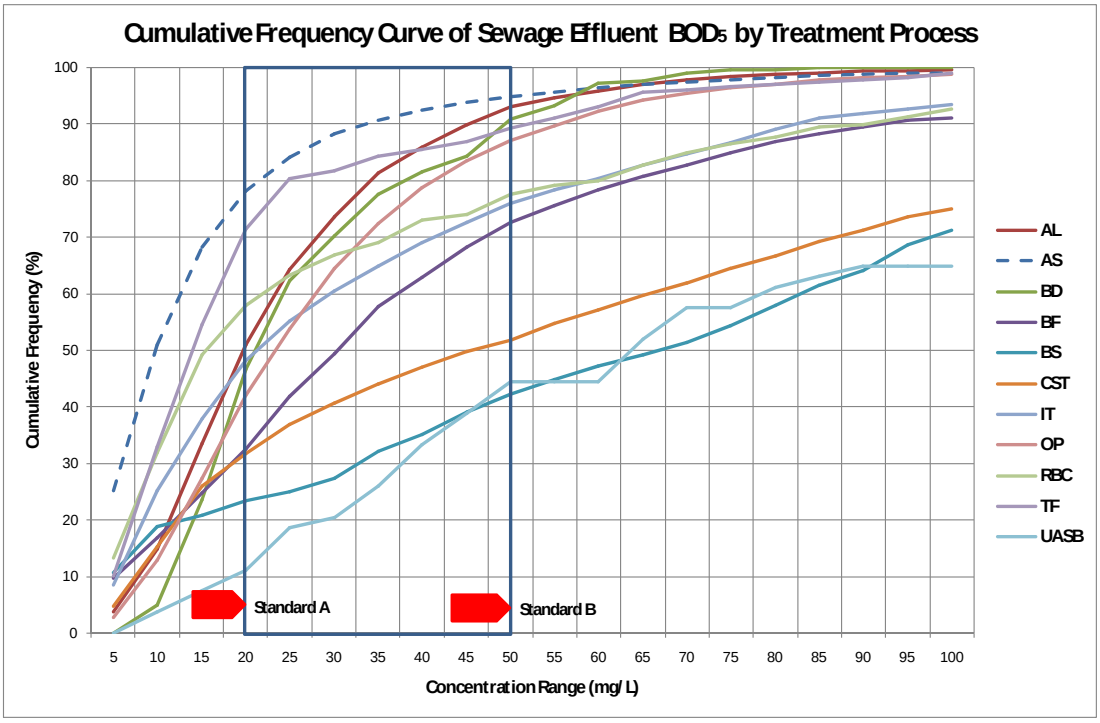


Figure 3.3.5 Cumulative Frequency Curve of Sewage Effluent BOD_5 from STPs

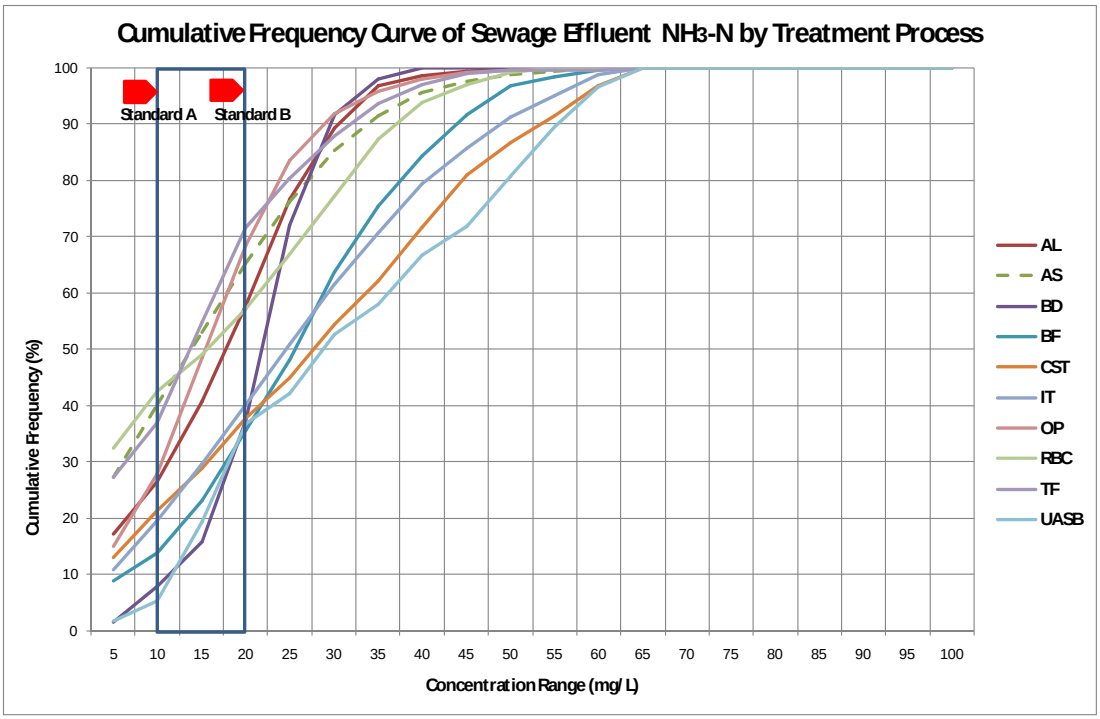


Figure 3.3.6 Cumulative Frequency Curve of Sewage Effluent NH_3-N from STPs

The cumulative frequency curve for other parameters such as COD, oil and grease (O&G), and suspended solids (SS) of sewage effluent from STPs is provided in **Appendix 3-B**.

Table 3.3.5 indicates the currently proposed sewage effluent standards by DOE and their achievement status by treatment process, which shows that "AS" complies with the new Standard A for Categories 1 and 2 except for the NH_3-N parameter.

Table 3.3.5 Compliance with Currently Proposed Sewage Effluent Standards by DOE

Category	Standard	BOD_5	COD	NH_3-N	O&G	SS
Category 1	**A**	**20.0**	**120.0**	**10.0**	**5.0**	**50.0**
	B	**50.0**	**200.0**	**20.0**	**10.0**	**100.0**
Category 2	**A**	**20.0**	**120.0**	N/A	20.0	**50.0**
	B	**50.0**	**200.0**	N/A	20.0	**100.0**
Category 3 (Mech.)	A	60.0	180.0	N/A	20.0	100.0
	B	80.0	240.0	N/A	20.0	120.0
Treatment process	AS	**16.2**	**65.0**	**16.2**	**4.8**	**27.3**
	TF	**21.5**	**67.6**	**15.2**	**2.9**	**29.0**
	AL	**24.6**	**90.1**	**17.7**	**6.0**	**43.4**
	BD	**26.7**	**81.1**	21.8	**2.5**	**32.7**
	OP	**29.3**	**105.7**	**16.5**	**5.5**	**50.4**
	RBC	**33.3**	**100.1**	**17.8**	**5.9**	**37.3**
	IT	**36.1**	**99.2**	26.2	**6.2**	**34.0**
	BF	**43.5**	**120.5**	25.9	10.5	**46.6**
	CST	66.5	158.9	28.3	**7.9**	**54.5**
	BS	72.9	183.5	32.5	13.2	**63.8**

16.2 Compliance with std. A **16.2** Compliance with std. B

Note: For categories, see **Table 3.3.17**.

3.3.3 Incidence of Waterborne Diseases

The number of reported cases of communicable diseases is indicated in **Appendix 3-C**. Among these, cholera, dysentery, typhoid and paratyphoid and hepatitis B are classified as waterborne diseases, and their incidences are shown in **Figure 3.3.7**. Although a sudden increase of incidences is sometimes observed, it can be concluded that the incidences of waterborne diseases have declined gradually in Malaysia. The number of reported cases of waterborne diseases in Japan in 1999 was 12 for cholera, 260 for dysentery, 26 for typhoid and 12 for

paratyphoid. Although the figures are higher in Malaysia than in Japan, it is generally viewed that the incidence levels in Malaysia are low when compared with that of other developing countries. The role of incidence of waterborne diseases as an index to evaluate the need for sewerage infrastructure is now deemed irrelevant in Malaysia.

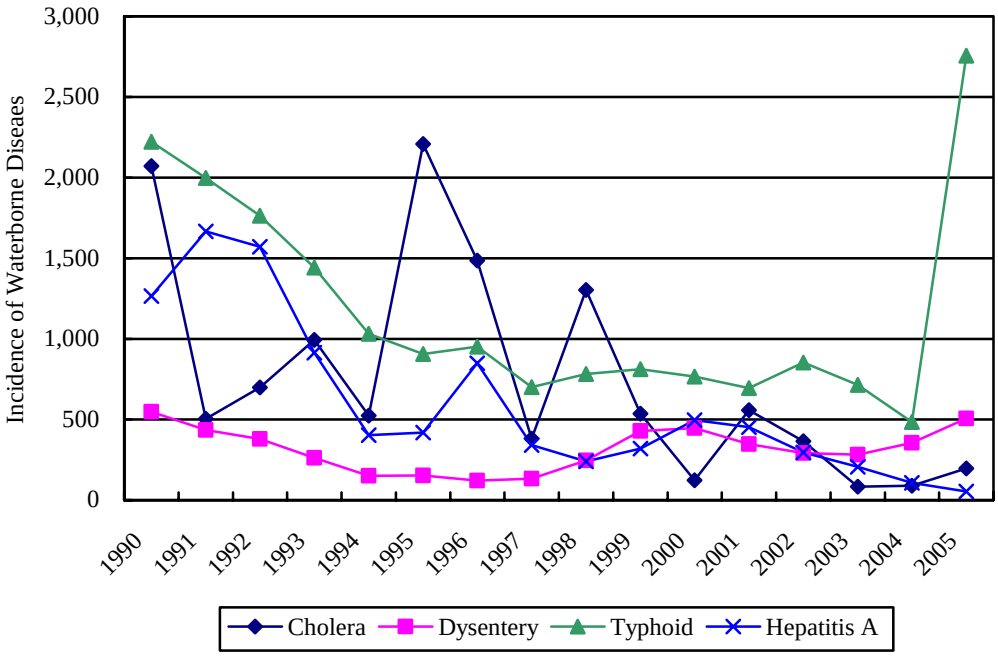


Figure 3.3.7 Incidence of Waterborne Diseases in Malaysia (1990-2005)

3.3.4 Water Pollution Status of Receiving Water Bodies

(1) Water Quality Index (WQI)

The Department of Environment (DOE) has been monitoring water quality of rivers since 1978. The Annual River Water Quality Monitoring Programme, which covered 1,085 stations in 146 river basins in 2005, monitors six parameters, such as biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), ammonia nitrogen (NH_3-N), suspended solids (SS), pH value and dissolved oxygen (DO) every two months.

DOE evaluates river water quality using the Water Quality Index (WQI) as shown in **Table 3.3.6** (refer to **Appendix 3-D**). Rivers are classified into three classes: (1) clean (C), (2) slightly polluted (SP), and (3) polluted (P) based on the WQI. As shown in **Table 3.3.7**, out of 146 river basins, 80 rivers are classified as "clean", 51 rivers as "slightly polluted" and 15 rivers as "polluted". DOE also monitors WQI (**Table 3.3.6**) of rivers based on each parameter (BOD_5, NH_3-N and SS). The water pollution status of rivers based on such

WQIs is shown in **Table 3.3.8.**

Table 3.3.6 Water Pollution Classification of Rivers Based on WQI

Parameters	Indicators		
	Clean (C)	Slightly polluted (SP)	Polluted (SP)
WQI	81 – 100	60 - 80	0 – 59
BOD_5	91 – 100	80 - 90	0 – 79
NH_3-N	92 - 100	71 - 91	0 – 70
SS	76 - 100	70 - 75	0 – 69

Table 3.3.7 Water Pollution Status of Rivers Based on WQI

	2001		2002		2003		2004		2005	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Category										
Clean (C)	60	50.0	63	52.0	59	49.2	58	48.3	80	55.0
Slightly polluted (SP)	47	39.2	43	36.0	52	43.3	53	44.2	51	35.0
Polluted (P)	13	10.8	14	12.0	9	7.5	9	7.5	15	10.0
No. of rivers monitored	120	100.0	120	100.0	120	100.0	120	100.0	146	100.0
No. of stations monitored	931		927		926		926		1,085	

Table 3.3.8 Water Pollution Status of Rivers Based on WQI by Parameter

Year	No. of rivers monitored	NH_3-N			BOD_5			SS		
		C	SP	P	C	SP	P	C	SP	P
2001	120	53	43	24	58	41	21	57	25	38
2002	120	51	40	29	69	29	22	78	14	28
2003	120	54	37	29	76	29	15	75	17	28
2004	120	43	47	30	65	37	18	78	11	31
2005	146	49	54	43	77	41	28	90	22	34

DOE uses the values from **Table 3.3.9** to classify the current water quality of rivers.

Table 3.3.9 Water Quality Classification of Rivers Based on WQI

Parameters	Unit	Class				
		I	II	III	IV	V
Ammonia Nitrogen	mg/l	< 0.1	0.1 - 0.3	0.3 - 0.9	0.9 - 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 - 3	3 - 6	6 – 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 - 25	25 - 50	50 – 100	> 100
Dissolved Oxygen	mg/l	> 7	5 - 7	3 - 5	1 – 3	< 1
pH	mg/l	> 7.0	6.0 - 7.0	5.0 - 6.0	< 5.0	> 5.0
Suspended Solids	mg/l	< 25	25 - 50	50 - 150	150 – 300	> 300
Water Quality Index (WQI)		> 92. 7	76.5 - 92.7	51.9 - 76.5	31.0 - 51.9	< 31.0

WQI is calculated based on six parameters—BOD_5, COD, NH_3-N, SS, pH and DO—but this combined parameters index is not a good indicator of water pollution attributed to domestic sewage because parameters such as COD and pH are easily influenced by industrial wastewater. Therefore, WQIs using BOD_5 and NH_3-N are adopted as evaluation indicators. The water quality data shall be taken at the monitoring station located immediately downstream of a discharge point of sewage effluent for a period of at least one year.

If WQIs using BOD_5 and NH_3-N are not obtained from the DOE reports, these can be calculated using the data from the water quality monitoring station immediately downstream of the sewage discharge point for the most recent year obtained from the ASMA website as described below.

(2) Water Quality of Receiving Water Body

1) DOE Reports

Regarding the BOD_5 SI (sub-index) and the NH_3-N SI, the following DOE information is available.

- River Quality 1996-2000
- Malaysia Environmental Quality Report 2006

The former compiles the water quality of main rivers in Malaysia for five years from 1996 to 2000 in terms of WQI, SS, NH_3-N, BOD_5, and heavy metals (As, Hg, Cd, Cr, Pb, Zn, Fe,

Mg); however, subsequent editions of the report have not been published. The advantage of this report is that the data on WQI, BOD_5 SI and NH_3-N SI can be gathered at on,, but, on the other hand, the report covers only a limited number of the main rivers.

The latter report, which can be downloaded from the DOE website, evaluates the water pollution status of main rivers and their tributaries according to five classes. It covers more rivers than those of the former but the status is based on the WQI.

The locations of the monitoring points are not clearly identified for both; however, it is assumed that, in the cases with a single monitoring station, the location is immediately upstream of the confluence of a tributary and at the estuary for a mainstream. But in cases with multiple monitoring stations in one river, the average is used for examination of water pollution status. For example, if the study area is located near the estuary of a big river like the Kuantan, the river is often classified as "clean", which does not reflect the actual status of the study area. In such cases, attention should be paid to the water pollution status of tributaries running through the study area.

Figure 3.3.8 shows the distribution of BOD_5 SI and NH_3-N SI based on the data in "River Quality 1996-2000". As the correlation between those two indicators is not clear, both indicators have been kept.

BOD_5 SI and NH_3-N SI are used for prioritising individual sewerage projects while the information from the Malaysia Environmental Quality Report 2006 is used for reference.

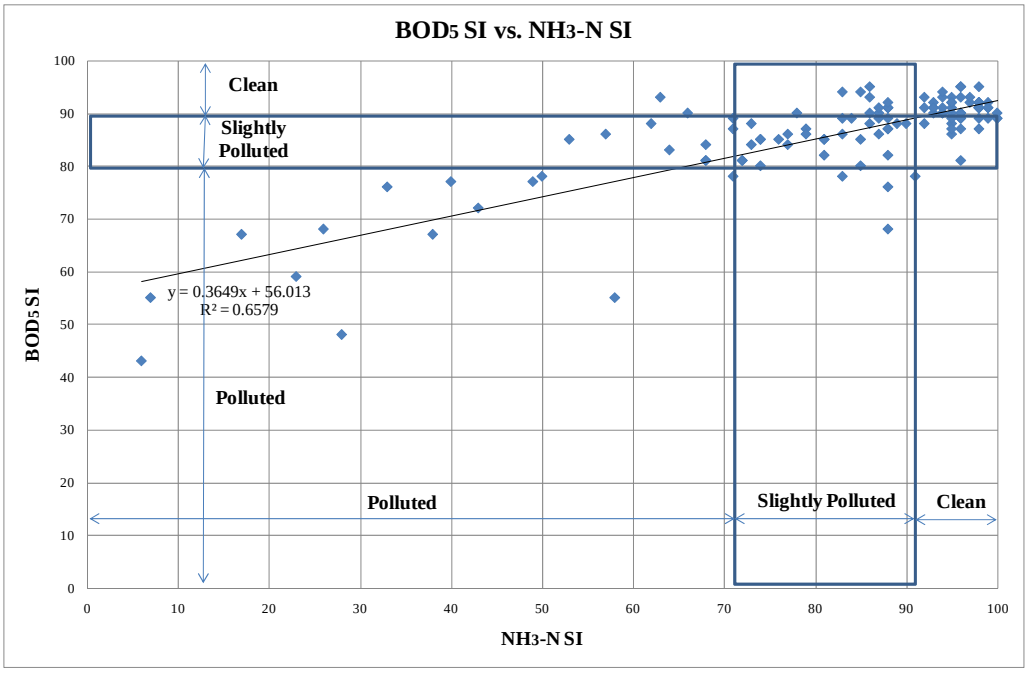


Figure 3.3.8 Correlation between BOD_5 Index and NH_3-N Index

2) ASMA Data

In 1995, the government signed a concessionaire agreement with Alam Sekitar Malaysia Sdn. Bhd. (ASMA) for 20 years, allowing ASMA to conduct air and water quality monitoring and reporting for DOE.

ASMA provides an online system on its web site where a registered customer with membership status can select a river basin and its monitoring stations to acquire water quality data for various periods.

(3) Reports on Water Pollution Incidences in the Media

There are news articles on water pollution issued by the media, which suggest serious water pollution of a particular river. Recently, it was reported that the Batu 11 Cheras Water Treatment Plant was shutdown temporarily due to high levels of domestic sewage pollution from the Upper Langat District. However, quantitative evaluation of such incidences is difficult.

3.3.5 Complaints from the Public

Table 3.3.10 shows complaints from the public to IWK for the five-year period 2003 to 2007. Responses to the complaints are categorized into 33 types, and the response time for each is internally defined as level of service (within 24, 48 and 72 hours). The number of annual complaints differs from year to year; complaints fell from approximately 110,000 in 2003 to 37,000 in 2007.

Broken down, the complaints on demand desludging (DCA), demand desludging, responsive desludging (IST) and pour flush concerned with desludging represented 61.5 % of the total while complaints of blockages in public sewers (SD01) and blockages in private sewers (SD03) represented 28.1%. Matters related to desludging and blockage accounted for approximately 90% of complaints. Trends in annual complaints, except those concerned with desludging, are shown in **Figure 3.3.9**.

The level of service for complaints on STPs including pumping stations is within 24 hours except for outlet submerged, which had a service level of within 72 hours. Complaints regarding STPs included: (1) pump not working, (2) overflow, (3) odour, (4) hole in fence, (5) re-fencing, (6) noise, (7) rubbish/pests, (8) overgrowth, (9) damage, (10) damage (utility), (11) outlet submerged and (12) trespassing.

Table 3.3.10 Complaints Received by IWK (2003-2007)

Code	Enquiry Type Description	2003	2004	2005	2006	2007	Total	%
DC02	Demand Desludging (DCA)	12,034	3,155	9,830	109		25,128	6.8
SA02	Demand Desludging	36,067	17,963	23,154	33,621	14,043	124,848	33.8
SA03	Responsive Desludging (IST)	4,234	2,386	2,129	3,255	1,239	13,243	3.6
SB06	Pour flush	19,259	8,637	9,160	20,809	6,027	63,892	17.3
SC01	Pump not working	7,130	1,305	1,359	3,751	1,124	14,669	4.0
SC03	STP : odour	1,310	523	1,001	1,643	329	4,806	1.3
SD01	Blockage (public)	20,619	16,634	14,889	17,661	7,142	76,945	20.8
SD02	Sewer collapse	473	516	588	1,278	393	3,248	0.9
SD03	Blockage (private)	5,513	6,008	7,092	5,339	2,855	26,807	7.3
SE02	Manhole cover missing	564	1,237	978	516	253	3,548	1.0
	Others	2,703	1,270	1,989	4,127	1,900	11,989	3.2
	Total	109,906	59,634	72,169	92,109	35,305	369,123	100.0

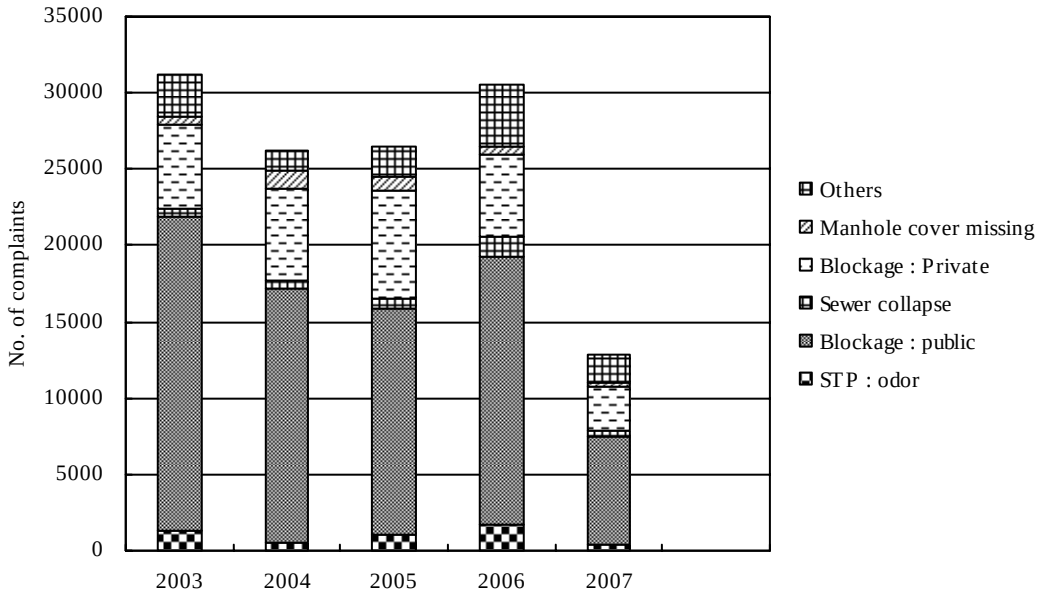


Figure 3.3.9 Complaints Received by IWK (2003-2007) (except for Desludging)

Complaints regarding STPs amounted to 4,809, or only 1.3% of the total over five years. In 2007, the figure was 329, of which Seberang Prai, Ipoh, and Pulau Pinang accounted for 83, 64, and 36, respectively, or 55.6% of the total for these three local authorities. DB Kuala Lumpur, MP Kajang, MP Melaka Bandaraya Bersejarah, MP Nilai, and MP Seremban accounted for more than ten complaints each, or 23.7% for the five local authorities. Therefore, local authorities with a high number of STP complaints are few, and, taking into account the number of existing STPs in those local authorities, the number of complaints is not necessarily that high.

The existing STP complaints shall be limited to functional and operational issues as shown in **Table 3.3.11**, which indicates 1,616 out of a total of 1,685 cases in 2007. Complaints regarding fence holes, re-fencing, overgrowth, rubbish/pests and trespassing have been excluded.

Table 3.3.11 Functional/Operational Complaints regarding Existing STPs under IWK O&M

Category	No. of cases	Percentage (%)
Pump not working	1,124	69.5
Overflow	23	1.4
Odour	329	20.4
Noise	50	3.1
Damage	51	3.2
Damage (utility)	12	0.7
Outlet submerged	27	1.7
Total	1,616	100.0

3.3.6 Beneficial Water Use of Receiving Water Bodies

(1) Distance from a Downstream Water Supply Intake Point

Water supply is the most important beneficial downstream water use. For this reason, the applicable effluent standards are categorized as Standard A and Standard B for discharge of effluent upstream or downstream of a water intake point. For BOD_5, a limit of 20 mg/L is applied, if there is a water intake downstream, while 50 mg/L is the limit in other cases. This index, which considers distance from a downstream intake point for water supply, gives a low score if a discharge point is far away from an intake as some river self-purification/dilution action is expected. On the contrary, it gets a high score if it is near an intake.

(2) Use for Water Supply

This is to evaluate project importance by the size of beneficiary population, or the total served population by downstream water treatment plants, when there are water intakes within the section sewage currently discharged from the study area and 10 kilometers downstream of a discharge point of effluent from a sewage treatment plant. This data is obtained from a water supply service provider.

Table 3.3.12 shows the water use condition of receiving water bodies in existing CSRs investigated.

Out of 24 CSRs reviewed, there are about 20 reports that provide some form of description on the physical relationship between the study area and water intake points, or whether the study area is located upstream or downstream of water intake points. Among them, one report provides general description on the desirable physical relationship between the study area and water intake points, but no concrete description on the particular area.

In total, 10 catchments are located upstream of water intakes, among which some of the sub-catchments in Tampin and Sg. Skudai are located upstream of water intake points.

