

Wastewater Investment Master Plan Package I: Bogor

Final Master Plan

September 2011
Indonesia Infrastructure Initiative

Australia Indonesia Partnership
Kemitraan Australia Indonesia

Mott MacDonald

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Indonesia Infrastructure Initiative

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Glossary and Acronyms

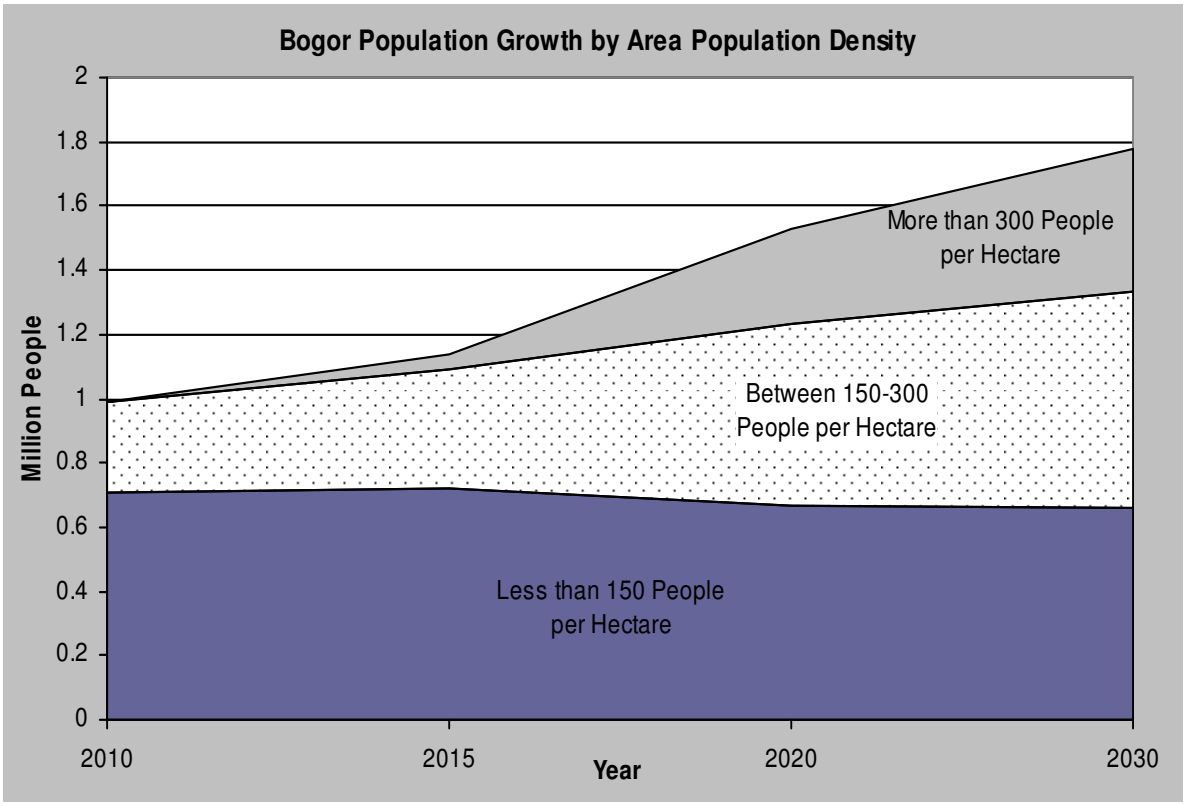
ABR	Anaerobic Baffle Reactor
ADB	Asian Development Bank
APBD	Anggaran Pendapatan Belanja Daerah (Regional Revenue Expenditure Budget)
APBN	Anggaran Pendapatan Belanja Nasional (National Revenue Expenditure Budget)
AusAid	Australian Agency for International Development
BAPEPAM	Badan Pengawas Pasar Modal (Capital Market Regulatory Official)
Bappeko	Badan Perencanaan Pembangunan Kota
Bappenas	Badan Perencanaan Pembangunan Nasional (National Development Planning Agency)
BLH	Badan Lingkungan Hidup (Environmental Agency)
BOD	Biochemical Oxygen Demand
BORDA	Bremen Overseas Research and Development Association
BOT	Built Operate Transfer
BPHTB	Bea Perolehan Hak atas Tanah dan Bangunan (land and buildings property transfer tax)
CBD	Central Business or Commercial District
CD	Covered Drains
CKTR	Cipta Karya dan Tata Ruang
COD	Chemical Oxygen Demand
CSS	City Sanitation Strategy
CT	Communal Treatment
DAK	Dana Alokasi Khusus
DED	Detailed Engineering Design
DEWATS	Decentralized Wastewater System
DGHS	Directorate General of Health Service
DGT	Directorate General of Taxation
DJCK	Direktorat Jenderal Cipta Karya
DKI	Daerah Khusus Ibukota (Special Capita District)
DKP	Dinas Kebersihan dan Pertamanan (Department of Hygiene and Gardening)
DPRD	Dewan Perwakilan Rakyat Daerah
EHRA	Environmental Health Risk Assessment
ESP	Environmental Service Program
FAP	Facultative Aerated Pond
FOPIP	Financial and Operational Performance Improvement Plan
GAPENSI	Gabungan Pelaksana Konstruksi Nasional Indonesia (The Indonesia Constructors Association)
GDP	Gross Domestic Product
GoA	Government of Australia
GoI	Government of Indonesia
GPS	Global Positioning System
IBRD	International Bank for Reconstruction and Development
ICD	Interceptors (leaching pit which has been made watertight or septic tank) and discharge of the effluent in adapted covered stormwater drains
IPLT	Instalasi Pengolahan Limbah Tinja (Septage Treatment Plant)
IUIDP	Integrated Urban Infrastructure Development Program
LIDAP	Local Institutional Development Action Plans
LKPP	Lembaga Kebijakan Pengadaan Pemerintah (Government Institution on Procurement Policy)
LP	Leaching Pit
LP+	Improved Leaching Pit
MCK	Community toilet and washing facility (Mandi Cuci Kakus)
MDB	Multilateral Development Banks

MDG	Millennium Development Goals
MMI	Mott MacDonald Indonesia
MOF	Ministry of Finance
MPW	Ministry of Public Works
MSMHP	Metropolitan Sanitation Management and Health Project
NGO	Non Governmental Organization
NJOP	Nilai Jual Obyek Pajak (property valuation)
NMCP	NGO Management Certificate Program
O&M	Operation & Maintenance
OBA	Output Based Aid
OD	Open Defecation
ODF	Open Defecation Free
PAMSIMAS	Penyediaan Air Minum dan Sanitasi berbaSis Masyarakat
PBB	Pajak Bumi dan Bangunan (Property Tax)
PD	Perusahaan Daerah (Government Owned Company)
PDAM	Perusahaan Daerah Air Minum (Local Drinking Water Corporation)
PERDA	Peraturan Daerah
Perpres	Peraturan Presiden (Presidential Decree)
PKL	Pedagang Kaki Lima (Food Stalls)
PLN	Perusahaan Listrik Negara (National Electricity Company)
PMK	Peraturan Menteri Keuangan (Ministry Of Finance Regulation)
POKJA	Kelompok Kerja (Work Group)
PP	Peraturan Pemerintah (Government Regulation)
PPN	Pajak Pertambahan Nilai
PPSP	Percepatan Pembangunan Sanitasi Pemukiman (settlement sanitation development acceleration)
PSO	Public Service Obligation
PSP	Private Sector Participation
Puskesmas	Pusat Kesehatan Masyarakat
RBC	Rotating Biological Contactor
RISPK	Rencana Induk Sanitasi Perkotaan Kota
RO	Reverse Osmosis
Rp.	Indonesian Rupiah
RPJMD	Rencana Pembangunan Jangka Menengah Daerah
RPJMN	Rencana Pembangunan Jangka Menengah Nasional
Rukan	Perumahan dan Perkantoran
Ruko	Rumah Toko
Sanimas	Sanitasi Masyarakat (community Based Sanitation)
SBS	Small Bore Sewerage
SDS	Sewer Discharge Station
SIER	Surabaya Industrial Estate Rungkut
SMS	Septage Management System
SOSEC	Social Economic
SPAL	Saluran Pembuangan Air Limbah
SS	Shallow Sewerage
SSDP	Sewerage and Sanitation Development Program
ST	Septic Tank
ST/AUF	Septic Tank with Anaerobic Upflow Filter
STei	Septic Tank effluent infiltration
STP	Sewage Treatment Plant
SUSENAS	Survei Sosial Ekonomi Nasional

TG1	Task Group 1
TG2	Task Group 2
TG3	Task Group 3
TG4	Task Group 4
TLP	Twin Leaching Pit
TPA	Tempat Pembuangan Akhir
TPS	Tempat Pembuangan Sementara
TUPOKSI	Tugas Pokok dan Fungsi (Main Task and function)
UASB	Upflow Anaerobic Sludge Blanket
UASBR	Upflow Anaerobic Sludge Blanket Reactor
Unair	Universitas Airlangga
UPTD	Unit Pelaksana Teknis Dinas
USAID	United States Agency for International Development
USRI	Urban Sanitation and Rural Infrastructures
WIP	Wastewater Investment Plans
WSI	Water and Sanitation Initiative
WTP	Willingness to Pay
WWTP	Waste Water Treatment Plant

Executive Summary

Bogor city is in the province of West Java directly to the south of Jakarta the capital of Indonesia. Bogor presently has about 985,000 inhabitants and it is expected that this number will grow to around 1.8 million by the end of 2030, the planning period of this wastewater masterplan. By then, one quarter of the population will live in areas with a population density of more than 300 capita/ha. In the chart below we present the population forecasts, showing the different population densities for the 'planning years' of this masterplan.



Current Situation

The increase in population will aggravate the present environmental problems related to inadequate wastewater collection, treatment and disposal. Currently:

- One out of every twenty inhabitants defecates in the open: usually in the rivers or drainage channels;
- Three out of every five inhabitants use wastewater treatment facilities which directly discharge into the surface water drainage channels;

- Less than a tenth of the sludge that accumulates in the on-site systems (mainly leaching pits) is collected and transported to the Tegal Gundil STP by private and government vacuum trucks. The remainder is either collected manually and dumped into the watercourses or land in Bogor, or accumulates in the on-site systems leading to overflow, malfunctioning and pollution of ground water and drainage channels.
- The present wastewater treatment facility at Tegal Gundil STP has a capacity to treat the wastewater from 2,400 properties, but only receives wastewater from 300. Only 270 properties are paying the fee with the amount collected is not even enough to cover the collection of the fees. The plant is operated badly and the effluent from the treatment facility frequently exceeds acceptable effluent discharge standards, even though the plant is under capacity. In addition the sludge drying beds are not being used for drying sludge.
- Almost all commercial enterprises discharge their wastewater untreated straight into the nearest stream. The government has started recording these practices but legislative action is limited.

In response to these problems, there are some promising local government wastewater initiatives paid for from National budgets, such as the SANIMAS community based neighbourhood wastewater collection and treatment systems. For the time being, not all initiatives have been successful and the selection of the right technology and location has been a major challenge. The City is also planning a future initiative that will require all planned condominium housing developments to have communal wastewater systems with modular treatment facilities.

Master Plan Goals

In this Wastewater Master Plan we aim to identify the present shortcomings and the conditions necessary for improved practices in the future. Practical and cost effective plans have been developed which, if implemented, will allow for very substantial improvements in the management of wastewater, leading to better environmental and living conditions and removing a major barrier for Bogor's economic growth.

Measurable aims include reducing the current daily environmental pollution load of 17 ton BOD (Bio Oxygen Demand) by 60% by the year 2030 to 8 ton BOD and to become Open Defecation Free (ODF) by 2015. The river quality upstream of Bogor is good, so this improvement will be beneficial to all downstream users, including Jakarta.

Social Inclusion

Inadequate waste water management effects all sectors of society but has a disproportionate impact on the urban poor. The wastewater improvement programme

that has been developed is a poor-inclusive programme: that means the intervention proposals have been developed in such a way that the environmental conditions of the city's slum dwellers is improved.

Appropriate Solutions

A pragmatic approach has been taken in the masterplan to produce low cost short term investment priorities which will offer immediate benefits that compliment medium and long term approaches that works towards providing a comprehensive sewerage system suitable for a major city of nearly 4 million inhabitants. This leads to the phased adoption of "quick fix" on-site solutions, medium term intermediate solutions and the foundations for long term of-site systems.

On-site Wastewater Systems

Where first stage sanitation improvements are required, on-site systems are often preferred because they can be constructed by the local community or the individual householder for low capital and operational cost. Well constructed and well maintained on-site sanitation systems can provide the same level of wastewater management and health benefits as a conventional off-site sewerage system. The use of on-site systems is prevalent within Bogor, unfortunately many are unacceptable as a result of incorrect installation or poor maintenance.

The repair and improvement of existing on-site systems and the installation of new good quality systems will go a long way towards meeting the masterplan's goals. By 2030, more than 75% of the wastewater systems in Bogor will be acceptable private on-site systems, particularly in the Western wastewater zone.

All on-site systems need to be appropriate to the conditions in which they are used including ground water level, soil permeability and population density. These systems must be developed along side suppliers and manufactures and must "fit" Bogor.

Households will need to be persuaded, incentivised and then helped to install or upgrade to these systems. Once installed, procedures need to be in place to ensure that tanks are emptied regularly (approximately once every 1-2 years) of septage and systems are maintained to avoid malfunction or overflow and the renewed pollution of groundwater and watercourses.

Increased institutional support and financial assistance, e.g. subsidies for the poor or credits for the medium-income will be required along side technical guidance, support

and mass media coverage so that the population at large understand the benefits available and how to access / implement them.

Intermediate Wastewater Systems

Intermediate systems have been developed in the Central and Eastern wastewater collection zones because there are areas where high ground water level, impermeable soils and/or population density render on-site systems inappropriate and where many households either do not generate enough wastewater for a conventional gravity sewerage system to operate effectively or cannot afford the estimated Rp 30,000/month off-site sewage fee required.

These intermediate systems will ultimately serve half (50%) of the properties in areas with population densities over 300 cap/ha, they will be located in low to medium income areas and housing estates. In areas where there are many private on-site systems, small-bore sewerage systems are to be applied; in other areas, shallow sewers.

Conventional Citywide Sewerage

The masterplan includes an “embryo” off-site wastewater system in the Paledang commercial and business area. The adjacent high-density residential areas will also be connected, this will allow about 15,000 people and 400 commercial enterprises to have proper wastewater services. The “embryo” wastewater system will at first operate as an independent module with decentralized wastewater treatment using a modular treatment plant (RBC/Rotating Biological Contactor). At a later date it can be incorporated into the Central wastewater collection zone. The embryo sewerage system and treatment plant will be operated and maintained by a professional entity, which will develop knowledge and experience of wastewater collection, transport and treatment. The “embryo” system should be profitable and its success will act as a proof of concept for the off-site model. This will form the impetus which will allow the purchase of land for future STPs for the planned city-wide sewerage system: one STP at Kayu Manis (9 ha) and the other STP at Ciluar (4 ha).

Implementation Strategy

The City has been divided into three wastewater collection zones. The Western zone will be covered by “on-site” systems, the Central and Eastern zones are to be dealt with by a mixture of “off-site”, “on-site” and “intermediate” systems.

Two main sewer lines have been identified that will be part of the long-term (post 2030) citywide sewerage system. One trunk sewer, in the Central wastewater collection zone,

with a potential sewerage catchment area of 1,200 ha, runs North from Jalan Sukasari, to an STP (Sewerage Treatment Plant) at Kayu Manis. The second trunk sewer is in the Eastern wastewater collection zone, with a potential sewerage catchment area of 1,400 ha. It runs North East from Jalan Raya Pajajaran, STP at Ciluar. There will also be a main sewer connecting the Tegal Gundil sewerage catchment zone to the Eastern trunk sewer.

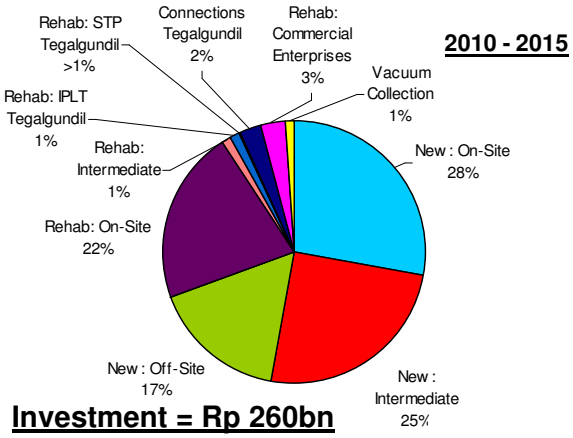
By 2030 these 2 wastewater collection systems will serve an estimated 50,000 domestic and commercial properties.

Trunk sewers are located in the main roads, as opposed to river banks, for several reasons:

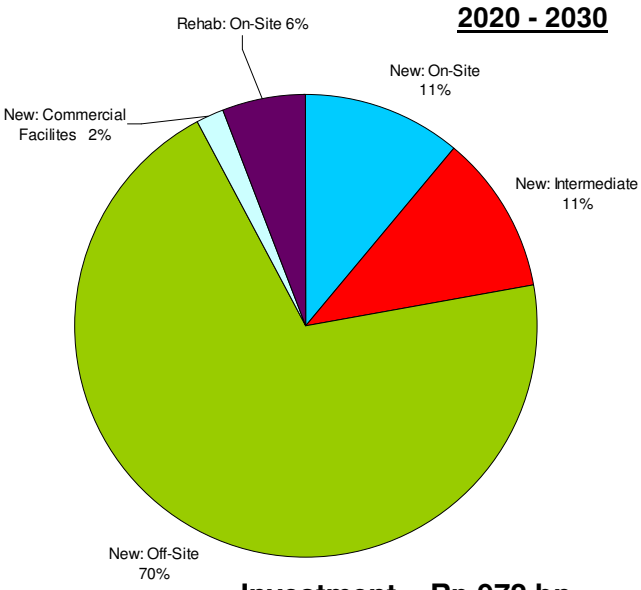
- It is feared that in the rainy season, high water levels and high water velocities would destroy sewers along the riverbanks.
- People who live around the river banks would need to be relocated;
- Bogor building regulations do not permit constructions along the rivers;
- A sewer along the riverside, without river crossings, can only receive water from one side. Hence twice the length of sewers would be needed.

Investment costs

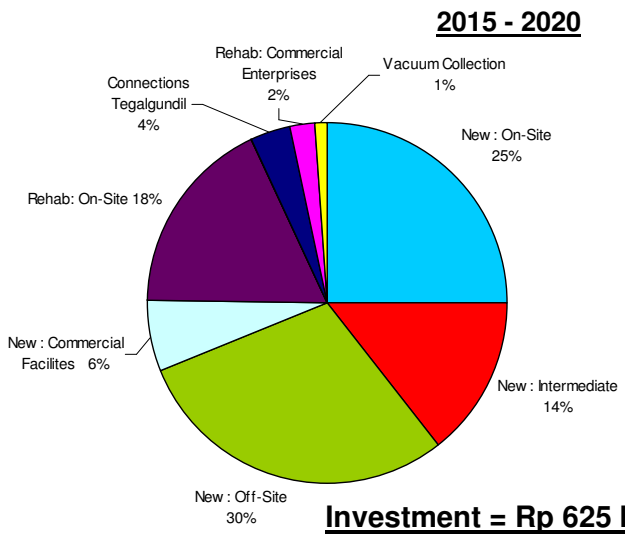
The total cost of the interventions to realise all the targets and objectives of the masterplan is in the region of Rp 1.9 trillion (US $ 206 mln.) over 20 years. The period by period split for this investment is represented in the piecharts below.



Investment = Rp 260bn



Investment = Rp 972 bn



Investment = Rp 625 bn

Operation and maintenance costs

The O&M costs are around 2% of the investment costs.

- Rp 30,000/month for off-site systems;
- Rp 15,000/household/month for intermediate systems;
- Rp 5,000/household/month for on-site systems.

Bottlenecks and strategies to deal with them

Improvements to the wastewater situation are hampered by 3 recognised bottlenecks. These are the fact that;

1. Many people are unconcerned about the present unsanitary conditions.
2. Few stakeholders, including the general public, the private sector and responsible government agencies have any knowledge of good wastewater systems. It is not regarded it as a prestigious issue.
3. The common belief that improvement of wastewater collection, transport and treatment costs too much money and provides poor value.

This Master Plan deals with these aspects by recommending the creation of an enabling environment by:

- **Improving public perception of environmental and health issues related to wastewater.** This has been dealt with in the WWMP Capacity Building Plan (CBP) and our proposals on 'software'.
- **Improving wastewater collection and treatment management knowledge.** This has been dealt with in the CBP and includes developing local knowledge among stakeholders, mass media campaigns and the dissemination of good practices.
- **Proposing cost effective interventions.** This has been dealt with by identifying "on-site" system programmes to cover as large an area as practical. "Intermediate" wastewater system proposals should be based on medium level technology, where appropriate. Finally "off-site" wastewater collection zones should be targeted at the properties that can afford to pay for the significant operation and maintenance costs of these systems.

1. Introduction

1.1 Background

The Government of Australia (GoA) announced the Water and Sanitation Initiative (WSI) in December 2008. The approved allocation for Indonesia is A$60.5 million. The bilateral funds are to be expended during the period 1 July 2009 - 30 June 2011. Mott MacDonald Indonesia was appointed by IndII as consultants for Package 1 – Surabaya and Bogor. A project commencement was given for 1st September 2010 with a project completion date of 30th June 2011.

The preparation of Wastewater Investment Plans under this assignment is one component of the WSI for Indonesia. Other components of WSI include the water and sanitation hibah and support to PAMSIMAS. The WSI program for Indonesia is being delivered through the Indonesian Infrastructure Initiative (IndII), which is a bilateral cooperation project between Australia and Indonesia, funded by the Australian Agency for International Development (AusAID). Tenders were issued for 3 packages of Wastewater Investment Masterplans covering 7 Cities.

1.2 Framework

This wastewater masterplan project is one element of the National Wastewater Strategy and Policy Implementation plan. The masterplan and wastewater system proposals that are included are identified within the national strategies for the development of domestic wastewater management systems. The implementation of the masterplan is directed through several regulations and commitments. The two main relevant regulations with regard to investment planning are:

- Public Work Regulation No. 16/PRT/M/2008 on National Strategy and Policy on Domestic Wastewater Management, and
- Government Regulation No. 16/2005 on Water Supply Development

The above regulations provide a framework on the common vision and mission of wastewater management system development and activities and do not provide so much technical guidance specific to wastewater. However, they have both been used in the development of the Master Plan for the City, with adjustments to match the wastewater topic and the areas' specific characteristics.

The Government of Indonesia (GoI) has also committed to achieve MDG's target in the sector of sanitation by 2015. This is that 76.8% of the national population should have access to safe and proper sanitation.

1.3 Definition of waste water

The term 'wastewater' led to some confusion during discussions in the early stages of the development of the masterplan. A more appropriate term would be 'human waste management', to distinguish it from storm water. In the framework of the Master Plan, we distinguish the following three terms:

- **Domestic wastewater**: consisting of:
  - 'Black' water ('kakus') = human waste (excreta and urine) + water used for anal cleansing and flushing the toilet (usually by hand, pour-flush)

  - 'Grey' water = water produced during bathing ('mandi') and cleaning/laundry ('cuci')
- **Non-domestic wastewater**[1]: water originating from small businesses, home industries, industrial areas;
- **Septage**: faecal sludge: the residue from faeces that remains after a period of anaerobic digestion in the leaching pit ('cubluk'), septic tank ('tanki septik') or any other treatment/storage system.

In the framework of the masterplan the term **'wastewater' refers to domestic wastewater consisting of black water, grey water and septage, but excluding storm water**. The removal, transport and treatment of septage are included in the Master Plan.

1.4 Aim and objectives of the Master Plan

The overall aim of the project is to develop a long term (2030) Master Plan and to develop, together with the City Governments, the tools and skills to prepare their own City Sanitation Strategies (CSS). In future years the City Governments should be able to develop better focussed goals, to be able to re-structure the management process where necessary, to facilitate the implementation of the programmes and to be better able to deliver, operate and maintain the physical infrastructure projects in the future.

The immediate objective of the masterplan is to identify selected priority projects for implementation in the first five year period of the masterplan, ie by 2015 and to enable Multilateral Development Banks (MDB's) and bilateral development agencies to commit to further development of the wastewater proposals in agreement with GoI. The output is tailored to match the specific requirements of MDB's or bilateral agencies that have committed to provide funding, provided that GoI has agreed to proceed with the funding proposals at a sufficiently early stage in the activity.

The project was divided into four Task Groups (TG) in the Terms of Reference (TOR), namely:
1. Reviewing the City Sanitation Strategy (TG1)
2. Master Plan Based on City Sanitation Strategy (TG2)
3. Feasibility Studies (TG3)
4. Capacity Building (TG4)

The selected projects were subject to a feasibility study, TG3, if found necessary, to be prepared under this project. The proposed investment programs are to be carefully assessed and require approval from local government. Necessary institutional/legislative changes have been proposed in order to facilitate implementation. These changes were identified under the Capacity Building task, TG4, of this project.

All work carried out during the project, in the development of the Master Plan, has been done in close consultation and collaboration with the local governments, to enhance their capacity in the skills for sustainable future wastewater management. The masterplan covers physical infrastructure, capacity building elements and the financial implications of wastewater system development.

1 Note. Non-domestic wastewater from home industries such as 'tahu' production or 'industrial' type pollution from animal slaughter etc can produce significant environmental effects on local communities. As we were unable to identify these locations, due to the study timescale, we are not covering this issue in the masterplan. See Section 6.5 for comments.

1.5 The Target for the City and strategic objectives of the master plan

1.5.1 Target:

The masterplan targets to create a healthy living environment in Bogor through the effective and sustainable collection, transport, treatment and final disposal/reuse of wastewater ('wastewater management').

1.5.2 Strategic objectives:

1. Immediate improvement of the wastewater situation of the 4.7% of the population of Bogor people who defecate at the moment in the open: So attaining Open Defecation Free (ODF) status by 2015.
2. Target the provision of wastewater systems for housing areas where people have relatively unhealthy living conditions. This is reflected in the EHRA Sanitation Risk score of the area.
3. Improvement of the quality and quantity of the city's wastewater infrastructure in such a way that the current level of 57% of the BOD pollution load of Bogor being released to the environment, is at least reduced to 15% by 2030. See Figure 4.1 for the growth in BOD load over the planning periods and the reduction of the BOD loads due to improved wastewater investment.
4. Clear insight, decisions and indications of the spatial reservations for the skeleton of the long-term (2030) infrastructure for adequate off-site wastewater service levels in the Linear Commercial Areas (LCA) by 2015;
5. Development of a 'starter' (embryo) off-site wastewater system in one of the LCA and adjacent high-density areas by 2015;
6. Increase the sewerage catchment area for Tegal Gundil STP
7. Development of a sustainable legal and institutional framework for management, operation and maintenance of improved wastewater facilities by 2015;
8. Motivate the population, commercial enterprises and institutes to implement, operate and maintain adequate wastewater facilities;
9. Development of physical, financial and knowledge capacity regarding wastewater improvements at all levels: government, institutes, commercial enterprises, neighborhood and community.

1.6 Study Area

The City of Bogor is in the Province of West Java Province, see Figure 1.1. The area covered by the Master Plan is the administrative area of the City, see Chapter 2, Figure 2.1. For those developed areas that are contiguous across the City boundary, only the land in the City is included in the Master Plan. Discussions should be held in the future about cross border cooperation with regard to the development of wastewater solutions for these areas.

Figure 1.1: Location of Bogor (see Appendix A.1)

Source: Adapted from Google Maps and BBC website Country Profile

1.7 Basis

The Master Plan has had to be developed in 6 months. This has meant various limitations and constraints on the study, namely:

- Inability to do detailed topographical surveys.
- SOSEC surveys had to be held in representative sample areas. Not all areas of the city were sampled.
- Use of secondary data without detailed review.
- General area analysis for recommended solutions.
- Use of Kelurahan boundaries, rather than geographical (built-up) community areas
- City data and statistics based on a Kelurahan records.
- Inability to include specific solutions to home industry wastewater
- Industrial wastewater has not been included in the study; waste should be treated by the industry that is producing the waste.

- Identification of the sites for the wastewater treatment plants has been limited to land within the administrative area of the City. Cross border cooperation could identify better sites.

1.8 Technical approach and methodology

The general approach and methodology consists of:

1. Population and Land Use Projections
2. Review of the City Sanitation Strategy
3. Development of Wastewater Systems' Coverage Spreadsheet
4. Identification of Appropriate Wastewate Systemes
5. Selection of Wastewater Systems using following terminology:
   a. "On-site" systems (individual household level)
   b. "Off-site" systems, being conventional sewerage (city wide level);
   c. "Intermediate" systems: a mix of communal systems and "off-site" systems, other than conventional sewerage (neighbourhood/cluster/module level).
6. Development of Off-Site City-Wide Conventional Sewerage Systems
7. Prioritisation

1.9 Planning horizons

The TOR requires that the Master Plan describes agreed interventions, both physical and non-physical, over a planning horizon of 20 years and groups them into four 5-year periods. The subsequent feasibility studies to be carried out under the project are to address the projects in the first 5-year period only.

In consultation with IndII, it was agreed to modify the grouping to three periods: a short period (5 years), medium-term period (10 years) and a long-term period (20 years). This is more in line with current planning practices in Indonesia: immediate improvements (5 years), paving the path for sustainable solutions (10 years) and indicating the long-term goal (20 years). In addition, Indonesia is developing so rapidly that another 'benchmark' between 10 and 20 years is not very effective.

As far as identifying the target years is concerned, we propose to use: 2015 (as year 5), 2020 (as year 10) and 2030 (as year 20). The main reason is that 2015 is a very important benchmark: the year of the Millennium Development Goals (MDGs).

From a foreign funding perspective the end of the short-term period, year 2015, might be very optimistic. Under normal circumstances the master plan would be approved in July 2011. Detailed feasibility studies would be approved in October 2011 and projects could be funded from 2012/13 onwards. Hence in terms of actual construction of the projects, year 5 of the masterplan would in effect be 2017/18.

Recommended Planning Horizons:

- Existing situation 2010 (year '0')
- Short-term period 2015 (year '5')
- Medium-term period 2020 (year '10')
- Long-term period 2030 (year '20')

1.10 How to read the master plan

A brief description of the different sections of the Draft Masterplan document, below, may help to explain the structure of the report:

- Chapter 2 - a brief description of the city and its character
- Chapter 3 - a brief summary of the current wastewater situation and the effect that it has on the society and environment of the city
- Chapter 4 - how we have looked at the future with regard to demand for services and strategic objectives
- Chapter 5 - a brief description of how we have selected the appropriate system for each area of the city and developed the timing recommendations for different interventions
- Chapter 6 - descriptions of the recommendations, timing and costs for the different types of wastewater systems, by area
- Chapter 7 - a detailed summary of the institutional situation of the current operation of the wastewater system and an analysis of the City Government's proposals for the future
- Chapter 8 - possible financing options for investments
- Chapter 9 - aspects and recommendations for capacity building
- Chapter 10- comments on private sector participation
- Chapter 11 - a description of the main investment proposals and recommendations for implementation
- Chapter 12 - a list of the priority projects for the first five years of the masterplan and brief recommendations for "follow up" activities and studies that should support the implementation of the wastewater improvements identified in the master plan.

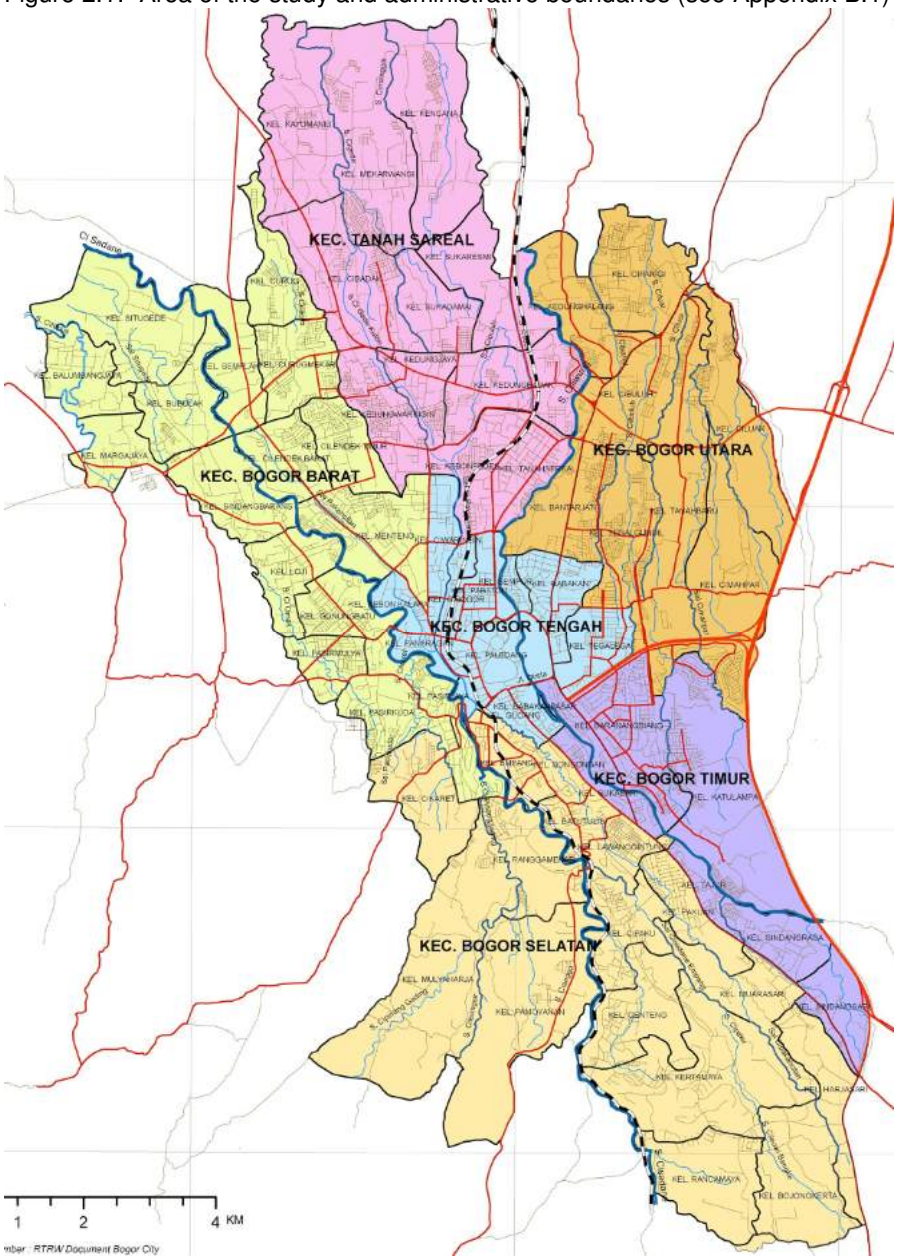
NOTE - some of the plans included in the main text are also included in the appropriate section Appendix at a larger scale for increased clarity.

2. General description of the city

2.1 Study Area

The City of Bogor is located in West Java Province of Indonesia, it is geographically located on 106° 48' longitude and 6° 36' latitude and is approximately 60 kilometres south of Jakarta. Bogor has 6 Kecamatans and 68 Kelurahan, covering an area of 118.50 Km^2 (11,850 Ha) with several rivers flowing through it. Figure 2.1 shows the area of study and its administrative boundaries.

Figure 2.1: Area of the study and administrative boundaries (see Appendix B.1)

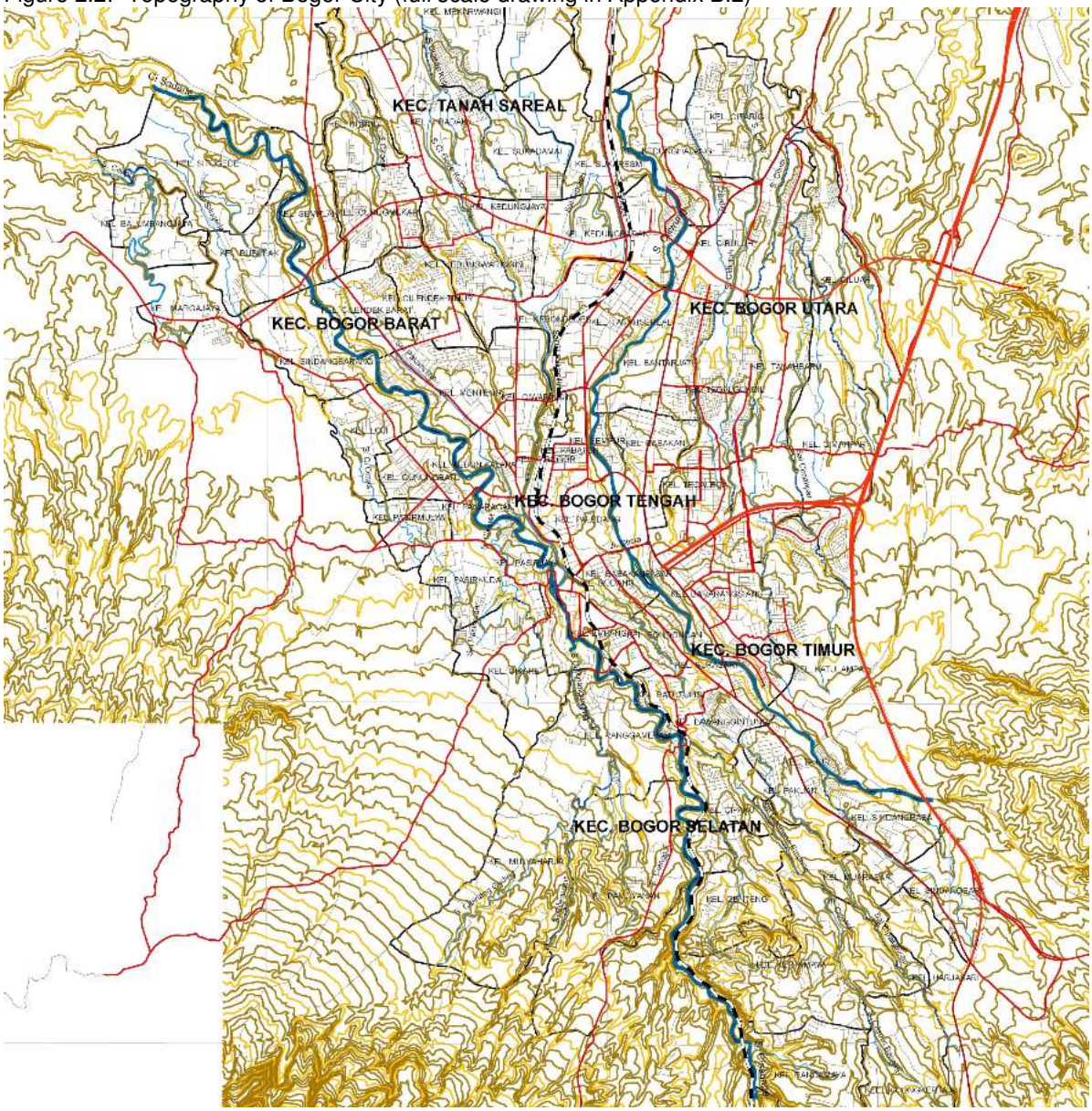


2.2 Physical condition

2.2.1 Topography

The topographical aspect of Bogor City basically varies between level and hilly, between 190m and 350m above sea level (mdpl). The city of Bogor is strategically placed for good economical growth due to its position in the middle of the Kabupaten Bogor area and also its close location to Jakarta. See Figure 2.2 for full topographical details of Bogor.

Figure 2.2: Topography of Bogor City (full scale drawing in Appendix B.2)



2.2.2 Geology

The geological structure of Bogor covers 2,719 Ha of andesitic flow, 3,249 Ha of alluvial fan, 1,372 Ha of sediment, 3,395 Ha of tufa and 1,112 Ha of silt, breccia, tuffa and capili. In general the city is covered by volcanic deposits from two extinct volcanoes, Mount Salak and Mount Pangrango (in the form of Breccia rocks tupaan/kpal). The layer of rock is located relatively deep from the surface and away from the river edges. Surface sediments are usually in the form of alluvial fan, consisting of sands and gravel.

2.2.3 Climate

The city of Bogor has a mild climate, the average monthly temperature is 26°C and the air humidity is about 70%. The lowest temperatures in Bogor are about 22°C, which often happens in December and January.

Bogor City is known as the “City of Rain” due to its high level of rainfall, the average annual rainfall is about 4,000mm to 4,500mm. The monthly rainfall is about 250mm to 335 mm, with the minimum monthly rainfall in September about 128mm and the maximum monthly rainfall in October about 346mm.

2.2.4 Hydrology

2.2.4.1 Surface Waters

Bogor City has 2 big rivers and 7 smaller rivers. The main rivers are the Ciliwung and Cisadane. The Cisadane river is used as the main raw water supply for the PDAM. In hydrological terms, the City is located on 3 watersheds (DAS), which are Cimahpar, Cikereti and Kalibaru.

The 4 smaller rivers in Bogor city are the Cipakancilan, Cidepit, Ciparigi and Cibalok. These rivers also have underground flow resulting in many springs which are used by the community for daily water usage.

2.2.4.2 Ground water

The depth of the ground water varies between 3 to 12 m normally. The depth of the ground water in the rainy season is about 3 to 6 m, while in the dry season the depth of the ground water could reach 10 to 12 m below the surface.

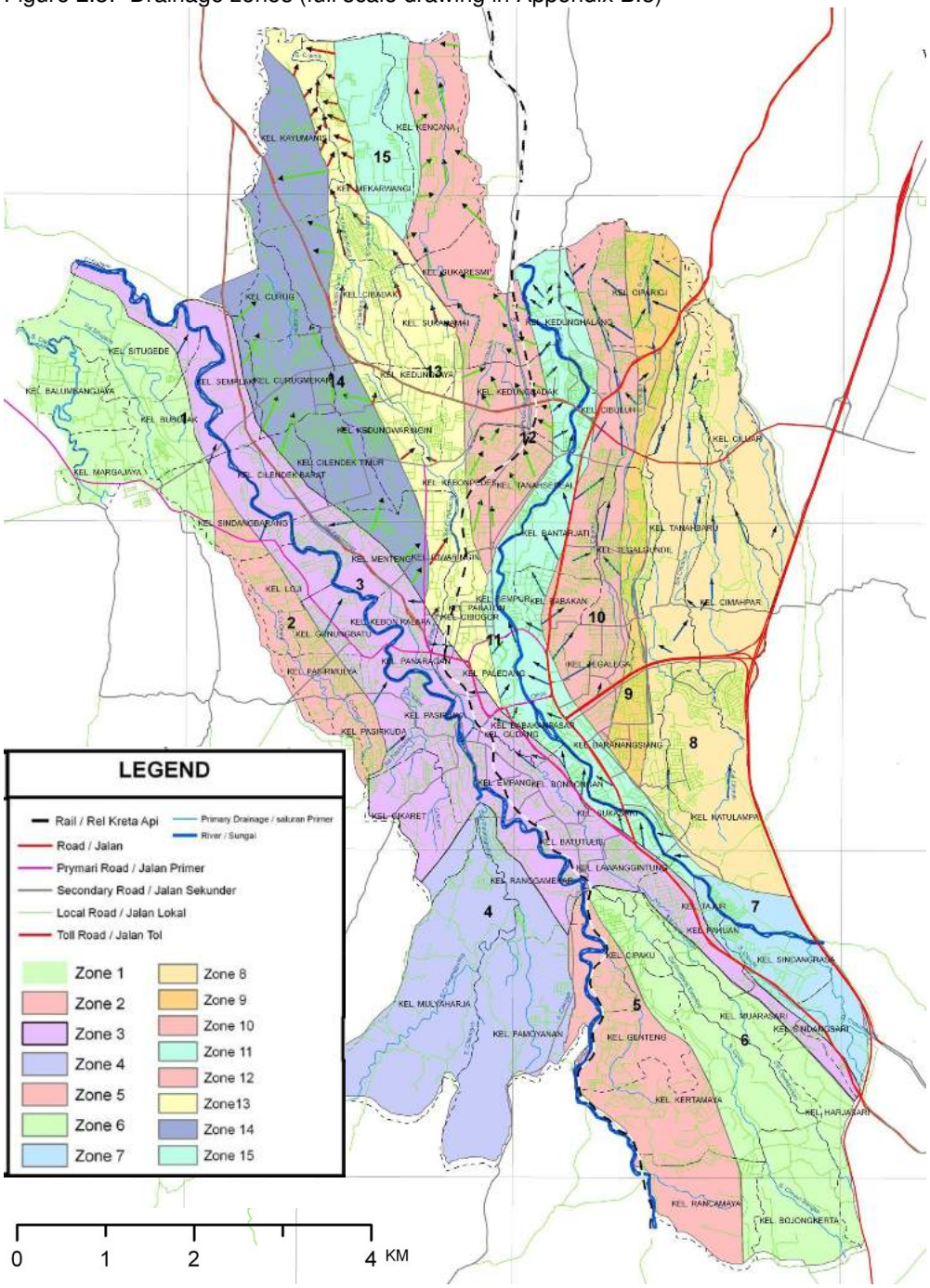
The quality of the ground water in Bogor City is relatively good. Nevertheless, the high level of soil erosion and the increased rate of land development are reducing rainfall infiltration and increasing run-off. This is thought to be one of the causes of the increase in depth of ground water during the dry season.

2.3 Services

2.3.1 Drainage

Most of the drainage system of the city follows the natural drainage pattern of the rivers that flow through the City, there are some man-made stormwater drains and irrigation systems. There are still irrigation lines that function separately from the stormwater drainage systems. The irrigation systems that have been changed into drainage systems are at Ciliwung Katulampa master line, Cibalok line, Bantarjati line (Cibalogo), Cisadane Empang Master Line, Cibuluh Secondary line, Cidepit secondary line and Ciereng secondary line. The drainage zones of Bogor are presented in Figure 2.3.

Figure 2.3: Drainage zones (full scale drawing in Appendix B.3)



2.3.2 Water supply

The city of Bogor is an area with adequate water supplies due to the high rainfall, supported by the type of soil and morphological condition of the area which allows it to store a large amount of water. Water supplies are from ground water, surface water sources including several springs. The ground water extraction is by means of dug wells, hand pumps and artesian pumps. The surface water extraction is by utilizing the springs, rivers and lakes.

The PDAM, Tirta Pakuan Water enterprise, provides treated piped drinking water to 58% of the population. 17% of the population uses water from dug wells, 17% from pumped wells, 11% from springs and 2% use river water. The PDAM, has a reported 95,587 connections and water consumption is estimated as 147 lit/person/day, the current level of leakage is estimated at 33%. The PDAM raw supplies come from springs and surface water. The springs are in 3 locations: Kota Batu Spring, Bantar Kambing Spring, and Tangkil Spring. The main raw surface water supply for treatment is taken from the main river Cisidane.

2.3.3 Solid waste management

Bogor City's solid waste generates from various sources, the estimated production is about 2.5 to 2.66 lit/person/day (Solid Waste Masterplan, 2008). The solid waste collection system is the traditional system, which is the pick-up and collect system. The 3R program is gradually starting in several regions.

The collection facilities provided by the City are bunkers (TPS) and containers (solid waste transfer stations) placed at specific locations next to the roads and paths. The household garbage is collected in trash bins placed at every house or plastic bags hung on the house fence. These are picked up by garbage collector cart.

Markets do not have organized waste storage, the garbage is piled on a spot, which is then put into sacks and transported to the City's solid waste landfill. The level of service for collecting and transporting market garbage is currently 93%. The garbage from commercial areas is collected in bunkers or large trash bins. The level of service for commercial properties is 78%.

The solid waste management in Bogor City is operated by the City Cleansing Office, the responsibilities of the office cover, collection, transporting to a temporary disposal site and transporting and final processing in the Galuga landfill facility.

The EHRA study survey analysis shows that there are still a large number of people that do not receive a good service for their household waste. This is shown by the large number of people throwing their garbage to drains/rivers/ditches (19%) or that incinerate the solid waste. In several kelurahan, the solid waste service coverage does not reach 50%, Kelurahan Bojong Kerta, Rancamaya, Genteng, Kertamaya, Harjasari, Pamoyanan, kencana, Situ Gede, Bubulak, Kayu Manis and Katulampa.

2.4 Land use and demography

2.4.1 Existing land use and population

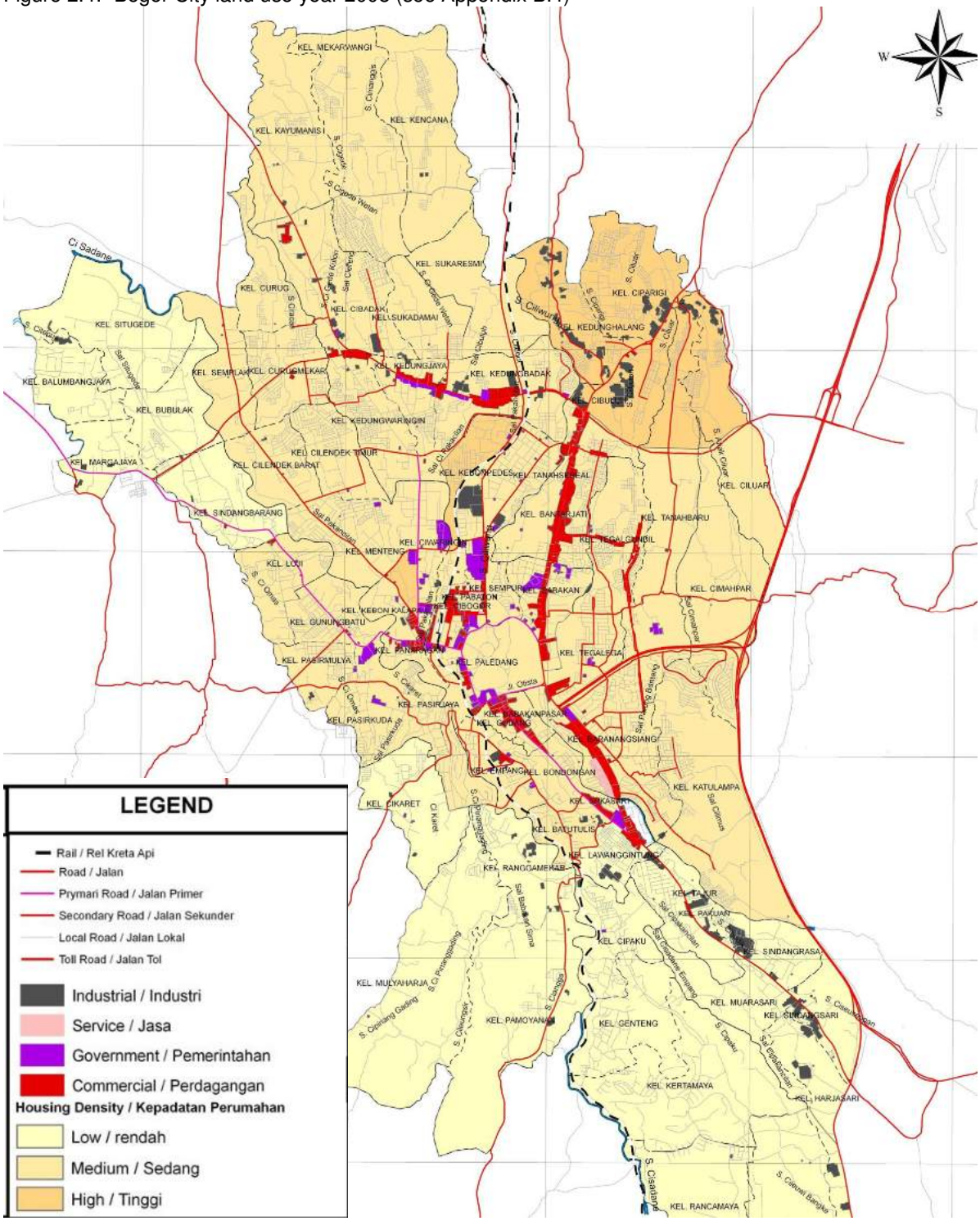
2.4.1.1 Land Use

Bogor City can be divided into 2 parts, they are:

- **Developed region** with a total area of 4,411 Ha or about 37% of the City area, with areas for commerce, residential housing, planned housing, military compounds, president's palace, industry, transport terminals.
- **Undeveloped region** with a total area of 7,438 Ha or about 63% of the City area, which consists of lakes, rivers, ponds, green open space, wasteland. The undeveloped region of the City is dominated by green open space with an area of 6,088 Ha, in these areas one can find urban forests, green lane streets, green lanes with high voltage electricity pylons, National Parks, City agricultural sites, sport fields, rivers, public graveyards, city parks, environment parks and recreational parks.