Table 3.3.12 Description of Sewage Effluent Standard in Existing CSRs

	Study Area	River Name	Application of Sewage Effluent Standard
1	Kerian Larut & Matang Kuala Kangsar		Standard B
2	Ipoh	Sg. Kinta	Standard B (no description)
3	Jinjang Kepong	Sg. Klang	Standard B (no description)
4	Gompak	Sg. Klang	Standard B
5	PetalingJaya, Shah Alam, Subang Jaya	Sg. Klang	Standard B
6	Upper Langat	Sg. Langat	Standard A
7	Kuala Langat	Sg. Langat	Standard B
8	Sg. Kepayang	Sg. Linggit	Standard B (no description)
9	Sg. Simpo	Sg. Linggit	Standard A, 19.5 km upstream of WIP
10	Sg. Simin		Standard B
11	Tampin	Sg. Melaka	Standard A/B, 24 km upstream of WIP
12	Alor Gajah	Sg. Melaka	Standard A, 10 km upstream of WIP
13	Melaka Tengah	Sg. Melaka	Standard A, Upstream of WIP, 374,000m^3/day at 3 WTPs
14	Jasin	Sg. Chin-Chin	Standard A, 7 km upstream of WIP, 1,700 m^3/day
15	Muar		Standard B
16	Batu Pahat	Sg. Batu Pahat	Standard B
17	Sg. Sukudai	Sg. Sukudai	Standard A/B
18	Kuala Terengganu	Sg. Terengganu	Standard B
19	Pulau Redang & Lang Tengah		Standard B, water supply under water pipe from the Peninsula
20	Kemaman District	Tributaries of Sg. Kemaman and others	Standard B
21	Kuantan	Sg. Kuantan and others	Standard A
22	Temerloh		Standard A
23	Bentong	Tributaries of Sg. Pahang	Standard A
24	Pulau Tioman		Standard B

Three reports mention average daily water production flow.

In this analysis average daily water production flow was adopted as an evaluation index.

No reports describe irrigation. The Department of Irrigation and Drainage (DID) provides locations of water intakes for irrigation.

(3) Water Intake Closure Duration

Closure of water intake from rivers due to saline water intrusion, inflow of toxic wastewater, inflow of high turbid water, deterioration due to water pollution, etc. are considered. For example, Batu 11 Cheras Water Treatment Plant suspended water intake on February 12, 2007 due to a high concentration of ammonia nitrogen, and a similar situation occurred in the previous years that had an impact on the supply of water to 350,000 people. Such water intake closure days shows the serious effect of water pollution.

The evaluation is based on water intake closure duration time in the most recent year at water treatment plants within the section sewage currently discharged from the study area and 10 kilometers downstream of a discharge point. Only closure of water intakes due to pollution from sewage sources should be used.

(4) Irrigation Use

The downstream irrigational use of river water is an effective indicator, which measures the potential impact of water pollution on agricultural activities. For this purpose, use of river water for irrigation is investigated within the section that sewage is currently discharged from the study area and 10 km downstream of the discharge point of sewage effluent, and is measured by the number of water intake points.

There are no descriptions of irrigational use downstream in 24 CSRs and SLPs. According to the result of inquiries to the agencies concerned in those areas, the information of water intakes for irrigational use include the place-name, area and/or water used, cultivated crops depending on the agency, etc. but no coordinates of intake points. Therefore, their exact locations cannot be identified in relation to the discharge points of sewage effluent from the proposed STPs. It is advised that this kind of survey should be done during the study for catchment strategy planning and included in the report.

(5) Recreational Use for Swimming

The suitability for recreational use of the river for activities such as swimming is considered within the section that sewage is currently discharged from the study area and 10 kilometers downstream of a discharge point. According to the National Water Quality Standards for Malaysia, a water use of Class IIB is defined as “recreational use with body contact”. The

present classification “Class II” of rivers is used for evaluation purposes.

3.3.7 Rationalisation Impact of Existing Sewage Treatment Plants

The number of sewerage facilities that IWK operates has increased with the number of sewage treatment plants reaching more than 9,000 units. For this reason, the rationalisation of existing sewage treatment plants is one of the key issues in formulating and reviewing sewerage catchment strategies.

The following are regarded as indicators to measure the rationalisation impact of existing sewage treatment plants:

(1) Number of STPs to be Rationalised and Number of ISTs to be Connected

The existing catchment strategy report generally provides a list of STPs to be rationalised, including private STPs and the number of ISTs to be connected. The rationalisation of existing STPs and connection of ISTs to a public sewerage system contribute to a reduction in operation and maintenance work, and this needs to be quantified in terms of reduction in operational man-months. O&M staff requirement of IWK is shown in **Table 3.3.13** by treatment process and size.

Table 3.3.13 O&M Staff Requirement for IWK

PE	0 – 500	500 - 2,000	2,000 - 10,000	10,000 - 20,000	20,000 - 50,000	50,000 -
CST	3 staff / 80 CST	3 staff / 40 CST		3 staff / 20 CST		
IT, OP, STP	3 staff / 20 STP (1 check/wk)	3 staff / 10 STP (21 heck/wk)	3 staff / 4 STP (51 heck/wk)	3 staff (daytime nly)	9 staff *1 (24 hours)	17 staff *2 (24 hours)
NPS	3 staff / 20 NPS	3 staff / 10 NPS		3 staff / 3.34 NPS		3 staff / 2 NPS

This table was developed by the JICA study team, taking into account the actual practice of IWK O&M, but the O&M staff requirements have been set with some allowance.
CST: Communal Septic Tank, IT: Imhoff Tank, OP: Oxidation Pond, STP: Mechanized Sewerage Treatment Plant, NPS: Network Pumping Station
Notes: *1. Staff is composed of one manager, two engineers and six technicians
*2. Staff is composed of one manager, four engineers and 12 technicians

Also, for individual septic tanks, one team is comprised of two members (one driver and

operator) and conducts desludging work at 8 to 10 ISTs daily for six days per week, although they may work Sundays in response to urgent demand. Current IWK desludging work is performed based on demand from the IST owners, and collected sludge is treated at the oxidation ponds with a margin in capacity under IWK O&M.

From these figures, it is possible to calculate the man-year reduction with the following equation.

Man-year reduction = (Reduction by STPs to be rationalised) + (No. of ISTs to be connected) / (10 × 312) ×2

In the catchment strategy report for Jinjang-Kepong (prepared in 1998), only one STP was proposed for a design population of 806,750. The existing 101 STPs and network pump stations shall be rationalised, and 19,112 ISTs shall be connected to a public sewerage system. When these values shown in **Table 3.3.13** are substituted in the above equation, then the following result is obtained.

man-year reduction = 45.2 + 1.5 + 19,112 / (10 × 312) × 2
= 46.7 + 12.3 = 59 man-year

The result suggests that STP rationalisation contributes to a substantial reduction in O&M workforce. Approximately 59 operators can be reduced in this catchment, which is considered to result in the maximum O&M reduction by rationalisation, taking into account design population size.

Table 3.3.14 Man-year Reduction by STPs to Be Rationalised in Jinjang-Kepong

PE	0 – 500	500 - 2,000	2,000 - 10,000	10,000 - 20,000	Total
IT	17(1)	18	1		36(1)
OP	2(1)	3	15	2	22(1)
STP	13(12)	11	13	1	38(12)
Total	32(14)	32	29	3	96(14)
Deployment	3 staff / 20 STPs (1 check/wk)	3 staff / 10 STPs (2 check/wk)	3 staff /4 STPs (5 check/wk)	3 staff (Daytime only)	
Man-year reduction	4.8 staff	9.6 staff	21.8 staff	9.0 staff	45.2 staff
NPS		5			5
Deployment		3 staff / 10 NPS			
Man-year reduction		1.5 staff			1.5 staff

Note: Figures in parentheses shows the numbers of STPs of which design PEs are unknown.

Appendix 3-E shows the reduction of O&M manpower requirement for existing pumping stations and STPs by local authority using the values in **Table 3.3.13**, and **Appendix 3-F** indicates the BOD_5 removal efficiency using the average BOD_5 of sewage effluent from existing STPs in **Table 3.3.4**.

As shown in **Table 3.3.15**, the O&M manpower reduction in the IST area through the connection to a public sewerage system is only 11.7% of the whole, but the current BOD_5 load discharged from there is 46.0% or almost half of the entire load. Therefore, it cannot be deducted from the amount of BOD_5 load discharged.

Table 3.3.15 BOD_5 Loads Discharged from Existing STPs and ISTs (Peninsula)

		STP	IST	Total
Total number of units	(nos.)	8,282	989,983	
Design PE	(PE)	15,159,824	4,949,915	20,109,739
Influent BOD_5 load	(ton/day)	833.8	272.2	1106.0
		(75.4%)	(24.6%)	(100%)
Effluent BOD_5 load	(ton/day)	91.4	78.0	169.3
		(54.0%)	(46.0%)	(100%)
Removal efficiency	(%)	89.0	71.4	84.7
O&M manpower	(capita·day)	3,423.8	453.3	3,877.4
requirement reduction		(88.3%)	(11.7%)	(100%)

Note: 1) The BOD_5 load discharged is calculated using the average sewage effluent BOD_5 concentration by treatment process for STPs while the effluent BOD_5 concentration from ISTs is assumed to be the same as that of CST.

2) For details, refer to **Appendix 3-I**.

Figure 3.3.10 shows the estimated reduction in O&M manpower requirements through rationalisation of existing STPs and connection of existing IST areas to a public sewerage system in each town. From this, the classification for scoring is established as indicated in **Figure 3.3.10**.

Figure 3.3.11 shows that O&M manpower requirements for STPs have a high correlation with the connected PE and especially when excluding the data of Kuala Lumpur and Shah Alam where the correlation coefficient is 0.990.

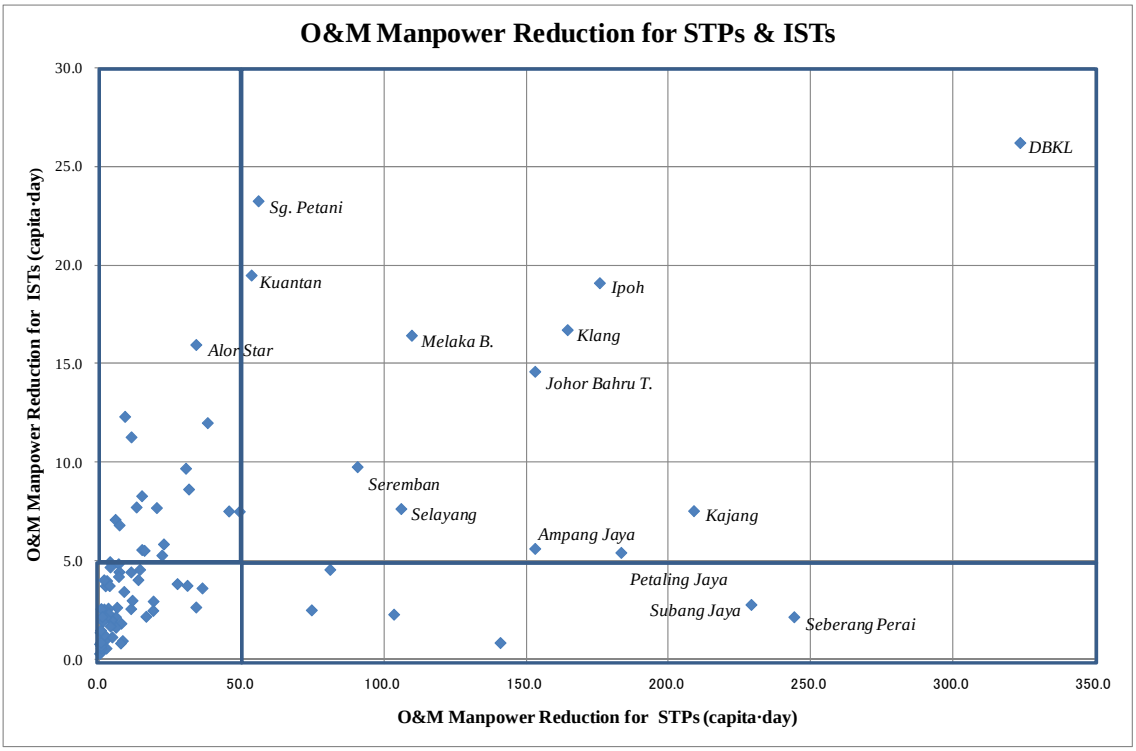


Figure 3.3.10 Estimated O&M Manpower Reduction for Existing STPs and ISTs

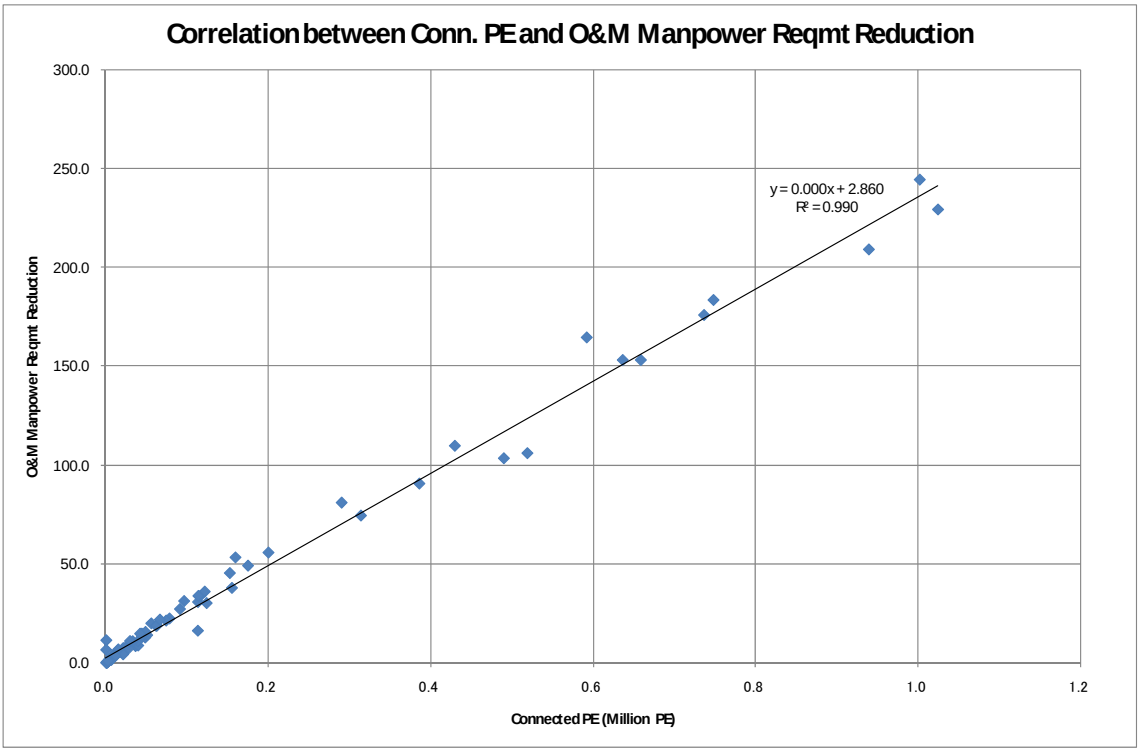


Figure 3.3.11 Correlation between O&M Manpower Requirement for STPs and Connected PE

Note: The data of Kuala Lumpur and Shah Alam are excluded from this figure.

(2) Potential Economic Benefits

When STPs are rationalised, some will be converted to pumping stations while the remainder will be decommissioned. These decommissioned sites have high commercial value in major urban areas. The land sale value is used as an index showing a potential benefit of rationalisation of existing STPs.

Through the discussion with the Malaysia side or SSD, SPAN and IWK, it is been found that land issues are in a somewhat complicated situation in Malaysia and that it is difficult to apply the idea of potential economic benefits to the unused STP sites at present. Accordingly this idea is deleted from the evaluation indicators.

(3) Pollution Load Reduction through Rationalisation

The existing catchment strategy reports give a list of existing sewage treatment plants to be rationalised with the type of treatment process and design PE. Also, the average BOD_5 of sewage effluent from existing STPs is given in **Table 3.3.5**. Since one PE indicates a per capita daily flow rate of 225 liters, it is possible to calculate a pollution load reduction through rationalisation by using this data. But this index is excluded from further study, since such reductions are already included in a pollution load reduction in **Sub-section 3.3.2**.

(4) Connection Potential

When a sewerage system is provided in a new area, the public is required to connect their houses to the public sewerage system. However, this is a financial burden to the public and most are reluctant to connect.

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Power to require premises to be connected to public sewerage system

57*. (1) The Commission may direct the owner or management corporation, or if the owner or* management corporation cannot with reasonable diligence be traced, the occupier if any *premises not connected to public sewerage system, to construct or install for the premises, within the period specified m the direction, a private connection pipe of material or size and at such level as to enable the premises to be properly and effectively connected to any public sewer or public sewerage system located within thirty meters from the boundary of the premises.*

(2) If the owner, management corporation or occupier to whom a direction under subsection (1) has been issued fails to comply with direction within the period specified in the direction, the Commission or any person authorized by the Commission may construct

or install the private connection pipe or cause the pipe to be constructed or installed and recover the expenses incurred in the construction and installation of such pipes from the owner, management corporation or occupier.

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The connection potential is measured by deducting the design PE by the connected PE to be rationalised.

3.3.8 Conservation of Local Water Cycle

When water is removed at the upstream sections of a river, used as city water and discharged into a river as sewage, the river flow decreases between the intake and discharge point. It is preferred to minimize this to improve the river's self-purification mechanism and in the interests of ecological preservation. This is the principle behind conservation of the local water cycle (see **Figure 3.3.12**).

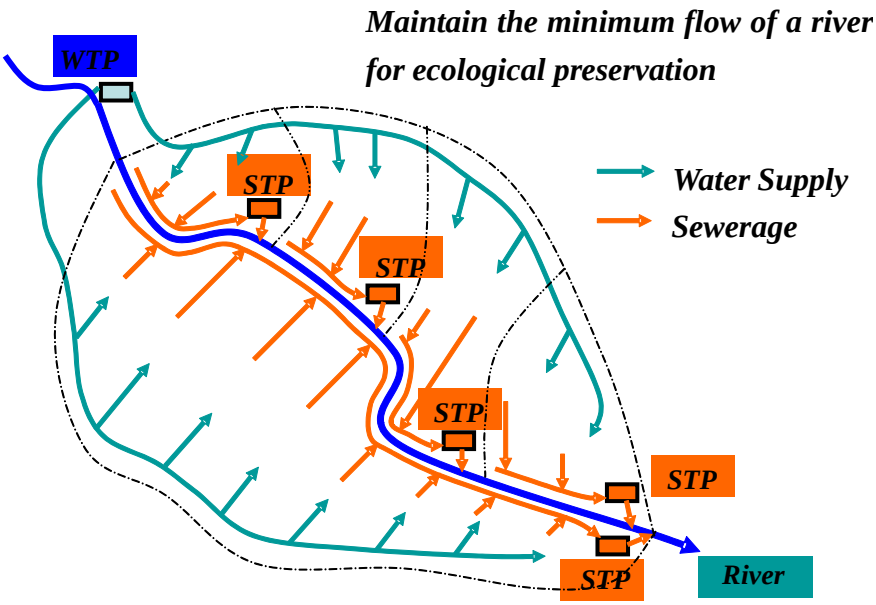


Figure 3.3.12 Conservation of Local Water Cycle

According to the meteorological data for monthly rainfall and wet days at several cities in Malaysia as shown in **Appendix 3-G**, every city receives rainfall every month and, in most cases, has at least 15 wet days even in the dry months. Therefore, the country is in a favorable environment from the perspective of maintaining the minimum required flow of a river.

However, the river flow is influenced by water intake amount upstream, thus, it is important to check with the local authorities whether the river in the study area maintains flow throughout the year and if there were periods with no flow in the past. This matter should be considered in the planning stage, but in the prioritisation of sewerage catchments/projects, it is better to use the report to confirm that this verification was performed, although this does not apply to existing reports, which do not take this issue into consideration.

3.3.9 First-time Permanent CSTP

The public sewerage projects are categorized into two types: (1) projects based on the SSD budget and (2) projects based on the funds of the Ministry of Finance or IWK. The former is accompanied with the construction of the STP or centralized sludge treatment facilities (CSTF) and represented by the JBIC projects. The latter is mostly composed of minor works such as rehabilitation, refurbishment, rationalisation, upgrading, replacement and repair work. If the definition of public sewerage project is extended to the contents of the latter, many areas will lose an opportunity for the construction of full-dress sewerage facilities by minor work.

Even though no CSTP have been constructed by the government fund, some STPs constructed by private developers and transferred to SSD play a key role in catchments/sub-catchments. Therefore, the first-time provision shall be evaluated based on whether the permanent CSTP authorized by SSD is being operated or constructed at that time, regardless of whether it is constructed by the government or with private funds.

This verification is conducted at three levels: (1) state, (2) local authority and (3) catchment. There are four cases as shown in **Table 3.3.16**. If there is another permanent CSTP in the particular sub-catchment (case 4) as shown in **Figure 3.3.13**, “Yes” is entered at all levels while, if there is no permanent CSTP at all levels (Case 1), all entries are “No”. The priority is given to Case 4.

Table 3.3.16 Existence of Permanent CSTPs Authorized by SSD

	State	Local authority	Catchment
Case 1	No	No	No
Case 2	Yes	No	No
Case 3	Yes	Yes	No
Case 4	Yes	Yes	Yes

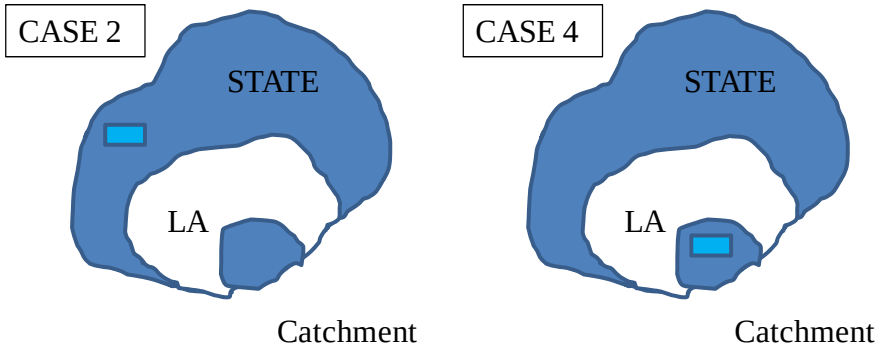


Figure 3.3.13 Existence of Permanent CSTP

Table 3.3.17 shows the sewerage projects currently reported to have been constructed with the Government-fund.

Table 3.3.17 Government-funded Sewerage Provisions in the Past

No	State	Project Name	Design Capacity (PE)
1	W.P. K. Lumpur	Pantai Tengah STP	10,000
2	Kedah	Padang Matsirat STP	STP - 25,000 CSTF - 100,000
3	N. Sembilan	Port Dickson Town STP	30,000
4	P. Pinang	Bayan Baru STP	200,000
5	P. Pinang	Jelutong Land Reclamation	n/a
6	P. Pinang	Jelutong STP	STP – 800,000
7	W.P. K. Lumpur	Bunus STP	STP - 352,000
8	W.P. K. Lumpur	Pantai STP	STP - 377,000 CSTF- 320,000
9	W.P. K. Lumpur	Bandar Tun Razak STP	STP - 100,000
10	W.P. K. Lumpur	Puchong STP	STP - 150,000
11	Selangor	Southern Kelang Valley CSTF	STP-22,000 CSTF- 400,000
12	P. Pinang	Sg. Nyior STP	STP-150,000
13	P. Pinang	Juru STP	STP – 150,000 CSTF – 300,000
14	Perlis	Kangar STP	STP – 30,000 CSTF – 150,000
15	Kedah	Kota Setar CSTF	CSTF – 300,000
16	W.P. K. Lumpur	Damansara STP	STP - 100,000
17	N. Sembilan	Sunggala STP	STP – 60,000 CSTF – 50,000
18	N. Sembilan	Kuala Sawah STP	STP - 240,000
19	Melaka	Sg. Udang CSTF	CSTF - 300,000

3.3.10 Reliability of Project Implementation

The biggest hurdle in implementing sewerage projects is acquiring land for the proposed STP. To assess the likelihood of acquiring the land, the proposed STP site can be categorized as follows:

1) Existing STP site
2) Already gazetted as the STP site
3) Public land
4) Private land but no resettlement issue
5) Private land with resettlement issue

3.3.11 Conditions of Existing Sewerage Facilities

(1) Risk Management

In Malaysia, the useful life of sewerage facilities is 80 years for civil structures and 25 years for mechanical and electrical facilities. However, some facilities transferred from the private sector are in a very poor state due to the poor quality of construction and material, in addition to the effect of the tropical climate. This problem must be addressed.

The aging index of existing sewerage facilities means the average age of all sewerage facilities after commissioning. As the simple average age of sewerage facilities does not reflect the treatment plant size, the following equation to calculate average useful years after commissioning is proposed:

$$\text{Aging Index} = \frac{\sum_{i=1}^{n}(PEi \times Yi)}{\sum_{i=1}^{n} PEi}$$

PEi Design PE of STP*i*

Yi useful years of STP*i* after commissioning
(= present year – commissioning year)

When an STP is located along the river and discharges sewage effluent directly into the river, equipment malfunction may lead to the discharge of untreated sewage effluent and cause water intake closure of a water treatment plant immediately downstream of such a discharge

point.

Risk quantification is, in general, calculated by the following equation:

Magnitude of a risk = (probability of undesirable event) × (impact of the event)

In this case, an aging index corresponds to the occurrence rate of unwanted event while the service population for water supply from such a water treatment plant corresponds to the impact of the event. The higher an aging index, the larger the risk, especially in the case of mechanical and electrical equipment.