For details of the existing land use in each Kecamatan, see Figure 2.4

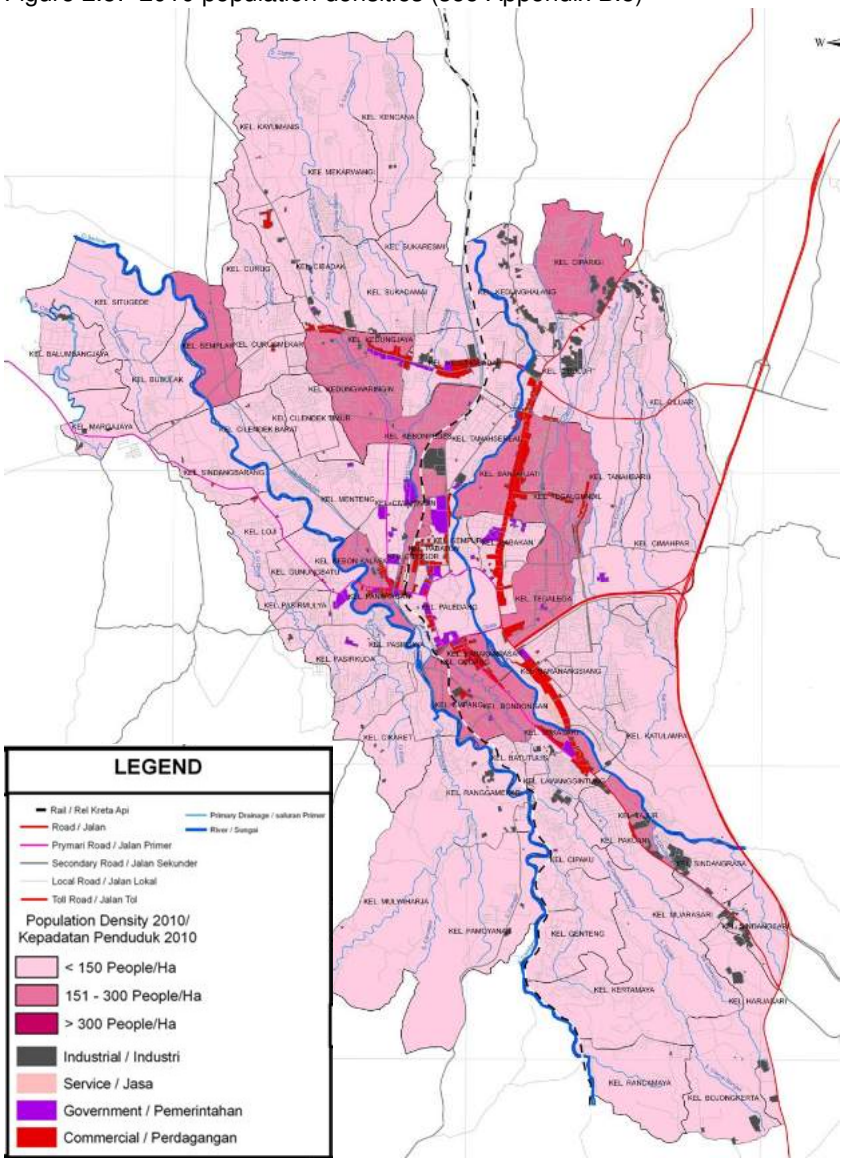
Figure 2.4: Bogor City land use year 2008 (see Appendix B.4)



2.4.1.2 Population

The population of Bogor City in the year 2009 was 946,204 people in an area covering 11,850 Ha. The population density for the year 2009 was 80 people/Ha. The Kelurahan population densities vary a lot across the City but are all low density when analysed by Kecamatan. See Figure 2.5 (and table in Appendix B.10) for the population distribution and density per Kelurahan.

Figure 2.5: 2010 population densities (see Appendix B.5)



2.4.2 Land use and population projections

2.4.2.1 Projected land use

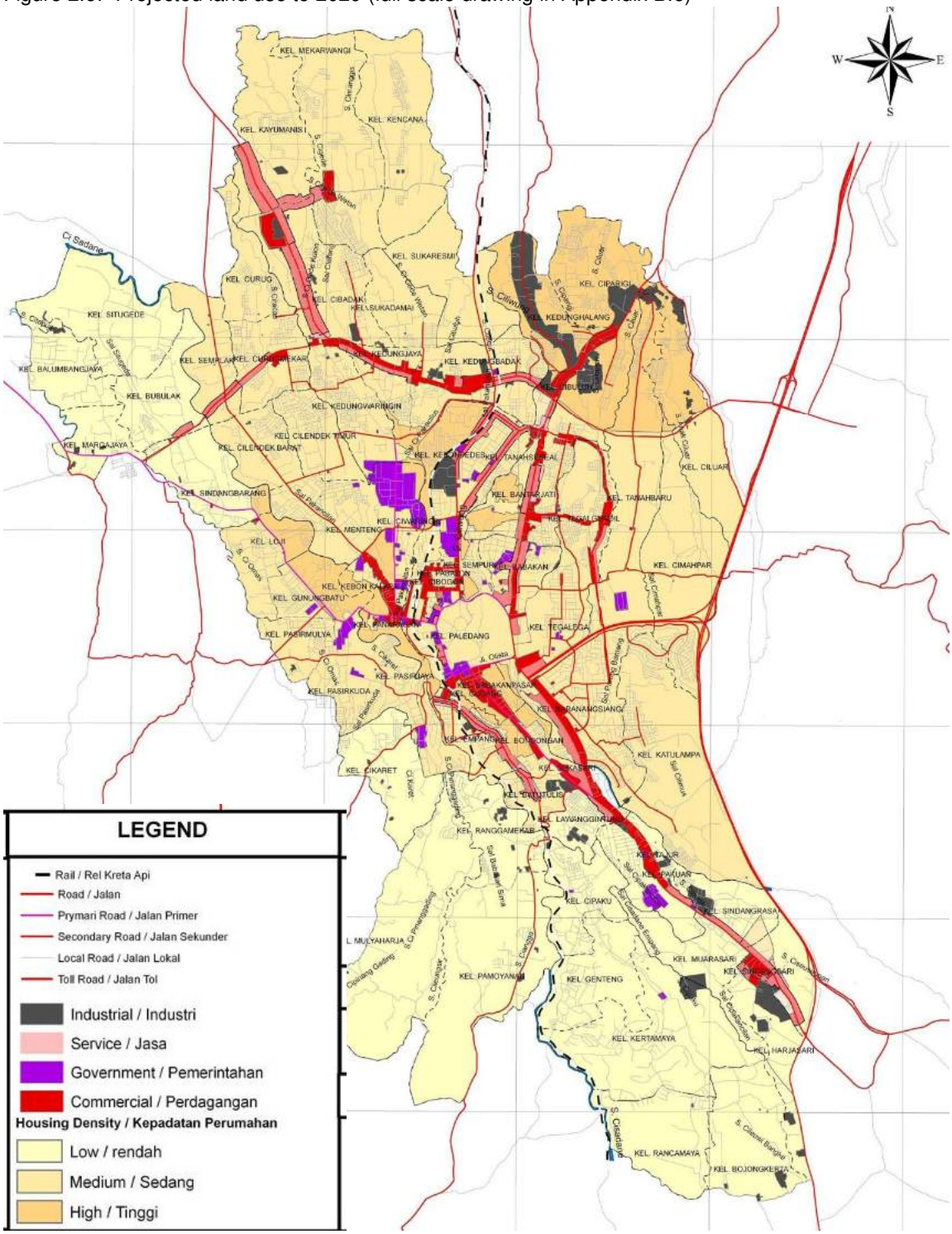
Bogor has developed the City Urban and Spatial Pattern Plan, 2008, which includes projected land use for the period 2009 to 2029. The spatial plan incorporates the following sector plans:

Table 2.1: Sector Plans for Bogor City

No	Designation	Description
1	Preservation Area Spatial Pattern Plan	(i) Local reservations (ii) Nature preservation area which is in the city's green region (iii) ex-lake "tuffah/plasma" preservation area which is the Bogor National Park (iv) landslide prone areas and (vi) Cultural heritage and science preservation areas.
2	Production Area Spatial Pattern Plan	(i) Housing area (ii) Industrial location Plan (iii) Service and commerce area (iv) Military area (v) Public facilities and infrastructures purpose plan (vi) Governmental area (vii) Tourism area and (viii) agricultural area
3	Green Open Space (RTH) Plan	Achieving a minimum of 30% green open space, by using strategies: (i) maintaining the current green open space (ii) increasing the area of green open space by searching for more potential green open space (iii) Turning back green open space to its original function (iv) Maintaining city agriculture as one of the components of green open space
4	Non Green Open Space (RTNH) Plan	(i) Develop the function, area and quality of non green open space as one of the City's public space (ii) Building new RTNH with area supply standards according to the applied standards and needs.
5	Informal Sector Plan	Involving the community aspects and the economic aspects. Allocating spaces for informal sectors activities; with strategies (i) arranging the current space for informal sector activities (ii) allocating new spaces for informal sector activities (iii) involving the community in controlling the space for informal sector activities.

For details of the City Urban and Spatial Pattern Plan, projected land use for the year 2029, see Figure 2.6

Figure 2.6: Projected land use to 2029 (full scale drawing in Appendix B.6)



2.4.2.2 Population projections

Over the last few years, the population growth of Bogor City has shown a strong increase with a growth rate of 2.83%. Growth is forecast to continue, as stated in the City Urban and Spatial Plan 2008 document with the explanation that Bogor is close to a Mega-City, Jakarta, with good water supplies and good communication links. Bogor is already becoming a satellite city to Jakarta (Urban Spatial Plan West Java Province).

The population growth figures are based on data provided by POKJA, the projection is from 2010 until 2030. The average rate growth used is 3.02% and varies between the different kelurahan. This projection also takes in-migration into account as well as natural population changes. The projected population densities per Kelurahan for the years 2015, 2020 and 2030 are presented in Figures 2.7, 2.8 and 2.9 below, full scale drawings are in appendicies B.7, B.8 and B.9. Detailed calculations are given in Appendix B.10. By examination of these density patterns, the North is the main growth area for Bogor.

Figure 2.7: 2015 population densities (see Appendix B.7)

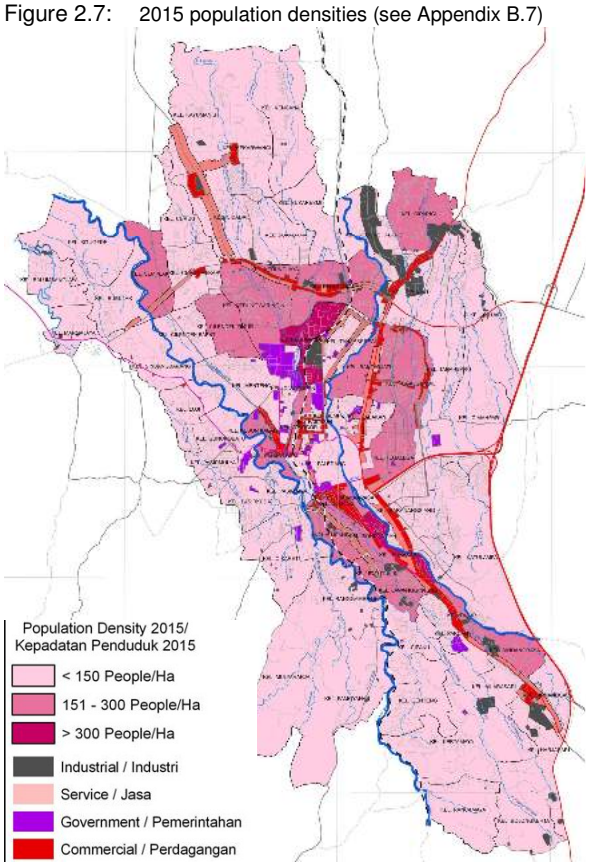


Figure 2.8: 2020 population densities (see Appendix B.8)

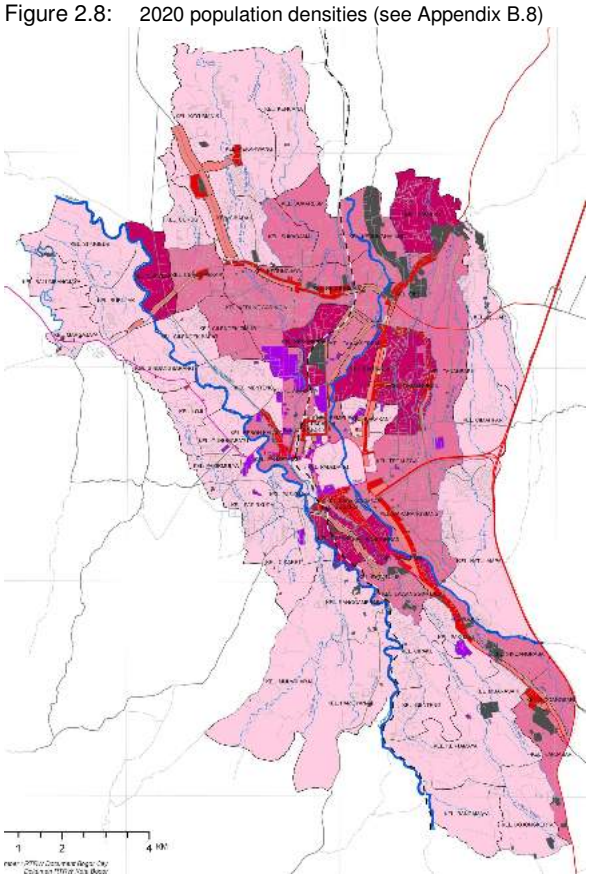
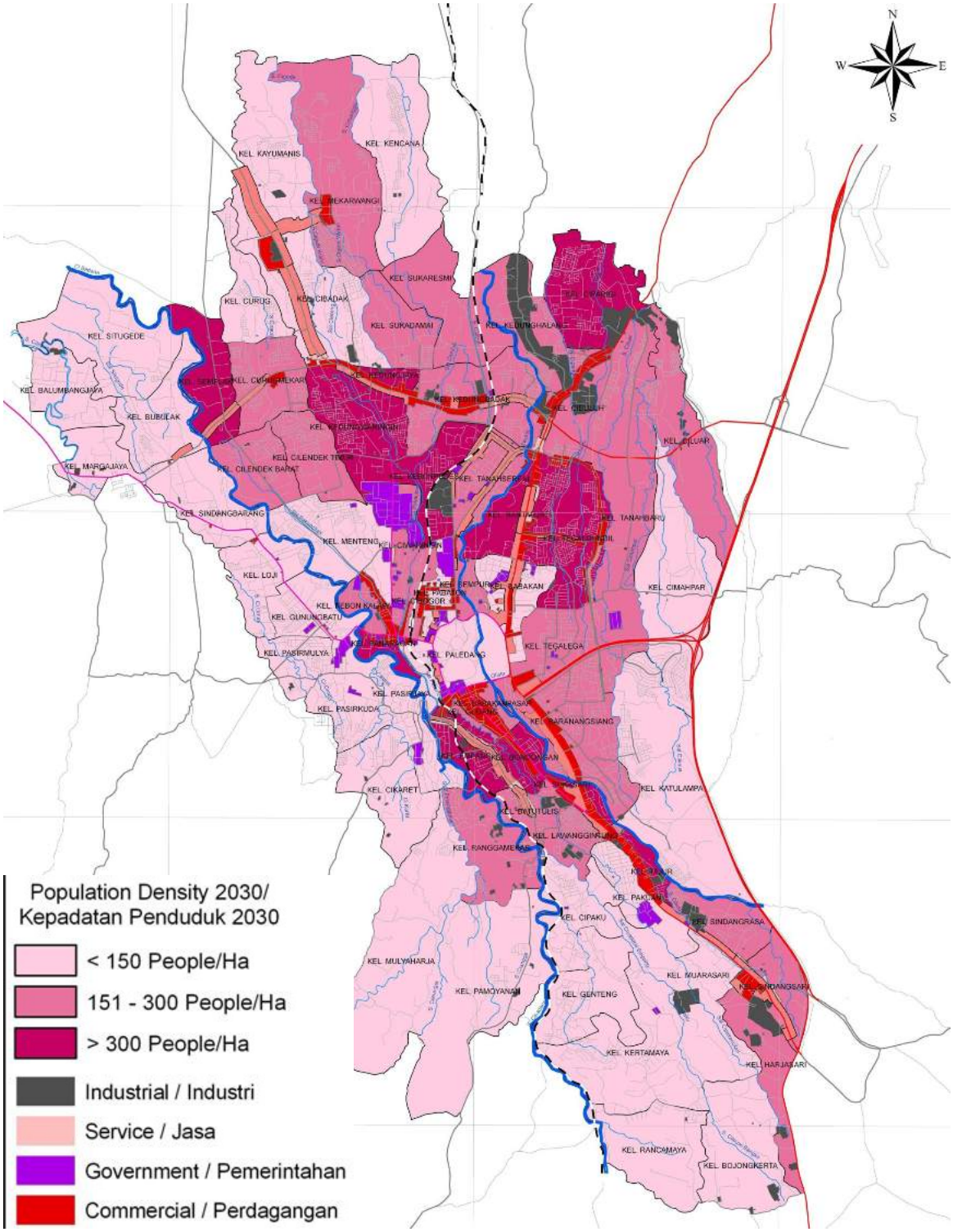


Figure 2.9: 2030 population densities (see Appendix B.9)



The projected population and densities to 2030 are presented in Table 2.2 and these show that 25% of the population will live in areas with population densities in excess of 300 persons/Ha by 2030. It should be noted that the population projection for 2011 gives the population of Bogor city as more than 1 million. This means that City of Bogor is now categorized as Metropolitan.

Table 2.2: Bogor Population Projection 2010 - 2030

Description	Unit	2010	2015	2020	2030
Area with population density < 150 cap/ha	ha	10,406	9,810	8,264	7,587
Area with population density 150-300 cap/ha	ha	1,444	1,888	2,714	3,105
Area with population density > 300 cap/ha	ha	0	152	872	1,158
Total area	ha	11,850	11,850	11,850	11,850
Population in areas with population density < 150 cap/ha	persons	710,000	720,000	670,000	660,000
Population in areas with population density 150-300 cap/ha	persons	280,000	370,000	560,000	670,000
Population in areas with population density > 300 cap/ha	persons	0	50,000	300,000	450,000
Total population	persons	990,000	1,140,000	1,530,000	1,780,000
Population in areas with population density < 150 cap/ha	%	72%	63%	44%	37%
Population in areas with population density 150-300 cap/ha	%	28%	32%	37%	38%
Population in areas with population density > 300 cap/ha	%	0%	4%	20%	25%
Household size	persons/hh	5	5	5	5
Households	number	198,000	228,000	306,000	356,000

Source: MMI Calculation, 2010

3. Description and review of the existing wastewater situation

3.1 Existing wastewater studies

The following studies are important to the development of this Master Plan:

- The City Sanitation Strategy.
- DED study on Tegalgundil;
- DED study on Tegal Gundil STP uprate;
- DED study on network expansion and development in Kelurahan Bantarjati;
- Separate septage treatment (IPLT) at STP Tegal Gundil;
- City of Bogor's Long Term Development Plan 2005 to 2025;
- City of Bogor's 2010 to 2014 - Medium Term Development Plan;
- The Development Plan and Medium Term Investment (RPIJM;
- Urban and Spatial Plan Document;
- Other studies (Environmental studies).

These studies are summarized in the following sections.

3.1.1 The City Sanitation Strategy (Strategi Sanitasi Kota/SSK)

The City Sanitation Strategy (CSS) is a City planning document, it has been produced by the Sanitation Working Group (Pokja Sanitasi). The CSS document status is:

- A complementary part to the RPJMD documents of the City of Bogor for the period 2010 to 2014, where it has precedence over the SKPD Strategy Plan and Work Plan;
- It is a reference document to the implementation of programs and activities in the field of sanitation, which will have a significant impact on all the people of the city of Bogor, in providing a clean and healthy living environment;
- A guide in developing the sanitation sector, including solid waste, city drainage, domestic wastewater and water supply.

The current CSS and its wastewater proposals have been evaluated. Where appropriate, the proposals were included in the Master Plan.

The CSS has stated the Vision and Mission for the City Government as follows:

Vision: to support the improvement of people's welfare through the improvement of the standard of health of the community and through the improvement of the environment.

Mission:

1. To improve the community's ability and capability to access sanitation services.
2. To improve the quality of a sustainable and continuous sanitation service

3. To improve behaviour of the community in clean and healthy living (PHBS)
4. Increases the cooperation between the community, private companies, City government, Provincial government and Central government in building a good sanitation sector.
5. Increase the communities' awareness about the importance of sanitation with regard to health and environmental issues.

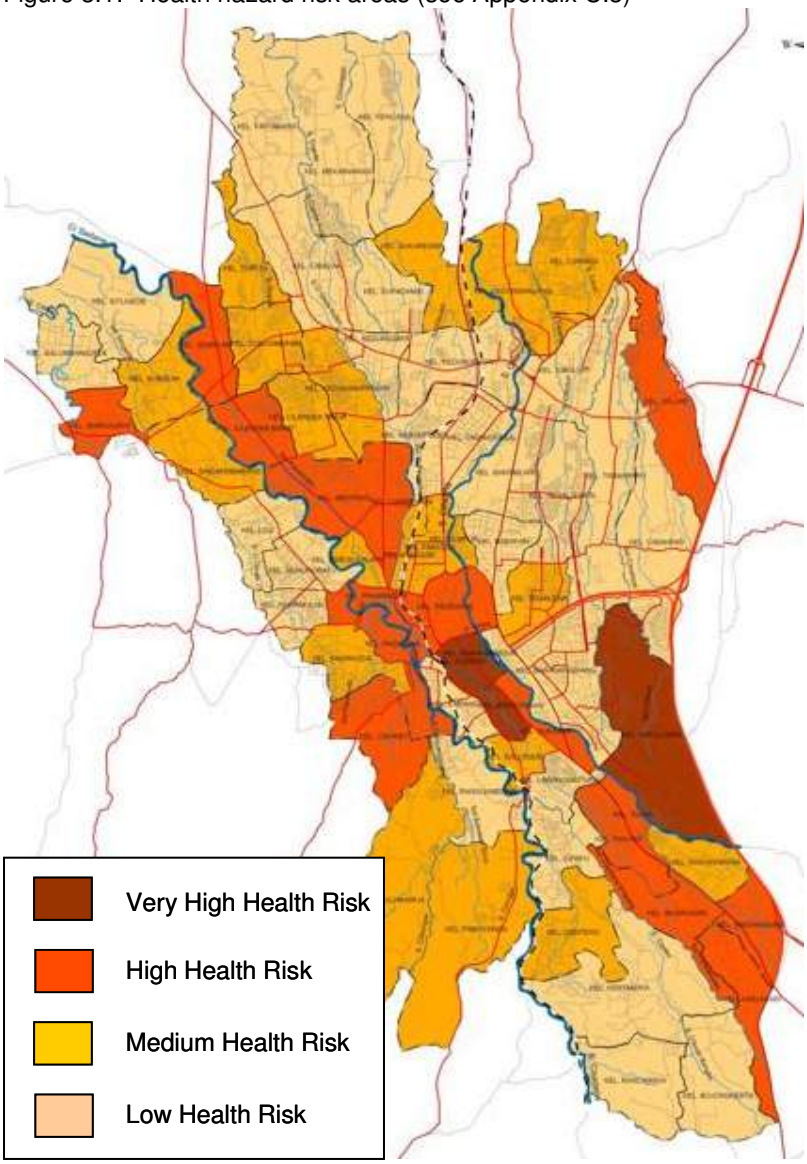
The following wastewater issues have been identified in the CSS:

- The CSS has identified the current scope of wastewater services
  - The ownership of wastewater facilities in the form of private and communal toilets and leaching pits/septic tanks has reached 69%. However 29% of the leaching pits/septic tanks pollute the environment; based on the 2010 EHRA survey.
  - There is a small sewerage area in Kelurahan Bantar Jati with 300 house connections, with treatment of the wastewater at STP Tegal Gundil.
  - On a community level, there are some SANIMAS systems in Kelurahan: Pamoyanan, Bubulak, Gunung Batu, Paledang, Balumbangjaya and Cimahpar. The systems were built by the Government, and the people contributed by donating land. The SANIMAS systems are managed by the communities themselves.