It should be noted that this index is not applied to any water catchment areas, which means that priority is given to the water catchment areas with water intakes for water supply.

(2) Condition of Existing STPs

IWK is exclusively responsible for the operation and maintenance of existing sewerage facilities in West Malaysia except for Johor Bahru city and Kelantan State. There are two types of defects in STPs. One is non-compliance to the Effluent Standard established by DOE, and the other is physical defects, including the damaged structures and breakdown of mechanical and electrical equipment.

1) Compliance to Effluent Standards

The revised Treated Sewage Effluent Discharge Standards is now under consideration by DOE. Under the revised Standards, as shown in **Table 3.3.17**, the STPs are classified into three categories based on the year of commissioning.

The limits proposed for all STPs in Category 3 are only applicable for 10 and 15 years in Catchment A and Catchment B areas respectively except for communal septic tanks and Imhoff tanks. Therefore, the STPs in Category 3, after the stated period, will be required to be upgraded or rationalised to meet the proposed new standard for development as shown in **Table 3.3.18**.

Likewise, the limits set for all STPs in Category 2 are only applicable for 10 and 15 years in Catchment A and Catchment B areas, respectively. Therefore, the STPs in Category 2, after the stated period, will be required to be upgraded or rationalised to meet the proposed new Standard A shown in **Table 3.3.18**.

Upgrading of the existing STPs is considered to be costly. Rationalisation of existing STPs is a strategy to address cost concerns related to investments leading to compliance to the revised standards.

2) Physical Condition of Existing STPs

IWK does not have a system to rate existing STPs based on physical condition. The STPs are classified as "refurbished" or "not refurbished", in which case the former is considered to be in a better condition than the latter.

When considering the requirement under the new effluent standards mentioned above, it is obvious that refurbishing of existing STPs will not be effective, hence, it is recommended that priority be given to rationalisation, which will ensure compliance to the new effluent standards. As shown in **Table 3.3.18**, STPs that do not meet the new effluent standards are identified with a special focus on treatment processes and with reference to **Table 3.3.5**, there is a need for additional qualification, since a single sample or parameter failure should not cause the plant to be classified as not meeting effluent standards.

The rationalisation rate is evaluated according to the following procedure:

- Preparation of the list of existing STPs in the study area (including the year of commissioning)
- Based on the list, identifying STPs that do not meet the new effluent standards
- Calculation of total design PE of non-compliant STPs
- Calculation of total design PE of non-compliant STPs (3) to be rationalised
- Calculation of the rationalisation rate of non-compliant STPs by dividing (4) by (3)

(3) No Application to Prioritisation of Sewerage Catchments/Projects

However, according to the survey of 24 CSRs and SLPs, a CSTP system is proposed for 144 (72.7%) sub-catchments out of 198 sewerage catchments proposed with the balance classified as existing STP connection, multipoint system, and not yet fixed due to low or non-priority, accounting for 9 (4.5%), 27 (13.6%) and 18 (9.1%) sub-catchments, respectively. Accordingly, the risk associated with the continuation of STP operations and issues of non-compliance to sewage effluent standards is expected to be addressed through the promotion of existing STP rationalisation.

The impact of the discharge of untreated sewage attributed to the breakdown of existing STPs is measured by another evaluation item—the average amount treated at the treatment plans located downstream. Also the rationalisation effect of existing STPs is confirmed in terms of reductions in O&M manpower requirements. To avoid the redundant evaluation, these evaluation items shall not be applied to prioritising sewerage catchments/projects.

Table 3.3.18 New Treated Sewage Effluent Discharge Standards under Consideration by DOE

Classification	Category 3						Category 2		Category 1			
By the year of commissioning	STPs constructed before the enforcement of Guidelines Vol. 4 (Jan. 1989)						STPs not classified into Categories 1 & 3		STPs to be constructed after the gazette date of new sewage effluent discharge standard			
Parameter	Primary T. Sys.		Partial Secondary T. Sys.		Secondary T. Sys. – Mech. plants		Eff. limits		Eff. Discharge (River)		Eff. Discharge (Lake & stagnate w.)	
	CST	IT	OP	AL	Stds. A	Stds. B	Stds. A	Stds. B	Stds. A	Stds. B	Stds. A	Stds. B
Temp.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	40	40	40	40
pH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.0-9.0	5.5-9.0	6.0-9.0	5.5-9.0
BOD_5	200	175	120	100	60	80	20	50	20	50	20	50
COD	N/A	N/A	360	300	180	240	120	200	120	200	120	200
SS	180	150	150	120	100	120	50	100	50	100	50	100
NH_3-N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	20	5	5
NO_3-N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	50	10	10
P	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	10
O&G	N/A	N/A	N/A	N/A	20	20	20	20	5	10	5	10

Note: All the limits listed are absolute, and that there shall be no exceeding at any given point of time.

3.3.12 Cost

(1) NPV of Revenue less Costs per PE

At present, for the financial evaluation of the selection of the priority option in CSR, NPV is calculated only for capital and O&M expenditures. Furthermore, O&M costs are sometimes set as a certain percentage of capital costs in CSP. Therefore, in the event the priority option is determined by NPV, the option with the lowest capital investment tends to be given higher priority. This NPV evaluation seems to be preferred by developers who may seek to reduce the initial capital investment and avoid constructing larger STP tailored for centralization.

It is better to introduce tariff revenue for each option into the NPV calculation of the financial analysis. The reasons for introducing the revenue are that lifetime profit or loss for the option can be calculated and the option most profitable or with the least financial losses can be selected as first priority.

On the other hand, by properly estimating O&M costs, options with larger capacity STP, which is consistent with centralization/rationalisation, may have the potential of being selected as the priority option. **Figure 3.3.14** shows the effects of properly setting O&M costs in the sample case. In this example, Project A involves construction of two STPs. Under Project B, it is assumed that one large STP will be constructed with a capacity equal to the two STPs in Project A. With the proper setting of O&M costs in accordance with the capacity of each STP, Project B, is shown to have lower O&M costs as shown on the right side of the chart.

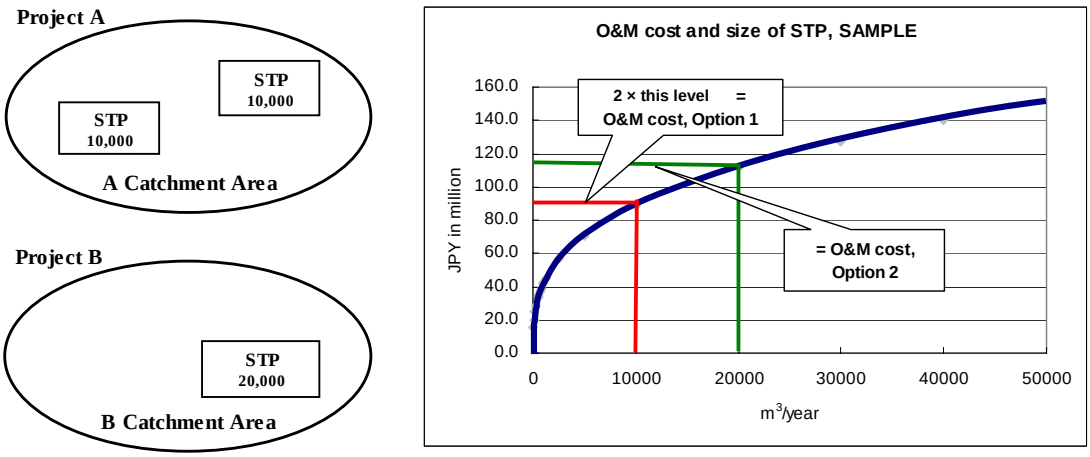


Figure 3.3.14 Simple Example of O&M Cost Comparison

Proper estimation of O&M costs and consideration of revenue contributes to minimizing the lifecycle net loss of the sewerage project.

Therefore, in the financial analysis, the following are considered in calculating NPV:

1) Tariff revenue is included in addition to costs
2) O&M costs are properly set for each treatment system

Through the trial application of the Manual to 25 catchments in CSRs as described in the next section, it is understood that projects with smaller PE have an advantage in the evaluation of NPV. In order to compare the variously-sized projects in an equitable manner, NPV of revenue minus costs was divided by the total design PE of the project.

(2) Trial Application of NPV/PE

Table 3.3.19 shows the result of trial application of the NPV/PE indicator to 25 catchments in several CSRs. NPV and B/C of each project were computed using the Manual's supporting programme by inputting the construction cost and design PE of the project. Catchments are ranked from the best (highest NPV/PE) to worst (lowest NPV/PE) in the table. It should be noted that the B/C ratio is automatically sorted from best to worst following the ranking of NPV/PE. In other words, NPV/PE and B/C ratio are highly correlated.

This ranking is considered reasonable for the following reasons. Small catchments with smaller PE result in lower rankings, while medium to large projects have a higher ranking. If construction cost divided by PE, which is construction cost per 1 PE unit, is smaller for a certain catchment, the project results in a higher ranking. Among the catchments with almost the same construction cost per PE, centralized or single STP catchment results in a higher ranking. These evaluation results are considered favorable, since the evaluation will contribute to the rationalisation and integration of STPs and will help to select cost-effective catchments.

(3) Construction Cost per Total Pollution Load Discharged

It is also relevant to include other indicators that express the efficiency or effect of capital investments in the project in reducing pollution from the project (how much capital investment is necessary to treat a certain amount of pollution load). First, the proposed indicator was the construction cost per unit of volume of reduced pollution load. However, through trial application, this was changed to construction cost per total pollution load

discharged due to data availability in the present CSR. Here, total pollution load discharged indicates the volume of pollution load discharged into the area after deducting pollution load reduction by existing STPs, CSTs and ISTs. In the trial, total pollution load discharged was calculated by total pollution load estimated by design PE minus estimated pollution load reduction by existing facilities.

The calculation formula of the indicator, construction cost divided by total pollution load discharged, is construction cost of the project (unit: million RM) divided by total pollution load discharged (unit: ton/day).

Table 3.3.19 Results of Trial Application of NPV/PE to 25 Catchments

No.	Carchments	NPV (Mil. RM)	B/C	NPV/PE (RM/PE)	Ranking	Notes		
						PE	Centralized/ multi-point	Construction cost/PE
1	MB Shah Alam	-122.98	0.24	-299.16	1	411,077	1 STP	288.98
2	PJD 3, MB Petaling Jaya	-77.39	0.23	-306.72	2	252,302	2 STPs	261.47
3	Tamping Tengah	-87.74	0.21	-387.50	3	226,436	Centralized	349.10
4	Yong Peng Catchment	-67.84	0.20	-399.00	4	170,024	Centralized	345.82
5	Taiping Catchment	-187.90	0.18	-423.62	5	443,562	2 STPs	383.41
6	Batu Pahat Catchment	-168.23	0.17	-436.11	6	385,746	Centralized	418.18
7	Bandar Melaka East	-279.75	0.17	-439.74	7	636,176	Centralized	438.58
8	Bdr Kuantan & Bdr Indera Mahkota	-176.21	0.17	-440.53	8	400,002	2 STPS	395.28
9	SJSK 2, MB Subang Jaya	-74.97	0.16	-468.56	9	160,003	1 STP	409.37
10	Jinjang-Kepong	-599.83	0.15	-512.05	10	1,171,422	Centralized	524.37
11	Temerloh District	-187.40	0.15	-541.29	11	346,205	4 STPs	445.82
12	Sg. Siput Catchment	-74.79	0.14	-544.03	12	137,472	2 STPs	442.24
13	Kuala Terengganu Selatan	-172.62	0.13	-589.92	13	292,615	4 STPs	492.02
14	Cukai Catchment, Kemaman	-38.69	0.13	-596.62	14	64,844	Centralized	472.38
15	Sg. Selangor, Gombak	-61.76	0.13	-640.38	15	96,001	Centralized	546.22
16	Sg. Gombak, Gombak	-50.60	0.13	-657.15	16	77,000	2 STPs	497.27
17	Bentong Town, Bentong	-90.34	0.11	-730.05	17	123,752	2 STPs	616.02
18	Sg. Simpo Catchment	-92.54	0.11	-731.29	18	126,547	1 STP	648.27
19	Sg. Simin	-117.35	0.11	-764.44	19	153,504	1 STP	691.31
20	Parit Buntar Catchment	-45.00	0.11	-772.74	20	58,233	1 STP	632.65
21	Ipoh Catchment	-885.06	0.10	-798.55	21	1,108,341	multi-point	771.69
22	Alor Gajah	-32.72	0.10	-863.32	22	37,898	1 STP	680.04
23	Kuala Terengganu Utara	-148.36	0.10	-885.22	23	167,594	2 STPs	780.82
24	K. Kangsar, Taiping & K.Kangsar	-151.01	0.07	-1,196.56	24	126,201	3 STPs	1,031.91
25	Bagan Serai, Taiping & K.Kangsar	-62.91	0.06	-1,347.10	25	46,702	2 STPs	1,108.56

If the pollution load reduced by the project is calculated precisely and mentioned in the CSR, it is more suitable to use pollution load reduced by the project than to use pollution load discharged for the purpose of observing efficiency or effect of the investment. Therefore, when the data of total pollution load reduced by the project is available in the future, this indicator should be replaced by construction cost (million RM) divided by total pollution load reduced (ton/day).

(4) Trial Application of the Construction Cost per Unit of Total Pollution Load Discharged

Table 3.3.20 shows the results of trial application of the indicator construction cost per total pollution load discharged, to 32 catchments in several CSRs.

Table 3.3.20 Results of Trial Application of Construction Cost per Unit of Total Pollution Load for 32 Projects

Ranking No.	Name of Catchment / Sub-Catchment	Construction cost (Mil. RM) / Total pollution discharged (ton/day)
1	Kuantan, Kuantan	6.723
2	Yong Peng, Bandar Penggaram, Batu Pahat	6.850
3	MB Shah Alam	7.196
4	Tampin Tengah, Tampin Dist. & Pulau Sebang	7.306
5	PJD3, MB Petaling Jaya, Petaling Dist.	7.540
6	Cukai, Kemaman District	8.181
7	SG1, Sg. Gombak, Gombak	8.342
8	Sg. Siput, Kuala Kangasar, Taiping & Kangsar	8.387
9	Bandar Kuantan & BIM, Kuantan	8.900
10	Bandar Penggaram, Batu Pahat	8.945
11	Sg. Duyung, Melaka Tengah	10.481
12	Jinjang – Kepong	11.341
13	Rawang, Sg. Selangor, Gombak	11.576
14	Bandar Melaka East, Melaka Tengah	11.576
15	Larut & Matang, Taiping & Kangsar	11.891
16	Bandar Melaka West, Melaka Tengah	12.058
17	Temerloh South 2, Temerloh	12.793
18	K. Terengganu Selatan, K. Terengganu	13.462
19	Parit Buntar, Kerian, Taiping & Kangsar	13.976
20	Sg. Udang, Melaka Tengah	14.286
21	Sg. Simpo	15.668
22	Bentong, Bentong	16.226
23	Kota Laksamana, Melaka Tengah	16.638
24	SJSK2 MB Subang Jaya, Petaling Dist.	16.929
25	Sg. Lereh, Melaka Tengah	18.360
26	Bertam, Melaka Tengah	18.388
27	Alor Gajah,	20.902
28	K. Terengganu Utara, K. Terengganu	22.500
29	Bagan Serai, Kerian, Taiping & Kangsar	22.847
30	Ipoh catchment	23.701
31	Kuala Kangsar, Taiping & Kangsar	24.005
32	Sg. Simin	26.477

Figure 3.3.15 shows the range and distribution of the calculated indicators of 32 catchments in trial application. Since the calculated indicators in the trial are within a certain range and scattered moderately, this indicator is regarded as usable as one of the indicators of the Manual.

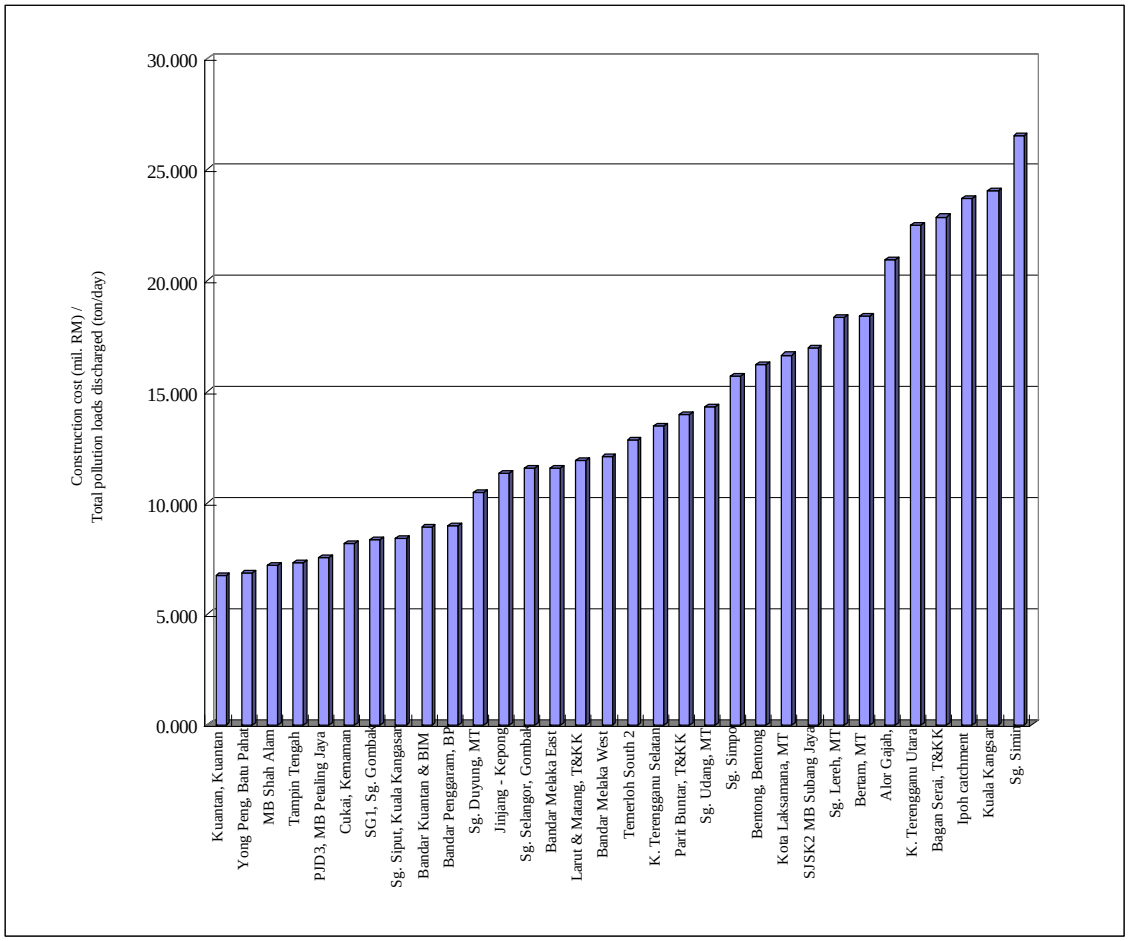


Figure 3.3.15 Distribution and Range of Indicators for 32 Catchments

3.3.13 User Affordability to Pay

The user affordability to pay is the basis for estimating the collection percentage of sewerage charges after sewerage provision and analised using the income bracket distribution. The Household Expenditure Survey (based on 14,084 nationwide respondents) conducted in 2004 and 2005 was analised. The survey provides no information on income differences at the municipal level.

According to the above Household Expenditure Survey, the average monthly household expenditure was MR1,953 nationwide, MR2,285 in urban areas, and MR1,301 in rural areas as shown in **Table 3.3.21**. Based on a current monthly sewage charge of MR8 per household and average household expenditures, sewerage charge as a percentage of household expenditures was 0.41% nationally, 0.35% in urban areas, and 0.61% in rural areas, all of which were below the maximum limit of 1% for affordability to pay set by the World Bank. Therefore, the

current sewerage charge is not considered to be an undue burden on the people and, thus, the user affordability to pay was eliminated from the evaluation indicators.

Table 3.3.21 Water and Sewage Expenditures as a Percentage of Total

	Nationwide	Urban	Rural	Upper limit by IBRD
Total	MR1,953	MR 2,285	MR 1,301	
Water	MR 28.78 (1.47%)	MR 34.16 (1.49%)	MR 18.21 (1.40%)	4%
Sewage	MR 0.82 (0.41%)	MR 1.16 (0.35%)	MR 0.16 (0.61%)	1%

Source: Report on Household Expenditure Survey 2004 and 2005, Department of Statistics, Malaysia, pp.43 & 181.

3.3.14 Promotion of Sludge Treatment

In Malaysia, the amount of domestic sewage sludge generated from septic tanks and STPs now amounts to 4.3 million cubic meters per year. IWK has plans to provide mechanized sludge dewatering facilities. For this reason, it is recommended that high priority be given to sewerage catchments/projects that include sludge treatment. Since, in general, most sludge is conveyed to the municipal solids dumping sites for disposal, the sludge disposal volume or sludge disposal cost reduction should be evaluated.

Wet sludge volume (m3/day) varies depending on the scale of sludge treatment and solids concentration (%). As shown in **Table 3.3.22**, in addition to consideration of the scale of sludge treatment scale as the basis of 50,000 PE, scoring is set so that the higher the solids concentration, the higher the score. However, digested sludge is afforded with one additional ranking increment in the evaluation, since it has the advantage of stabilizing sludge quality.

Cost reduction in sludge treatment is regarded as an alternative to sludge disposal volume. The cost for sludge disposal will be a larger burden to IWK in the future, since conveyance of sludge to remote dumping sites and traffic jams, especially in urban areas, will deteriorate efficiency, making the extent to which sewage sludge should be treated at a sewage treatment plant a significant issue.

However, this evaluation item is excluded from prioritisation of sewerage catchments/projects for the following reasons:

1) Sludge treatment management plans are formulated as separate plans independent of that for sewage treatment in almost all catchment strategy reports.

2) Centralized sludge treatment facilities (CSTF) are not necessarily located at the STP site.
3) CSTFs receive sludge generated from existing STPs and desludged from ISTs and pour flush latrines.
4) Therefore, it is difficult to include sludge treatment in the evaluation items.

Table 3.3.22 Scoring Based on the Scale and Solids Concentration of Sludge Treatment

Type of sludge	Mixed sludge	Digested sludge	Thickened sludge	Dewatered sludge	Dried sludge
Typical solids concentration (%)	1	2.5	5	20	40
Score					
≤50,000 PE	0	4	4	6	8
>50,000 PE	2	6	6	8	10

Reference: Dried and wet sludge volumes at 50,000 PE under the following conditions

Dried sludge volume (ton/day)	2.228	1.448	2.228	2.228	2.228
Wet sludge volume (m^3/day)	222.8	57.9	44.6	11.1	222.8

Conditions:

Design population	: 50,000 PE	
Unit sewage flow rate	: 225 L/capita per day	
Design sewage flow rate	: 11,250 m^3/day	〔= 50,000 × (225/1,000)〕
Influent SS	: 220 mg/L	
SS removal	: 90%	
Design sludge volume	: 2.228 ton/day	〔= 11,250 × (220/1,000,000) × (90/100)〕
Organic content	: 70%	
Digestion rate	: 50%	
Digested sludge volume	: 1.448 ton/day	〔= 2.228 × (1 - (70/100) × (50/100)〕

3.3.15 Consideration of Special Conditions

There are a various kinds of national projects not governed by sewerage provisions, such as industrial park development, tourism development, and comprehensive regional development. The involvement with national projects in some specified areas or cities shows to what extent the government has focused on the development of such areas, and it is reasonable to pay a certain level of attention to these areas in terms of sewerage provision.

The national projects considered here are as follows:

1) Iskandar regional development
2) Northern corridor economic region
3) Eastern economic corridor

When the planned CSTP becomes the primary facility in the area, the sludge treatment should be conducted in the same premises. Tanker transfer of sewage sludge from, in all likelihood, the largest sludge generation source to other sites is uneconomical and is associated with potential problems like traffic congestion and decentralized O&M. The inclusion of sludge treatment in the CSTP construction is a high priority from this viewpoint.

3.3.16 Selected Evaluation Items and Indicators

Through the study described in **Sub-sections 3.3.1 to 3.3.15**, the following evaluation items and indicators were finally selected for the Manual for Reviewing/Evaluation/Prioritising of Sewerage Catchments/Projects

1) Importance of city/area
   - Growth rate of population
   - Design population size
   - Rate of commercial and industrial PE
   - Annual hotel guests by locality
2) Pollution load
   - Total domestic pollution load generated
3) Water pollution status of receiving water body
   - Water Quality Index (BOD_5)
   - Water Quality Index (NH_3-N)
4) Complaints from the public
   - Complaints related to STP odour
   - No. of existing STPs
5) Beneficial water use of receiving water bodies
   - Total average water production by downstream WTPs
   - Annual water intake closure duration at downstream WTPs
   - Intake points for irrigational use
   - Recreational use for swimming

6) Rationalisation impact of existing sewage treatment plants
   - Reduction in O&M manpower requirement by rationalisation of existing STPs and connection of IST area to public sewerage systems
   - Population of the new service area connected to sewerage
7) Conservation of local water cycle
   - Study on local water cycle
8) First-time permanent CSTP
   - Existence of a permanent CSTP
9) Reliability of project implementation
   - Land acquisition status of a proposed STP site
10) Financial analysis
   - NPV divided by PE
   - Construction cost per pollution load generated
11) Consideration of special conditions
   - Involvement with national projects
   - Inclusion of sludge treatment within the STP site
   - Extension of sewage effluent discharge pipes from an STP to waters downstream of an intake point

3.4 Trial Application to Sewerage Catchments Proposed in 24 CSRs and SLPs

3.4.1 Problems in Data Collection

(1) Existing CSTRs and SLPs Used for Trial Application

25 existing CSRs and five sewerage local plans (hereinafter referred as “SLPs”) have been investigated (see Appendix 3-I for details). Although the reports investigated include those prepared in the past, relatively new reports are preferable and were selected in principle.

Table 3.4.1 shows the relationship between the target year and the year that reports were prepared, which suggests that most of the plans were formulated with a target years ranging from 2015 to 2035. A target year of 2015 was generally found in old reports and, in the case of Gombak, the report was prepared with a target year of 2015 in 2004 when a target year of 2020 was the norm. The preparation of SLPs is a relatively new practice, and small scale SLPs, such as those of Sg. Simpo, Sg. Simin, and Sg. Skudai, contained a target

year of 2020 while larger SLPs, such as those of Kuantan and Kuala Terengganu, used a target year of 2035.

Table 3.4.1 Year of Issue and Target Year for CSRs and SLPs

SRC prepared in	Target Year					
	2010	2015	2020	2025	2030	2035
1998		Jinjang-Kepong (Hulu Langat)	(Ipoh)			
1999		Kuala Langat				
2000			Larut&Matang Kerian Kuala Kangsar Tampin Muar			
2001		(Kuantan)	(K.Terengganu) Kemaman Dist.			
2002	(Dungun)		Alor Gajah Batu Pahat Pulau Tioman			
2003			Sg. Keyayong LP Sg. Simin Melaka Tengah Jasin			
2004		Gombak				
2005			Temerloh Bentong LP Sg. Sukudai			
2006			LP Sg. Simpo	Petaling Dist.		
2007			P. Redang			LP Kuantan LP K. Tereng.
2008						Iskandar Upper Langat Ipoh Kota Kinabalu

Note: The CSRs in parenthesis were not used in this study as a result.

Both CSRs and SLPs have been prepared for Kuantan and Kuala Terengganu. As the basic data used in SLPs were updated using previous CSRs, the information in SLPs was utilized in this analysis. SLPs for Sg. Simpo, Sg. Simin（both Negeri Sembilan）and Sg. Skudai (Johor), have been updated using part of the catchment of previous CSRs.

Dungun is excluded due to its proximate target year of 2010.

Consequently, in this analysis 19 CSRs and five SLPs were reviewed. **Table 3.4.2** shows 24 areas divided into 116 catchments and further divided into 196 sub-catchments.

The CSRs have a variety of content from Jinjang-Kepong, in which only one centralized STP has been proposed to cover the entire study area to Petaling district, which is composed of three major local authority jurisdictions and divided into 38 planning units. The study area of CSRs was defined based on the catchment or river basin in most cases but

sometimes on the administrative jurisdiction. There are no clear definitions for secondary classes of areas, such as sub-catchments, sewerage zones, and planning blocks, among others, but in the interest of convenience it is often used as single unit for planning purposes. In one sub-catchment, single or multiple centralized STPs or a multi-point system may be proposed.

(2) Limitations on Informative Value of Existing CSRs

Table 3.4.2 Planning Units in CSRs and SLPs

Catchment Strategy Report		Catchment	Sub-catchment	Remarks
Taiping & Kuala Kangsar	Larut & Matang	2	2	
	Kerian	3	7	
	Kuala Kangsar	2	5	
Ipoh		3	4	2001 CSR
Jingjang-Kepong		1	1	
Petaling District	DB Shah Alam	3	16	
	DB Petaling Jaya	3	11	
	MP Subang Jaya	3	11	
Gombak		4	13	
Kuala Langat		7	7	
Sg. Kepayang		1	1	
LP Sg. Simpo		1	1	
LP Sg. Simin		1	1	
Tampin		5	8	
Alor Gajah		1	1	
Melaka Tengah		7	9	
Jasin		6	8	
Muar		14	16	
Batu Pahat		14	15	
LP Sg. Skudai		1	10	
LP Kuala Terengganu		2	5	
P. Redang & P. Lang Tengah		5	5	Island tourism
Kemaman District		4	9	
LP Kuantan		8	8	
Temerloh		4	4	
Bentong		3	6	
Pulau Tioman		7	7	Island tourism
Upper Langat		7	17	On-going
24		116	196	

Aside from information that is not clearly required by the existing Guidelines, it is no exaggeration to say that almost no CSRs surveyed contained all required information, as indicated below.

1) Lack of Basic Information

Table 3.4.3 summarises the basic information (design population, design PE by use, water intake, IST and STPs by sub-catchment) provided by the existing CSRs. Only six reports provided a complete set of information. For reports with a lack of data, the person in charge of prioritising sewerage catchments/projects is forced to either exclude the report from further consideration or the omitted evaluation items themselves, or to supplement the data using justifiable means so as to avoid removal from further study. The following measures were taken in this study.

Table 3.4.3 Basic Information Available

	District/City(Town)	Design population	Design PE by land use	WIPs	IST	STPs by sub-catchment
1	Kerian *[1]	×	× [3)]	[6)]	×	×
2	Larut & Matang *[1]	×	× [3)]	[6)]	×	×
3	Kuala Kangsar *[1]	×	× [3)]	[6)]	×	×
4	Ipoh	×		×	×	×
5	Jinjang Kepong	×	×		×	×
6	Gombak	× [1)]	×	×		
7	Shah Alam *[2]	×		×	[4)]	×
8	Petaling Jaya *[2]	×		×	[4)]	×
9	Subang Jaya *[2]	×		×	[4)]	×
10	Upper Langat	×		×	×	×
11	Kuala Langat			×		×
12	Sg. Kepayang		×			×
13	(L/P) Sg. Simpo	×	×	×	×	×
14	(L/P) Sg. Simin	× [1)]	×	×		×
15	Tampin		×	×	×	×
16	Alor Gajah	×		×	×	×
17	Melaka Tengah	×	×	×	×	×
18	Jasin	×	×	×	×	×
19	Muar [5)]			×		
20	Batu Pahat	×		×	×	×
21	(L/P) Sg. Sukudai [5)]			×		
22	(L/P) Kuala Terengganu	×		×	×	×
23	Pulau Redang [6)]	×	×	×		
24	Kemaman District	×	×	×	×	×
25	(L/P) Kuantan	×		×	×	×
26	Temerloh	× [2)]	×	×	×	
27	Bentong	× [2)]	×	×	×	×
28	Pulau Tioman [6)]			×		×
	Data points available	22	16	25	16	23

*1 The CSR for Larut & Matang and Kuala Kangsar covers the jurisdiction of three local authorities, Taiping, Kerian and Kuala Kangsar.

*2 The CSR for Petaling District covers the jurisdiction of three local authorities, Shah Alam, Petaling Jaya and Subang Jaya.

Note [1-6]: Corresponds to the description in (1).

(a)The design population itself is used as an index to represent planning scale and is also concerned with the population growth rate, so its absence has a critical impact on the evaluation of sewerage catchments/projects. The design PEs are clarified in all CSRs and the residential design PE equals the population. If the design PE is less than two times the current PE, the design and current populations are calculated by dividing the design and current PEs by 1.25, respectively (see **Figure 3.4.1** for reference). The design and current population is presented in this way for Gombak (design PE/current PE = 1.08) and Sg. Simin (1.08), but the method is not applied to Sg. Kepayang (6.38) and Tampin (5.55).

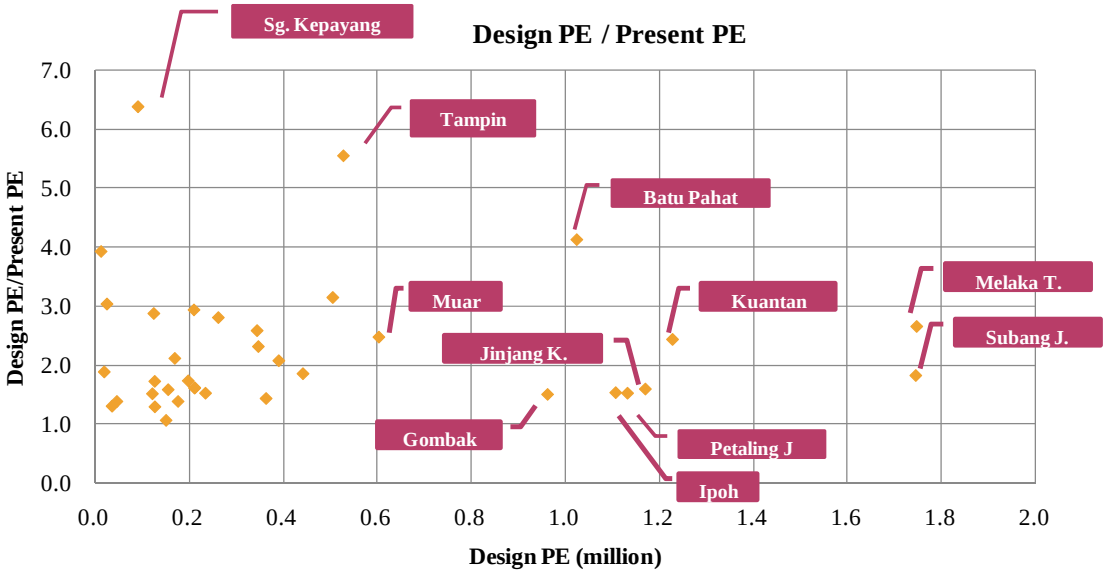


Figure 3.4.1 Design PE Divided by Current PE vs. Design PE

(b) In Termerloh and Bentong, the total population is given in the report but no breakdown in terms of priority and non-priority areas, which are determined based on the proportion of the design PE to the respective areas.

(c) In Taipin and Kuala Kangsar, the design population is fixed as an intermediate value of the population projected by both the census population growth rate method and the land uses method. The proportion using the population projected by the land uses method is applied to the calculation of the commercial and industrial design PE ratio. In spite of such efforts, the adoption of this commercial and industrial design PE ratio as an index was abandoned because the data collected was insufficient.

(d) In Ipoh, Shah Alam, Petaling Jaya and Subang Jaya, there is no information on ISTs

in the report, which is supplemented with the IWK data.

(e) Due to the lack of detailed information on Muar, Sg. Sukudai, and Kuala Langat, those areas were excluded from this analysis.

(f) Paulau Redeang and Pulau Timon were excluded from the analysis due to their island resort tourism economies.

2) Discrepancies between the Text and Appendix

In many reports, design PE, and information of existing STPs and ISTs are shown in the appendices with no indication of relevance to the text. In those cases the information is available only for the entire area but not at the sub-catchment level.

3) Lack of Summary Sheets

In the text, the design PEs by sub-catchment for five year periods have been indicated, but, notwithstanding the population projection by the land use method, it is rare to show the design PE by use. To gather such information, vast energy is required in the course of scanning, data checking and data processing since data sources are in hardcopy format.

4) Lack of Design Population Projections

Although there is Population Projection section in every report, the actual content refers to the population equivalent (PE) projection in some reports. Omission of the population projection may lead to overestimation of design PE due to an absence of comparison between the two calculations.

5) Difference in Approach to the Study Area

There are two approaches to address study area: one is to categorize the study area into priority and non-priority areas and exclude the latter from sewerage planning, and the other is to formulate catchment plans for all communities even in rural areas. This difference in approach makes the evaluation of the entire area difficult.

6) Ambiguity in the Definition of Planning Unit

All the information is not necessary presented on a planning unit basis. Sometimes a few sub-catchments are described together without respective breakdown data. Some sub-catchments, in which a centralized STP system is proposed, are combined to estimate costs. Sewerage projects reported with different sizes in different reports may distort the prioritisation of sewerage catchments/projects. Even if the sub-catchment will ultimately

have a few centralized STPs, it is recommended that the sewerage system be described according to a CSTP basis including the cost estimation.

3.4.2 Procedures for Application of the Manual for Prioritising Sewerage Catchments/Projects

The following procedure for application of the Manual for prioritising sewerage catchments/projects is proposed in this Study (see **Figure 3.4.2**):

Step 1: Data collection from existing CSRs/SLPs
Step 2: Supplementation of data
Step 3: Identification of special projects
Step 4: Grouping of catchments/projects based on design PE
Step 5: Scoring
Step 6: Prioritisation of catchments/projects
Step 7: Selection of catchments/projects

(1) Step 1: Data Collection from Existing CSRs/SLPs

Data is collected from existing CSRs and SLPs in order to complete the data sheet showing the necessary data, which includes not only direct data but also indirect data concerned, such as the year the report was published, final selected option (CSTP, multipoint or on-site systems), structure of catchments/sub-catchments, etc. Some indicators require data processing from the raw data.

(2) Step 2: Supplementation of Data

Some data may need to be reviewed before the Manual is applied. The data sheet is scrutinized for data missing, numerically abnormal values, discrepancies among relevant data, etc. and, as necessary, consideration of ways to reasonably supplement or correct such data. Even in the event that data cannot be successfully supplemented, such projects are not excluded from the prioritisation of sewerage catchments/projects, but the will have a disadvantage in scoring in accordance with the principle “no data, no score”.

(3) Step 3: Identification of Special Projects

Special consideration may be afforded to sewerage projects with special features. An example of such projects may, for example, include (but not be limited to) an island tourism resort development that is unlikely to be selected under normal prioritisation procedures, but meets the national policy, or a sewerage project that, in the absence of urgent measures, may otherwise cause a serious impact to the environment.

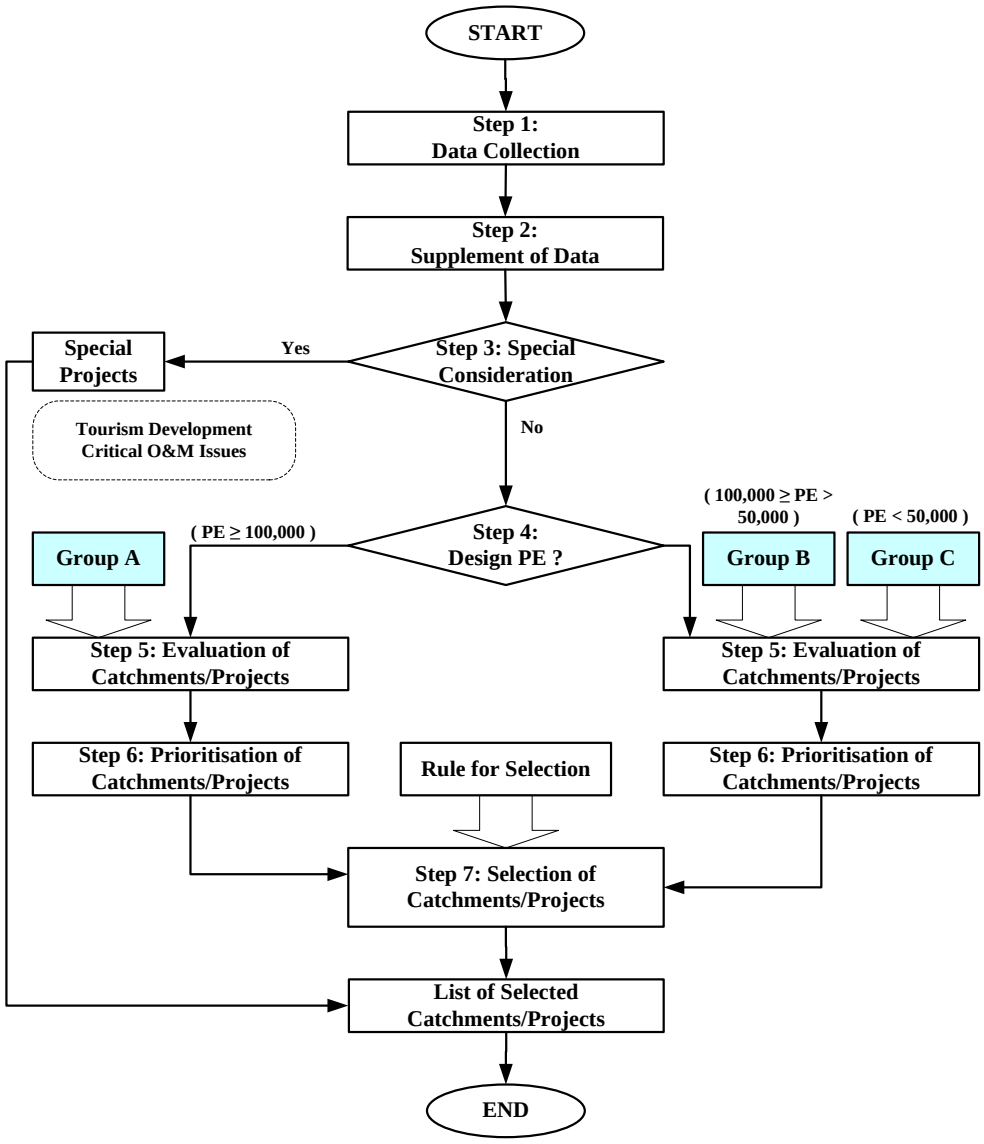


Figure 3.4.2 Flowchart for Prioritisation of Sewerage Catchments/Projects

(4) Step 4: Grouping of Catchments/Projects Based on Design PE

The catchments/projects are categorized into three groups with a design PE, namely PE≥100,000 (Group A: high PE), 100,000>PE≥50,000 (Group B: middle PE) and PE<50,000 (Group C: low PE).

(5) Step 5: Scoring

Scoring is calculated for the three groups, indicating classification criteria for each evaluation items, as follows: "Group A" for high PE, "Group B" for middle PE and "Group C" for low PE. As the default values are embedded in the cells on the EXCEL worksheet,

the scoring before and after weighting application is calculated automatically. The default values are changeable, if necessary.

(6) Step 6: Prioritisation of Catchments/Projects

Sewerage catchments/projects are prioritised based on the scores. Three project lists are prepared for high, middle and low design PE groups.

(7) Step 7: Selection of Catchments/Projects

A special project list and three prioritised project lists by design PE size are now targeted. Selection of catchments/projects is performed in accordance with the rules.

3.4.3 Considerations for Scoring

(1) Setting of Weighting Methods

The following three weighting methods were used for the study.

1) Overall balance weighting (see "Tot-W15" in **Figure 3.4.3**and **Figure 3.4.4**)
   The maximum weighting is three times the minimum and the intermediate weighting is 1.5 times the minimum.

2) Weighting for priority issues (30%) (see "Env-W30", "Rat-W30" and "Inv-W30" in **Figure 3.4.3**)
   Special attributes that receive increased weighting are environmentally-friendly (water pollution status), rationalisation promotion, and investment-efficiency. The maximum weighting is six times the minimum and the intermediate weighting is three times the minimum.

3) Increased weighting (50%) (see "Env-W50", "Rat-W50" and "Inv-W50" in **Figure 3.4.3**)
   Similar to weighting for priority issues (30%) type, there are three types: environmentally-friendly (water pollution status), consolidation promotion and investment-efficient types. The maximum weighting is 10 times the minimum and the intermediate weighting is five times the minimum.

The differences among the above weightings were assessed using the following three methods:

1) Comparison between overall balance weighting and increased weighting (30%)
2) Comparison between overall balance weighting and increased weighting (50%)
3) Comparison among all levels of increased weighting (15, 30, and 50%) on environmentally-friendly aspects

The findings were as follows:

1) Comparison between the overall balance weighting and increased weighting (30%) (see **Figure 3.4.5**)

   - Compared with the overall balance weighting, there are some, though not significant, changes in ranking using increased weighting (30%).
   - Using increased weighting (30%), investment-efficiency had a stronger impact on rankings than environment-friendly and consolidation promotion aspects.
   - Some rural towns showed large declines in rankings based on the design PE (see the straight dotted line in **Figure 3.4.4**), presumably attributed to the fact that water pollution status is classified as "clean" and there are few existing STPS to be rationalised.

2) Comparison between the overall balance weighting and increased weighting (50%) (see **Figure 3.4.6**)

   - Among important items, the consolidation promotion type tends to rank after the overall balance, followed by environmentally-friendly and efficient investment types. The ranking of the efficient investment type changes drastically in some catchments/projects.
   - Even when the increased weighting (50%) is applied, no sewerage projects moved from the lower ranked groups into the top ranks, although the reverse situation is possible.

3) Comparison among all levels of increased weighting (15, 30, and 50%) on environmentally-friendly aspects (see **Figure 3.4.7**)

   - Increased weighting (30%) had no significant impact compared to increased weighting (15%), which is equivalent to the overall balance weighting. Increased weighting (50%) magnifies any changes resulting from application of its 30% counterpart, but its actual impact on ranking would be less than 15.

(2) Necessity for Grouping Based on Design PE Size

Based on the size of the design PE, the study area or towns for trial application were categorized into four groups: (1) Group A (PE≥200,000), (2) Group B (200,000>PE≥100,000), (3) Group C (100,000>PE≥50,000) and Group D (PE<50,000). As shown in **Figure 3.4.4**, some catchments/projects in Group B are competitive with those in Group A, but there is no such project in Groups C and D. Furthermore, there is almost no change in ranking, despite changing the weighting of special aspects from 15% to 30%. This is due to the fact that, since the design PE of the study areas or towns is distributed across a wide PE range of 48,000 to 1,170,000, the classification ranges for scoring become less precise, and the low design PE group has a tendency to gather in the low scoring range. **Table 3.4.4** summarises the frequency that each score appears in the overall balance weighting, which reveals that Groups C and D share only 15.7% in the 1st class, and 20.8%, 33.1%, 47.4% and 79.1% in the 5th class. It suggests that no matter what, Groups C and D cannot enter into the top group.

Since SPAN is responsible for monitoring the social obligation of providing sewerage services in rural areas, it is recommended that study areas or towns be categorized into high and low design PE groups to improve the chances of sewerage project implementation for the low design PE group. The manuals that apply to the high and low design PE groups are hereinafter called “Manual A” and “Manual B”, respectively. The basic difference between Manuals A and B is not weighting, but classification intervals. Since the classification intervals are ideally set so that score frequency will be almost even, they are set so as to distribute evenly on the Excel sheet when calculating the ranking and percentage from the top of each data set.

The classification intervals shown in **Table 3.4.5** are established for the study areas or towns used for trial application of the Manual and should be regarded as approximate figures. It is advisable to check the actual distribution of each score and adjust the classification intervals accordingly.

Figure 3.4.8 shows an example of the classification intervals for design population with and without design PE classification. Depending on the evaluation index, some classification intervals cannot be changed in the way that WQI, which is based on the DOE standard, can, and some indicators are simple “yes/no” questions, as in the first sewerage provision using government funds. It should be noted that the score frequency is not necessary for every classification, since the classification intervals are set at regular intervals.