  Data on the coverage of wastewater facilities on a city scale is presented in Appendix C.1, see the table and map. The wastewater for each Kecamatan and wastewater service condition, is presented in Appendix C.2

- **Health hazard risk areas** of wastewater service have been identified. Kelurahan have been identified that have a potential health hazard, based on the lack of toilet ownership in each area. The areas with low numbers of toilets are areas with a high risk of health hazards. Based on this the risk groups were, as follows: 0 – 40% extremely high risk, 41% - 57% high risk, 58% - 76% medium risk and 77% - 100% low risk. The analysis of the risk assessment for the Kelurahan is presented in Figure 3.1. The areas with highest risks are in Kel. Gudang, Kel Babakanpasar, Kel.Katulampa, Kel Pakuan, Kel Semplak, Kel Bondongan, Kel Muarasari, Kel Margajaya, Kel Pasirjaya, Kel Sindangsari, Kel Cikaret

Figure 3.1: Health hazard risk areas (see Appendix C.3)



- **Continuous wastewater service improvement**, by:
  - Improving the scope of service for a proper and environmentally friendly wastewater service.
  - Prioritizing the use of low cost, high benefit and user friendly technology in managing domestic wastewater.
  - Realization of constructing wastewater systems that are participative and responsive to the primary needs of high health risk areas in poor communities.
  - Applying minimum standards (SPM) to domestic wastewater service.

- Improving the awareness of clean and healthy living behaviour, particularly in managing domestic wastewater.

- **Targets**:
  - Increase regional expenditure on physical construction of wastewater projects.
  - Increase the capacity of the staff of SKPD on wastewater technology options to enable them to manage wastewater systems at a low cost and high effectiveness by the end of 2015.
  - Increase the use of Tegal Gundil STP and increase the number of sewerage connections from 300 to 600 properties.
  - Increase the number of toilets with septic tanks or connections to communal septic tanks.
  - Improve the operational effectiveness of septic tanks by more frequent sludge emptying.
  - Decrease the amount of wastewater discharged to creeks/watercourse/rivers and leaching pits.
  - Reduce the practice of open defecation (OD).
  - Increase the communities' awareness not to dispose of domestic wastewater to stormwater drains and watercourses.

- **Stages in achieving the targets for wastewater**
  - Develop the planning of wastewater integrated management in each area of service through a centralized system with "cross subsidy" policy.
  - Increase access to centralised sewerage for the general society and communal systems for the poor communities.
  - Improve and optimize facilities for treating domestic wastewater to fulfil minimum standards.
  - All stakeholders to be responsible for domestic wastewater management including the wastewater facilities for organized housing areas (i.e. constructed by developers), the cost will be charged to the developers and will be included in the price of the house. The construction will be conducted in stages for priority areas with bad sanitation and high population density, in order of the scale of the priority.
  - Synchronize the budgets for wastewater with the performance of the wastewater management.
  - Establish a Local Government Regulation on new wastewater provision and practises based on previous regulations.
  - Improve the campaign of Sanitation and Health Behaviour Change (CHBC =PHBS) on proper wastewater development targets.
  - Improve the competencies of wastewater management in technical and non-technical aspects.

  The stages in achieving the targets are presented in Appendix C.4.

- **Wastewater programs and activities**. Should be prepared through stages of, determining priority areas, program establishment, setting priorities, project staging and the plan of action. In determining

the priority areas several criteria have been established: (i) priority areas based on the survey results of EHRA, secondary data and SKPD[2] perception, (ii) the number of beneficiaries, (iii) cost per capita, and (iv) cost of restoring operation and maintenance. Based on these items above, the activities and programs for wastewater are recommended to cover:

- Increasing Regional expenditure on wastewater from 0.5% to 3% by the end of 2015.
- Optimizing Tegal Gundil IPAL
- Developing off-site sewerage service.
- Improving the quality of the off-site wastewater service.
- Improving the quality of the on-site wastewater service.
- Increasing the number of toilets with septic tanks
- The decrease in the practice of open defecation

- **Monitoring and evaluating**. The monitoring and evaluating procedure to be used is the UU RI No.25/2004, referring to the National Development and Planning System and Government Regulation No.08/2008, regarding - stages, setting procedure, monitoring and evaluating the execution of Regional Development Plan planning.

The Environmental Health Risk Assessment survey (EHRA) was part of the development of the CSS. The EHRA survey covered 8 indicators of health, including household characteristics, latrine (jamban) ownership, defecation habits, solid waste handling, hand washing using soap, road conditions in front of houses, water supply, condition of channel which transports wastewater from the household to open drain, flooding risk, children's hygiene habits.

The availability of leaching pits/cubluk and household grey water disposal systems are two items that are used to plan the need for the wastewater systems in Bogor. The EHRA results have been used to develop a priority assessment for each kelurahan, it is based on the health risk level and the toilet and wastewater conditions for the area as of the main variables. The priority is used to plan the wastewater system type and the technical selection for a given area.

3.1.2 DED study on Tegal Gundil STP uprate

This was undertaken by PT SCM Tirta Utama in 2010. The goal of the study was to review the current operation of the plant and identify what is needed to ensure it functions adequately, including:

- Propose a treatment system using: (i) pre-treatment to eliminate the solids and equalization tanks to improve the homogeneity of the effluent both in quality and quantity (ii) Bio digester with sedimentation zone, anaerobic zone, aerobic zone, and diffuser and sludge pumps.
- The flow rate is planned to be 3 l/sec with a contact time of 8 hours. Treated effluent is expected to have a BOD $\leq$ 24 mg/l and TSS $\leq$ 50 mg/l
- The original budget is Rp. 2.2 billion. This has recently been increased to Rp 3.0 bil.

[2] SKPD = satuan kerja perangkat daerah (local government officer)

3.1.3 DED study on network expansion and development in Kelurahan Bantarjati

In 2010, PemKot Bogor hired PT Daya Cipta Mandiri, to prepare the DED for an additional 350 house connections for 2011. Some of the details are as follows:

- Collector sewers are from 100 mm (4") diameter PVC with maximum flow is 0.51 l/sec.
- Main sewer 200 mm (8") diameter, with maximum flow 8.9 l/sec.
- The original budget was Rp. 2.5 billion (Rp 7 mln/hh for network expansion), this has recently been increased to Rp 3.36 bil including the house connections.

In the March 2011 DMP we recommend increasing the number of planned connections to 600, this was to maximize the use of the existing capacity at the STP and to increase wastewater coverage in Bogor.

3.1.4 Separate septage treatment (IPLT) at STP Tegal Gundil

PU-CK in Jakarta has taken the initiative to provide a separate septage treatment at Tegal Gundil STP, with a latest estimate of Rp 2.9 bil. Its aim is to improve the septage treatment capacity of the City of Bogor so that there is a good alternative to haphazard disposal of septage.

3.1.5 City of Bogor's Long Term Development Plan 2005 to 2025

Wastewater management development is already included in the 2005 to 2025 long term development plan, under the heading of creating a City that is clean, beautiful, orderly and comfortable (BERIMAN) with proper facilities and environmentally friendly. Development of the physical infrastructure is guided toward the development of systems for sanitation, water supply, electricity, gas and modern telecommunication facilities to fully support the basic needs of the people and city activities by increasing the quantity and quality of the city's integrated utility networks.

3.1.6 City of Bogor's 2010 to 2014 - Medium Term Development Plan

Key relevant elements of this Plan include:

- Wastewater management plan is part of the Mission Statements of the City Government i.e. "Creating a clean city with the proper and environmentally friendly facilities and infrastructure";
- The wastewater development program is in the Public Work Affairs section of the Regional Development Program, with program targets for (i) optimizing Tegal Gundil STP (ii) developing a new STP/IPLT (Feasibility Study, AMDAL, DED, land clearing, physical construction) (iii) adding more septage emptying trucks and (iv) providing communal septic tanks;
- Development to continue the development from the previous City plan, which were (i) Transportation (ii) Poverty (iii) Sanitation and (iv) Street Vendors.

3.1.7 The Development Plan and Medium Term Investment (RPIJM)

Key relevant issues of this Plan include:

- States that wastewater management in the City of Bogor requires a well considered master plan that will not only accommodate the issues at hand but will also anticipate the issues to come.

- In the institutional aspect of the plan, restructuration/reorganizing is required so that the main tasks and function of the wastewater management can be synchronized in a coordination way so that it will also define the work relation/mechanism of the related stakeholders
- The on-site sanitation system needs to be standardised so that it is technically and environmentally feasible. Also communal systems need to be developed, particularly for the slum areas or areas with unhealthy environment conditions (MCK and communal wastewater treatment systems)
- For the offsite sanitation systems, an efficient and effective technology needs to be developed, whether its for STP or IPLT (Septage treatment) and also to determine the fit location and operational and maintenance costs.
- From the financial aspect, a system needs to be developed that is accessible to the people and a clear mechanism of financing systems from income. Other sources of finance also need to be considered particularly those from investments and private sectors involvement.
- From the legal aspect, a set of regulations needs to be devised on wastewater management, where it also regulates the involvement of private sectors, investors and the community. It also states binding and punishable sanctions are needed. The regulation would also have a monitoring and supervision mechanism.
- For the community and private sector involvement aspects, constant counselling and socialization is needed by various methods and media.

3.1.8 Urban and Spatial Plan Document

In the draft layout of the Local Government Regulation on RT/RW of city of Bogor, 2009 to 2028, in Article 53 it is stated that regarding wastewater management system development:

- Development of communal septic tanks in high density areas
- Development of sewerage systems for domestic waste and non-domestic waste in each residential area.
- Development of wastewater and sludge treatment facility in Kayu Manis
- Optimizing the existing sludge treatment facility in Tegal Gundil – North Bogor
- Prevention of domestic and non domestic waste discharge to the rivers
- Development of public toilet (MCK) for river bank communities
- Promote community awareness on river and environmental safe guards
- Enforcement of fines and charges for causing river pollution

3.1.9 Other studies (Environmental studies)

Various environmental studies have been carried out covering the Bogor area, these are listed below, and for a detailed description, see the Environmental Assessment report in Appendix C.5.

- Dokumen Status Lingkungan Hidup Daerah Kota Bogor Tahun 2009 – *Bogor Environmental Status Document, 2009*
- Dokumen Laporan Akhir Kegiatan: Pengujian Kualitas Air Sungai, Situ, dan Sumur, oleh Kantor Lingkungan Hidup Kota Bogor, Tahun 2010 – *Final Report: River, Pond and Well Water Quality, Bogor Environmental Agency Office, 2010.*

- Dokumen Laporan Akhir Pengujian Kualitas Limbah Cair Kegiatan Usaha/Industri Kota Bogor, oleh Kantor Lingkungan Hidup Kota Bogor, Tahun 2010 – *Final Report: Industrial Wastewater Quality Report, Bogor Environmental Agency Office, 2010.*
- Dokumen Pengelolaan Lingkungan Hidup (DPLH), Kegiatan Pengoperasian Instalasi Pengolahan Air Limbah (IPAL) Tegal Gundil, di Kelurahan Tanah Baru, Kecamatan Bogor Utara, Kota Bogor, November 2010 – *Environmental Management Document, WWTP Tegal Gundil, Kelurahan Tanah Baru, Kecamatan Bogor Utara, Kota Bogor, Operational Activity Report, November 2010.*
- Dokumen Laporan Rencana Pengelolaan Lingkungan Jangka Menengah dan Panjang, Western Java Environmental Management Project (WJEMP), Kota Bogor Local Environmental Strategy, Kantor Pengendalian Lingkungan Hidup (KPLH) Kota Bogor, September 2004 – *Mid and Long Term Environmental Management Plan, Western Java Environmental Management Project (WJEMP), Bogor City Environmental Agency Office, September 2004*

3.1.10 Conclusions and developments from the past wastewater studies

DED study on Tegal Gundil STP uprate

The DED study confirms observations in the field that the STP is in a state of disrepair. Besides rehabilitation, an uprate has been proposed although the present capacity is above the capacity required. The uprade technology deviates from the present technology. See section 3.2.1.7 & 6.2.2.2 for an analysis of the capacity and an assessment of the present situation and proposed uprate.

DED study on network expansion and development in Kelurahan Bantarjati

The DED study has resulted in a design for the expansion of the network. The actual number of connections is subject to change because of budget restrictions. The tendering of the works is in process. PU-CK Bogor intends to connect an additional 350 houses in 2011 and pay for the sewer extensions and house connections with APDBII funds, at a quoted cost of Rp 2.5billion.

Separate septage treatment (IPLT) at STP Tegal Gundil

The study on a separate septage treatment plant at STP Tegal Gundil has resulted in a proposal and a DED. The tendering of the works is in process. See section 6.7 for an analysis of septage treatment in Bogor. PU-CK Bogor intends to connect an additional 350 houses in 2011 and pay for the sewer extensions and house connections with APDBII funds, at a quoted cost of Rp 2.5billion.

Critical Assessment of CSS

The CSS provides a good overview of the existing situation and has strategic goals set for the future. The CSS is also ambitious by increasing the regional expenditure on wastewater six fold. It mentions on-site, off-site and intermediate systems but lack clear-cut targets. The development of intermediate systems like Small Bore Systems is predominantly geared toward housing estates and not to the high-density kampung. Regarding off-site systems, the CSS does not recognize the fact that a sustainable off-site system needs a substantial proportion of 'non-poor' connections to foot part of the operation and maintenance bill. The CSS assumes that government subsidies and cross-subsidies will solve lack of O&M funds. Lastly, the CSS

merely expands on the existing Tegal Gundil sewerage scheme without reflecting on the underlying cause why this scheme is not performing well.

Further details of the relationship between the CSS and Master Plan can be found in Section 6.8.

3.2 Findings in the field

3.2.1 Existing wastewater services

3.2.1.1 Individual Houses

Most houses have individual on-site systems and use a cubluk (leaching pit) to dispose of their black water. They discharge the grey water into soakaway pits or into the storm water channel at the front or behind the houses. Most residents have the perception that the cubluk is the same as a septic tank and is an acceptable form of wastewater treatment. Some people who have limited land available build the leaching pit under kitchen or living room and cover it with tiles, leaving no access chamber cover; this makes desludging impossible without digging up the floor. As the soil in Bogor is rather permeable, this system functions rather well. However, the leaching pits are rarely emptied and may overflow into the nearby surface water channel if the pit is clogged and leachate cannot percolate into the subsoil leading to unhygienic conditions.

There are many areas that do not have proper sanitation facilities. These areas are generally highly-populated slum areas, located along the riverside where the household wastewater is disposed of into the river.

3.2.1.2 Intermediate, communal treatment and small bore sewerage systems

Public MCK (Mandi Cuci Kakus/Washing, Cleaning and Toilet facilities) and public toilets are usually situated in the high-density kampung areas along the rivers. Recently some SANIMAS systems have been introduced funded by the Province of West-Java from a World Bank Loan. The Sanimas is a communal MCK facility that also receives wastewater from neighbouring houses. Treatment is usually an Anaerobic Baffle Reactor (ABR, see Appendix F.3), sometimes in combination with a sludge digester, which could produce biogas. The community contributes land for the MCK and ABR, the province building materials and pipes for the collection system. The novelty of the implementation of SANIMAS in Bogor is the fact that not PU (as in the past) but the community has control over the funds used for contracting the works.

3.2.1.3 Tegal Gundil STP and sewage collection system

The area of service was initially for the housing in Indraprasta Area 1, it is located on the eastern side of Tegal Gundil STP, it was planned for about 600 connections (60% of the Indraprasta Housing). Only 300 properties have connected, of these only 240 pay the charges.

Sewerage system

Based on the design, the installed main sewer to the STP had a stated capacity for 600 properties. The maximum capacity of the pipe is actually enough to allow for flows from 700 properties (a 16% increase from the original design). See Appendix C.11 for the sewer flow analysis.

Tegal Gundil STP

In the original design of the plant, it was assumed that the characteristic of the wastewater was BOD 400 mg/l, while according to the analysis of the current wastewater, it is not more than 200 mg/l, or 50% lower than it was planned. Based on the current condition, it is estimated that Tegal Gundil STP is capable of treating up to 2400 properties from the 600 that was originally planned. This means that Tegal Gundil STP can treat waste from a sewage collection area beyond the Indraprasta Housing 1. By changing the system into a Facultative Aerated Pond system (surface aerators in the facultative ponds) could even increase the capacity from 2400 properties to 3000 households on the present site.

A detailed engineering assessment is given in Appendix C.6

3.2.1.4 Commercial areas

Buildings in commercial areas include malls, hotels, offices, commercial houses, shop-houses (ruko), and office-houses (Rukan). The PDAM records show there are about 4,500 commercial connections. Municipal regulations state commercial buildings should install a wastewater treatment facility, but they are often absent. Even international brand fast food restaurants and hotels discharge the effluent of their grease trap straight into the nearest stream. Commercial buildings that have wastewater treatment operate activated sludge reactor or rotating biological contactors (RBCs). Offices have usually septic tank with soakaway pits.

3.2.1.5 Septage collection and treatment

Based on calculations from the number of vacuum truck and trips made, only 8% of the sludge produced in Bogor from the cubluk/septic tanks is disposed of to the Tegul Gundil STP. The residual sludge either;

- Accumulates in the septic tanks and leaching pits;
- Overflows to surface drains of rivers from the overflowing septic tanks; and/or
- Is collected and dumped illegally on land or to the rivers.

3.2.1.6 Sanitation coverage

Table 3.1 gives a summary of the 2010 data from surveys and analysis.

Table 3.1: Existing condition and coverage of sanitation - Bogor 2010

Description	Unit	2010
Open defecation	% total	4.7%
Coverage sanitation	%total	95.3%
Coverage unacceptable systems	% total	56.7%
Total coverage open defecation and inacceptable systems	% total	61.4%
Coverage acceptable systems	% total	38.6%
Coverage sanitation	% total	95.3%
Coverage acceptable off-site systems	% total	0.2%
Coverage unacceptable off-site systems	% total	0%
Coverage acceptable intermediate systems	% total	1%
Coverage unacceptable intermediate systems	% total	0.5%
Coverage acceptable on-site systems	% total	37.5%

Description	Unit	2010
Coverage unacceptable on-site systems	% total	56.2%
Coverage septage collection	% production	7.8%
BOD load	%BOD produced	57%

Sources : MMI

3.2.1.7 Comments on the PU-CK plans for the upgrade and extension of Tegal Gundil STP

The sewage treatment technology at Tegal Gundil STP is a 'classic' example of waste stabilization pond system, very appropriate to the site, climate and operation and maintenance conditions of Bogor. Despite this it is neglected, badly operated and not maintained properly. Field visits showed that the anaerobic pond was partly empty, the facultative ponds full of sludge and the sludge drying beds in use as a garden to cultivate bananas and cassava. The sewage treatment plant was designed to connect 600 houses of a housing estate, however, only 300 houses connected and 270 households are paying monthly Rp 3000. In addition to the wastewater of 300 houses, the treatment facility also receives around 300m^3 septage a month.

PU-CK Jakarta is planning to renovate and uprate the treatment process at the STP at a quoted cost of Rp 3 billion. The plan is to position a 'bio-digester' parallel to the anaerobic ponds. An alternative could be to use the existing technology to 2,400 house connections and the Facultative Aerated Pond technology to treat the waste of 3,000 house connections.

3.2.2 Environmental assessment

Studies and reviews of the available documents and reports on environmental issues have been made. A series of site visits was also conducted relating to the availability of the sites for the location of the STPs, including, the existing IPAL at Tegal Gundil, Ciluwer (Antara station for domestic waste), Kayu Manis (prospective location for TPPAST). Site visits were also conducted to the several commercial/ business/ industrial activities producing wastewater, also to several communities who use the Ciliwung River for washing, bathing and defecation in Kelurahan Katulampa.

The SLHD reports (Regional Environmental Status) of Bogor City 2009, describes the situation of the environment in Bogor City, also the pressure that has come onto the environment and the potential problems arising, so that the government may be able to determine what policy should be applied in controlling and solving the problems. The report states that at the city level, Bogor is facing environment pollution (air and water) and degradation of the quality of the environment and the community has a lack of awareness towards the environment.

For full details of the environmental assessment of the current situation see Appendix C.5

3.2.2.1 Water quality

The level of pollution load from the community in the city of Bogor to the environment is currently reaching 60% - 70% of the total BOD produced per day, this is polluting water resources, particularly the surface water. The kecamatans with the highest water pollution is Kecamatan Bogor West, Tanah Sareal, and Bogor North. The other source of water pollution that needs to be considered is from industrial waste, this has been identified from review of the monitoring of the river water quality in the Ciliwung and Cisadane

rivers; by the low ratio of BOD toward COD which indicates that the water pollutant substances are from industrial waste not from normal domestic waste and will be difficult to be degraded naturally.

Regarding household water wells, from the analysis for six shallow wells located in the city, almost all of them contained detergent, although only one of those wells contain detergent higher than the drinking water quality standard and had a relatively high Ecoli bacteria concentration (PerMenKes No.416 1990). Detergent in the water samples is something that indicates infiltration from domestic wastewater. In several areas with high population densities, the existence of Ecoli bacteria in well water indicates domestic wastewater pollution, this also shows significant correlation to the high number of cases of diarrhoea in the City.

In 2010, Bogor City Environmental Official conducted a quality test on Tegal Gundil IPAL wastewater, and the conclusion is that almost all of the samples tested have failed the wastewater quality parameters, especially for BOD (the complete analysis of results can be seen in Appendix C.5. The receiving water body for Tegal Gundil STP is the middle part of Ciluar River (Kelurahan Tanah Baru). From the data in the final report on the analysis of Ciluar River water quality in 2010, the water from Ciluar River did not meet the standard quality for Class II water usage, based on the Government regulation No.82/2001 on Water Quality Management and water Pollution. There was a high level of BOD, and the number of coliform exceeded the standard quality.

3.2.2.2 Commercial wastewater discharges

The observations by the Bogor Environmental Official on treated wastewater effluents from 41 commercial/industrial enterprises, showed that 35 samples did not meet the environment quality standard, therefore law enforcement of industrial activities need to be increased. Site visits during December 2010 also found that 70% of commercial/industrial activities do not treat their wastewater properly (based on effluent quality analysis).

3.2.3 Social aspects

A SOSEC survey of 800 households was carried out in November 2010 and several community FGDs were carried out during November and December. For full details of the SOSEC and FGD findings see Appendix C.7. The following is a brief summary of some of the analysis of the responses:

- **Household sanitation:** Most respondents defecate in toilets (85%) followed by river/drains (9%), public toilets (3%) and fish ponds (3%). Regarding disposal of the toilet waste, for the 187 respondents with private toilets, the disposal is septic tanks (probably leaching pits) (67%), straight into river/watercourse (26%), leaching pit (1%), others (6%). Out of the total respondents (N=200) only 12% had ever used the sludge vacuum service (generally during the last 3-5 years).
- **Household data:** The household average expenses in a month is about Rp 2,085,220 the expenses related to food about 47% (Rp. 975,640), followed by transportation 18% (Rp. 366,955), education expenses and household equipment and mortgages each are 9% (Rp. 178,020). The proportion of expenses for sanitation and security is only 0.4% or about Rp. 9,080.

3.3 Assessment of the current wastewater situation

3.3.1 General review

The City of Bogor needs to decrease pollution of its rivers and ground water caused by unsafe wastewater disposal. The improvement of the management of domestic wastewater, wastewater from commercial areas and the collected septage can make an important contribution.

3.3.2 Weaknesses

Based on the sources of pollution and wastewater management service, several issues are identified as follows:

- Tegal Gundil STP is not performing properly; the BOD of the treated effluent is sometimes higher than the BOD of the influent. The STP is not operated and maintained properly: it is used to grow vegetables for the people working there (cassava and bananas). Hence, it serves more as a garden than a wastewater treatment plant.
- There is little demand for septage emptying services. The current trucks collect on average only one load per day (3 m^3). There is no market because the soil is permeable and the water table is low, hence people do not regularly experience problems, they wait till the tank is really full and overflowing. They do not know that it is important to remove the septage regularly to obtain sufficient hydraulic retention time, as a result the effluent from the septic tank is not adequately treated.
- Housing areas being built by property developers are not adopting an environmentally friendly design concept, especially regarding healthy and safe wastewater management. For example, only small leaching pits of Batako at the front of the house are provided and grey water is led into the stormwater drains without any treatment;
- The wastewater management in the commercial areas is not good: 85% of those establishments with treatment plants do not meet the effluent standard required:
- More than 50% of all industrial waste is not treated:
- Problems with community wastewater systems lack of proper operation and maintenance. During one of our field visits we found that the payments being made by the users for O&M were not being used to repair the damaged water supply.
- Public MCKs that are built on the riverside are not used, they are not used due to the high charge to use them, the people in the area continue to defecate into the river
- Wastewater management in non organized housing area is bad:

Appendix C.8 describes the cause and effect relationship that leads to having an inadequate wastewater service at STP Tegal Gundil. See Appendix C.9 and C.10 for a summary of the sanitation service assessment for the City.