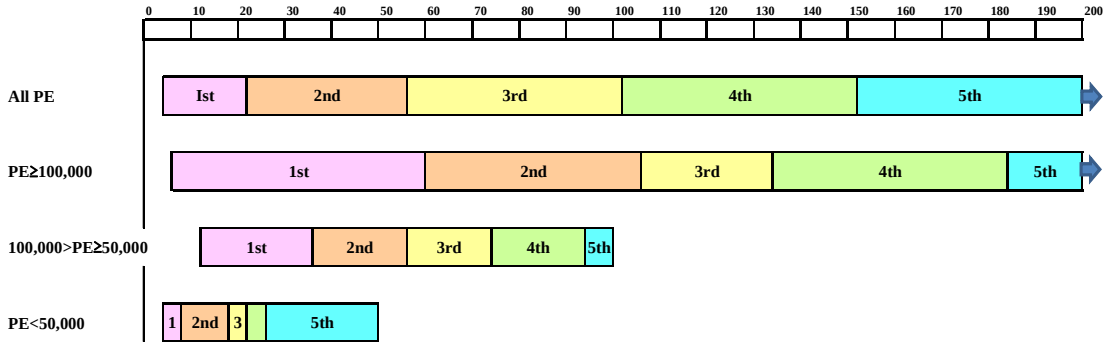
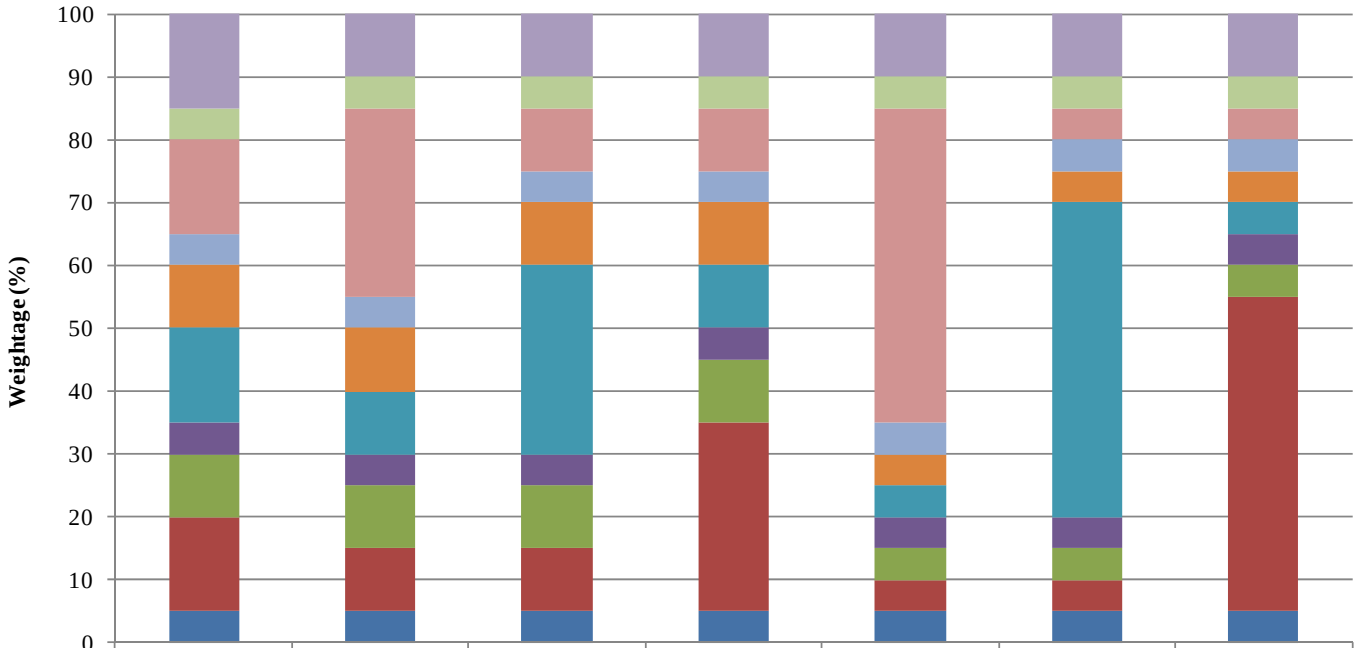


Figure 3.4.8 Comparison of Classification Intervals for Design Population

Figure 3.4.3 Weightage Allocation by Prioritisation Type



	Tot-W15	Env-W30	Rat-W30	INV-W30	Env-W50	Rat-W50	INV-W50
Importance of area	15	10	10	10	10	10	10
Pollution load	5	5	5	5	5	5	5
Water pollution status	15	30	10	10	50	5	5
Complaints of existing STPs	5	5	5	5	5	5	5
Beneficial water use	10	10	10	10	5	5	5
Rationalisation impact on existing STP/IST	15	10	30	10	5	50	5
Existence of permanent CSTP	5	5	5	5	5	5	5
Reliability of project implementation	10	10	10	10	5	5	5
Financial viability	15	10	10	30	5	5	50
Consideration for special conditions	5	5	5	5	5	5	5

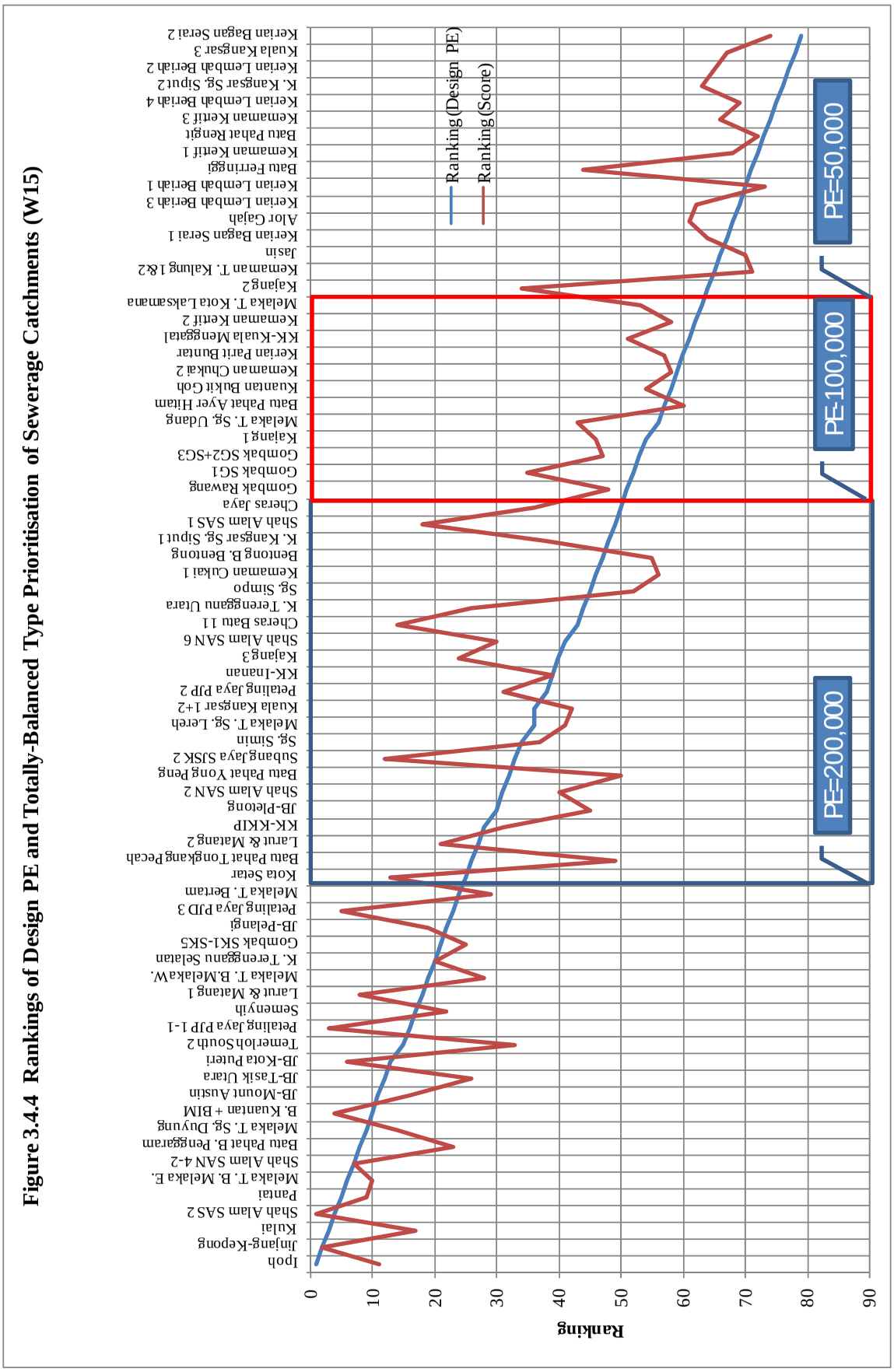


Figure 3.4.4 Rankings of Design PE and Totally-Balanced Type Prioritisation of Sewerage Catchments (W15)

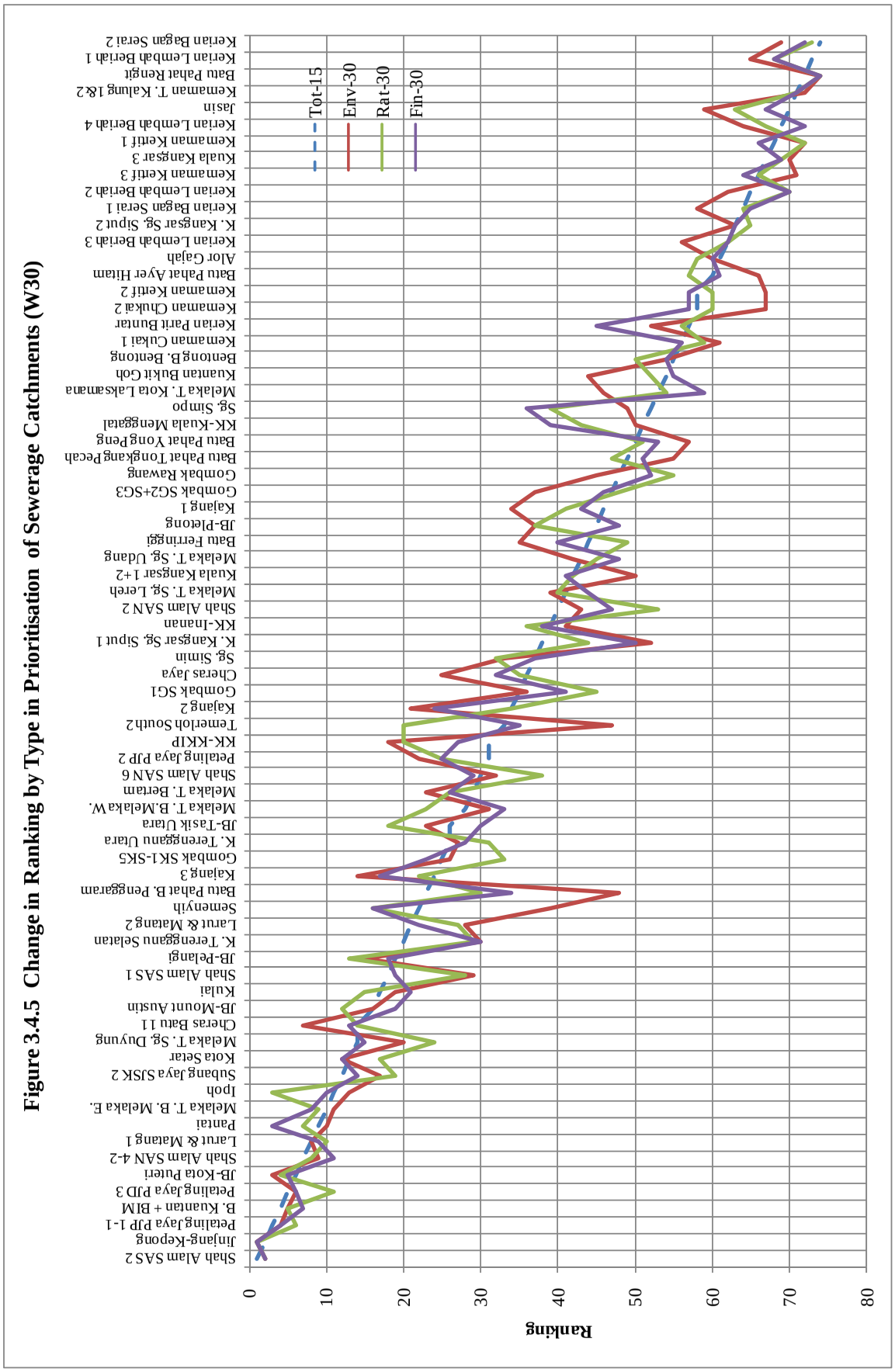
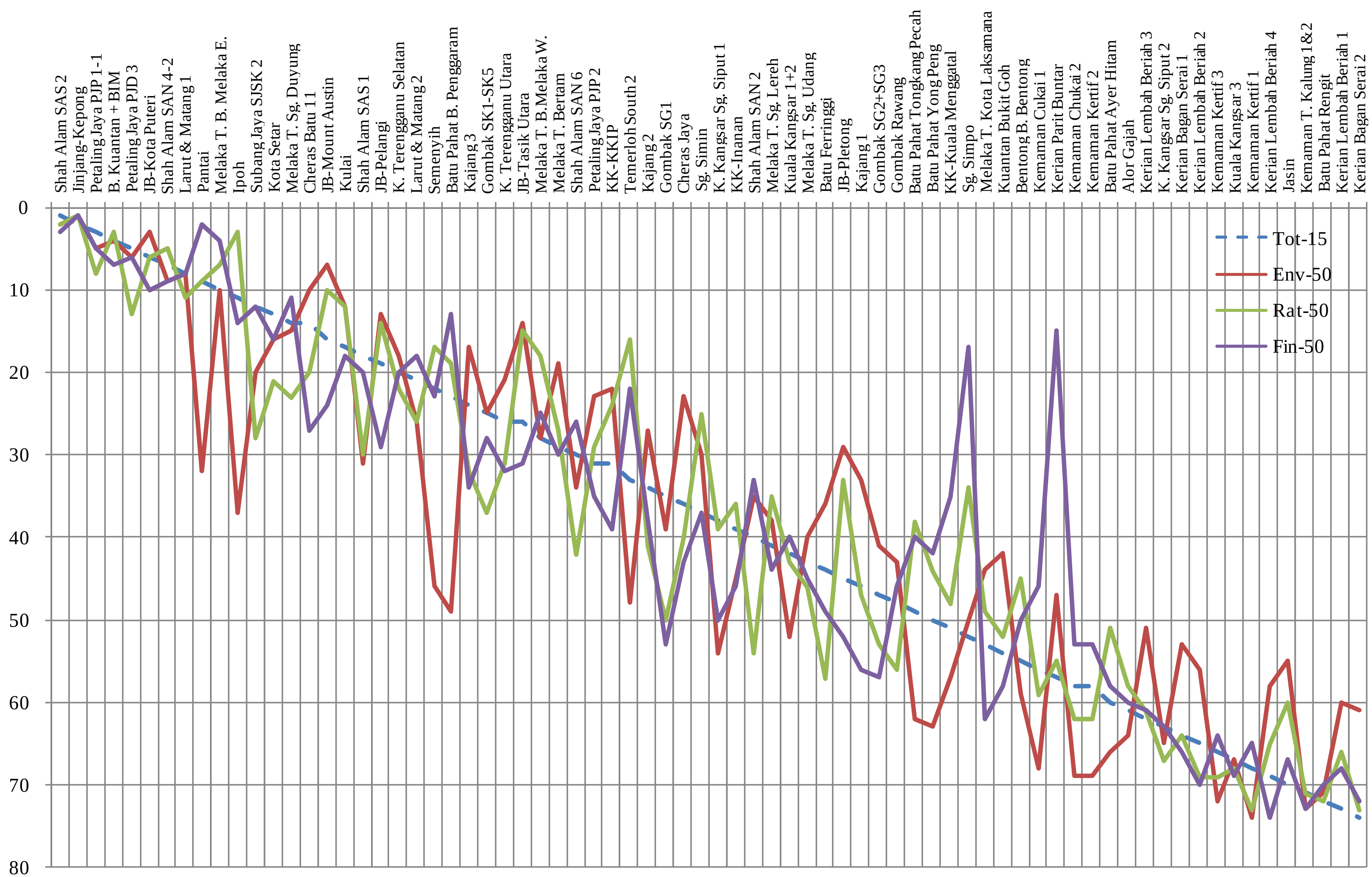


Figure 3.4.5 Change in Ranking by Type in Prioritisation of Sewerage Catchments (W30)

Figure 3.4.6 Change in Ranking by Type in Prioritisation of Sewerage Catchments (W50)



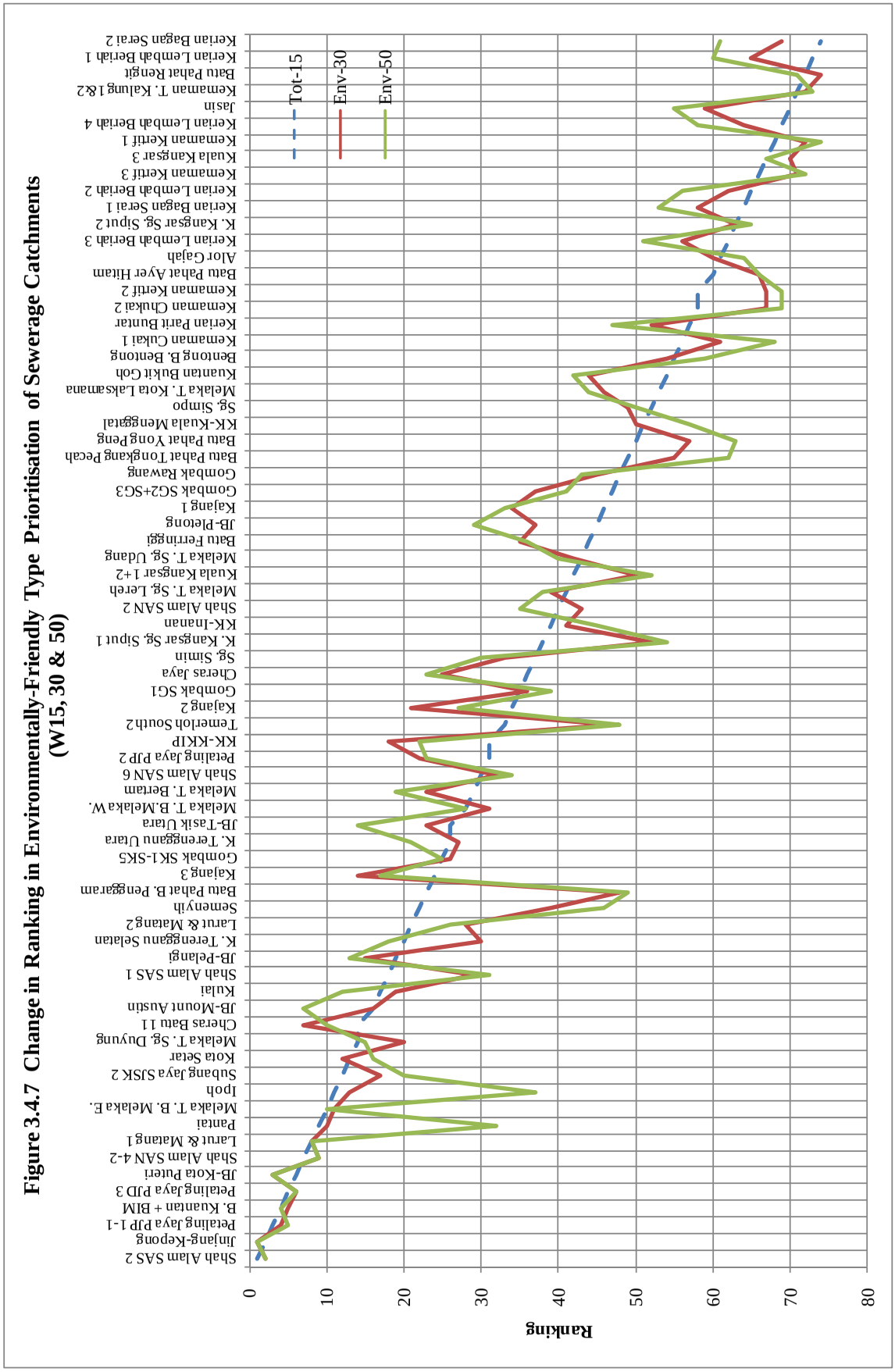


Figure 3.4.7 Change in Ranking in Environmentally-Friendly Type Prioritisation of Sewerage Catchments (W15, 30 & 50)

Table 3.4.4 Score Frequency Based on Design PE Class

Design PE Class & Score		All						PE < 100,000					
		10	8	6	4	2	Total	10	8	6	4	2	Total
Importance of Area													
	Growth rate of population	14	13	14	9	15	65	6	3	8	5	5	27
	Design Population	9	13	15	13	15	65	0	0	6	8	13	27
	Annual Hotel guests	5	2	6	6	6	25	1	1	0	0	5	7
Pollution load													
	Total pollution load generated	9	12	15	15	14	65	0	0	0	13	14	27
Water pollution status at the downstream													
	BOD_5 SI	34	23	6			65	8	16	3			27
	NH_3-N SI	52	7	6			65	19	3	5			27
Complaints from the public													
	Complaints on existing STPs	10	13	13	26	0	62	4	3	1	4	14	26
	No. of existing STPs	9	10	12	12	12	55	0	1	3	3	10	17
Water use condition at the downstream													
	Total water production by WTPs	1	2	5	0	1	9	0	1	2	0	1	4
	Water intake closure duration time at WTPs	1	5	0	0	0	6	0	2	0	0	0	2
	No. of intakes for irrigational use	0	0	0	0	0	0	0	0	0	0	0	0
	Classification by WQI	19	46				65	9	18				27
Rationalisation of existing STPs													
	Total O&M man-power requirement reduction	9	10	13	13	13	58	0	0	4	6	12	22
	Connecting potential in the new service area	12	12	13	13	15	65	0	0	7	9	11	27
Existence of permanent CSTP													
	Existence of permanent CSTP	67	2				69						
Reliability of project implementation													
	Prospective of land acquisition for STP site	16	4	12	31	2	65	4	0	6	17	0	27
Financial analysis													
	NPV / Design PE	13	14	13	14	11	65	1	5	6	10	5	27
	Construction cost / Pollution load discharged	10	14	14	14	13	65	4	9	7	6	1	27
Consideration for national projects													
	Necessity for consideration	0	0	0	0	0	0	0	0	0	0	0	0
Total		102	120	133	135	115	605	16	25	44	64	91	240
Design PE / All (%)								15.7	20.8	33.1	47.4	79.1	39.7

Table 3.4.5 Evaluation Index Intervals for Scoring in Groups A, B and C (1/2)

		Unit	Manual A (PE ≥ 100,000)					Manual B (100,000>PE≥50,000)				
			10	8	6	4	2	10	8	6	4	2
Importance of Area												
	Growth rate of population	%	4.0	2.8	1.9	1.2	Less	4.8	2.7	2.2	1.7	Less
	Design Population	person	180000	130000	100000	60000	Less	93000	74000	56000	35000	Less
	Annual Hotel guests	Mil. person	3400	2600	900	300	Less	4900	4900	1600	90	Less
Pollution load												
	Total pollution load generated	ton/day	20.4	13.5	9.9	7.6	Less	5.4	5.0	4.1	3.2	Less
Water pollution status at the downstream												
	BOD_5 SI		79	90	More	-	-	79	90	More	-	-
	NH_3-N SI		70	91	More	-	-	70	91	More	-	-
Complaints from the public												
	Complaints on existing STPs	nos.	91	36	6	1	Less	154	15	6	0	0
	No. of existing STPs	nos.	105	89	46	26	Less	66	36	27	10	Less
Water use condition at the downstream												
	Total water production by WTPs	m^3/day	660000	370000	55000	28000	28000	26000	26000	26000	26000	26000
	Water intake closure duration time at WTPs	hrs	327	327	313	313	313	313	313	313	313	313
	No. of intakes for irrigational use	nos.	4	3	2	1	0	4	3	2	1	0
	Classification by WQI		II	III	-	-	-	II	III	-	-	-
Existence of permanent CSTP												
	Existence of permanent CSTP		NNN	YNN	YYN	-	-	NNN	YNN	YYN	-	-
Rationalisation of existing STPs												
	Total O&M man-power requirement reduction	man-year	47	28	20	11	0	11.1	6.7	3.7	1.3	Less
	Connecting potential in the new service area	PE	257000	146000	114000	56000	Less	98000	64000	58000	31000	Less
Reliability of project implementation												
	Prospective of land acquisition for STP site		Exist. STP	Gazet-ted	Public	No resettle.	Re-settle.	Exist. STP	Gazet-ted	Public	No resettle.	Re-settle.
Financial analysis												
	NPV / Design PE	NPV/PE	-33	-45	-63	-140	Less	-46	-57	-64	-78	Less
	Construction cost / Pollution load discharged	Mil. RM/ton/day	29	12	9	7	Less	29	12	12	9	Less
Consideration for special conditions												
	Involvement in national project		Yes	No	-	-	-	Yes	No	-	-	-

Table 3.4.5 Evaluation Index Intervals for Scoring in Groups A, B and C (2/2)

		Unit	Manual C (PE <50,000)										
			10	8	6	4	2						
Importance of Area													
	Growth rate of population	%	10.4	3.6	2.0	1.8	Less						
	Design Population	person	26,000	21,000	17,000	8,000	Less						
	Annual Hotel guests	Tho. person	800	800	90	90	Less						
Pollution load													
	Total pollution load generated	ton/day	2.1	2.0	1.6	1.3	Less						
Water pollution status at the downstream													
	BOD_5 SI		79	90	More	-	-						
	NH_3-N SI		70	91	More	-	-						
Complaints from the public													
	Complaints on existing STPs	nos.	28	3	0	0	Less						
	No. of existing STPs	nos.	14	4	3	0	Less						
Water use condition at the downstream													
	Total water production by WTPs	m^3/day	370000	370000	37000	28000	28000						
	Water intake closure duration time at WTPs	hrs	313	313	313	313	313						
	No. of intakes for irrigational use	nos.	4	3	2	1	0						
	Classification by WQI		II	III	-	-	-						
Existence of permanent CSTP													
	Existence of permanent CSTP		NNN	YNN	YYN	-	-						
Rationalisation of existing STPs													
	Total O&M man-power requirement reduction	man-year	4.9	0.6	0.5	0	0						
	Connecting potential in the new service area	PE	36,000	27,000	19,000	12,000	Less						
Reliability of project implementation													
	Prospective of land acquisition for STP site		Exist. STP	Gazet-ted	Public	No resettle.	Re-settle.						
Financial analysis													
	NPV / Design PE	NPV/PE	-25	-82	-95	-115	Less						
	Construction cost / Pollution load discharged	Mil. RM/ton/day	25	17	13	12	Less						
Consideration for special conditions													
	Involvement in national project		Yes	No	-	-	-						

3.4.4 Design of Scoring Sheet

The scoring sheet is composed of seven tables **A** through **G** in the EXCEL worksheet shown in **Figure 3.4.9**, of which each function is described in **Table 3.4.6**.

Table 3.4.6 Function of Tables on Scoring Sheet

	Description
Table A	Contains data collected from existing catchment strategy reports (CSRs) or sewerage local plans (SLPs), which is composed of raw data and automated calculations using equations embedded in the cells, and transferred after separate calculation. The input data field is contained in the column range R through CZ, and one set of catchment/sub-catchment data is in a single column. Therefore, the maximum number of catchments/projects that can be ranked at one time is eighty-seven (87). In other words, the tables on the EXCEL worksheet in **Figure 3.4.9** are designed with 87 sets of data as a constraint. When increasing the maximum number of data sets, it will be necessary to redesign tables and equations embedded in the cells
Table B	Contains data related to scoring and scoring conditions, such as two-step weighting, point allocation criteria and scores corresponding to criteria is kept by evaluation index.
Table C	Contains scoring results before weighting application. The data in **Table A** is classified using the scoring classification criteria, and scores are made based on such classification results
Table D	Contains scoring results after weighting application. The scores in **Table C** are converted to scores using the weighting in **Table B**. There are two kinds of weighting data, namely one for evaluation indicators composing respective evaluation items and the other for evaluation items. The calculation of this two-step weighting is done at once.
Table E	This table summarises the frequency of scores. Except for sub-indicators for BOD_5 and NH_3-N, WQI, existence of a permanent CSTP, prospect of land acquisition for a proposed CSTP and consideration of special conditions, the desired result is that score frequencies are about the same. However, this may not always be the case due to bias in data distribution.
Table F	Results in **Table D** are summarised by evaluation item.
Table G	When scores are automatically calculated by equations by categorizing the data into five classes based on the percentage of the ranking from the top using the number of data and ranking for each data, this table is the calculation sheet used to get the point allocation criteria from the results by calculating in reverse. In this case, point allocation criteria in **Table B** show the results of **Table G**. The table is large due to the use of Excel functions (VLOOKUP and MATCH), but it can be prepared instantly by selecting cell **A1** and initiating the macro with the key operation "**Ctrl + Shift + Z**". Correct function of the macro also assumes a maximum number of data sets of eighty-seven (87).

There are two options for the point allocation criteria included in **Table B** as shown in **Figure 3.4.10**. In **Figure 3.4.10(1)**, the point allocation criteria to determine a score are set in advance

so as to make the frequency of each score equal. For this reason, it is necessary to adjust the table for the point allocation criteria whenever there is a change in the number of data sets. To prevent this situation, in **Figure 3.4.10(2)** an equation is embedded in each cell on the Excel worksheet to calculate the number of data points and rank data and identify the ranking in percentage terms such as 0-20%, 20-40%, 40-60%, 60-80%and 80-100% from the top, thus deciding a score. The frequency of each score may not always be equal due to joint data for catchments/sub-catchments or a bias in data distribution.

In the flow of **Figure 3.4.10(2)**, the point allocation criteria in **Table B** of **Figure 3.4.9** are provided as the results of automatic scoring calculation.

3.4.5 Trial Application to 24 Areas

The results of trial application of the Manual to 24 areas or towns are shown in **Figures 3.4.11 to 3.4.14**.

Figure 3.4.9(1) Scoring Sheet for Prioritisation of Sewerage Catchments/Projects

225	Per PE sewage flow (Lpcd)	123,456.7	Data manually input
55	Per PE BOD5 pollution load (gpcd)		
		123,456.7	Data supplemented
70	Effluent BOD5 of IST (mg/L)		
20	Effluent BOD5 after sewerage provision (mg/L)	123,456.7	Data automatically calculated but sometimes manually input
10	Number of ISTs desludged per day	123,456.7	Data transferred from separate calculation sheets
312	Annual working days		
2	No. of workers per crue for IST desludging		

Table A Base Data

	Catchment Strategy Report (CSR)		Jinjang-Kepong	Gombak	Gombak	Gombak	Gombak
	Catchment		Jinjang-Kepong	Sg. Gombak	Sg. Gombak	Sg. Kelang	Sg. Selangor
	Sub-catchment		Jinjang-Kepong	Gombak SG1	Gombak SG2+SG3	Gombak SK1-SK5	Gombak Rawang
	Recommended sytem		1 CSTP	2 CSTPs	To Bunus	To Bunus	1 CSTP
Planning Fundamentals							
	Year of report completed		1998/10	2004/12	2004/12	2004/12	2004/12
	Area to be sewered	(ha)	6,860				
	Base year		1997	2000	2000	2000	2000
	Present population	(nos.)	441,997	50,594	72,045	178,598	59,394
	Present PE	(PE)	730,873	66,401	72,045	189,987	69,976
	Target year		2015	2015	2015	2015	2015
	Design Population	(nos.)	806,750	74,199	93,148	217,887	82,437
	Design PE for sewage treatment	(PE)	1,171,422	96,204	93,148	231,740	98,239
	Target year						
	Design population	(nos.)					
	Design PE for sewage treatment	(PE)					
	Design residential PE		724,157	74,199	93,148	211,294	82,437
	Design commercial & industrial PE	(PE)	270,376	6,620	0	13,853	13,857
	Design PE / Design population	(times)	1.45				
	Design PE / Present PE	(times)	1.60				
	Dry weather average flow	(m3/day)	263,570	21,646	20,958	52,142	22,104
	Wet weather average flow	(m3/day)	317,000				
	Wet weather peak flow	(m3/day)	569,423	61,563	59,820	134,627	62,721
	Sewage treatment process						
	Design PE for sludge treatment						
	Design sludge volume for CSTF	(m3/day)					
	Design dry solids for STP	(ton/day)					
	Design sludge volume for IST	(m3/day)					
	Design dry solids for IST	(ton/day)					
	Sludge treatment process						
	Final sludge condition						
	Costruction period Phase 1		1997-2000				
	Costruction period Phase 2		2001-2005				
	Construction cost Phase 1	(Mil. RM)	82.4				
	Construction cost Phase 2	(Mil. RM)	260.9				
	Land cost	(Mil. RM)	81.6				
	Sewer system	(Mil. RM)					
	Pumping station	(Mil. RM)					
	Sewage treatment Plant	(Mil. RM)					
	Construction cost	(Mil. RM)	664.8	38.3	128.4	142.7	52.4
	Annual O&M cost	(Mil. RM/yr)	14.6	1.6	4.0	4.3	1.3
	Per PE construction cost	(RM/PE)	568	398	1,379	616	534
	Per PE annual O&M cost	(RM/yr/PE)	12	16	43	19	14
	Period for NPV calculation	(yr)					
	NPV of construction cost (at 8.0%)	(Mil. RM)					
	NPV of annual O&M cost (at 8.0%)	(Mil. RM)					
	Total NPV (at 8.0%)	(Mil. RM)			87.8	94.9	48.8
	Per PE NPV	(RM/PE)			942	409	496
Importance of the /area							
	Growth rate of population	(%)	3.4	2.6	1.7	1.3	2.2
	Per PE density	(PE/ha)					
	Growth rate of design PE	(%)	2.7	2.5	1.7	1.3	2.3
	Design population	(nos.)	806,750	74,199	93,148	217,887	82,437
	Rate of residential PE	(%)	61.8	77.1	100.0	91.2	83.9
	Rate of commercial & industrial PE	(%)	23.1	6.9	0.0	6.0	14.1
	Annual hotel guests	(nos.)	15,012,021				
Pollution loads							
	Total pollution load generated	(ton/day)	64.428	5.291	5.123	12.746	5.403
	Total pollution load removed by existing STPs & ISTs	(ton/day)	12.524	0.000	0.000	0.000	0.000
	Total pollution load reduced	(ton/day)	46.633	4.858	4.704	11.703	4.961
	BOD5 load after sewerage provision	(ton/day)	5.271	0.433	0.419	1.043	0.442
	BOD5 load dischrged from existing STPs	(ton/day)	3.278				
	BOD load dischrged from existing ISTs	(ton/day)	1.505				
Water pollution status							
	DOE water quality monitoring station		1 K22	1K18	1K18	1K18	1K18
	Standard A/B		B	B	B	B	B
	Sub-index for BOD5		71	76	76	76	76
	Sub-index for NH3-N		0	36	36	36	36
	River basin		Batu	Gombak	Gombak	Gombak	Gombak
	River status		P	SP	SP	SP	SP
Complaints from the public							
	Complaints on STPs	(nos.)	83	15	15	15	15
	No. of STPs	(nos.)	96				
Water use condition							
	Total water production by WTPs	(m3/day)					
	Duration time of water intake closure at WTPs	(hrs)					
	No. of intakes for irrigational use	(nos.)					
	Classification by WQI						
	DOE class		III	III	III	III	III
Rationalisation of existing sewerage facilities							
	Design PE of STPs to be rationalised	(PE)	219,118				
	No. of STPs to be rationalised	(nos.)	96				
	Design PE of ISTs to be connected	(PE)	95,560				
	No. of ISTs to be connected	(nos.)	19,112				
	Existing STP O&M man-power requirement	(man-day)	47.1				
	Existing IST O&M man-power requirement	(man-day)	12.3				
	Total O&M man-power requirement	(man-day)	59.4	0.0	0.0	0.0	0.0
	Design PE of growth	(PE)	952,304	96,204	93,148	231,740	98,239
	Redundant land area after rationalisation	(ha)	21.59				
	PE rationalisation rate	(%)	18.7				
Conservation of local water cycle							
	Study on local water cycle						
Existence of permanent CSTP							
	Existence of permanent CSTP		YNN	NNN	NNN	NNN	NNN
Reliability of project implementation							
	Prospective of land acquisition for STP site		Existing STP	Existing STP	Existing STP	Existing STP	No resettlement
Financial analysis							
	NPV	(Mil RM)	-652.9	-44.3	-130.6	-142.3	-56.7
	B/C ratio		0.13	0.16	0.06	0.12	0.13
	NPV / Design PE	(RM/PE)	-55.7	-46.0	-140.2	-61.4	-57.7
	Construction cost / Pollution load discharged	(Mil RM/ton/	10.3	7.2	25.1	11.2	9.7
Consideration for special conditions							
	Involvement in national projects						
	Inclusion of sludge treatment in CSTP site						
	Extension of sewage effluent discharge pipe						

Table B Weightage and Scoring Conditions
Default Value (2)

Weightage		Unit	Scoring Criteria					Score				
[1]	[2]		1st class	2nd class	3rd class	4 th class	5th class	1st class	2nd class	3rd class	4 th class	5th class
15	40	%	4	3	2	1	Less	10	8	6	4	2
	40	person	120000	80000	40000	20000	Less	10	8	6	4	2
	20	person	1600000	800000	400000	200000	Less	10	8	6	4	2
5	100	ton/day	10	7.5	5	2.5	Less	10	8	6	4	2
0	0	ton/day						10	8	6	4	2
15	60		79	90	More			10	6	3		
	40		70	91	More			10	6	3		
15	100		P	SP	C			10	6	3		
5	50	cases	40	20	10	1	Less	10	8	6	4	2
	50	nos.	75	50	25	5	Less	10	8	6	4	2
10	40	person	240000	120000	60000	30000	Less	10	8	6	4	2
	20	days	10	7	5	3	Less	10	8	6	4	2
	20	nos.	4	3	2	1	0	10	8	6	4	2
	20		II	III				5	0			
15	60	man-year	25	15	5	1	Less	10	8	6	4	2
	0	ha	60	40	20	10	More	10	8	6	4	2
	0	%						10	8	6	4	2
	40	PE	200000	100000	50000	25000	Less	10	8	6	4	2
0	100		Yes	No				10	0			
5	100		NNN	YNN	YYN			10	6	3		
10	100		Existing STP	Gazetted	Public	No resettleme	Resettlement	10	8	6	4	2
15	60	RM/PE	-40	-60	-80	-400	Less	10	8	6	4	2
	40	mil RM/ton/da	20	14	10	8	Less	2	4	6	8	10
5	100		Yes	No				10	0			
	0		Yes	No				10	0			
	0		Yes	No				10	0			
	0		Yes	No				10	0			
100	800											

Table C Score before Weightage Application

Importance of the /area							
	Growth rate of population	(%)	8.0	6.0	4.0	4.0	6.0
	Design population	(nos.)	10.0	6.0	6.0	10.0	6.0
	Annual hotel guests	(nos.)	10.0				
Pollution loads							
	Total pollution load generated		10.0	4.0	4.0	8.0	4.0
	Total pollution loads reduced						
Water pollution status							
	Sub-index for BOD5		10.0	10.0	10.0	10.0	10.0
	Sub-index for NH3-N		10.0	10.0	10.0	10.0	10.0
	WQI		10.0	6.0	6.0	6.0	6.0
Complaints from the public							
	Complaints on STPs	(nos.)	10.0	6.0	6.0	6.0	6.0
	No. of STPs	(nos.)	10.0				
Water use condition							
	Total water production by WTPs	(m3/day)					
	Water intake suspension days at WTPs	(hrs)					
	No. of intakes for irrigational use	(ha)					
	Classification by WQI		0.0	0.0	0.0	0.0	0.0
Rationalisation of existing sewerage facilities							
	Total O&M man-power requirement reduction	(man-year)	10.0	2.0	2.0	2.0	2.0
	Redundant land area after rationalisation	(ha)	10.0				
	PE rationalisation rate	(%)					
	Connecting potential in the new service area	(nos.)	10.0	6.0	6.0	10.0	6.0
Conservation of local water cycle							
	Study on local water cycle						
First time works of permanent CSTP							
	Existence of permanent CSTP		6.0	10.0	10.0	10.0	10.0
Reliability of project implementation							
	Prospective of land acquisition for STP site		10.0	10.0	10.0	10.0	4.0
Financial analysis							
	NPV / Design PE	(RM/PE)	8.0	8.0	4.0	6.0	8.0
	Construction cost / Pollution load discharged	(mil RM/ton/	8.0	10.0	4.0	6.0	8.0
Consideration for special conditions							
	Involvement in national projects						
	Inclusion of sludge treatment in CSTP site						
	Extension of sewage effluent discharge pipe						

Table E Appearance Frequency of Score

Total	1st class	2nd class	3rd class	4 th class	5th class
72	15	13	18	13	13
72	14	14	15	14	15
33	6	7	7	7	6
74	14	15	15	15	15
74	42	24	8		
74	61	7	6		
65	12	13	13	27	0
64	12	13	13	13	13
9	1	2	5	0	1
6	1	5	0	0	0
0	0	0	0	0	0
74	19	55			
68	13	14	13	14	14
47	47	0	0	0	0
0	0	0	0	0	0
74	14	15	15	15	15
76	69	2	1	2	2
74	20	4	13	31	6
74	14	15	15	15	15
74	14	15	15	15	15
6	6	0			
0	0	0			
0	0	0			
0	0	0			

Table D Score after Weightage Application

Importance of the /area			13.8	7.2	6.0	8.4	7.2
	Growth rate of population	(%)	4.8	3.6	2.4	2.4	3.6
	Design PE density	(%)					
	Design population	(nos.)	6.0	3.6	3.6	6.0	3.6
	Rate of Commercial & industrial PE	(%)	0.0	0.0	0.0	0.0	0.0
	Annual hotel guests	(nos.)	3.0				
Pollution loads			5.0	2.0	2.0	4.0	2.0
	Total pollution load generated	(ton/day)	5.0	2.0	2.0	4.0	2.0
	Total pollution loads reduced	(ton/day)					
Water pollution status			15.0	15.0	15.0	15.0	15.0
	Sub-index for BOD5		9.0	9.0	9.0	9.0	9.0
	Sub-index for NH3-N		6.0	6.0	6.0	6.0	6.0
	WQI		15.0	9.0	9.0	9.0	9.0
Complaints from the public			5.0	1.5	1.5	1.5	1.5
	Complaints on STPs	(nos.)	2.5	1.5	1.5	1.5	1.5
	No. of STPs	(nos.)	2.5				
Water use condition			0.0	0.0	0.0	0.0	0.0
	Total water production by WTPs	(m3/day)					
	Water intake suspension days at WTPs	(hrs)					
	No. of intakes for irrigational use	(ha)					
	Classification by WQI		0.0	0.0	0.0	0.0	0.0
Rationalisation of existing sewerage facilities			15.0	5.4	5.4	7.8	5.4
	Total O&M man-power requirement reduction	(man-year)	9.0	1.8	1.8	1.8	1.8
	Redundant land area after rationalisation	(ha)	0.0				
	PE rationalisation rate	(%)					
	Connecting potential in the new service area	(nos.)	6.0	3.6	3.6	6.0	3.6
Conservation of local water cycle			0.0	0.0	0.0	0.0	0.0
	Study on local water cycle						
Existence of permanent CSTP			3.0	5.0	5.0	5.0	5.0
	Existence of permanent CSTP		3.0	5.0	5.0	5.0	5.0
Reliability of project implementation			10.0	10.0	10.0	10.0	4.0
	Prospective of land acquisition for STP site		10.0	10.0	10.0	10.0	4.0
Financial analysis			12.0	13.2	6.0	9.0	12.0
	NPV / Design PE	(RM/PE)	7.2	7.2	3.6	5.4	7.2
	Construction cost / Pollution load discharged	(mil RM/ton/	4.8	6.0	2.4	3.6	4.8
Consideration for special conditions			0.0	0.0	0.0	0.0	0.0
	Involvement in national projects						
	Inclusion of sludge treatment in CSTP site						
	Extension of sewage effluent discharge pipe						

TOTAL	78.8	59.3	50.9	60.7	52.1
Ranking	2	31	49	27	46

Table F Summary of Scoring

	Jinjang-Kepong	Gombak	Gombak	Gombak	Gombak
	Jinjang-Kepong	Sg. Gombak	Sg. Gombak	Sg. Kelang	Sg. Selangor

Figure 3.4.9(2) Scoring Sheet for Prioritisation of Sewerage Catchments/Projects

Table G Scoring Criteria (As Computational Results)

Growth rate of population			Design population			Annual hotel guests			Total pollution loads generated			Complaints on STPs			No. of STPs		
	No. of Data	72		No. of Data	72		No. of Data	33		No. of Data	74		No. of Data	65		No. of Data	64
Ranking	Growth rate of popula (%)		Ranking	Design population (nos.)		Ranking	Annual hotel guests (nos.)		Ranking	Total pollution loads gen (ton/day)		Ranking	Complaints on STP (nos.)		Ranking	No. of STPs (nos.)	
1	72	21.3	1	806,750		1	15,012,021		1	70.580		1	178		1	330	
2	71	12.9	2	744,804		1	15,012,021		2	64.428		2	154		2	248	
3	70	11.9	3	476,056		3	4,917,513		3	50.276		2	154		3	193	
4	69	10.4	4	259,092		3	4,917,513		4	43.502		2	154		4	168	
5	68	9.6	5	217,887		3	4,917,513		5	39.100		2	154		5	145	
6	67	9.5	6	191,870		6	3,468,063		6	34.990		2	154		6	117	
7	66	7.5	7	187,171		7	2,645,518		7	27.878		2	154		7	113	
8	65	7.2	8	183,058		7	2,645,518		8	21.216		2	154		8	105	
9	64	5.8	9	175,073		7	2,645,518		9	20.426		9	145		9	98	
10	63	5.5	10	172,998		7	2,645,518		10	20.302		10	91		10	96	
11	62	5.2	11	169,908		7	2,645,518		11	20.263		11	83		11	88	
12	61	5.1	12	165,815		12	1,668,743		12	19.767		11	83		12	87	
13	60	4.8	13	152,660		12	1,668,743		13	19.333		13	39		13	82	
14	59	4.4	14	146,792		14	1,100,656		14	19.036		14	38		14	77	
14	58	4.4	15	139,619		14	1,100,656		15	16.721		14	36		15	76	
16	57	4.0	16	139,113		14	1,100,656		16	15.129		14	36		16	71	
16	56	4.0	17	136,955		17	925,725		17	13.983		14	36		17	69	
18	55	3.8	18	133,016		18	803,615		18	13.454		14	36		18	67	
18	54	3.8	19	131,967		19	781,369		19	13.002		14	36		19	66	
18	53	3.8	20	130,730		19	781,369		20	12.746		20	29		19	66	
21	52	3.6	21	127,075		21	567,457		21	12.386		20	29		19	66	
21	51	3.6	22	123,474		22	333,088		22	12.095		20	29		22	55	
23	50	3.5	23	121,763		23	329,667		23	12.018		23	28		23	51	
24	49	3.4	24	117,285		23	329,667		24	11.177		23	28		24	49	
25	48	3.3	25	115,339		23	329,667		25	10.840		25	16		25	47	
26	47	3.1	26	112,742		23	329,667		26	10.413		26	15		26	46	
27	46	3.0	27	110,812		23	329,667		27	9.862		26	15		27	44	
27	45	3.0	28	106,180		28	90,991		28	9.797		26	15		28	38	
29	44	2.9	29	104,453		28	90,991		29	9.715		26	15		29	36	
30	43	2.8	30	102,203		28	90,991		30	9.351		26	15		29	36	
31	42	2.7	31	100,789		28	90,991		31	8.548		26	15		29	36	
31	41	2.7	32	99,682		28	90,991		32	8.396		32	6		32	35	
31	40	2.7	33	95,278		28	90,991		33	8.021		32	6		32	35	
34	39	2.6	34	93,148					34	7.867		34	4		34	33	
34	38	2.6	35	92,767					35	7.827		34	4		35	31	
36	37	2.5	36	87,767					36	7.592		34	4		36	29	
37	36	2.2	37	82,792					37	7.362		34	4		37	27	
37	35	2.2	38	82,437					38	7.116		34	4		38	26	
39	34	2.1	39	74,199					39	7.086		39	3		39	24	
40	33	2.0	40	69,066					40	6.960		39	3		40	21	
40	32	2.0	41	67,316					41	6.897		39	3		41	20	
42	31	1.9	42	60,133					42	6.796		39	3		41	20	
42	30	1.9	43	56,386					43	6.568		43	1		43	14	
42	29	1.9	44	51,411					44	6.422		43	1		44	11	
42	28	1.9	45	49,406					45	6.409		43	1		45	10	
42	27	1.9	46	43,365					46	5.845		46	0		45	10	
47	26	1.8	47	41,050					47	5.403		46	0		47	9	
47	25	1.8	48	40,136					48	5.291		46	0		48	8	
49	24	1.7	49	35,986					49	5.123		46	0		49	7	
49	23	1.7	50	35,809					50	4.960		46	0		49	7	
49	22	1.7	51	30,585					51	4.289		46	0		51	6	
52	21	1.6	52	26,966					52	4.074		46	0		52	4	
52	20	1.6	53	26,272					53	4.029		46	0		53	3	
54	19	1.5	54	23,176					54	3.566		46	0		53	3	
55	18	1.3	55	22,205					55	3.203		46	0		55	2	
55	17	1.3	56	21,756					56	3.063		46	0		56	1	
57	16	1.2	57	21,458					57	2.989		46	0		56	1	
57	15	1.2	58	21,160					58	2.952		46	0		58	0	
57	14	1.2	59	21,112					59	2.244		46	0		58	0	
60	13	1.1	60	20,219					60	2.209		46	0		58	0	
61	12	0.9	61	19,108					61	2.110		46	0		58	0	
61	11	0.9	62	17,041					62	2.087		46	0		58	0	
63	10	0.8	63	14,770					63	2.084		46	0		58	0	
63	9	0.8	64	11,594					64	2.001		46	0		58	0	
65	8	0.6	65	9,730					65	1.843		46	0				
66	7	0.5	66	8,960					66	1.650							
67	6	0.4	67	8,189					67	1.589							
68	5	-0.1	68	6,492					68	1.393							
69	4	-0.7	69	6,218					69	1.343							
70	3	-1.0	70	6,123					70	1.335							
71	2	-1.8	71	3,805					71	0.993							
72	1	-3.0	72	3,428					72	0.705							
									73	0.532							
									74	0.481							

Growth rate of population			Design population			Annual hotel guests			Total pollution loads generated			Complaints on STPs			No. of STPs		
	No. of Data	72		No. of Data	72		No. of Data	33		No. of Data	74		No. of Data	65		No. of Data	64
Ranking	Growth rate of popula		Ranking		Design population	Ranking	Annual hotel guests		Ranking	Total pollution loads gen		Ranking	Complaints on STP		Ranking		No. of STPs
72	1	-3.0	72	1	3,428	28	1	90,991	74	1	0.481	46	1	0	58	1	0
71	2	-1.8	71	2	3,805	28	2	90,991	73	2	0.532	46	2	0	58	2	0
70	3	-1.0	70	3	6,123	28	3	90,991	72	3	0.705	46	3	0	58	3	0
69	4	-0.7	69	4	6,218	28	4	90,991	71	4	0.993	46	4	0	58	4	0
68	5	-0.1	68	5	6,492	28	5	90,991	70	5	1.335	46	5	0	58	5	0
67	6	0.4	67	6	8,189	28	6	90,991	69	6	1.343	46	6	0	58	6	0
66	7	0.5	66	7	8,960	23	7	329,667	68	7	1.393	46	7	0	58	7	0
65	8	0.6	65	8	9,730	23	8	329,667	67	8	1.589	46	8	0	56	8	1
63	9	0.8	64	9	11,594	23	9	329,667	66	9	1.650	46	9	0	56	9	1
63	10	0.8	63	10	14,770	23	10	329,667	65	10	1.843	46	10	0	55	10	2
61	11	0.9	62	11	17,041	23	11	329,667	64	11	2.001	46	11	0	53	11	3
61	12	0.9	61	12	19,108	22	12	333,088	63	12	2.084	46	12	0	53	12	3
60	13	1.1	60	13	20,219	21	13	567,457	62	13	2.087	46	13	0	52	13	4
57	14	1.2	59	14	21,112	19	14	781,369	61	14	2.110	46	14	0	51	14	6
57	15	1.2	58	15	21,160	19	15	781,369	60	15	2.209	46	15	0	49	15	7
57	16	1.2	57	16	21,458	18	16	803,615	59	16	2.244	46	16	0	49	16	7
55	17	1.3	56	17	21,756	17	17	925,725	58	17	2.952	46	17	0	48	17	8
55	18	1.3	55	18	22,205	14	18	1,100,656	57	18	2.989	46	18	0	47	18	9
54	19	1.5	54	19	23,176	14	19	1,100,656	56	19	3.063	46	19	0	45	19	10
52	20	1.6	53	20	26,272	14	20	1,100,656	55	20	3.203	46	20	0	45	20	10
52	21	1.6	52	21	26,966	12	21	1,668,743	54	21	3.566	43	21	1	44	21	11
49	22	1.7	51	22	30,585	12	22	1,668,743	53	22	4.029	43	22	1	43	22	14
49	23	1.7	50	23	35,809	7	23	2,645,518	52	23	4.074	43	23	1	41	23	20
49	24	1.7	49	24	35,986	7	24	2,645,518	51	24	4.289	39	24	3	41	24	20
47	25	1.8	48	25	40,136	7	25	2,645,518	50	25	4.960	39	25	3	40	25	21
47	26	1.8	47	26	41,050	7	26	2,645,518	49	26	5.123	39	26	3	39	26	24
42	27	1.9	46	27	43,365	7	27	2,645,518	48	27	5.291	39	27	3	38	27	26
42	28	1.9	45	28	49,406	6	28	3,468,063	47	28	5.403	34	28	4	37	28	27
42	29	1.9	44	29	51,411	3	29	4,917,513	46	29	5.845	34	29	4	36	29	29
42	30	1.9	43	30	56,386	3	30	4,917,513	45	30	6.409	34	30	4	35	30	31
42	31	1.9	42	31	60,133	3	31	4,917,513	44	31	6.422	34	31	4	34	31	33
40	32	2.0	41	32	67,316	1	32	15,012,021	43	32	6.568	34	32	4	32	32	35
40	33	2.0	40	33	69,066	1	33	15,012,021	42	33	6.796	32	33	6	32	33	35
39	34	2.1	39	34	74,199				41	34	6.897	32	34	6	29	34	36
37	35	2.2	38	35	82,437				40	35	6.960	26	35	15	29	35	36
37	36	2.2	37	36	82,792				39	36	7.086	26	36	15	29	36	36
36	37	2.5	36	37	87,767				38	37	7.116	26	37	15	28	37	38
34	38	2.6	35	38	92,767				37	38	7.362	26	38	15	27	38	44
34	39	2.6	34	39	93,148				36	39	7.592	26	39	15	26	39	46
31	40	2.7	33	40	95,278				35	40	7.827	26	40	15	25	40	47
31	41	2.7	32	41	99,682				34	41	7.867	25	41	16	24	41	49
31	42	2.7	31	42	100,789				33	42	8.021	23	42	28	23	42	51
30	43	2.8	30	43	102,203				32	43	8.396	23	43	28	22	43	55
29	44	2.9	29	44	104,453				31	44	8.548	20	44	29	19	44	66
27	45	3.0	28	45	106,180				30	45	9.351	20	45	29	19	45	66
27	46	3.0	27	46	110,812				29	46	9.715	20	46	29	19	46	66
26	47	3.1	26	47	112,742				28	47	9.797	14	47	36	18	47	67
25	48	3.3	25	48	115,339				27	48	9.862	14	48	36	17	48	69
24	49	3.4	24	49	117,285				26	49	10.413	14	49	36	16	49	71
23	50	3.5	23	50	121,763				25	50	10.840	14	50	36	15	50	76
21	51	3.6	22	51	123,474				24	51	11.177	14	51	36	14	51	77
21	52	3.6	21	52	127,075				23	52	12.018	14	52	36	13	52	82
18	53	3.8	20	53	130,730				22	53	12.095	13	53	39	12	53	87
18	54	3.8	19	54	131,967				21	54	12.386	11	54	83	11	54	88
18	55	3.8	18	55	133,016				20	55	12.746	11	55	83	10	55	96
16	56	4.0	17	56	136,955				19	56	13.002	10	56	91	9	56	98
16	57	4.0	16	57	139,113				18	57	13.454	9	57	145	8	57	105
14	58	4.4	15	58	139,619				17	58	13.983	2	58	154	7	58	113
14	59	4.4	14	59	146,792				16	59	15.129	2	59	154	6	59	117
13	60	4.8	13	60	152,660				15	60	16.721	2	60	154	5	60	145
12	61	5.1	12	61	165,815				14	61	19.036	2	61	154	4	61	168
11	62	5.2	11	62	169,908				13	62	19.333	2	62	154	3	62	193
10	63	5.5	10	63	172,998				12	63	19.767	2	63	154	2	63	248
9	64	5.8	9	64	175,073				11	64	20.263	2	64	154	1	64	330
8	65	7.2	8	65	183,058				10	65	20.302	1	65	178			
7	66	7.5	7	66	187,171				9	66	20.426						
6	67	9.5	6	67	191,870				8	67	21.216						
5	68	9.6	5	68	217,887				7	68	27.878						
4	69	10.4	4	69	259,092				6	69	34.990						
3	70	11.9	3	70	476,056				5	70	39.100						
2	71	12.9	2	71	744,804				4	71	43.502						
1	72	21.3	1	72	806,750				3	72	50.276						
									2	73	64.428						
									1	74	70.580						