3.3.3 Strengths and Opportunities

Bogor City has some potential strengths to ensure an adequate improvement of the wastewater situation in an efficient and effective way:

- The sanitation working group (POKJA) members are very active and supportive on planning for the development of the wastewater systems in the city;

- The intermediate systems using the SANIMAS approach are an example: other towns visit Bogor to learn from the Bogor experience.

Bogor also has some good opportunities to improve wastewater situation:

- It is close to Jakarta and can profit from the interest of the Central Government;
- It will soon become a metropolitan city and need adequate infrastructure.

4. Assessment of future demands and strategic objectives

4.1 Aims and strategic objectives of the wastewater masterplan

A master spreadsheet has been developed which includes the coverage of wastewater systems, incorporates the strategies and objectives included in the Master Plan (Chapters 1.4 and 1.5), includes the timescales for meeting the objectives, includes current BOD load to the environment, calculates BOD removal scenarios, includes the wastewater system categorisations and calculates the investments needed to meet the objectives. See Appendix A.2, for details.

The spreadsheet shows:

1. A summary section with existing coverages calculated (2010) and targeted (2015, 2020, 2030).

2. A general section with the summary of the population forecasts.

3. The targeted coverage of off-site and intermediate systems is entered (2015, 2020, 2030).

4. The coverage of on-site systems is calculated from the difference between the total coverage and coverage of off-site and intermediate systems in Step 3.

5. Grey-water system targets are derived from the on-site coverage.

6. Calculation of the volume of septage and consequently a calculation of the need for septage collection in terms of truck and trips are derived from the number of on-site systems.

7. A summary of the existing number of non-domestic systems and the targets for the planning period.

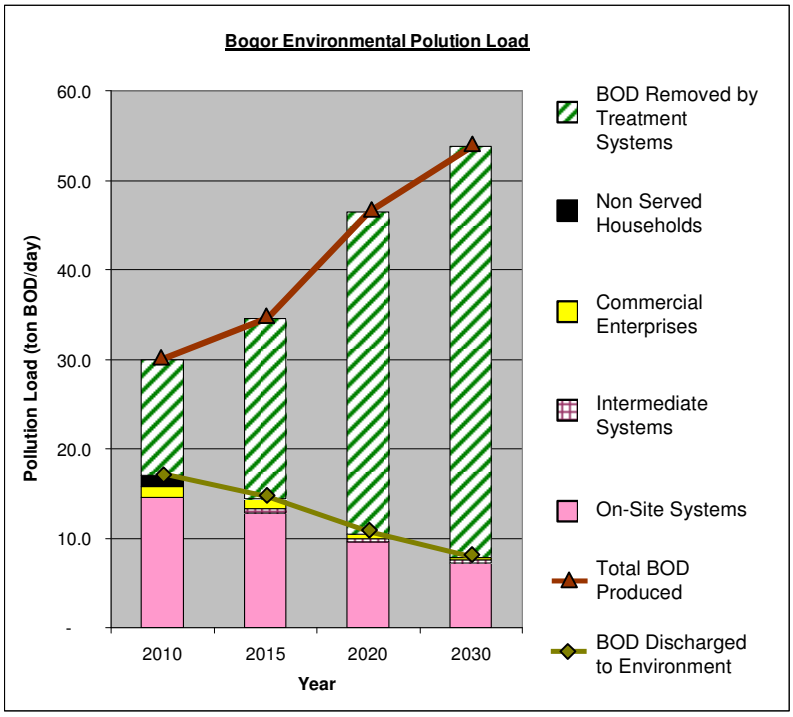
8. Based on the values generated in Steps 2 to 7 and using professional engineering judgement regarding the treatment efficiencies, a calculation of the pollution load in terms of BOD/day was determined for all periods.

9. Calculation of the capacities of the treatment plants and composition of wastewater.

10. Calculation of the cost of the programme implementation based on generated unit cost rates.

Figure 4.1 below illustrates achievement of Strategic Objective 3 i.e improvement of the quality and quantity of the city's wastewater infrastructure in such a way that the current level of 57% of the BOD pollution load of Bogor being released to the environment, is at least reduced to 15% by 2030.

Figure 4.1: Environmental Pollution Load Bogor



Source: Mott MacDonald and Pokja Analysis

4.2 Guiding principles

The following were the guiding principles used[3]:

- In line with good governance principles there should be full transparency regarding the responsibility for wastewater management at City Level, Neighbourhood level and at the level of households, enterprises and institutes;
- In line with good governance principles there should be a clear distinction between policy making, legislation and operation and maintenance levels;
- Human dignity, quality of life and environmental security at household, enterprise and institute level should be at the centre of the approach, which should be responsive and accountable to needs and demands in the Bogor and national setting:
  - Solutions should be tailored to the full spectrum of social, economic, institutional, health and environmental concerns;
  - The household and community environment should be protected;
  - The economic opportunities of waste recovery and use should be harnessed;

3 Based on the Bellagio principles, see for instance Household-Centred Environmental Sanitation, Implementing the Bellagio Principles in Urban Environmental Sanitatio, Provisional Guideline for Decision-Makers, "Eawag: Swiss Federal Institute of Aquatic Science and Technology, June 2005"

- In line with good governance principles, decision- making should involve participation of all stakeholders, especially the consumers and providers of services:
  - Decision-making at all levels should be based on informed choices;
  - Incentives for provision and consumption of services and facilities should be consistent with the overall goal and objective;
  - Rights of consumers and providers should be balanced by responsibilities to the wider human community and environment;
- Treated effluent and septage should be considered a resource, and its management should be holistic and form part of integrated water resources, nutrient flows and waste management processes:
  - Inputs should be reduced so as to promote efficiency and water and environmental security;
  - Exports of effluent and septage should be minimized to promote efficiency and reduce the spread of pollution;
- The domain in which environmental sanitation problems are resolved should be kept to the minimum practicable size (household, community, Kelurahan, Kecamatan, catchment, and city) and wastes diluted as little as possible.
  - Waste should be managed as close as possible to its source;
  - Additional technologies for waste sanitization;
  - Reuse should be developed;
- The investments aimed at improving immediate and short-term sanitary problems should be 'non-regret' investments. That is they form part of the longer-term vision.
- Wastewater management strategy for Bogor city according to collection zones, consisting of West zone, Central zone and East zone. These zones should follow the natural drainage zones of the city to avoid unnecessary pumping;
- Control of the growing backlog of wastewater infrastructural needs.

4.2.1 Reuse of wastewater, septage and nutrients

This Master Plan focuses on minimizing the health hazards associated with wastewater. By the introduction of improved wastewater management, new worlds of reuse opportunities open:

4.2.1.1 On-site systems:

- Because grey water is kept separate from black water, treated grey water is a good source to water gardens and parks provided it is bacteriologically safe;
- Reuse of accumulated sludge in on-site systems as a soil conditioner: on an individual basis this is made easy in the twin leaching pit system applicable in low density areas;
- Introduction of EcoSan toilets where the urine is separated from the excreta. Diluted urine is good source of Phosphorus and can be applied without any harm. Phosphorous is required in agriculture and the world stock of Phosphorous is being depleted with the coming 20-50 years. Phosphorous can be retrieved by means of struvite from urine and/or wastewater. Composted excreta are a good soil conditioner. There are several initiatives in Indonesia, but up to now the success has been limited

because of the cultural reluctance to handle fresh excreta and the direct relation between wastewater and food.

- Reuse of treated Septage at the iSeptage treatment facility.

4.2.1.2 Intermediate systems:

- The Community treatment systems as Sanimas and MCK++ are in principle good opportunities to generate biogas that can be used for cooking.

4.2.1.3 Off-site systems:

- Treated effluent of the STP can be used for watering city parks, provided it is bacteriologally safe;
- Dried sludge from the STP is a good soil conditioner. Its use is very common in Indonesia.

4.3 Priorities and prioritisation

4.3.1 Priority zones

For the initial development of the citywide sewerage system we have identified “embryo” (or starter) sewerage areas based on business and commercial areas.

For the areas identified for “onsite” and “intermediate” wastewater systems, each Kelurahan has been assigned a priority, based on population density and the “health risk” assessment for the area. The health risk assessment was identified from the EHRA household survey carried out during 2010 as part of the development of the CSS.

In line with the aims and objectives of the wastewater masterplan the following areas are to receive priority:

a. Commercial areas with enterprises like malls, hotels, restaurants, etc. which can afford to contribute financially to cover operating and maintenance costs of a professional waste water entity;
b. Areas where people are living in relatively unhealthy living conditions. This is reflected in the EHRA score;
c. Areas where there is a lot of open defecation, these are in general the areas where at the moment the coverage of wastewater facilities is relatively low;
d. Areas where it is relatively cost-effective to implement wastewater improvement: areas with high population densities and a low coverage of wastewater facilities.

a. Commercial areas

Bogor City does not have a specific Central Business District (CBD), the commercial areas in Bogor have developed along the main roads or protocol streets, they are classified as Linear Commercial Areas (LCA). Bogor has two main LCAs:

- East LCA consists of Jl Pajajaran Street, Jl Pandu, Jl Raya Bogor.
- Central LCA consists of Jl Tajur, Jl Pahlawan, Jl Siliwangi, Jl Suryakencana, Jl Merdeka, Jl KH Soleh Iskandar.

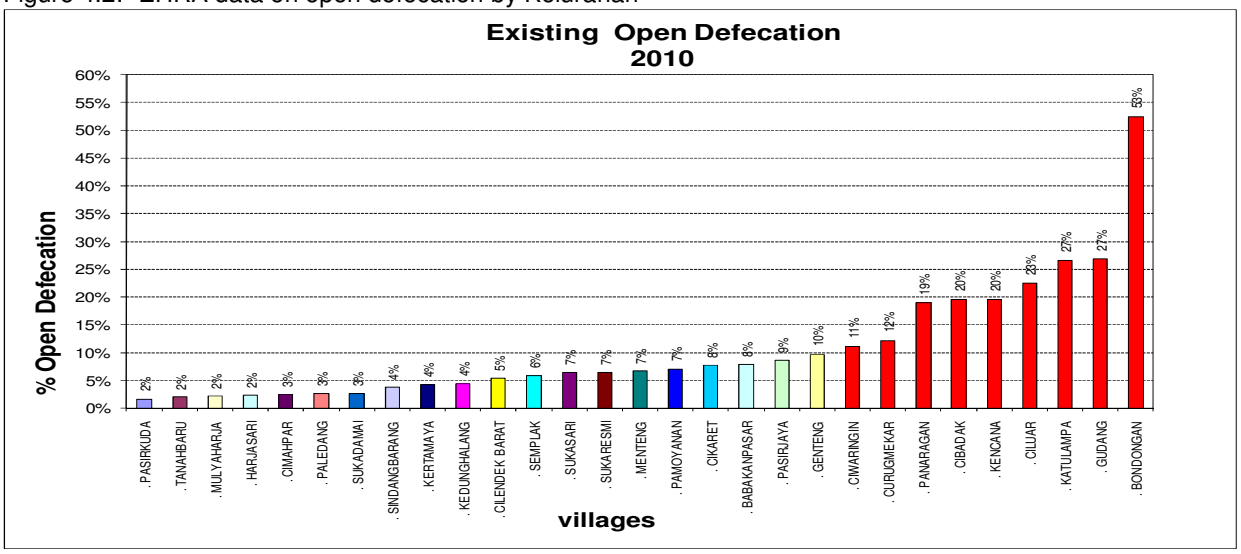
b. Areas with high EHRA sanitation risk scores

The most recent EHRA sanitation risk score for Bogor was prepared in 2010 and it has resulted in scores per Kelurahan based on characteristics of the houses, the source of drinking water, the sanitary habits reflected in the fact whether people are washing their hands with soap before the meal and how they deal with children's faeces, the solid waste management, the physical conditions of the roads in the area, wastewater facilities: both for black water and for grey water, water related and water borne diseases and whether messages from the media are reaching the population.

c. Areas with open defecation:

4.7% of the population of Bogor use open defecation (OD). The 2010 EHRA assessment for each Kelurahan, see Figure 4.2 for details, identified nine Kelurahan with the highest OD (%), they have been selected for priority intervention, they are coloured red. The percentage of OD in these 9 Kelurahan exceeded more than 10%. These 9 kelurahan are also included in the top 11 priority areas, see Section 4.2.2 - Prioritisation of the timing of the intervention.

Figure 4.2: EHRA data on open defecation by Kelurahan



d. Areas with low wastewater facilities coverage and high population density

Information for each Kelurahan is available regarding the coverage of wastewater facilities and gross population density. The 'lack of coverage' multiplied by the gross population density also provides a score that can be used in the selection of the areas for improvement.

4.3.2 Prioritisation of the timing of the intervention

A combination of the EHRA Sanitation Risk Score and the lack of coverage of sanitation facilities is used to identify the areas for immediate implementation. The top 11 kelurahan have been included as needing improvement during the 2010 – 2015 period. See Figure 4.3 for the location of the areas identified and Table 4.1 for details of the 11 kelurahan.

The coverage of sanitation services is based on the existing wastewater facilities, with a weighting score of 75% and the combined coverage of water supply, drainage and solid waste with a weighting score of 25%.

Figure 4.3: High priority Kelurahan (full scale drawing in Appendix D.1)

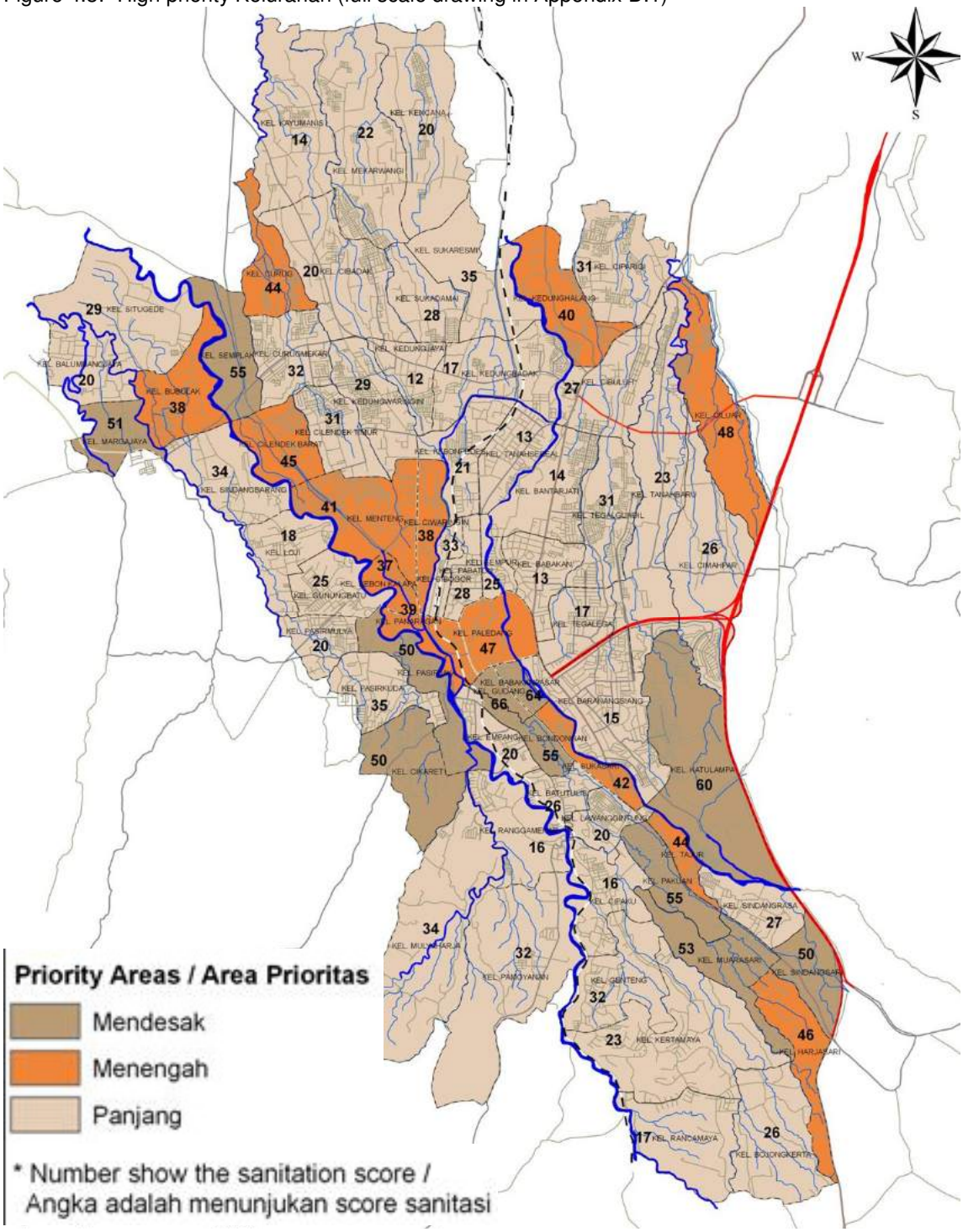


Table 4.1: EHRA risk score – Top 11 Kelurahan

No.	ID.	Kelurahan	Score	RANKING
1	4.2	KEL. GUDANG	65.7	1
2	4.3	KEL. BABAKANPASAR	64.3	2
3	2.4	KEL. KATULAMPA	60.0	3
4	1.10	KEL. PAKUAN	54.9	4
5	5.14	KEL. SEMPLAK	54.8	5
6	1.14	KEL. BONDONGAN	54.6	6
7	1.9	KEL. MUARASARI	53.1	7
8	5.10	KEL. MARGAJAYA	51.4	8
9	5.3	KEL. PASIRJAYA	50.4	9
10	2.1	KEL. SINDANGSARI	50.0	10
11	1.16	KEL. CIKARET	49.9	11

Table 4.1 and Figure 4.3 show the results for the determination of the priority areas based on the EHRA Risk Score as presented in the above paragraphs. See Appendix D.2 for the full analysis of the priority.

- **High priority areas by 2015**: (current population in these kelurahan 158,000) Kel. Gudang, Kel Babakan Pasar, Kel.Katulampa, Kel Pakuan, Kel Semplak, Kel Bondongan, Kel Muarasari, Kel Margajaya, Kel Pasirjaya, Kel Sindangsari, Kel Cikaret
- **Priority areas by 2020** : (current population in these kelurahan 247,000) Kel Ciluar,Kel Paledang, Kel Harjasari, Kel Cilendek Barat,Kel Tajur, Kel Curug, Kel Sukasari, Kel Menteng, Kel Kedunghalang, Kel Panaragan, Kel Bubulak, Kel Kebon Kalapa

Open Defecation areas
Although the priority areas generally cover all the OD priority areas, only 7 of the 30 OD priority areas are the in the same category as the high priority areas based on the EHRA/lack of infrastructure assessment. To attain ODF by the MDG target date of 2015, it is important that in the first phase of the masterplan, OD priority areas are superimposed on this list.

4.4 Desired future situation

The following desired future situation has been identified based on strategies included in the 2010 CSS and discussions with POKJA. Details of the targets and timescales to be met are presented in Table 4.2.

Table 4.2: Desired future situation in Bogor

Description	Unit	2010	2015	2020	2030
Open defecation	% total	4.7%	0%	0%	0.0%
Coverage sanitation	%	95.3%	100%	100%	100%
Coverage inacceptable systems	% total	56.7%	24%	9%	0%
Total coverage open defecation and inacceptable systems	% total	61.4%	24%	9%	0%
Coverage acceptable systems	% total	38.6%	76%	91%	100%
Coverage sanitation	% total	95.3%	100%	100%	100%
Coverage acceptable off-site systems	% total	0.2%	2%	5%	14%
Coverage unacceptable off-site systems	% total	0%	0%	0%	0%
Coverage acceptable intermediate systems	% total	1%	6%	10%	13%
Coverage unacceptable intermediate systems	% total	0.5%	0%	0%	0%
Coverage acceptable on-site systems	% total	37.5%	55%	77%	73%
Coverage unacceptable on-site systems	% total	56.2%	37%	9%	0%
Coverage septage collection	% production	7.8%	50%	100%	100%
BOD load	%BOD produced	57%	42%	23%	15%

Sources : MMI

In line with this and the aims and strategic objectives stated in Chapter 1.5, the following desired situation for the planning horizons has been identified:

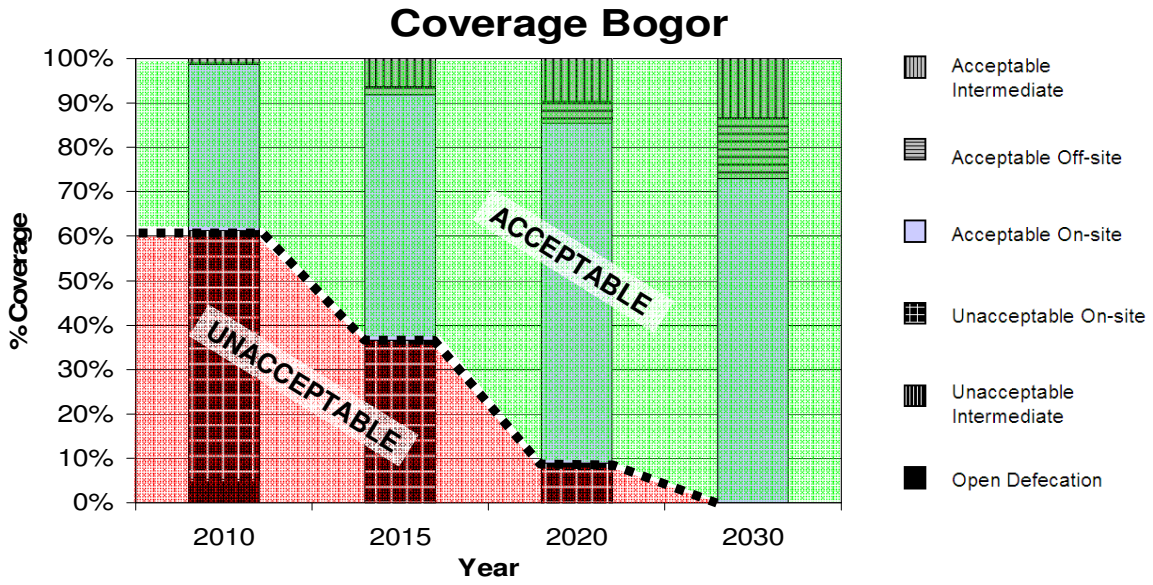
- **By 2015**:
  - Reached the status of Open Defecation Free (ODF);
  - Reduced the number of unacceptable wastewater facilities by 1/3 compared to 2010;
  - Developed an “embryo” off-site system in one linear commercial area and adjacent high density housing area;
  - Increased the septage collection to 75% of all on-site sanitation systems and all collected septage is treated in an environmentally proper way;
  - Increased the number of connections to the Tegal Gundil STP sewage collection system to 900.
  - Improved the treatment performance of Tegal Gundil STP by better operation.
- **By 2020**:
  - The number of unacceptable on-site facilities has been reduced to 9%;
  - The wastewater treatment facility at Tegal Gundil has reached 2/3 of its maximum capacity: 2000 out of a potential 3000 house connections;
  - Overall 25% of the high density areas are served by off-site systems;
  - The septage collection services cover 100% of the on-site sanitation systems and all collected septage is treated in an environmentally proper way;
  - 50% of the operation and maintenance costs of off-site and intermediate systems are covered by the collection of user fees (maximum 50% subsidy).

- Commenced the development of the trunk sewers and STPs in the Central and Eastern sewage collection zones, allowing 12,300 connections

- **By 2030**:
  - Overall, 50% high density housing areas and commercial areas are served by off-site systems;
  - The remaining 50% of the high density housing areas is served by intermediate systems;
  - Extension of the trunk sewers in the Central and Eastern sewage collection zones and increased the capacity of the two STPs, allowing 50,000 connections
  - All operation and maintenance costs of off-site and intermediate systems are covered by the collection of user fees (no subsidy).

The desired future situation for Bogor is presented in Figure 4.4 below.

Figure 4.4: Desired future situation



5. Wastewater system selection and timing

5.1 Selection criteria and wastewater category flow chart

Where first stage sanitation improvements are required, on-site systems are often preferred because they can be constructed by the local community or the individual householder for low capital and operational cost. It is often the case that well-constructed and well-maintained on-site sanitation systems can provide the same level of wastewater management and health benefits as an off-site conventional sewerage system with STP.

Nonetheless off-site or communal sanitation systems are more typical in high densely populated developed cities due in part to the scarcity of space required for on-site systems at each individual dwelling. This is of increasing relevance in cities where populations are more commonly being housed in residential tower blocks, and off-site or communal sanitation systems may be seen as an indicator and possibly a contributor to a city's economic development.

In Bogor the application of on-site systems is particularly constrained by the high density of buildings in certain areas. These constraints favour the selection of off-site solutions for Bogor in these areas. However, a sewerage system should only be considered if:

- Enough water is available to transport the waste and to prevent deposition in the sewers;
- The population can afford to cover the higher operation and maintenance costs or the government can afford to subsidize it;
- Site conditions are favourable for sewer gradients: the area should have enough natural slope to minimize the need for pumping.

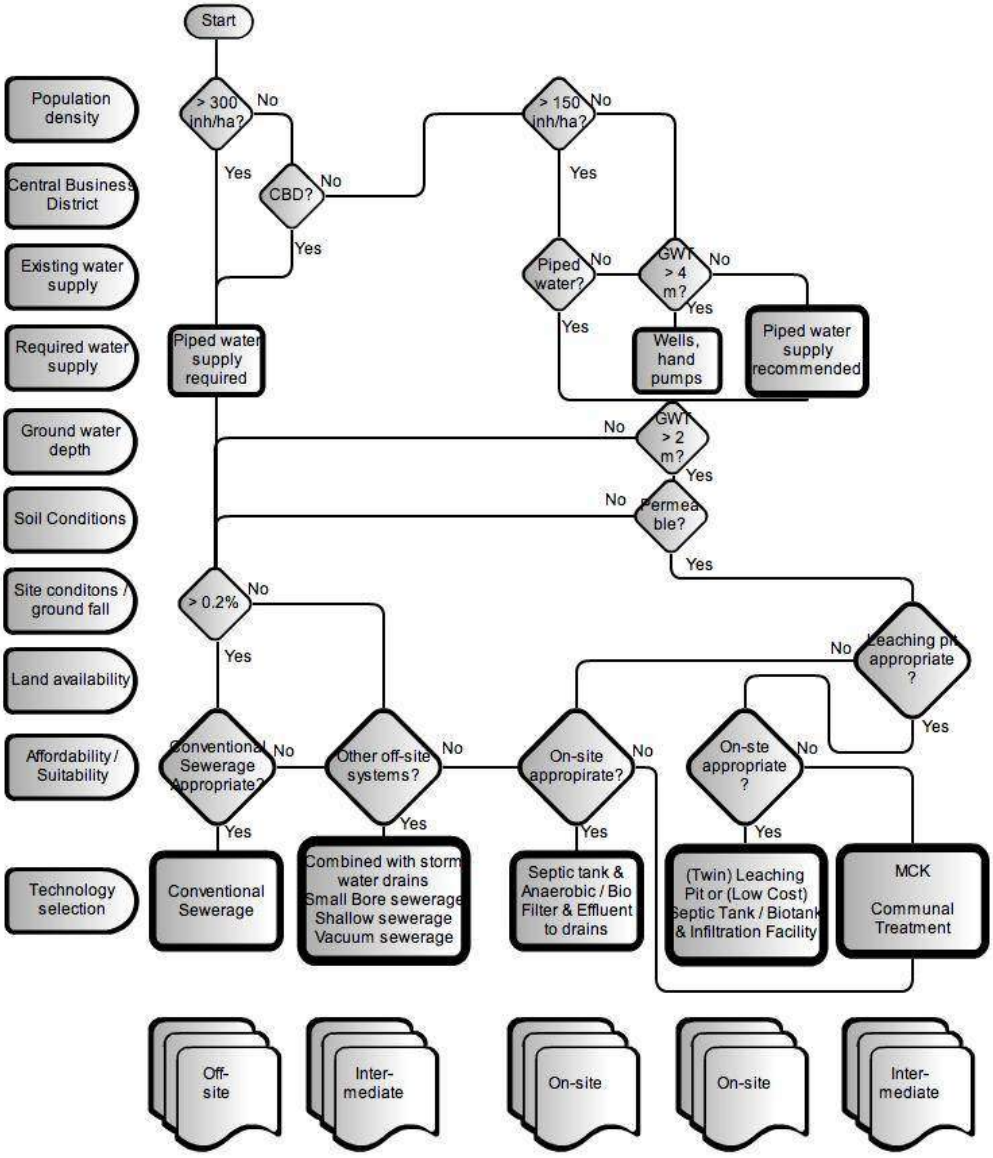
These constraints must be carefully considered when planning wastewater systems. An indicative flow chart, see Figure 5.1, has been developed as a tool to assist in the planning process. This is the first 'rough' step to determine where on-site systems are possible and where off-site solutions are suitable.

The chart uses the following indicators:

- Kelurahan/Kecamatan gross population density, as the figures of the built-up or net density are not available;
- Presence of a Central Business District or linear commercial district;
- Existing or planned public water supply;
- Groundwater depth, soil conditions/permeability;
- Slope of the ground surface, availability of land;
- Affordability and suitability.

If conventional sewerage was determined to be unaffordable and suitable "on-site" systems not possible, then other systems were considered. In the framework of the Master Plan these have been termed 'intermediate' systems.

Figure 5.1: Indicative technology selection - flow chart



This flow chart is in line with the Minimum standards for Urban Residential Wastewater Services, 2010. See Table 5.1.

Table 5.1: Minimum standards for Urban Residential Wastewater Services[4]

Type of Service	Minimum Service Standard Indicator	Remarks	Target	Deadline
A. Access to Wastewater Collection Infrastructure and Facilities				
A.1 Provision of wastewater infrastructure and facilities to meet public need, in the form of private toilets, communal toilets or public toilets	• Private or communal or public toilets available, equipped with at leas • Squat/sit toilet bowl • Goose-neck/water seal	• National policy of development of water supply and environmental sanitation community based, Bappenas, 2003. • SPM Peraturan Menteri PU • Reference book, national systems and technology options, 2010		2015
A.2 Watewater management using low-density (≤ 300 people/ha) on-site system	• In cities: toilets are connected to septic tanks with absorption fields • The distance between the septic tank absorption field and water well is at least 10 meters.	National Standard (SNI) 03-2398-2002 concerning Procedures for planning septic tanks with absorption field		2015
B. Access to Sludge Collection				
B.1 Removal of sludge from septic tanks	• Vacuum sludge truck available • Easily contactable service centers established	Reference book, national systems and technology options, 2010		2015
C. Wastewater Management				
C.1 Management of sludge removed from septic tanks	• Sludge treatment plants set up, at least in cities with a population of 50.000 septic tanks user	Reference book, national systems and technology options, 2010		2015

4 Minimum Service Standards (SPM) are based on the Indonesian Government Regulations and Ministrial Decree 14/PRT/M/2010 On minimum service standards Public Works and Planning

Type of Service	Minimum Service Standard Indicator	Remarks	Target	Deadline
C.2 Quality management of sludge treatment plant	• Effluent complies with quality standards	Decree of the Minister of the Environment 112/2003 concerning Domestic Wastewater Quality Standards and amendments		2015
C.3 Wastewater management using off-site sanitation system in cities with a high population density (› 300 people/ha) and cities that are not technically suited to on-site	• Local/community wastewater pipe network and treatment system established, or • Area wastewater pipe network and treatment systems established	Decree of the Minister of the Environment 112/2003 concerning Domestic Wastewater Quality Standards and amendments		2015
C.4 Quality management of wastewater treatment plant	• Effluent complies with quality standards	Decree of the Minister of the Environment 112/2003 concerning Domestic Wastewater Quality Standards and amendments		2015
D. Regulation and Management				
D.1 Implementation of management and delivery of residential wastewater services	• Wastewater management unit/agency established at the municipal level			2015
D.2 Provision of regulatory framework for residential wastewater services	• Regional Government Regulation on wastewater management established	National policy of development of water supply and environmental sanitation community based, Bappenas, 2003.		2015
D.3 Implementation of outreach and campaigns to promote public participation	• Public outreach/campaign conducted at least twice a year	Management unit alt municipal level		2015
D.4 Provision of funding for wastewater development and management	• Regional budget funds allocated for wastewater management, at least for operation and maintenance (O/M)			2015

The following procedure was adopted to identify possible conventional sewerage areas for the City:

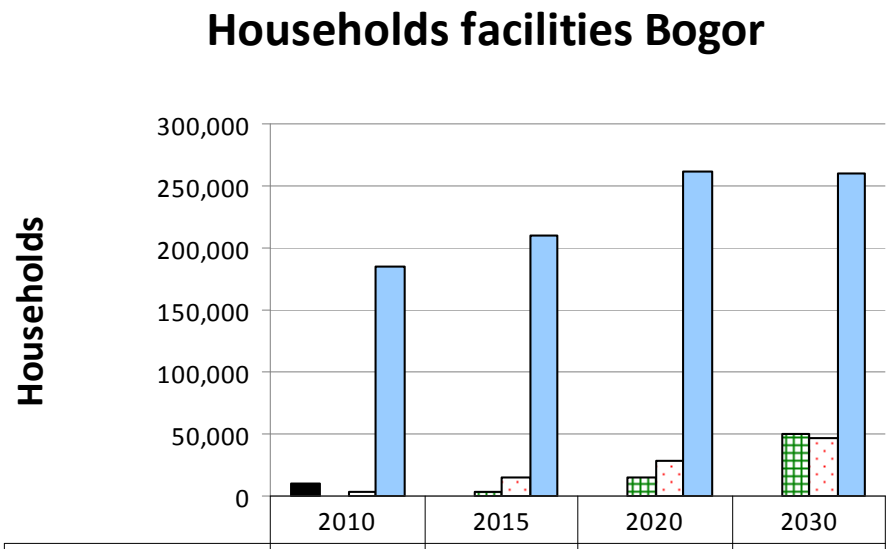
1. Identification of those areas with a projected population density in excess of 300 persons/ha in 2015, 2020 and 2030, based on population density calculations (see Section 2.3.1)
2. Identification of existing and planned linear business and commercial districts (LCDs) based on the existing situation and urban development plans
3. Combination of high density and LCD areas on maps and assessed the suitability/affordability of conventional sewerage in these areas from a financial point of view based on
   a. The outcome of Focus Group Discussions with the private sector
   b. Discussions with the POKJA
4. Combination of these areas on maps with an assessment of the topographical and site conditions:
   a. Presence of rivers which form a barrier due to the steep slopes of the river banks;
   b. Potential site for STPs a the tail end;
   c. In indication of how much sewage could flow under gravity and how much would have to be pumped;
5. The areas that 'remain' after Steps 3 and 4 were plotted as potential 'sewerage catchment areas' on topographical maps of the City
6. Subsequently potential sewerage catchment areas were 'connected' in a logical way and possible locations of future trunk sewers were defined. These alignments were checked in the field (GPS) and discussed with the Roads Department (Bina Marga). Trunk sewers were located in the main roads versus along riverbanks for several reasons:
   a. It is feared that in the rainy season, high water levels and high water velocities would destroy sewers along the riverbanks. To prevent this, expensive measures are required;
   b. People who live around the river banks would need to be relocated;
   c. Bogor builing regulations do not permit constructions along the rivers;
   d. A sewer along the riverside without crossings can only receive water from one side. Hence twice the length of sewers would be needed.

5.2 Area categorization by 2015, 2020 and 2030

Following the methodology explained in section 5.1 we have identified the coverage of on-site, intermediate and off-site systems require meeting the aims and strategic objectives for Bogor stated in Section 4.4 for each of the planning horizons. The overall result is presented below in Figure 5.2.

Appendix E shows the locations and the numbers of new wastewater systems programmes that are proposed for 2015, 2020 and 2030 for Bogor City.

Figure 5.2: Overview of type of household wastewater facilities



	2010	2015	2020	2030
Open Defecation Households	9,306	0	0	0
Off-Site Households	300	4,000	15,300	49,300
Intermediate Households	3,000	14,472	29,101	47,450
On-Site Households	185,394	209,528	261,599	259,250

5.3 Prioritisation of the development of the wastewater system

The priorities for the development of the wastewater system for Bogor come straight from the strategic objectives stated in Chapter 4.1 and area prioritization from Chapter 4.2:

5.3.1 Priority interventions for the short term (2015):

The proposed interventions for the first 5 years of the masterplan are as follows:

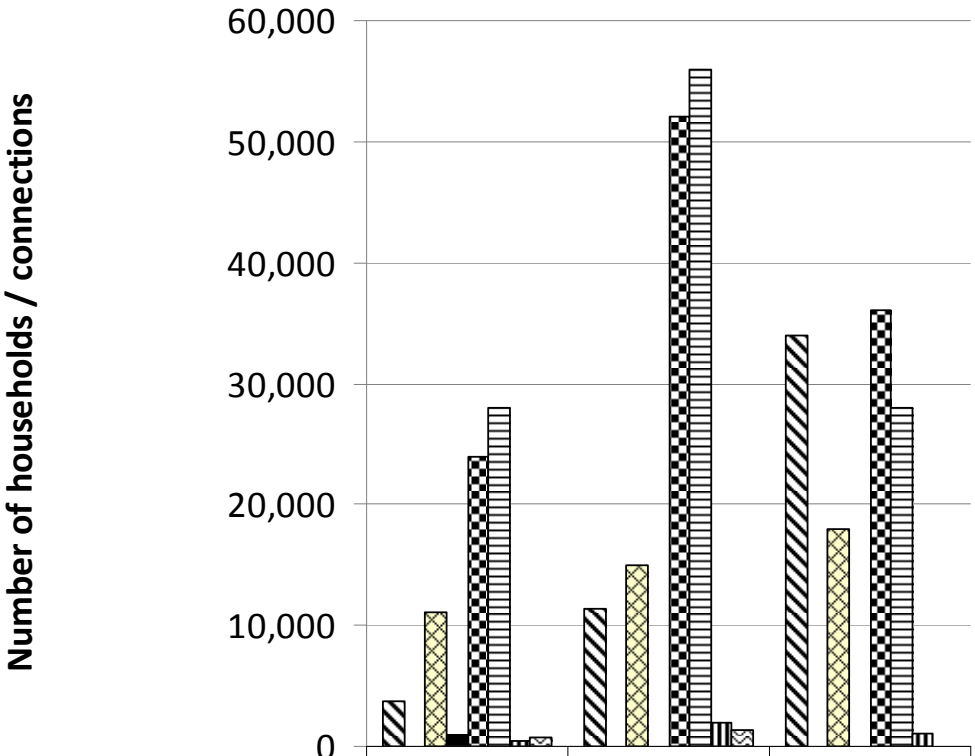
- Immediate improvement of the wastewater situation of those people who defecate at the moment in the open to achieve Open Defecation Free (ODF) status in Bogor City. This program is focused on urban poor. The systems proposed are intermediate and on-site wastewater systems in the areas with low sanitation coverage. Based on the findings of the EHRA survey of sanitation service facilities, the locations are in Kel. Bondongan, Kel. Gudang, Kel.Katulampa, Kel Ciluar, Kel Kencana, Kel Cibadak, Kel Panaragan, Kel Curugmekar, Kel Ciwaringin, Kel Genteng, Kel Pasirjaya, Kel Babakan Pasar, Kel Cikaret, Kel Pamoyanan, Kel Menteng, Kel Sukaresmi, Kel Sukasari, Kel Semplak, Kel Cilendek Barat, Kel Kedunghalang, Kel Kertamaya, Kel Sindangbarang, Kel Sukadamai, Kel Paledang, Kel Cimahpar, Kel Harjasari, Kel Mulyaharja. Kel Tanahbaru and Kel Pasirkuda.

- Improvement of the wastewater situation in the Kelurahan with relatively unhealthy living conditions, ie the area is identified as having a high EHRA wastewater sanitation risk. The systems proposed are intermediate and on-site wastewater systems in the areas with low sanitation coverage.
- Development of the proposals for the skeleton sewerage system for Bogor for the long-term (2030) that will allow adequate off-site wastewater service levels in the commercial and business areas. This will be used to identify the land acquisition for the centralized sewage treatment plants and the routing of the trunk sewers;
- Land acquisition for the 'starter' (embryo) off-site wastewater treatment plant;
- Detailed design, tendering and commencement of the construction of the 'starter' (embryo) off-site wastewater system in one of the commercial areas and surrounding high-density areas by 2015;
- Extend the number of connections in the Tegal Gundil sewerage catchment to about 600 households and improve the performance of the existing STP
- Further development of the City requirement for the provision of intermediate wastewater systems for planned condominial housing development areas, systems to be funded by the developer. For detail of the housing development areas see Appendix E 4.
- Development of a sustainable legal and institutional framework for management, operation and maintenance of improved wastewater facilities;
- Motivate the population, commercial enterprises and institutes to implement, operate and maintain adequate wastewater facilities;
- Training/education of the government staff on sanitation;
- Develop an information centre for sanitation where people can obtain drawings, instructions, guidance and support for appropriate on-site solutions.

5.4 Achievement indicators

The overall achievement indicators are shown in Figure 5.3.

Figure 5.3: Achievement indicators



	2010-2015	2015-2020	2020-2030
New: Off-Site Connections	3,700	11,300	34,000
Rehab: Off-Site Connections	-	-	-
New: Intermediate	11,000	15,000	18,000
Rehab: Intermediate	1,000	-	-
New: On-Site	24,000	52,000	36,000
Rehab: On-Site	28,000	56,000	28,000
New: Commercial Facilities	500	2,000	1,000
Rehab: Commerical Facilities	800	1,300	-

Source : Consultant and POKJA

5.5 Sustaining the programme and key performance indicators

5.5.1 Sustaining the programme in general terms

The programme activities will be sustained if after the initial programme interventions (see 5.3), all stakeholders are involved: city government, private sector and community are able to continue without special programmes and interventions. After 5 years the initial programs will have been implemented and it will take another 5 years for them to become sustainable. Besides the institutional development, the Table 5.2 shows the desired result and the activities that are necessary to achieve a sustainable situation by 2020. These have been elaborated in the WWMP Capacity Building Plan report.

Table 5.2: Sustaining the program

Problem	Solution/Desired result	Activities
Wastewater installations installed do not work properly due to poor design/ wrong locations/ wrong operation and maintenance.	Government agencies and staff are knowledgeable on wastewater management so they can guide designs and contractors in a good way. Contractors and general public have good information and good examples of appropriate wastewater technologies.	Government level: Education of existing government staff; When recruiting only knowledgeable staff (part of job descriptions); Wastewater information Centre where contractors and the general public can obtain information on appropriate technologies (models, construction drawings, etc.).
Wastewater management has a very low priority (is not 'sexy'.	High priority for wastewater management	The local leaders (mayor) make sure wastewater becomes an important issue; Award and reward for most clean and green area/government official; Good examples at government offices, hospitals, School sanitation, Puskesmas sanitation.
Poorly installed wastewater installations keep on polluting the environment.	Every owner of a wastewater treatment installation is responsible for good operation and maintenance.	Publish the effluent quality of all licenced installations on the internet; Award and reward for the best working installation, visit by the mayor and publicity.
The perception is that the treatment of wastewater only costs money.	At all levels it is realized that there is also an economical benefit in living healthy.	PR campaigns and interviews with influential people.

The conditions required to sustain the programme mentioned in Table 5.2 are listed in Table 5.3.

Table 5.3: Conditions required to make the program sustainable

Programme	Conditions
Construction of new off-site house connections	Income from sewerage fee should be equal or more than the operation and maintenance costs.
Construction of new intermediate facilities	Good socialisation of the proposals to the community during the planning phase Monitoring of the appropriateness of intermediate facilities; Dissemination of the monitoring results.
Construction of new on-site facilities	Within the building permit there should be a prescription that every house should have an adequate on-site facility; Monitoring of the facilities; Law enforcement.

Programme	Conditions
Construction of new treatment facilities for commercial enterprises	Within the business permit there should be a prescription that every commercial enterprise should have an adequate wastewater treatment facility; Law enforcement.

5.5.2 Performance indicators

Performance indicators in this respect are output indicators: the indirect results of the wastewater programme. We present the list of proposed performance indicators in Table 5.4.

Table 5.4: Recommended Performance Indicators

Indicator	Target 2015	Target 2020
Financial: cost recovery public facilities (sewerage system, MCK, intermediate systems)	50%	100%
Institutional: is there an institution which: Oversees, monitors and the operation of public facilities; Operates public facilities (off-site, septage treatment, intermediate systems); Oversees and monitors private and community wastewater facilities.	Available	The 'man in the street' knows who is responsible and where to complain. Complaints are followed up within 3 days.
Environmental: the proportion of BOD load Bogor town discharging into the environment compared to the BOD load produced.	42%	23%
Technical: treatment efficiency of off-site, intermediate and on-site systems	60%	80%
Social/behavioural: hand washing after toilet use and before food preparation	50%	100%

6. Proposed future wastewater facilities

6.1 Introduction

The different technical solutions proposed fall into three categories, which are covered in the following sections:

1. Off-site systems –Conventional sewerage with wastewater treatment plants, all managed by centralised operator;
2. On-site systems – both new and upgraded facilities with maintenance generally wholly under the responsibility of the householder or community groups;
3. Intermediate systems –A combination of the above two with maintenance duties shared between centralised operator and community participation.

Also included in this chapter, is consideration of:

- Grey water disposal;
- Non-domestic wastewater; and
- Septage collection and treatment.

6.2 Design approach and system definition

Designing a sewer system for major cities which are already densely populated and developed will present an infinite number of possible solutions.

The design of the sewerage system has therefore been approached as an iterative staged process whereby parameters may be defined first which allow the prescription of a certain type of wastewater collection system and then appropriate design options of these systems will be presented.

1. Review client requirements
2. Review existing and future demographics and land use
3. Review city needs and previous studies
4. Review existing sewerage already implemented (and their performance)
5. Meet the defined guiding principles
6. Work within the identified priority zones
7. Meet the desired future situation

The outcome of this data review has allowed the development of a wastewater system programme for the administrative area of Bogor for the planning horizons 2015, 2020, and 2030. By relating the available wastewater collection technologies to the parameters defined above an outline plan for system investment type can be developed.

Together with this overview plan for development a list of short term investment priorities, shown in section 5.3.1, will be used as a quick reference for devising and then comparing the suitability of system option design.

6.3 Norms and standards

As set out in the Section 5.1, all interventions must meet the minimum standards for Urban Residential Wastewater Services, 2010. Amongst others, these minimum service standards are used as the basis for the technical criteria, listed and explained in Table 6.1.

Table 6.1: Technical criteria applied in WWMP Bogor

Type of criteria	Item	Methodology/Value	Source
Planning criteria	Planning horizon	2010 (Year 0), 2015 (Year 5), 2020 (year 10), 2030 (year 20)	ToR, discussion Pokja, agreement IndII, January 2011
Planning criteria	Population forecast	RT/RW	Practices Master planning Water Supply Indonesia
Guiding principles	Sustainability	See Section 4.2	Inspired by Bellagio principles
Technology selection criteria	Distinction between on-site/ off-site / intermediate	See Section 5.1	MMI, Minimum service standards Indonesia[5]
Effluent standards	BOD effluent	50 mg BOD/litre	The national Standard for Effluent Quality uses 100 mg BOD/l but the Governor can adjust it to 50 mg BOD/l[6]
Influent standards (Quality)	BOD influent	Black water: 450 mgBOD/l, Grey water 175 mgBOD/l, Domestic wastewater (mix Black and Grey): 240 mgBOD/litre, based on 80% ratio wastewater/ drinking water, 25% black water, 75% grey water. Drinking water: 144-175 lcd. See Table 6.3, Section 6.4	Literature and experience MMI. Values are in line with field findings reported in the field study on centralized systems in Indonesia[7].
Influent standards: quantity	Flows	Average flow based on PDAM projections, Maximum flow based on peak factor 2-3. See section 6.4	PDAM Bogor and MMI experience in the field.
On-site systems	Overall requirements	Appropriate technology: environmentally acceptable, convenient, simple to operate, long lasting and minimal maintenance, upgradable and acceptable costs. See Section 6.5.2.	MMI and Pokja
On-site systems	Technical design septic tank plus soakaway	2 chambers: 1st chamber 2/3 total volume, 5 year desludging interval, sludge accumulation 40 litres/person/year, Effluent retention just before desludging: 3 days. Hence for family of 5, Minimum Septic Tank Volume: 3 days * 5 people * 200 lcd + 5 people * 5 years * 40 sludge = 4 m^3. Sidewall area soakaway based on actual field data: 50 (clay) – 250 (sand) litres/m^2/day.	SNI, National Standards Indonesia[8], MMI
On-site systems	Technical design leaching pit / low	1 pit, only black water, 5 years desludging interval and 5 days retention	MMI

[5] Minimum Service Standards (SPM) are based on the Government Regulation PP 38/2007 and Ministerial Decree 14 PRT/2010

[6] National Standards for Effluent Quality, Ministry of Environment Decree 112, 2003

[7] Comparative study Centralized wastewater treatment in Indonesia, ESP, 2004

[8] The "Standar Nasional Indonesia (SNI) nomor 03-2398-2002" mentions minimum 3 year desludging interval and minimum 1.5 days hydraulic retention time before desluding.

Type of criteria	Item	Methodology/Value	Source
	cost septic tank	time before desludging. Hence, family of 5: 5 persons * 5 years * 40 litres/person/year + 5 persons * 4 days * 25% * 100 lcd = 1.5 m^3.	
	Biotank	1 pit, no sludge accumulation 6 days retention time, only black water: 6 persons * 6 days * 25% * 100 lcd = 1m^3.	Supplier
Grey water disposal	Soak away	Bottom > 1.5 m above groundwater, Sidewall area soakaway based on actual field data: 50 (clay) – 250 (sand) litres/m^2/day.	TTPS[9]
Off-site systems	Technical design	See specific sections on design criteria sewerage (Section 6.4.1.3) and sewage treatment (Section 6.4.2)	MMI

6.4 Off-site systems

6.4.1 Sewerage

The first part of the off-site wastewater systems to define is the trunk main routes, from this then collection zones can be outlined, and finally detailed analysis of detailed off-site sewerage design options.