	Growth rate of population				Design population				Annual hotel guests				Total pollution loads generated				Complaints on STPs				No. of STPs			
From the top	Value	One rank down	Average		Value	One rank down	Average		Value	One rank down	Average		Value	One rank down	Average		Value	One rank down	Average		Value	One rank down	Average	
20	4.4	4.0	4.2		146,792	139,619	143,206		3,468,063	2,645,518	3,056,791		19.0	16.7	17.9		39	36	38		87	82	85	
40	3.0	2.9	3.0		106,180	104,453	105,317		1,668,743	1,100,656	1,384,700		9.7	9.4	9.5		15	6	11		47	46	47	
60	1.9	1.8	1.9		56,386	51,411	53,899		781,369	567,457	674,413		6.4	6.4	6.4		3	1	2		26	24	25	
80	1.2	1.1	1.2		21,458	21,160	21,309		329,667	90,991	210,329		2.2	2.2	2.2		0	#N/A	#N/A		6	4	5	
100	-3.0	-3.0	-3.0		3,428	3,428	3,428		90,991	90,991	90,991		0.5	0.5	0.5		0	0	0		0	0	0	
From the top	Ranking	One rank down			Ranking	One rank down			Ranking	One rank down			Ranking	One rank down			Ranking	One rank down			Ranking	One rank down		
20	14	57			14	58			6	23			14	60			13	47			12	52		
40	27	44			28	44			12	20			29	45			26	34			25	39		
60	42	26			43	29			19	13			44	30			39	23			38	26		
80	57	13			57	15			23	6			59	15			46	#N/A			51	13		
100	72	1			72	1			28	1			74	1			46	1			58	1		

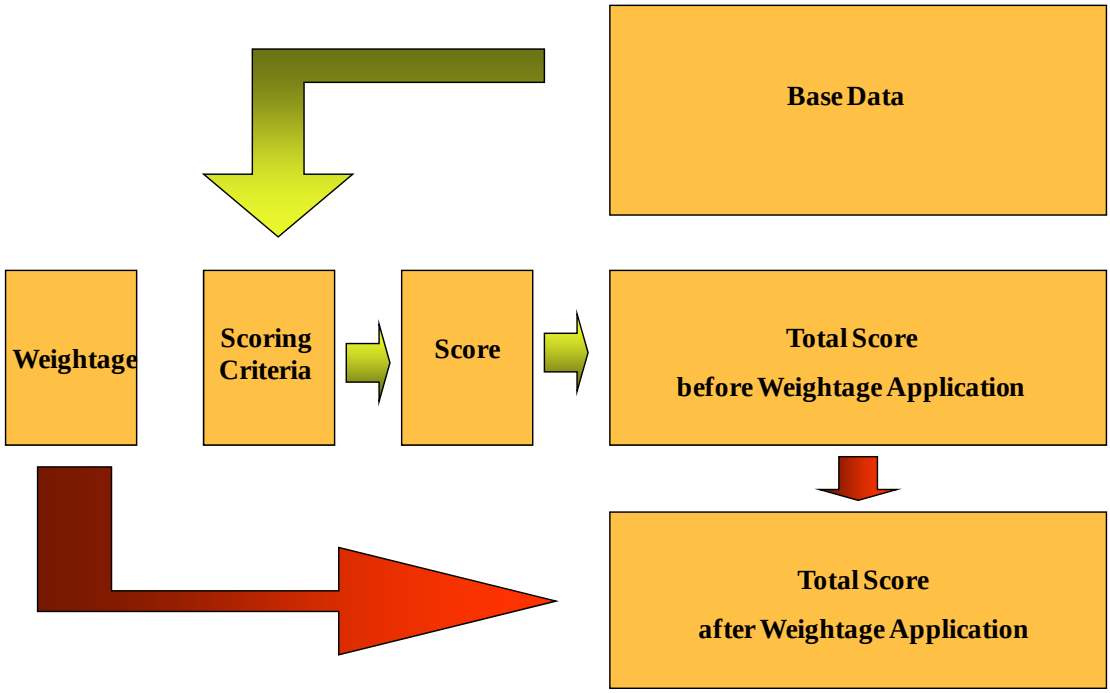


Figure 3.4.10(1) Example of Point Allocation Criteria Set in Advance

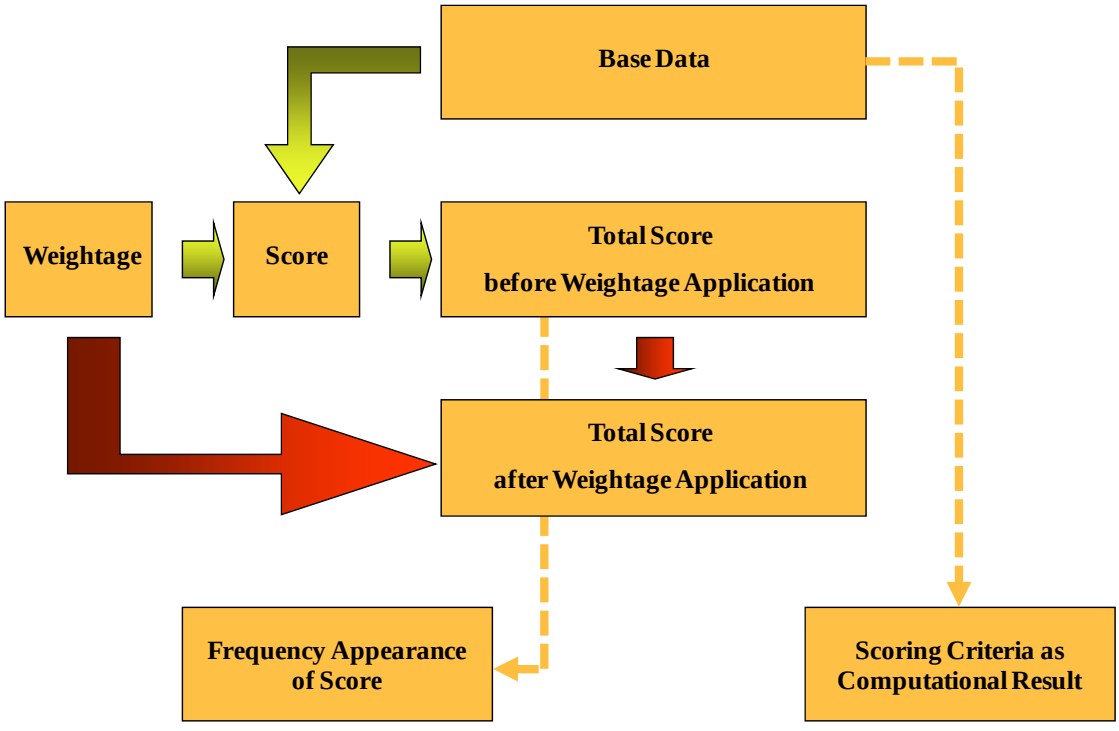


Figure 3.4.10(2) Example of Point Allocation Criteria Generated by Calculation

Figure 3.4.11 Totally-Balanced Type Prioritisation of Sewerage Catchments (for All PE at Full Design PE, W15)

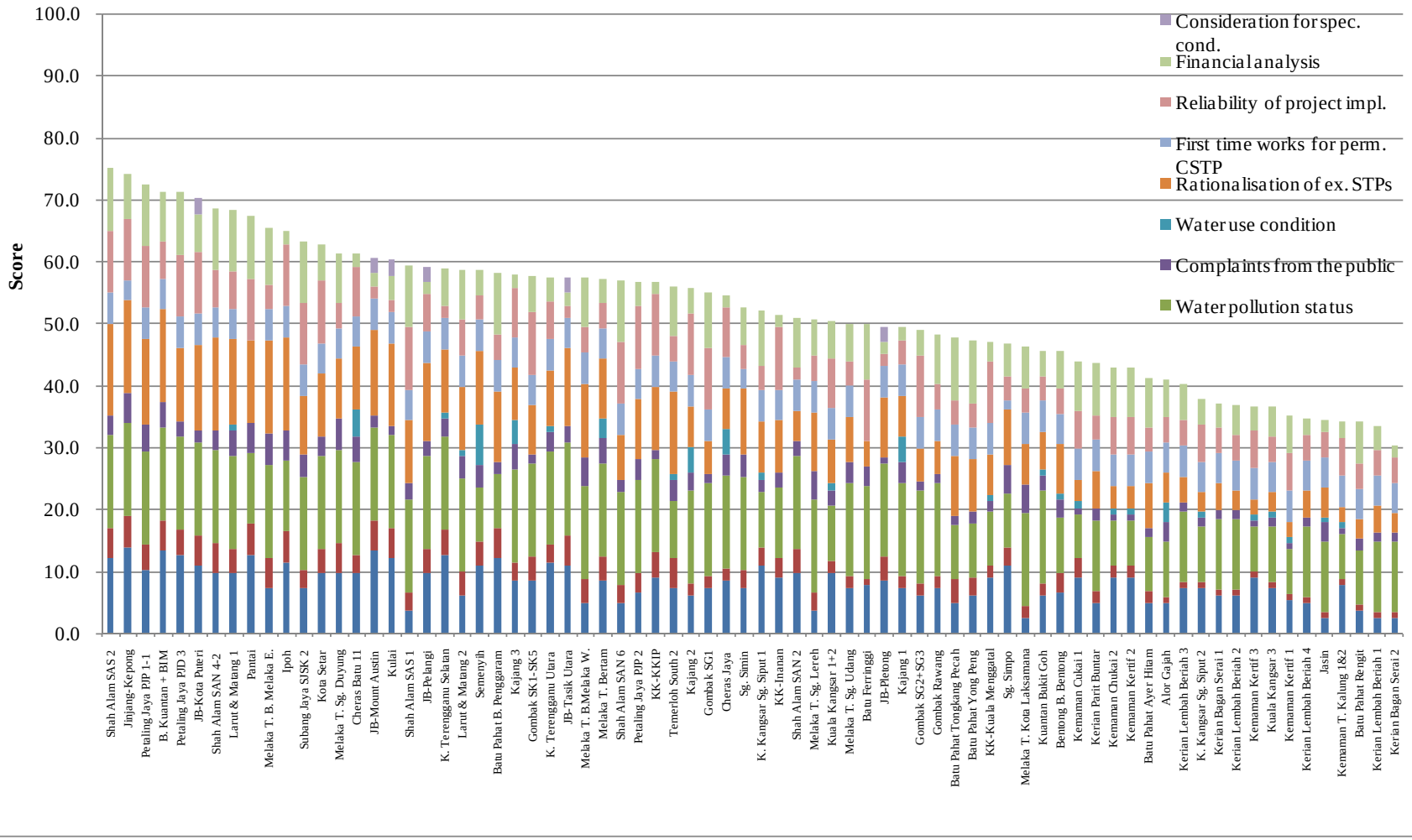


Figure 3.4.12 Totally-Balanced Type Prioritisation of Sewerage Catchments (For PE≥100,000 at Full Design PE, W15)

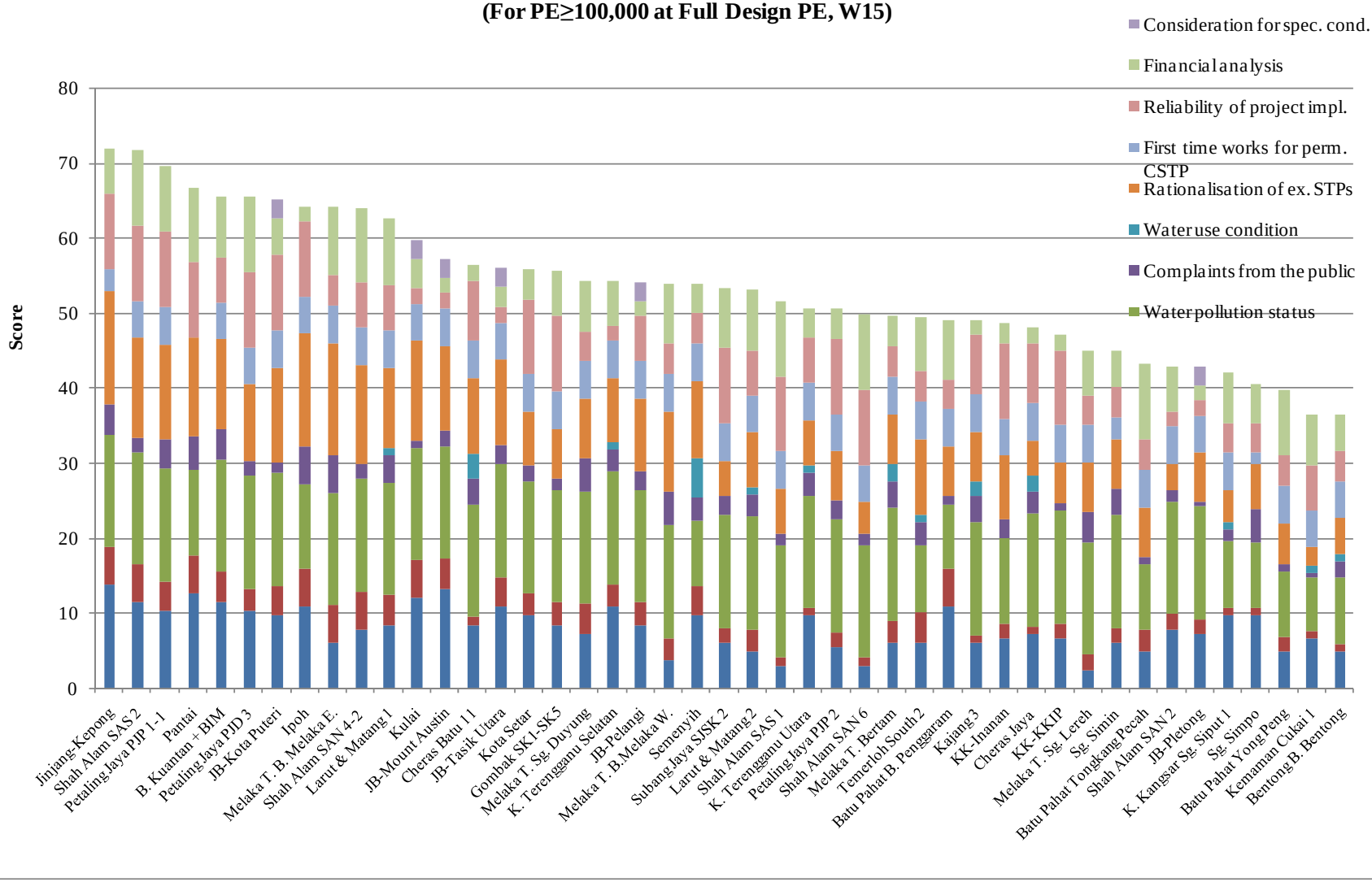


Figure 3.4.13 Totally-Balanced Type Prioritisation of Sewerage Catchments (For 100,000>PE≥50,000 at Full Design PE, W15)

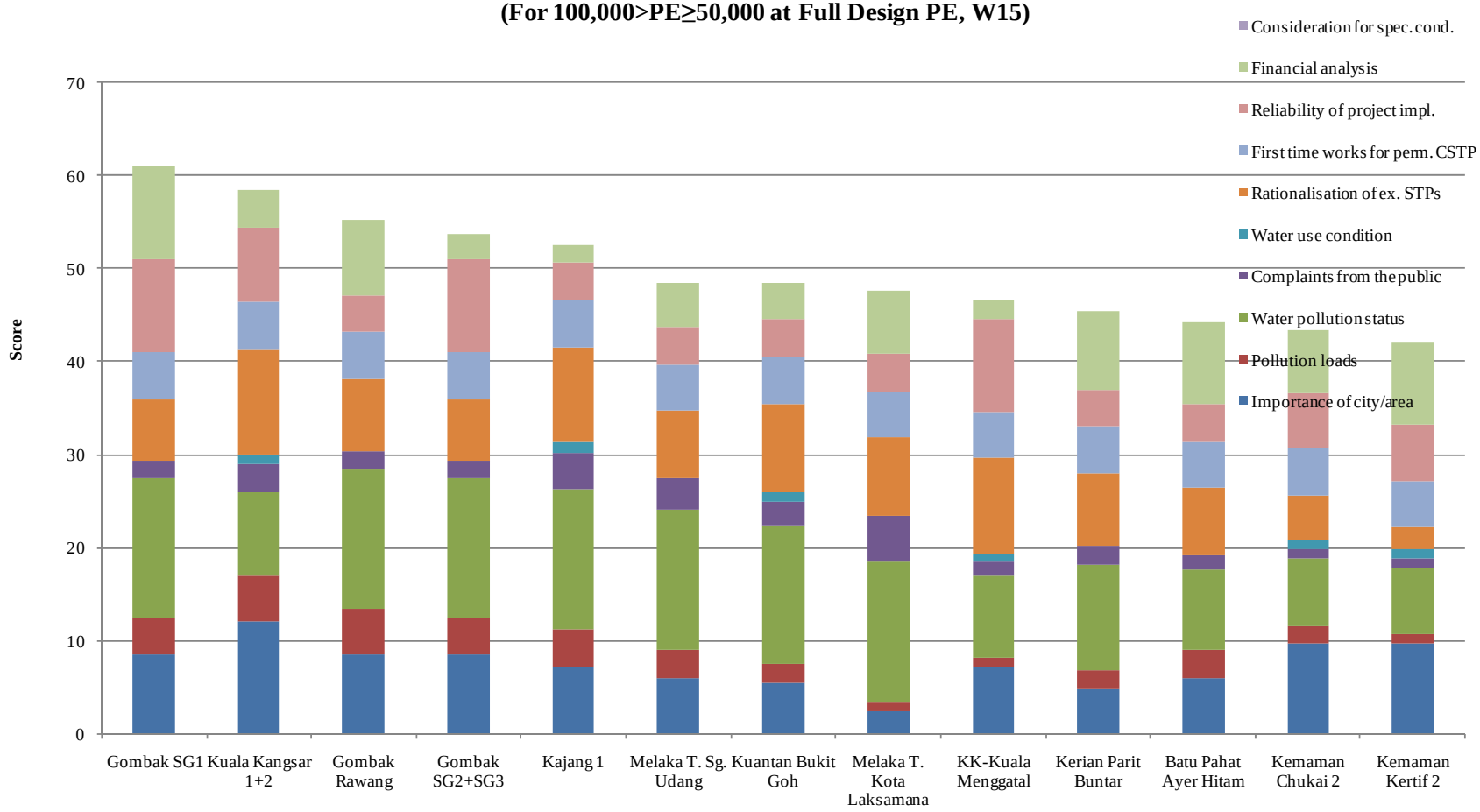
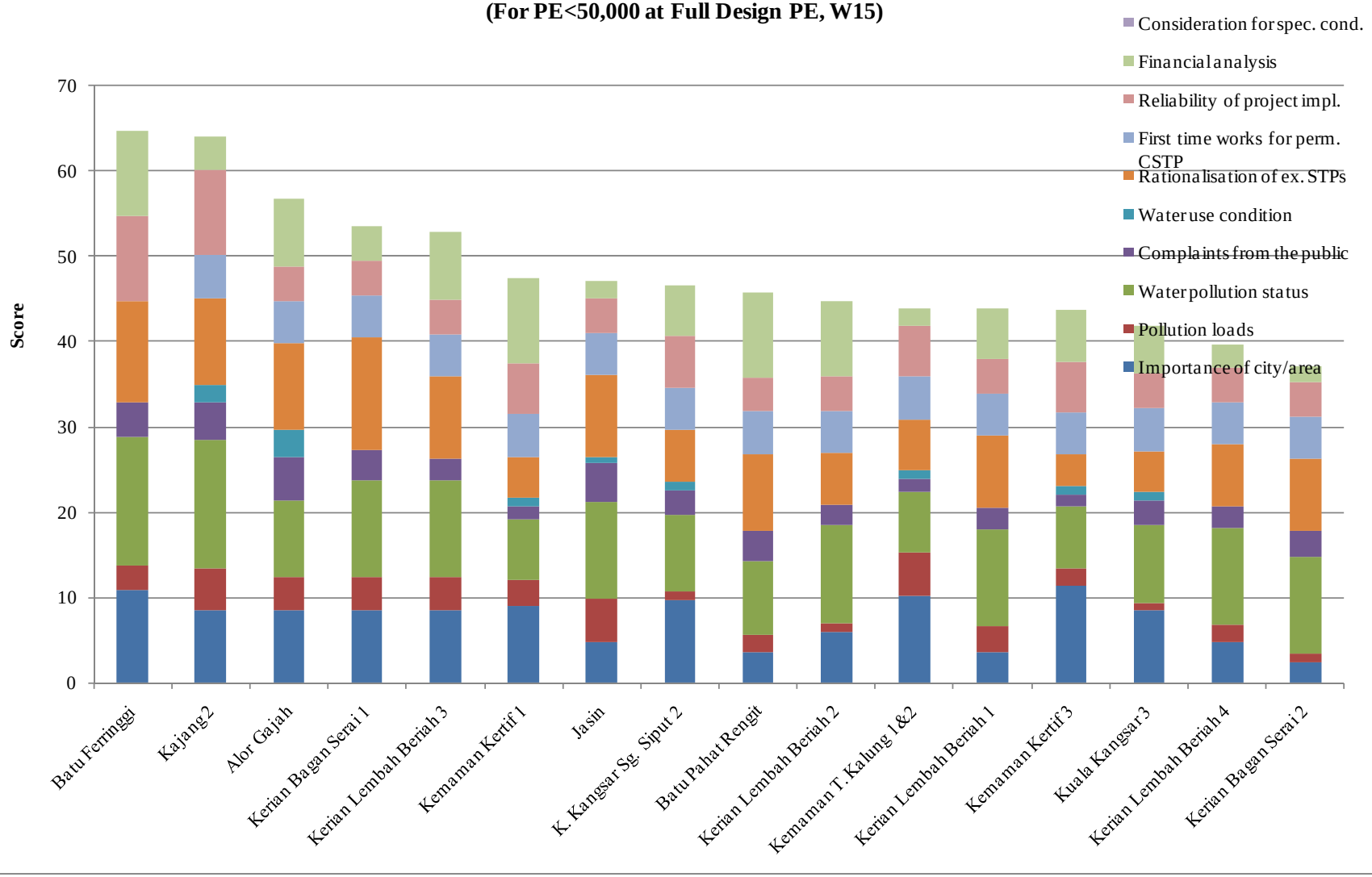


Figure 3.4.14 Totally-Balanced Type Prioritisation of Sewerage Catchments (For PE<50,000 at Full Design PE, W15)



3.4.6 Catchment/Project Selection for Implementation

As shown in **Figure 3.1**, there are two routes to the final catchment/project selection stage. One is to skip the prioritisation process due to the existence of special considerations, like an island tourism development project, and the other is to pass the prioritisation process. As a result, there are special projects and three lists of prioritised sewerage catchments/projects for final selection.