6.4.1.1 Development of trunk main routes

Bogor City is divided into three drainage areas; these areas have been adopted as the wastewater collection zones. With the methodology presented in Chapter 5, the majority of the Kelurahans identified as suitable for off-site sewerage systems, fall within two of the wastewater collection zones, the Central zone and the Eastern zone. The two zones are as follows:

- The **Central zone** lies between the Cisadane River and Ciliwung River with a total area of about 1200 hectares and around 70,000 households in high-density areas (>300 cap/ha) plus commercial areas. In this zone it is planned to connect about 34,000 households and commercial properties by 2030. The proposed location of the STP for the central zone is at Kayu Manis village at the same location as the solid waste disposal site;
- The **Eastern zone** lies east of the Ciliwung River with a total area of about 1400 hectares and around 79,000 households in high-density areas plus commercial areas. The Eastern zone will have two sewerage areas:
  - The Ciluar sewerage catchment with about 12,000 households and commercial properties by 2030. The proposed locations of the STP in this zone is at Ciluar village;
  - The Tegal Gundil catchment with 3,000 household connections. The sewage is treated in the existing Tegal Gundil STP.

The ground levels in these zones are very variable; and not all areas can flow by gravity: around 50% of the sewage catchment areas will need to be pumped to the trunk sewers. The trunk sewers are positioned in such a way that they can convey the sewage by gravity to the STPs.

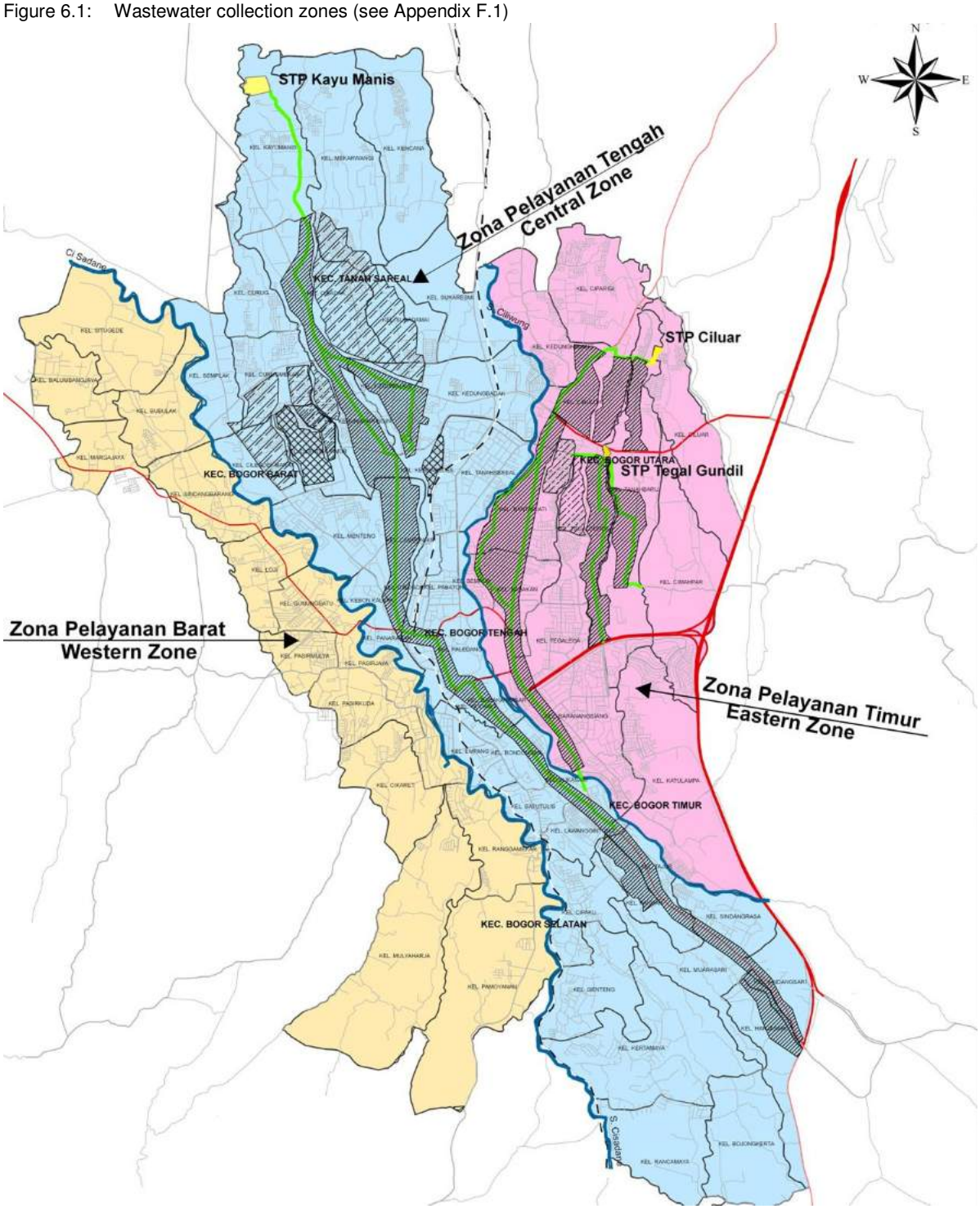
[9] Reference Book on sanitation options: Buku Referensi Opsi Sistem dan Teknologi Sanitasi, TTPS, 2010

Groundwater levels are low, greater than 4m, groundwater is not expected to be a problem during the construction of the sewers. Groundwater infiltration into the sewers during operation is expected to be negligible.

For details of the planned wastewater collection zones, the trunk sewers and the proposed sites for the centralized STPs, see Figure 6.1 and Appendix F.1. For details of the Kelurahan planned for wastewater systems see Appendix F.4. The table shows clearly the population density criteria applied and the presence of commercial areas.

Any sections of the Central or Eastern zone trunk sewers that are laid in advance should be sized and positioned in such a way that they can be an integrated part of the future (2030) city-wide trunk sewerage system.

Figure 6.1: Wastewater collection zones (see Appendix F.1)



The trunk sewers scheme will be developed in phases; the phasing is explained in Section 6.1.4.

The technological arrangement of the sewerage follows the classical approach:

- A trunk sewer along the main commercial and institutional streets (Jalan Protokol), along a route with the best hydraulic gradient to minimise pumping;
- Lateral sewer lines which collect wastewater from the adjacent commercial and high density/high income areas;
- Connector sewer lines, which collect water from the intermediate systems: small bore sewerage and/or shallow sewerage systems (See Section 6.4).

The main reason for following the 'classical' approach is to minimise capital costs, operation costs and maintenance costs.

6.4.1.2 Division into sewerage catchments

As explained in Section 6.1.1, Bogor is proposed to have two wastewater collection zones: a Central sewerage catchment connected to Kayu Manis STP, and an Eastern sewerage catchment connected to STP Ciluar with an Eastern sub- zone connected to STP Tegal Gundil.

For the short-term period (2010-2015) two smaller wastewater catchment areas are planned:

- An extension of the existing sewerage catchment sub-zone connected to STP Tegal Gundil, increasing the connection coverage to 900 households by 2015;
- An 'embryo' off-site sewerage catchment in the commercial area of Paledang for 2,665 households and 435 commercial enterprises. The wastewater collection system planned is a conventional sewerage system and the collected wastewater is treated in a temporary STP on land behind the Dinas Kebersihan office. The section of the Central collection zone trunk sewer that passes through the embryo area will be installed at the size required for the future citywide system. See Appendix F.2 for details of the embryo area.

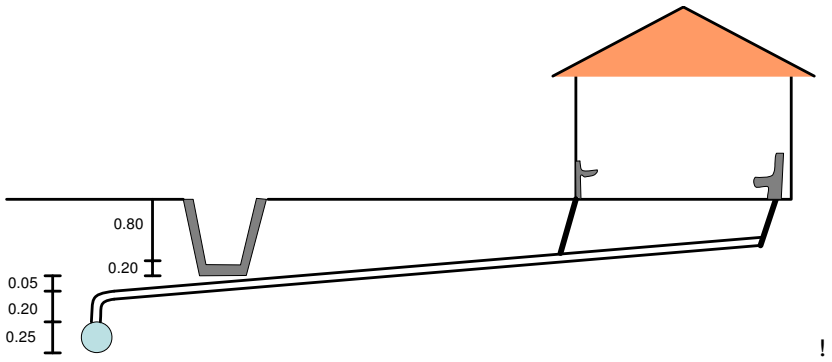
6.4.1.3 Design

The design for the sewerage system will use the following design criteria:

- The system will, as much as possible be **separated from storm water**. However, this will not always be possible as inflow during heavy storms through manholes cannot be avoided and some allocation of the design flow has to be made for illegal/inappropriate connections and cross connections. Hence, some overcapacity is required and emergency storm-water overflows will need to be located at strategic locations;
- The system will **include grey water** the water originating from washing, laundry and cleaning. A waste return ratio of 70% of water supplied will be used to calculate wastewater contribution. The average water supplied to domestic properties is 166 litre/capita/day (average per capita water use in Bogor according to PDAM);
- As we are dealing with areas with low groundwater levels, the design will **not incorporate infiltration** from ground water;
- Flushing will be required in the early stages of the construction of the trunk sewers. In the beginning not all sewers will work at maximum capacity. As the sewers are designed for maximum capacity at a relatively shallow slope, sedimentation and blockages are to be expected, so regular flushing will be required;

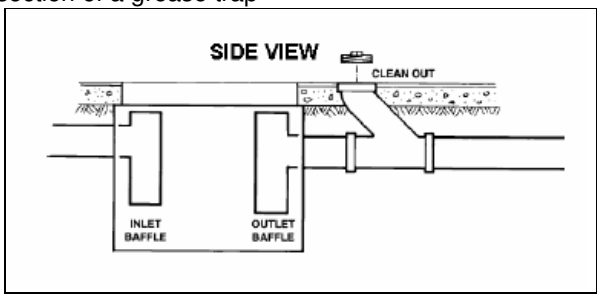
- Any sections of the Central or Eastern zone trunk sewers that are laid in advance should be installed at the size required for the future citywide trunk sewerage system.
- Interceptor tanks: for new property connections, the use of interceptor tanks should be discouraged, as it will unnecessarily increase the costs to the householder. For existing properties which have a watertight interceptor (septic tank) it will be useful to have the septic tank as a pre-settling tank. In that case the system can function as a small bore sewer and sewer lines can be laid at shallower gradients;
- When Manning's formula is used for the sewerage design, we suggest use of a Coefficient of roughness pipes (n) of 0.013. This gives a velocity of 0.9 m/s at full bore conditions for a 900 mm diameter pipe;
- Peaking factor: for the trunk sewer a value of 2 is suggested, for the lateral sewers a value of 3-4;
- A minimum velocity of 0.7 m/s at ultimate flow conditions and 0.6 m/s at initial flow conditions is suggested to ensure self-cleansing;
- Maximum velocity: 1.5 m/s to prevent damage to the pipes due to scouring;
- Due to the hilly topography of Bogor pumping may be necessary to maximise the number of areas that can connect to the trunk sewers. To minimize operation and maintenance costs, the pumping need to be minimized as much as possible by 'intelligent' design;
- Any railway crossings need to be tunnelled;
- Minimum gradients: in order to attain a 0.7 m/s minimum velocity the theoretical minimum slope for a 200 mm diameter pipe is 0.0052 m'/m' and for a 600mm diameter pipe 0.0012 m'/m'. We suggest to keep a minimum slope of 0.001 m'/m' as the installation of pipes at a lower gradient will be difficult to be constructed by inexperienced contractors;
- Minimum invert depth at manholes should be around 1.5 m as we have to take into account that many sewers will have to pass under storm water drainage channels. See Figure 6.2.

Figure 6.2: Explanation of minimum invert level: 1.5 m



- Maximum depth to invert: the maximum depth is likely to be 6 m, it will be very difficult to construct deeper trenches in the rocky areas of Bogor;
- Crossing of rivers: use duplicated siphons or pipe bridges given the hilly topography of Bogor;
- Grease traps (see Figure 6.3) are a necessary element for domestic connections, as wastewater from the kitchen may contain an appreciable amount of fat and grease, which can cause blockages on small diameter pipes.

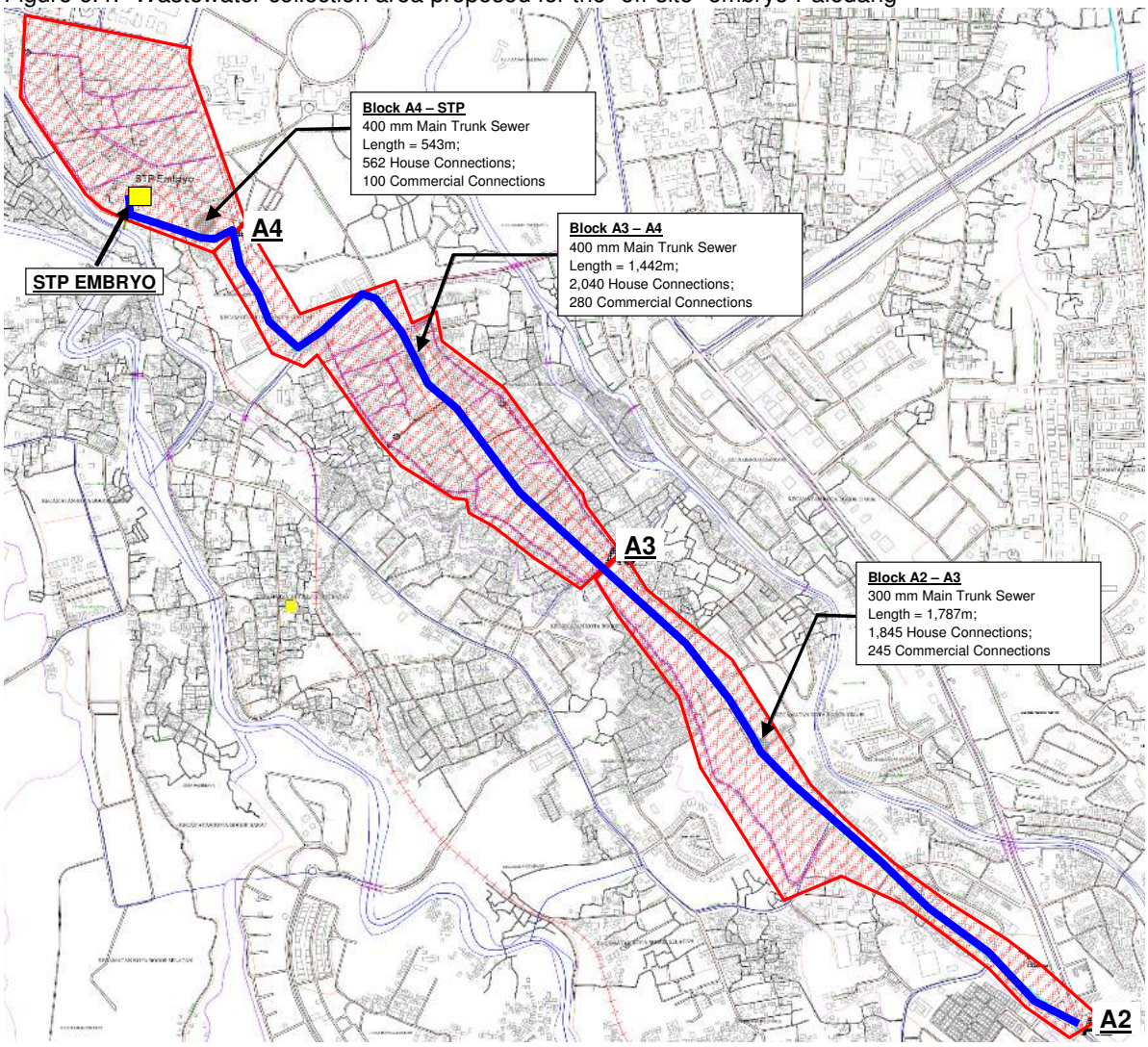
Figure 6.3: Typical cross-section of a grease trap



Using the design parameters referred to in the section above, the design of the trunk sewers for the 2030 situation has been prepared; see Figure 6.1 and the design for the “Embryo” area as shown in Figure 6.4.

The Paledang embryo trunk sewer is part of main trunk sewer for the planned Central sewerage catchment area for Bogor. The sewer has been designed for expected year 2030 flows and operates as a gravity system. The sewer starts as 300mm dia and increases to 400mm dia, it runs at a depth of between 1.2m and 3m. For details of the planned Central wastewater collection zone see Figure 6.4 and Appendix F.1 of the Feasibility Study.

Figure 6.4: Wastewater collection area proposed for the “off-site” embryo Paledang



6.4.2 Off-site centralised sewage treatment plants

6.4.2.1 Introduction

As indicated in Section 6.2.1, investment on the following centralised STPs is planned:

- Existing STP Tegal Gundil, currently serving 300 connections and ultimately 3,000 connections;
- Proposed temporary STP Paledang serving the “embryo” sewerage catchment area with 3,100 connections;
- Proposed STP Kayu Manis, serving ultimately 34,000 connections.

- Proposed STP Ciluar, serving ultimately 12,300 connections.

6.4.2.2 STP Tegal Gundil

The existing STP at Tegal Gundil is located under the highway in an area of land about 1.4 ha and currently serving 300 houses of the residential area of Indraprasta. The number of connections can be extended to 3000 by connecting houses in Kelurahan Tanahbaru, Bantarjati and Tegal Gundil, see Figure 6.5. The current performance of the treatment process is inadequate, operation and maintenance practices need to be improved to allow the treatment process to perform as it was designed. See Chapter 3, Section 3.4 for comment on the current operational situation at the STP.

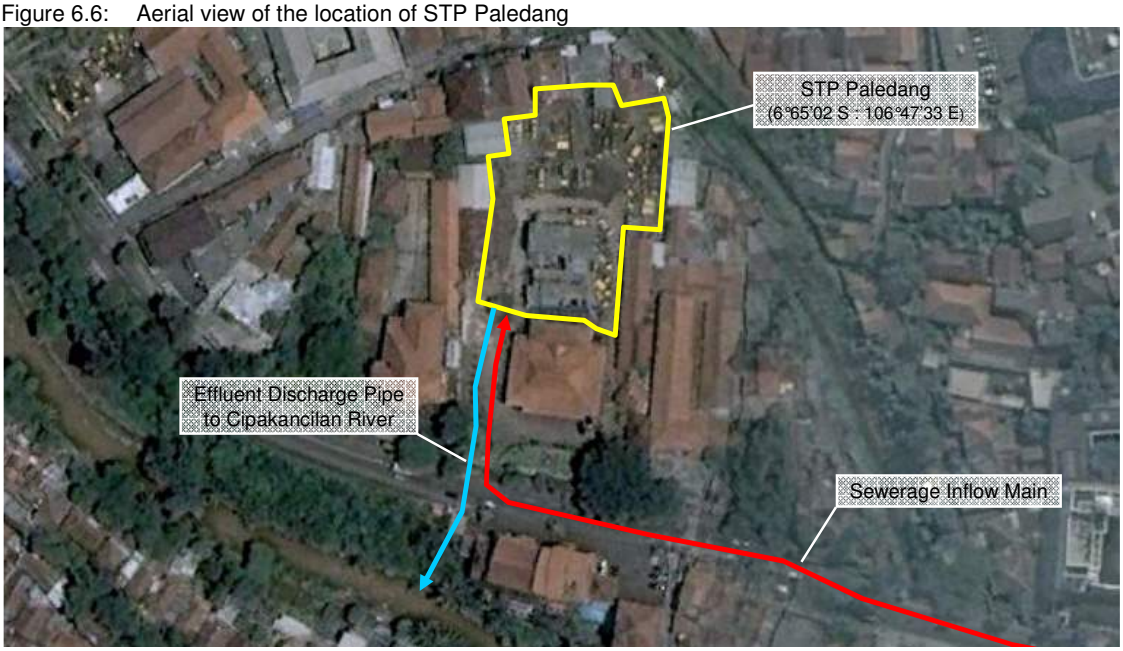
Figure 6.5: Location of STP Tegal Gundil

Source: Google Earth Professional

6.4.2.3 Temporary STP Paledang for the embryo area

The proposed STP at Paledang will treat the wastewater from the off-site embryo sewerage system serving 4400 house connections and 500 commercial enterprises in a high-density housing area and commercial area. There were two options available for the STP: a site near the prison at the bank of the river and a site at in the premises of the Dinas Kebersihan Office. The site near the prison is preferred as it avoids a pumping stage. However the owner of the riverbanks, the irrigation department does normally not allow the construction of facilities in its riverbanks. Hence, the second best alternative was chosen: it is located at the back of the Dinas Kebersihan office at the site of the redundant solid waste incinerator. See Figure 6.6 and Figure 6.7.

Figure 6.6: Aerial view of the location of STP Paledang



Source: Google Earth Professional

Figure 6.7: View of the location of STP Paledang

Source: MMI

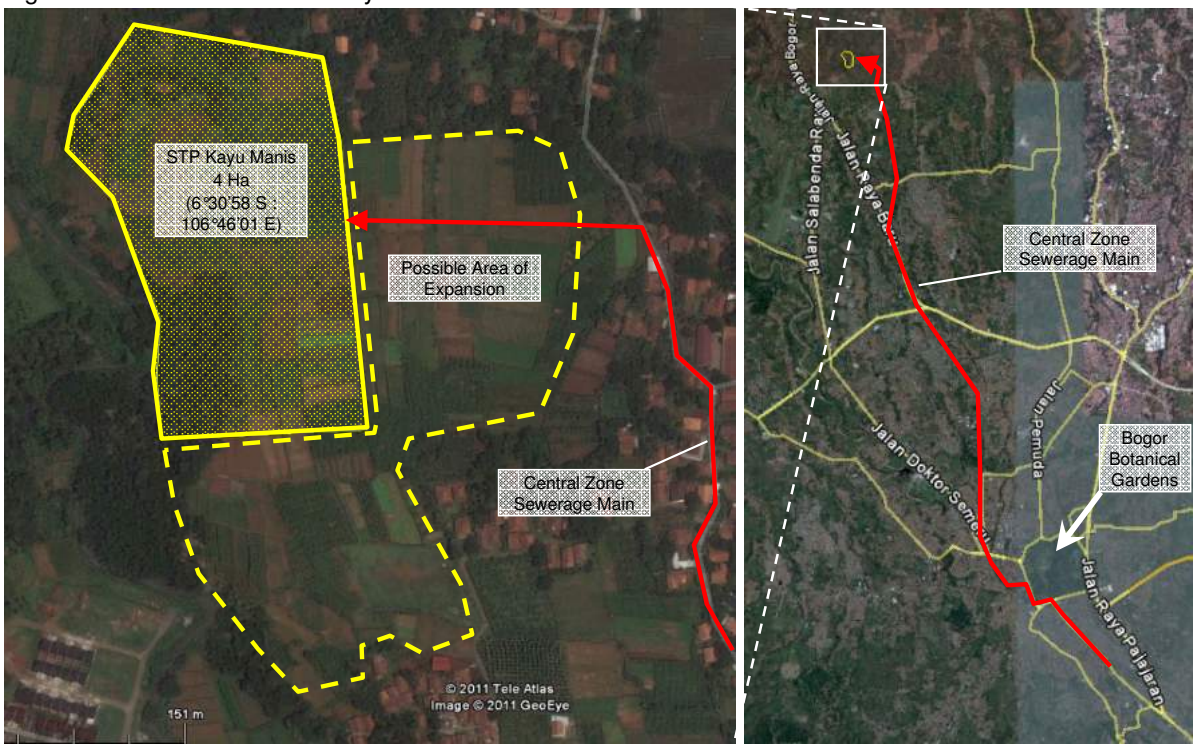
6.4.2.4 STP Kayu Manis

The STP at Kayu Manis will treat the following wastewater flows:

- Up to 2020: 12,300 house connections and 1,400 commercial enterprises;
- By 2030: a total of 30,200 house connections and 3,800 commercial enterprises.

By using the Facultative Aerated Lagoon technology (see Appendix F.3) the available land at the solid waste disposal site (4 ha) is sufficient for the 2020 capacity only. An advantage of this site however is that it may be possible to expand the site to take account of the larger foot print needed (additional 4 ha) needed in the period 2020-2030. This, along with the sites location, is showin in Figure 6.8 below.

Figure 6.8: Location for STP Kayu Manis 2020



Source: Google Earth Professional

6.4.2.5 TP Ciluar

The proposed STP at Ciluar will treat the wastewater of 11,000 house connections and 1,300 commercial enterprises. 1.7 ha of available land has been identified in the village of Ciluar in Kec North Bogor, see Figure 6.19.

Figure 6.9: Location of STP Ciluar

6.4.2.6 Alternative locations for STPs

Within the boundaries of the Municipality of Bogor, there are no alternative STP sites available at the downstream side, which belong to the City. It is well possible that negotiations with neigbouring kabupaten lead to more favourable sites. However they will increase the lengths of the trunk sewers. The City government is presently acquiring the site of STP Kayu Manis.

6.4.2.7 Selection of technology

Selection of technology STP Tegal Gundil

As explained in section 3.4.3, the present Waste Stabilization Pond (WSP) system at STP Tegal Gundil is big enough to treat the wastewater of up to 2,400 households. One of the reasons is the relative low strength of the wastewater that is arriving at the treatment plant: 200 mg BOD/l instead of the design value of 400 mg BOD/l. The number of connections can actually be increased to 3,000 house connections if surface aerators are installed in the existing stabilisation ponds, thus turning the existing WSP process into an aerated pond system.

Selection of technology for 'embryo' STP Paledang

For details of Water Water Treatment Techonologies see Appendix F.3.