At first, the reasonableness of special projects shall be checked with background information, and if the special projects are accepted by the agencies concerned, the first budget installment shall be distributed.

In catchment/project selection from three lists, it is recommended that following two approaches be studied:

Option 1: A certain number of projects are selected from the middle and low design PE groups.

Option 2: A certain percentage of the budget is allotted to the middle and low design PE groups

A certain number of projects or a certain percentage of budgets shall be set, taking into account, the nationwide status of sewerage provision, local conditions, and emergencies, among others. In general, the construction cost per project in the lower design PE group is less than that in the higher design PE group as shown in **Table 3.4.7**.

Table 3.4.7 Example of Construction Cost per Project of Different Design PE Groups

Verification 1	High design PE group (PE≥100,000)	Low design PE group (PE<100,000)
No. of catchments	31 catchments	26 catchments
Average design PE	310,000	48,000
Average construction cost	RM 159.0 mil.	RM 41.0 mil.

The following principle shall be always considered in catchment/project selection:

"One project from one area"

1) Given the importance that sewerage service be spread throughout the country, this principle should be adhered to as much as possible.

2) But in some areas, the implementation of only one project may not be sufficient to address a problem of a certain scale and urgency, and more than one project may be allowed in the same area.

3.5 Trial Application of the Manual to Upper Langat River Basin

In the report for Upper Langat River Basin Sewerage Catchment Strategy, the study area is divided into the following seven catchments and 12 sewerage catchments are proposed. The catchments of Semenyih and Bangi Selatan are further divided into four and two sub-catchments to establish an independent sewerage schemes for each. However, since the data for such sub-catchments except for design PE are not given in the report, an individual sewerage scheme is not targeted in this report. Also, the catchment of BBB South has two CSTP systems. Therefore, it should be noted that the catchments of Semenyih, Bangi Selatan and BBB South are composed of multiple projects, which mean that the size of the catchment represented by design PE increases.

Langat
Cheras (Cheras Batu 11, Cheras East, Cheras Jaya)
Kajang （Kajang 1, Kajang 2, Kajang 3）
Bandar Baru Bangi (BBB North, BBB South)
Semenyih
Beranang
Bangi Selatan

The outline of those sewerage catchments is summarised in **Table 3.5.1** with the location map of Upper Langat shown in **Figure 3.5.1**.

(1) Water Pollution Status

As an index to show the water pollution status of the public water bodies, there are two indicators: (1) Water Quality Index (WQI) based on the six parameters and (2) the combination of BOD_5 and NH_3-N sub-indicators. Theoretically, there are two patterns for the former and nine patterns for the latter, which is useful in discriminating the scoring for sewerage catchments. In the actual data for the Upper Langat River Basin, four patterns (P-P, SP-P, C-P and C-C) appeared in the latter against two patterns of “slightly polluted and “clean” as shown in **Table 3.5.2**. The combination of BOD_5 and NH_3-N sub-indicators is then used to prioritise sewerage projects in the Upper Langat River Basin.

Table 3.5.1 Outline of 12 Sewerage Catchments Proposed for the Upper Langat River Basin

	Catchment		Langat	Cheras	Cheras	Cheras	Kajang	Kajang	Kajang	Bandar Baru Bangi	Bandar Baru Bangi	Semenyih	Beranang	Bangi Lama
	Sub-catchment		Langat	Cheras Batu 11	Cheras East	Cheras Jaya	Kajang 1	Kajang 2	Kajang 3	BBB North	BBB South	Sub-total	Beranang	Sub-total
	Major mununicipalities involved		MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang	MP Kajang
	Proposed sewerage system		1 CSTP	1 CSTP	1 CSTP	1 CSTP	1 CSTP	1 CSTP	1 CSTP	1 CSTP	2 CSTPs	4 CSTPs	MP	1 CSTP
Planning Fundamentals														
**	Base year		2005	2005	2005	2005	2005	2005	2005	2005	2005	2005	2005	2005
**	Present population	(nos.)	58,100	76,024	69,461	57,605	62,775	31,125	79,199	92,677	126,307	66,400	15,800	46,527
**	Present PE	(PE)	69,720	85,147	83,353	64,517	70,308	34,860	88,703	103,799	151,569	79,680	18,960	55,833
**	Target year		2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
**	Design Population	(nos.)	82,350	133,016	121,533	100,789	82,792	41,050	104,453	111,940	152,560	127,075	17,265	56,198
**	Design PE for sewage treatment	(PE)	149,734	129,377	179,033	106,264	90,177	40,800	138,038	130,124	346,523	275,069	136,092	82,344
**	Land cost	(Mil. RM)	6.290	21.000	12.000	0.000	25.900	0.000	22.100	0.000	0.000	46.750	0.000	3.430
**	Construction cost	(Mil. RM)	21.644	339.581	5.747	300.380	210.710	42.555	271.213	6.973	12.416	230.206	3.169	36.975
**	Annual O&M cost	(Mil. RM/yr)	0.812	3.232	0.107	2.261	2.310	0.460	1.158	0.321	0.187	2.007	0.067	0.783
**	DOE water quality monitoring station		1L15	1L15	1L05	1L05	1L05	1L04	1L05	1L04	1L03	1L09	1L09	1L09
**	Standard A/B		A	A	A	A	A	A	A	A	A	A	A	A
Importance of city/area														
	Growth rate of population	(%)	2.4	3.8	3.8	3.8	1.9	1.9	1.9	1.3	1.3	4.4	0.6	1.3
	Design population	(nos.)	82,350	133,016	121,533	100,789	82,792	41,050	104,453	111,940	152,560	127,075	17,265	56,198
**	Annual hotel guests	(nos.)												
Pollution loads														
	Total pollution load generated	(ton/day)	8.235	7.116	9.847	5.845	4.960	2.244	7.592	7.157	19.059	15.129	7.485	4.529
	Total pollution load removed by existing STPs & ISTs	(ton/day)	1.407	11.399	4.304	5.272	4.549	2.024	6.065	2.836	7.855	5.881	1.216	1.860
	Total pollution load discharged	(ton/day)	6.828	(4.283)	5.543	0.573	0.411	0.220	1.527	4.321	11.204	9.248	6.269	2.669
Water pollution status														
**	WQI(BOD_5)		78	78	69	69	69	67	69	67	81	96	96	96
**	WQI(NH_3-N)		37	37	38	38	38	29	38	29	46	70	70	70
Complaints from the public														
**	Complaints on STPs	(nos.)	36	36	36	36	36	36	36	36	36	36	36	36
**	No. of STPs	(nos.)	288	288	288	288	288	288	288	288	288	288	288	288
Water use condition														
**	Total water production of WTPs	(m3/day)	55000	55000	28000	28000	28000	28000	28000	28000	28000	664000	664000	664000
**	Water intake suspension days at WTPs	(hrs)	327.75	327.75	313.35	313.35	313.35	313.35	313.35	313.35	313.35	313.35	313.35	313.35
**	Irrigational area	(ha)												
**	Classification by WQI		III	III	III	III	III	III	III	III	III	II	II	II
Rationalisation of existing sewerage facilities														
**	Design PE of STPs to be rationalised	(PE)	18,471	221,991	85,234	97,760	79,279	36,250	105,996	54,336	162,479	105,102	23,391	36,491
**	No. of STPs to be rationalised	(nos.)	7	67	14	29	36	9	47	6	5	31	3	8
**	Design PE of ISTs to be connected	(PE)	12,070	12,775	0	12,770	15,595	5,200	20,790	2,500	0	14,675	1,000	1,270
**	No. of ISTs to be connected	(nos.)	2,414	2,500	0	2,500	1,500	500	2,000	500	0	2,935	200	254
	Design PE of growth	(PE)	119,193	(105,389)	93,799	(4,266)	(4,697)	(650)	11,252	73,288	184,044	155,292	111,701	44,583
**	Existing STP O&M man-power reduction	(man-year)	3.4	50.3	30.0	19.0	14.9	11.6	25.9	18.4	20.6	19.8	5.2	15.1
	Existing IST O&M man-power reduction	(man-year)	1.1	1.1	0.0	1.1	0.7	0.2	0.9	0.2	0.0	1.3	0.1	0.1
	Total O&M man-power reduction	(man-year)	4.5	51.4	30.0	20.1	15.6	11.8	26.8	18.6	20.6	21.1	5.3	15.2
First works for sewerage provision														
**	Government-funded sewerage provision		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reliability of project implementation							flood retention pond		Malay reserve					
**	Prospective of land acquisition for STP site		Existing STP	Gazetted	Existing STP	Gazetted	No resettlement	Existing STP	Public	Existing STP	Existing STP	No resettlement		No resettlement
Financial analysis														
**	NPV	(mil RM)	-31828	-356291	-21502	-326309	-233653	-47477	-270129	-13243	-18522	-271426	-9554	-45399
**	B/C Ratio		0.36	0.05	0.46	0.04	0.05	0.22	0.04	0.45	0.37	0.04	0.53	0.19
Consideration for national projects														
**	Necessity for consideration													

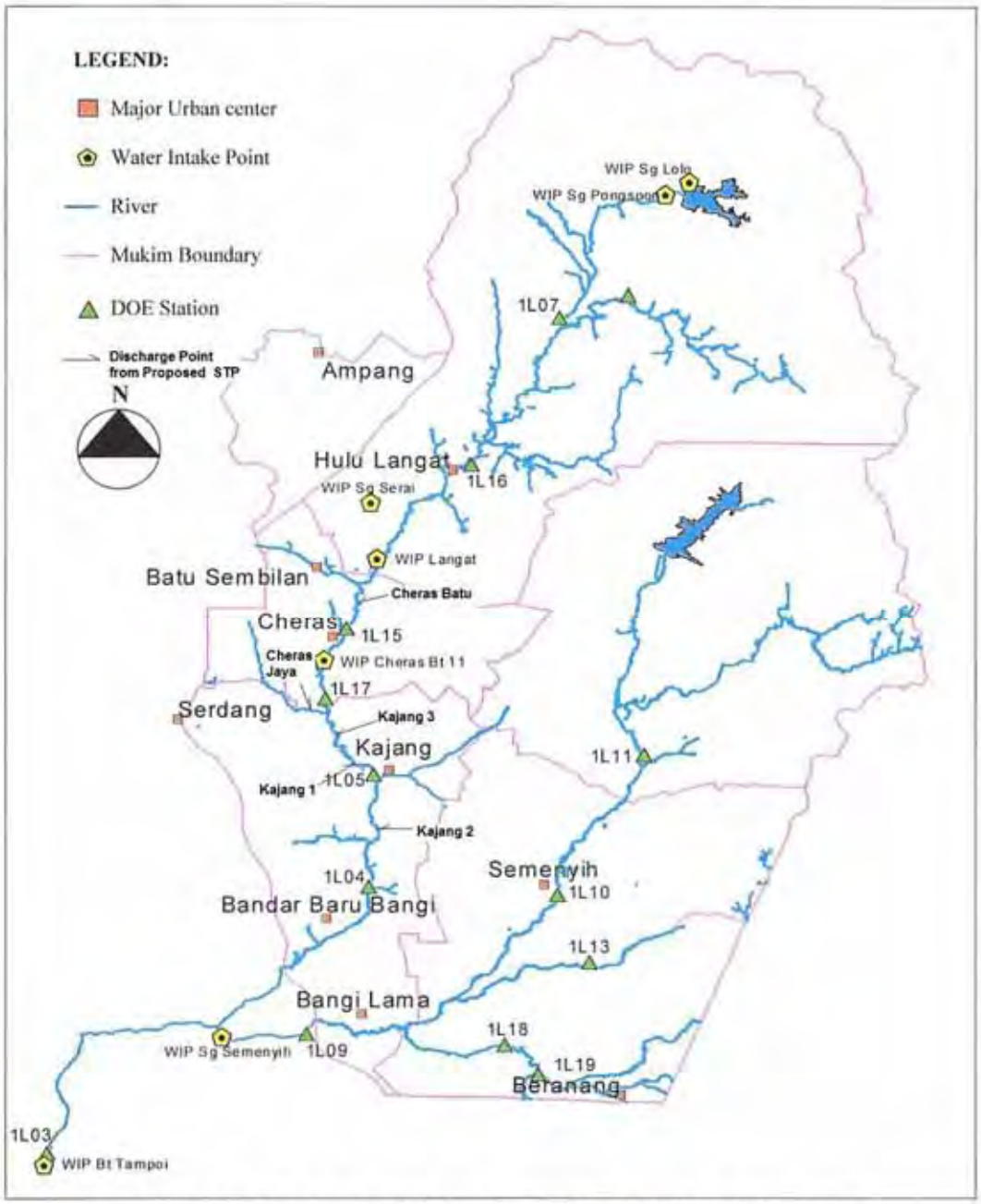


Figure 3.5.1 Location of DOE Monitoring Stations and Water Intakes in the Upper Langat River Basin

Table 3.5.2 Water Pollution Status of the Upper Langat River Basin

Station		DO% (Sat)	BOD_5 (mg/L)	COD (mg/L)	SS (mg/L)	pH (mg/L)	NH_3-N (mg/L)	WQI	BOD_5 SI	NH_3-N SI	Class	WQ Status		
												WQI	BOD_5 SI	NH_3-N SI
1L01	Ave.	70.2	2	27	165	6.39	0.57	74	91	61	III	SP	C	P
	No.	18	18	18	18	18	18							
1L02	Ave.	63.7	4	31	137	6.65	0.92	69	82	50	III	SP	SP	P
	No.	36	36	36	36	36	36							
1L03	Ave.	80.2	5	34	217	7.10	1.07	71	81	46	III	SP	SP	P
	No.	36	36	36	36	36	36							
1L04	Ave.	73.4	8	37	248	7.20	2.02	63	67	29	III	SP	P	P
	No.	56	56	56	56	56	56							
1L05	Ave	75.3	8	38	415	7.06	1.48	63	69	38	III	SP	P	P
	No.	36	36	36	36	36	36							
1L15	Ave	89.0	6	38	564	7.17	1.49	66	78	37	III	SP	P	P
	No.	36	36	36	36	36	36							
1L16	Ave	101.0	2	25	64	7.33	0.31	84	93	70	II	C	C	P
	No.	18	18	18	18	18	18							
1L07	Ave	102.1	2	21	12	7.50	0.05	92	94	95	I	C	C	C
	No.	18	18	18	16	18	18							

P: Polluted SP: Slightly polluted C: Clean

Note: The values below the determination limit of NH_3-N or less than 0.01 are treated as 0.01 to average calculation.

Source: Prepared by the JICA Study Team based on ASMA data from the period 2005 to 2007.

(2) Beneficial Water Use Conditions

The Upper Langat River Basin is regarded as one of the valuable water sources for urban water supply in the Kuala Lumpur Metropolitan Area. The nominal capacities of the Water Treatment Plants (WTPs) located in the Upper Langat River Basin are listed in **Table 3.5.3**, which is composed of two big WTPs, namely the Langat WTP in the Langat River and the Semenyih WTP in the Semenyih River, a tributary of the Langat River, and five small WTPs. In 2007, water intake closures occurred at two WTPs. Once at the Cheras Batu 11 WTP, and three times at the old module and two times at the new module of the Bukit Tampoi WTP, although the incidents at the new module overlapped with those of the old module, as shown in **Table 3.5.4**. The direct cause was identified as high NH_3-N concentrations in river water, which were reportedly attributed to domestic wastewater, including sewage effluent from the existing sewage treatment plants in the basin. Although the damage was minimized since water intake closure had not occurred at large WTPs, it is now regarded as an urgent matter to preserve the water quality of water sources in the metropolitan area.

Table 3.5.3 WTPs in the Upper Langat River Basin

	WTP	Nominal capacity (m^3/day)	River
1	Pangsoon	182,000	Langat River
2	Lolo	41,000	Langat River
3	Serai	90,000	Langat River
4	Langat	454,000	Langat River
5	Cheras	27,000	Langat River
6	Semenyih	636,000	Semenyih River
7	Bukit Tampoi	28,000	Langat River

Source: Antara Jurutera Perunding Sdn Bhd, "Sewerage Catchment Planning and Sludge Management Strategy Study for Upper Langat River Basin", Department of Sewerage Services, MEWC, July 2008

Table 3.5.4 Water Intake Closures at WTPs in the Upper Langat River Basin

WTP	Date	Duration of intake closure		Cause
Cheras Batu 11	February 12	14.5 hrs		High concentration of NH_3-N
Bukit Tampoi		Old module	New module	Ditto
	February 5	7.6 hrs		Ditto
	February 6	267.0 hrs	252.0 hrs	Ditto
	March 13	38.75 hrs	39.75 hrs	Ditto

The results of the trial application of the Manual to the proposed 12 sewerage catchments in the Upper Langat CSR are summarised below. In the application, the overall balance weighting was used, and the extra factor and divisions based on design PE were not applied as the study area was aggregated as a whole.

Rank	Catchment	Score
1	Cheras East	63.6
2	Cheras Batu 11	57.6
3	Langat	56.0
4	BBB South	54.6 (composed of two projects)
5	BBB North	53.0
6	Cheras Jaya	51.6
7	Semenyih	50.9 (composed of four projects)
8	Kajang 3	47.8
9	Kajang 2	46.2

10	Kajang 1	42.2
11	Bangi Selatan	46.9 (composed of two projects)
12	Beranang	39.3

The Manual was applied to the prioritisation of sewerage catchments in Upper Langat, but the results as stated earlier differed from the feeling on the Malaysian side that Cheras Batu 11, Cheras Jaya, Kajan 1, Kajan 2 and Kajan 3 would be highly ranked. For this reason, the verification was performed jointly with the Malaysian side to clarify the nature of this gap in expectation.

1) It was found that, in well developed areas, the growth rate of population and design PE was relatively low depending on the demarcation of the area while in less developed areas, it was set high due to the high potential for development and capacity for population acceptance. This led to the result that the well developed area was rated lower than the less developed area in importance of the area based on three indicators: the growth rate of population, design population and tourism guests by locality. To reduce this tendency, a new index with considering density, such as design PE / sewered area, should be introduced. This is a proposed are of improvement for the Guidelines, since area data is not provided in most existing reports.

2) In Upper Langat, the design PE of growth, which is calculated by subtracting design PE of existing STPs and ISTs from design PE, is negative in four sub-catchments out of twelve. This means that the STPs have already been sufficiently provided with such sub-catchments. If actual status differs, there is the possibility that the design PE will be underestimated. Although the Upper Langat Report used for trial application was not the Final Report, this is a is a future issue of the report that should be addressed.

3) With respect to complaints from the public, the data on complaints related to existing STPs and the number of existing STPs are common to all sub-catchments in Upper Langat due to the use of data at the LA level, which make comparison impossible. From the recognition of the need to improve this situation, it has been acknowledged that the complaints must be broken down to the sub-catchment level as well as in accordance with the number of existing STPs. The complaints related to existing STPs shall be limited to operational and functional issues.

4) As construction costs differed significantly by sub-catchment in Upper Langat, costs were broken down to show that the construction costs for Langat, Cheras East, BBB North, BBB South, Bangi South and Beranang are composed of sewer trunk, manhole

and connection primarily to rationalise the existing STPs, but do not include the cost for STP construction to meet design PE by 2035. Only in Sub-catchment 2 of Bangi South to which a MP system is recommended, the cost for upgrading the STP is estimated for NPV analysis. Therefore, it is not proper to compare such sub-catchments with Cheras Batu 11, Cheras Jaya, Kajan 1, Kajang 2 and Kajang 3 with which a CSTP system will be provided.

In addition, to avoid this kind of confusion, the construction cost must be given with a breakdown of land, sewer, network pumping station and STP at a minimum for improvement.

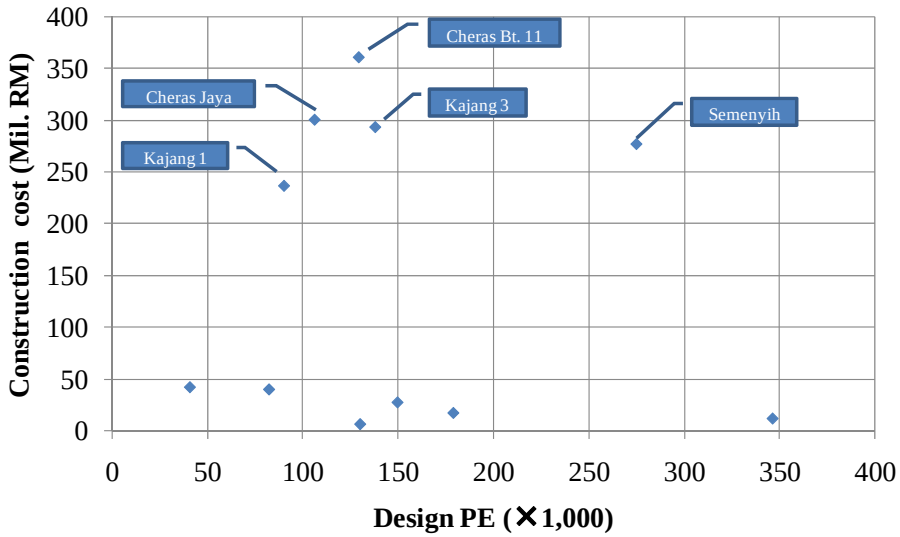


Figure 3.5.2 Design PE vs. Construction Cost in the Upper Langat River Basin

5) Simply failing to address problems and doubts concerning data compiled from the report and instead to adjust weighting is sloppy, resulting in the distortion of results. In this case, the review of report is the first priority.

The results of prioritisation among Cheras Batu 11, Cheras Jaya, Kajan 1, Kajang 2 and Kajang 3 are as follows:

Cheras Batu 11	57.6
Cheras Jaya	53.6
Kajang 3	53.4
Kajang 2	53.2
Kajang 1	45.4

Except for Cheras Batu 11 and Kajan 1, there is no substantial difference among the remaining three sub-catchments, Cheras Jaya, Kajan 3 and Kajang 2.

3.6 Application of the Manual on an Actual Project Basis

This Manual has been developed to prioritise sewerage catchments with full design PE at the target year. But in the project implementation, the project size is reduced to actual design PE, namely one third or one fourth depending on the full design PE, under the concept of phased construction. Is this Manual applicable to such actual projects?

The concept of catchments/projects is shown in **Figure 3.6.1**.

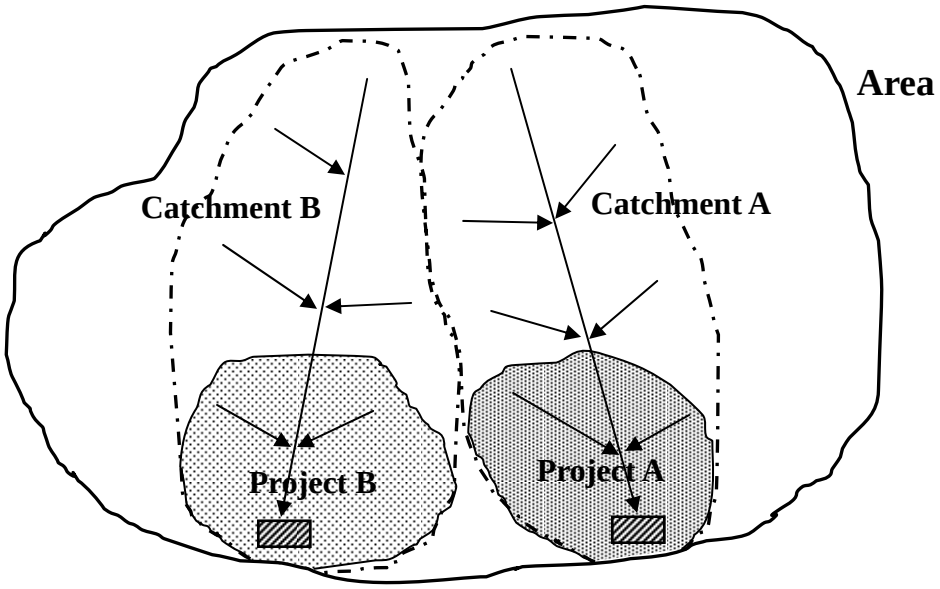


Figure 3.6.1 Concept of Catchments/Projects

When the design PE is reduced from full design PE to actual PE for implementation, it means that the service area is also reduced, which results in a change in the growth rate of population, design population, complaints on existing STPs, rationalisation impact and financial viability. If this data is obtainable, the Manual is applicable to the prioritisation of sewerage projects by substituting such data for those at the full design PE.

In the case of a catchment strategy proposing more than one sewerage catchment in general, the steps of project brief, project specification, design brief, detailed design and construction are followed. The project specification step is required for large-scale projects, but it may be

shortened for small-scale projects. Steps for the project brief, project specification and design brief are regarded as part of the planning stage, and the design PE is determined in the design brief step. It is suggested that the design PE for implementation be decided in the project brief step and to start collecting data on the design PE for implementation.

It should be noted that the comparison of projects in the design PE for implementation is effective only among projects and comparison should not be made among catchments/projects except where the full design PE is small and used as the design PE for implementation.

Table 3.6.1 Relationship between Catchment and Project in Prioritisation

Evaluation Item	Catchment	Project
Importance of city or area	×	×*
BOD_5 pollution load generated	×	×*
Water pollution status	× (BOD_5, NH_3-N)	
Complaints from the public	×	×*
Water use condition	×	×
Rationalisation impact	×	×*
First public sewerage works		
Reliability of project implementation	×	×
Financial viability	×	×
Consideration of special conditions	×	×*
	⇓	⇓
	Scoring	Scoring

×* data at the actual PE for implementation

3.7 Manual

The Manual for Reviewing, Evaluating, and Prioritising Sewerage Catchments/Projects, including instruction on usage, is described in detail in the separate Volume.