The surface area of sites for the temporary STP is very limited. Hence, the technology applied should either be anaerobic or high rate aerobic. Anaerobic digestion requires relatively little volume compared with a high rate aerobic system. The anaerobic systems, which could be suitable is the Upflow Anaerobic Sludge

Blanket Reactor (UASB). The widely applied Anaerobic Baffle Reactors (ABR) are only suitable for relatively small systems and would require too much space. An Imhoff Tank would produce an effluent that would not be acceptable as it would be above 100 mg BOD/l. Aerobic systems, like activated sludge treatment also requires a high level of skill of the operators. Only the private sector in Bogor has experience with this kind of operation and maintenance, e.g. the technical staff of Botani Square. For the time being, we assume that it will not be possible to arrange the O&M by the private sector and we assume that a government agency will be responsible for O&M. Bogor has experience with the operation of waste stabilization ponds at STP Tegal Gundil but experiences many O&M problems. Problems are also clearly visible at the site.

Based on the superior effluent quality and ease of operation coupled with the concerns being expressed about the UASB process due to the experiences in Medan the use of the, more expensive, Rotating Biological Contactor (RBC) is selected. The structure the RBC for the STP can be in glass-fibre reinforced plastic (GRP), hence after 10 years of operation the installation can easily be reused at other sites. The RBC has the advantage of being a proven technology with good effluent quality.

A comparison of these two treatment process options are summarised in Table 6.2 below.

Table 6.2: Comparative summary of the treatment process option for STP Paledang

Criterion	UASB	Rotating Biological Contactor
Land	< 625 m2 → 'go'	< 625 m2 → 'go'
Investment	Volume 775 m3 * Rp 9.29 mln = Rp 7.2 bln	Volume 500 m3 * Rp 21.6 mln = Rp 10.8 bln.
O&M Costs	2% (Rp 144 mln/y)	3% (Rp 216 mln./year)
Odour Emissions	Likely	Possible
Operation Complexity	Simple	Very simple
Effluent Quality	Good: 43 mg BOD/l.	Very good: 31 mg BOD/l.
Experiences in Indonesia for domestic wastewater	Not very positive in Medan. Positive in South America and India there are many well functioning installations.	Long experience, very good e.g. Banjarmasin

Selection of technology for STP Kayu Manis and STP Ciluar

Given the fact that there are limited operation and maintenance skills available in the region, the Facultative Aerated Pond (FAP) system has been selected, see Appendix F.7.

6.4.2.8 Design criteria and technological aspects

Calculation of the composition of the wastewater

The composition and strength of the wastewater varies between one area and another in Bogor and depends mainly on the prosperity. One the one hand: the more prosperous, the richer the diet, the higher the BOD load per person. On the other hand: the more prosperous, the more water used, the weaker the wastewater (low BOD per litre). The average BOD contribution per inhabitant in Bogor is estimated at 28 gram BOD/cap/day. We present the overall composition of the wastewater in Table 6.3.

Table 6.3: Composition of wastewater in Bogor

Description	Source	Unit	2010	2015	2020	2020
Domestic piped water usage	PDAM Bogor	lcd	166	166	166	166
Ratio drinking water/waste water	MMI review Indraprasta pumping station in Bogor	%	70%	70%	70%	70%
Daily wastewater production	Calculation	lcd	116	116	116	116
Ratio volume black/grey water	MMI Estimate	%	25%	25%	25%	25%
Strength black water	MMI Estimate	mg BOD/l	450	450	450	450
Strength grey water	MMI Estimate	mg BOD/l	170	170	170	170
BOD contribution black water	Calculation	gBOD/cap/day	13	13	13	13
BOD contribution grey water	Calculation	gBOD/cap/day	15	15	15	15
Ratio black/grey BOD	Calculation	%	88%	88%	88%	88%
Domestic waste production per capita (pe)	Calculation	gBOD/cap/day	28	28	28	28
Daily BOD load domestic wastewater	Population forecast	kg BOD/day	27,609	31,792	42,669	49,641
Daily BOD load wastewater commercial enterprises	Number enterprises: PDAM	kg BOD/day	2,513	2,793	3,910	4,468
Daily BOD load domestic wastewater and ww commercial enterprises	Calculation	kg BOD/day	30,122	34,585	46,578	54,109
Strength domestic wastewater	Calculation	mg BOD/l	240	240	240	240
Strength wastewater commercial enterprises	Calculation	mg BOD/l	400	400	400	400

Source: PDAM Bogor, investigations and assessment MMI

Design of STP Tegal Gundil at maximum capacity

As detailed in section 6.2.1, the present WSP process at STP Tegal Gundil is sufficient to treat the waste from 2400 households. Applying a minimum retention time of 4 days, the wastewater of 2400 connections can be treated satisfactory. The quality of the effluent is 14 mg BOD/l and E-coli are virtually absent. See Appendix F.5 for details of the process calculation.

Design of temporary STP Paledang RBC

The treatment process is designed for the 2020 situation, as it is expected that by that time the central trunk mains to the STP Kayu Manis will be commissioned and the temporary STP Paledang can be taken out of service. The calculation of the treatment capacity and composition of the wastewater is presented in Appendix F.6. The main wastewater characteristics are:

- Daily capacity 3100 m^3/day;
- BOD influent 240 mg/l;
- BOD load 744 kg BOD/day.

Design of FAPs at STP Tegal Gundil, Ciluar and Kayu Manis

The WSP process at Tegal Gundil can be changed to FAP by the addition of aerators in the stabilisation ponds. Ciluar and Kayu Manis will be developed as FAP systems. The design criteria and the design for the FAP systems at the 3 locations for the years 2020 and 2030 are presented in Appendix F.8 with details of an FAP system in Appendix F.3.

6.4.2.9 Land requirements

The land requirement for the RBC reactor at STP Paledang is about 625 m^2.

The land requirements for the FAPs for the years 2020 and 2030 is presented in Table 6.4. It is essential that this land is reserved in the development plans for the City and secured as soon as possible. At the moment there is 4 ha available for STP Kayu Manis.

Table 6.4: Land requirements for the FAP system

Treatment Options	Kayu Manis	Kayu Manis	Ciluar
	2020	2030	2030
Gross Land requirement (ha)	4	8	4

6.4.3 Phasing 2015/20/30

The following phasing is foreseen:

- Start up phase (2010-2015):
  - Development of one embryo ('starter') sewerage system (see section 6.1.3); The collected wastewater will be treated in temporary STP Paledang behind the Dinas Kebersihan office (see Chapter 6.2 for details);
  - Extension sewers to the Tegul Gundil IPAL wastewater collection zone, to allow the connection of an additional 600 households, taking the total number of connections to 900.
  - Construction of 'Embryo' temporary STP Paledang 3,100 m3/day;
  - Rehabilitation STP Tegal Gundil, to enable it to treat wastewater from 900 domestic connections;
- Extension and 'skeleton' phase (2015-2020):
  - Commencement of the trunk sewer in the Central collection zone from Jalan Surya Kencana to Kayu Manis; to allow connection of 12,300 households and 1400 commercial properties to the STP Kayu Manis;
  - The success of the embryo will be used to secure funds to help fund construct the construction of the STP Kayu Manis (see Chapter 6.2);
  - Extension sewers to the Tegul Gundil IPAL wastewater collection zone, to allow the connection of an additional 2100 households, taking the total number of connections to 3,000.
  - Construction STP Kayu Manis up to 12,300 connections;

- Upgrading STP Tegal Gundil from waste stabilization ponds to facultative aerated pond system with increased capacity for 3,000 connections;

- Mature phase: (2020-2030):
  - Sewerage extensions to allow a total of 34,000 connections to the Central collection zone including the connection of the embryo sewerage system to the Central trunk sewer for treatment at STP Kayu Manis;
  - Commencement of the trunk sewer in the Easter zone to allow connection of 12,300 households and commercial properties to STP Ciluar.
  - Extension STP Kayu Manis to 34,000 connections;
  - Construction STP Ciluar up to 12,300 connections.

6.4.4 Investment cost estimate

We present the investment costs for the off-site centralized sewerage system in Table 6.5. The investment costs are based on recent cost estimates in Makassar, Medan, Yogyakarta and the Feasibility Study. The total investment costs are Rp 709,000 million (US$ 79 mln).

Table 6.5: Investment costs for off-site conventional sewerage

COST ESTIMATE (mln)	2010-2015	2015-2020	2020-2030	Total
Off-site Paledan/Kayu Manis and Cianjur				
- new off-site house connections: hc+lateral sewers	Rp26 000	Rp92 000	Rp340 000	Rp458 000
- new off-site house connections costs for trunk sewers	Rp6 000	Rp46 000	Rp170 000	Rp222 000
Off-site Tegalgundil				
- new off-site house connections: hc+lateral sewers	Rp6 430	Rp22 505	Rp-	Rp28 935
Total investment cost	**Rp38 430**	**Rp160 505**	**Rp510 000**	**Rp708 935**
Total investment cost US$(mln)	$4	$18	$57	$79

The costs for the STPs are presented in Table 6.6. A “per connection” unit cost has been developed and used for costing the sewage treatment plants. The unit cost developed is based on system costs in other cities in Indonesia and cost estimates during the Feasibility Study (Phase 1). The costs for the rehabilitation of STP Tegal Gundil have been derived from the PU-CK (Jakarta) budget information. The costing for the uprate (intensification) of the treatment process at STP Tegal Gundil has not been included because it is not necessary and is likely not to work. For justification of this decision please see Section 3.4.3.3. and the June WWMP Final Feasibility Study Report – Bogor.

Table 6.6: Investment Costs for the STPs

COST ESTIMATE (mln)	2010-2015	2015-2020	2020-2030	Total
Off-site STPs Paledang / Kayu Manis and Ciluar				
- Costs for STP based on costs per	Rp11 000	Rp46 000	Rp170 000	Rp227 000

COST ESTIMATE (mln)	2010-2015	2015-2020	2020-2030	Total
hh connection				
Off-site STP Tegal Gundil				
- Rehabilitation STP	Rp800	Rp-	Rp-	Rp800
Total (Rp mln)	**Rp11 800**	**Rp46 000**	**Rp170 000**	**Rp227 800**
Total (US$ mln)	$1	$5	$19	$25

Note - Once the embryo wastewater system has been connected to the Central trunk sewer the STP for embryo Paledang can be decommissioned and dismantled. If the RBC basin and roof is constructed out of glass fibre it can be lifted out of the ground and reused for the treatment of wastewater at other sites, e.g. at an institution or at an intermediate system (housing estate)

6.4.5 Operation and maintenance costs

Based on a fairly recent USAID-funded study[10], the operation and maintenance (O&M) costs are estimated at Rp 30,000/connection/month. This is around 2% of the investment costs. Hence the annual O&M costs is Rp 18.5 billion/year by 2030.

6.4.6 Sustaining the programme of off-site systems

As explained in Chapter 5.1, there are certain risks involved in applying off-site solutions. In Table 6.7 we indicate the major risks and remedial actions to minimize the risks. The actions have both a motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural) and have been elaborated in the WWMP Capacity Building Plan.

Table 6.7: Sustaining Off-Site Systems

Risk	Motivational and capacitating activities
Not all households and enterprises want to connect to the off-site system 1. Underperformance of the system 2. Lack of O&M funds	Campaigning (mass media, individual approach) to explain the benefits of sewerage; Legislation that 100% of properties need to be connected; All properties pay a fee whether they are connected or not; Install property connections together with the collector sewers; Subsidize households that are not able to pay or cross-subsidize;
Risk: people discharge unwanted materials (grease, fat, chlorine, etc.) into the sewers.	Explain how a sewerage system works and what is required from a behavioral point of view by means of mass media; Install grease traps at all property connections
Contractors do not construct the pipes properly.	Pay contractors only after the whole system has been inspected; Strict supervision during construction; Hire only contractors, who have experience with sewerage if possible.
Not enough flow in the system, causing blockages.	All properties connected should have a piped water supply connection; Install flushing devices on the sewers.
Too much flow in the system due to entry of storm water through manholes and illegal connections	Install emergency overflows and flush overflow pipes at intervals.

[10] Comparative study Centralized wastewater treatment in Indonesia, ESP, 2004

Risk	Motivational and capacitating activities
at household level, leads to 'thin' wastewater (low BOD) and failures at the STP.	
The staff does not know how to operate and maintain the STP	Appoint only educated staff to run the STP; Joint venture with other effluent and sewage treatment entities to facilitate peer visits and learning-on-the job;
The land for the STP is not made available.	Do not start construction of sewers until land has been purchased for sewage treatment
Contractors do not properly construct the sewage treatment works.	Pay contractors only after the whole system has been inspected; Strict supervision during construction; Hire only contractors, who have experience with sewage treatment works.
Not enough flow in the system.	Build the STP in relatively small parallel units. Ensure full property connection to the sewerage system
Low BOD of the incoming sewage due to too much flow in the system due to entrance of storm water through manholes and bad flushing procedures.	Install emergency overflow.

6.5 On-site domestic systems

6.5.1 The challenges to be met

In order to deal with the present problems identified in Chapter 3 and to fulfill the future demands identified in Chapter 4, section 4.3, a large number of on-site facilities need to be rehabilitated and new facilities need to be implemented.

In this section we identify what kinds of technologies are required for the new systems.

6.5.2 Technology options

In section 5.1 we have indicated that the selection of appropriate wastewater technologies depends on several physical factors and non-physical factors. The most appropriate technology is that technology that provides the most socially and environmentally acceptable level of service at the least economic cost. More precisely, an appropriate technology is:

- Environmentally acceptable: the wastewater is handled in such a way that it cannot affect human beings. The wastewater is not accessible to flies, mosquitoes, rodents etc. The handling of fresh excreta is avoided. In areas where the people depend on ground water as a resource for drinking water, the groundwater is not polluted;
- Convenient: there are limited odours and unsightly conditions. The facility is at short walking distance from the house;
- Simple to operate: the daily operation is to be minimal and only requires simple and safe routine;
- Long lasting and minimal maintenance: a long technical lifetime and only occasional (once in two years) maintenance;
- Upgradable: in future step-by-step (incremental) improvements and extensions are possible;

- Acceptable cost: this does not mean necessarily that the system is cheap. The technology selected is within economic and financial reach of the household and town budgets.

In Figure 6.10 we indicate the range of technology options appropriate for specific conditions in Bogor. We refer to:

- Population density: on-site systems are usually restricted to low (< 150 cap/ha) and medium (150-300 cap/ha) densities: in these areas there is almost always room for the construction of an on-site wastewater treatment and disposal facility;
- Income: we differentiate between low-income (< Rp 1.1 million/month or PRAKS[11] and KS1), medium income (Rp 1.1-3 million/month or KS2/KS3) and high income (> Rp 3 million/month or KS3 Plus);
- Unfavourable soil conditions: in Bogor unfavourable soil means high groundwater table, usually in low lying locations close to the rivers.

We have assumed that all parts of Bogor can be served by mechanical septage collection services; hence there is no need to identify systems that need to be emptied manually.

[11] PRAKS, KS2/3 etc. are National indicator of poverty

Figure 6.10:Appropriate on-site technologies options for Bogor

Density / Income	*Low density [< 150 cap/ha]*		*Medium density [150-300 cap/ha]*	
Low income [< Rp 1.1 mln/month] ***PRAKS2+KS1***	Favourable soil	Unfavourable soil (high gwt / close to rivers)	Favourable soil	Unfavourable soil (high gwt / close to rivers)
	TWIN LEACHING PITS [1.1] / reuse of septage	**MCK [3]** / ANAEROBIC BAFFLE REACTOR AND ANAEROBIC FILTER / EFFLUENT TO DRAINS	(SHARED) **LOW COST SEPTIC TANK [1]**	**LOW COST SEPTIC TANK / ANAEROBIC UPFLOW FILTER [1.5]** ('BIO TANK') / DRAIN
Medium income [Rp 1.1 - Rp 3 mln./month] ***KS 2+KS3***	Favourable soil	Unfavourable soil (high gwt / close to rivers)	Favourable soil	Unfavourable soil (high gwt / close to rivers)
	LOW COST SEPTIC TANK [1]	**IMPROVED (RAISED/COLLAR)LOW COST SEPTIC TANK [1.2]**	**LOW COST SEPTIC TANK [1]**	**LOW COST SEPTIC TANK / ANAEROBIC UPFLOW FILTER [1.5]** ('BIO TANK') / DRAIN
High income [> Rp 3 mln./month] ***KS3***	Favourable soil	Unfavourable soil (high gwt / close to rivers)	Favourable soil	Unfavourable soil (high gwt / close to rivers)
	SEPTIC TANK WITH EFFLUENT INFILTRATION PIT [2] / reuse effluent	**SEPTIC TANK WITH (RAISED) EFFLUENT INFILTRATION FIELD [2.1]**/ reuse effluent	**SEPTIC TANK WITH EFFLUENT INFILTRATION PIT [2]** / reuse effluent	**SEPTIC TANK / ANAEROBIC UPFLOW FILTER [2.2] ('BIO TANK')** / DRAIN

Key:

On-site systems
Intermediate systems

Hence, the following range of technologies is appropriate for Bogor conditions:

- 1: Low Cost Septic Tank (LCST) with soakaway;
- 1.1: Twin Leaching Pits (TLP);
- 1.2: Improved (raised/collar) Low Cost Septic Tank (LCST+) with soakaway;
- 1.5: Low Cost Septic Tank with Anaerobic Upflow Filter and discharge of effluent into storm water drains;
- 2: Septic Tank with effluent infiltration pit (ST);
- 2.1: Septic Tank with (raised) effluent infiltration field (STei)

- 2.2: Septic Tank with Anaerobic Upflow Filter ('Biotank') and discharge of effluent into storm water drains (ST/AUF).

Details of these are included in Appendix F.3.

6.5.3 Recommendations of technology

We have studied the specific conditions per Kecamatan for the different years and identified the most appropriate technologies. We present the result of our analysis in Table 6.9.

Table 6.8: Recommended on-site technologies new systems

SYSTEM			2010-2015		2015-2020		2020-2030	
			Number HH	%	Number HH	%	Number HH	%
1	Low Cost Septic Tank	LCST	4 560	19%	4 680	9%	5 550	15%
1.1	Twin Leaching Pits	TLP	-		-		-	0%
1.2	Improved (raised/collar) Low Cost Septic	LP+	5 040	21%	13 840	27%	5 550	15%
1.5	Low Cost Septic Tank with Anaerobic Upflow Filter	ST/AUF	-		-		-	0%
2	Septic Tank with effluent infiltration pit (ST)	ST/ei	14 400	60%	33 800	65%	24 900	70%
2.1	Septic Tank with / Infiltration Field	ST /if	-		-		-	
2.2	Septic Tank with Anaerobic Upflow Filter ('Biotank') and discharge of effluent into storm water drains (ST/AUF)	ST/AUF	-		-		-	0%
	Total		**24 000**	**100%**	**47 000**	**100%**	**36 000**	**100%**

6.5.4 Incremental improvements

Incremental improvements to on-site systems can be made over the years as the prosperity of the householder improves, or the desire to improve their private systems increases. Some incremental technology improvements that can be made have already been mentioned in section 6.3.2, they are:

- Single leaching pit replaced by a LCST or improved raised or collar leaching pit;
- Unacceptable septic tank contruction replaced by a proper septic tank with effluent infiltration pit;

Other incremental improvements relate to the conversion of on-site systems into intermediate systems:

- LCST or ST connected to communal treatment systems (Technology 3.1, see Section 6.4);
- LCST or ST connected to small bore sewer systems (Technology 6, see Section 6.4).

In the period 2020-2030 around 39,000 systems will need to be improved in this way.

6.5.5 Investment cost estimates

The costs are indicated in Table 6.10. Given the high number or relatively poor people we have used the figure Rp 3 million/system, to represent the cost of the LCST at around 50% of the cost for a 'normal' septic tank.

Table 6.9: Cost of program of on-site systems (Rp million)

Investment costs on-site systems	2010-2015	2015-2020	2020-2030	Total
- new on-site facilties	Rp 72 000	Rp 156 000	Rp 108 000	Rp 336 000
- rehabilitation on-site facilities	Rp 56 000	Rp 112 000	Rp 56 000	Rp 224 000
Total	**Rp 128 000**	**Rp 268 000**	**Rp 164 000**	**Rp 560 000**
Total (US $)	$ 14 m	$ 30 m	$ 18 m	$ 62 m

6.5.6 Operation and maintenance (O&M) costs

The operation and maintenance costs are restricted to emptying of the facility once every two years. At the moment the city government vacuum tankers charge Rp 200,000 / trip. Hence, the annual costs are Rp 100,000 / facility or about 5% of the investment costs.

6.5.7 Sustaining program on-site systems

As explained in Section 3.4 on the existing situation, there are many risks involved in the use of on-site solutions. In Table 6.11 we indicate the major risks and remedial actions to minimize the risks and ensure environmental benefit. The actions have motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural) and have been elaborated in the WWMP Capacity Building Plan report.

Table 6.10: Sustaining the on-site sanitation program

Risk	Motivational and capacitating activities
Wastewater management is not regarded as an issue, the construction of on-site systems has a very low priority, nobody is interested in upgrading their existing facility of purchasing a new system.	Persuasion and campaigning to explain the benefits of on-site systems; Legislation that 100% of properties need to be provided with an on-site system; School sanitation; Low Cost Septic Tanks Demonstration models Good toilets at Puskesmas and other government institutions; Explain how an on-site system works and what is required from a behaviour point of view by means of mass media reporting; Blame and shame neighbourhoods with poor on-site sanitation systems; Rewards for areas with good systems: a new mosque or kindergarten;
Many households think that on-site systems are expensive, nobody wants to purchase one.	Provide good and affordable solutions: introduce and market the Low Cost Septic Tank with soak-away; Subsidize the purchase of on-site systems; Micro-credit schemes to assist in the purchase of an on-site system; Arisan schemes to purchase on-site systems;
Existing systems fail because they are never emptied	Subsidize the emptying of the Low Cost Septic Tanks, make it free of charge; Include the emptying of septic tanks by introducing a service charge when purchasing the Low Cost Septic Tank.
Existing systems fail of bad construction and inappropriate	Develop a good 'Bogor' toilet and market that way;

Risk	Motivational and capacitating activities
systems.	Mass media coverage for appropriate examples.

6.5.8 The challenges of rehabilitation of on-site systems

As a household is usually not aware that its on-site system is not functioning well, the rehabilitation of on-site systems is as challenging, if not more so, than the introduction of new appropriate on-site systems. Hence, an integral part is 'software' on on-site systems and the creating an enabling environment, as elaborated in the WWMP capacity building report section 5.7. Activities have a motivational and capacitating nature, including:

- Study performance existing on-site systems: what parts are failing?
- Develop Surabaya fit system for rehabilitation: what is the most effective way to rehabiliate?
- Pilot projects on rehabilitation and dissemination of the results
- Marketing rehabiliatation of on-site systems
- Orgainize the commniut through NGO's to motivate and capacitate and technical backstopping of the NGO's
- Training of sanitarians and government staff on how to rehabilitate on-site systems
- Dissemination of plans, drawings, maquettes etc.through the (mobile) Wastewater Information Centre
- Rehabiliation of the sanitation at schools, Puskesmas and institutes
- Award houdeholds with the best rehabilitation and blame and shame household that are not interested in cooperating.

These activities need to be elaborated in the DED phase of the implementation.

6.6 Intermediate domestic community systems and decentralized treatment

6.6.1 The challenges to be met

In order to deal with the present problems identified in Chapter 3 and to fulfill the future demands identified in Chapter 4, section 4.3, a large number of new facilities need to be implemented. In high-density areas (greater than 300 cap/ha) on-site solutions are not possible anymore due to lack of space and off-site solutions may not always be operationally or financially feasible. Hence a new generation of systems is required. In the framework of this wastewater masterplan we have termed them as 'intermediate systems'. This name could imply that these systems are not adequate systems, the opposite is true: the intermediate systems described here and recommended for Bogor are "grown-up", well developed solutions that can be adapted to the specific site conditions of the area.

6.6.2 Technology options

In Section 6.3.2 we provide a matrix of appropriate on-site systems. Matrix definitions of appropriate systems have also been developed for intermediate systems.

In Figure 6.11 we indicate the range of technology options appropriate for specific conditions within Bogor. We refer to:

- Population density: a particular type of intermediate system, the MCK is applied in low (< 150 cap/ha) density areas. Intermediate systems are typically solutions for high density (>300 cap/ha) areas where it is difficult to find space for the construction of an on-site wastewater treatment and disposal facility;
- Income: we differentiate between low-income (< Rp 1.1 million/month or PRAKS[12] and KS1), medium income (Rp 1.1-3 million/month or KS2/KS3) and high income (> Rp 3 million/month or KS3 Plus);
- Level of community involvement required;
- Existing coverage of on-site wastewater facilities.

Figure 6.11:Appropriate intermediate technology options for Bogor

<table>
<tr><td>Density / Income</td><td colspan="3">High density [> 300 cap/ha]</td></tr>
<tr><td rowspan="2">Low income [< Rp 1.1 mln/month] PRAKS2+KS1</td><td colspan="3">High level community involvement required</td></tr>
<tr><td colspan="3">COMMUNAL TREATMENT [3.1] / ANAEROBIC BAFFLE REACTOR / biogas / ANAEROBIC UPFLOW FILTER / EFFLUENT TO DRAINS</td></tr>
<tr><td rowspan="2">Medium income [Rp 1.1 - Rp 3 mln/month] KS2+KS3</td><td colspan="2">Low coverage on-site sanitation</td><td>High coverage on-site sanitation</td></tr>
<tr><td colspan="2">SHALLOW SEWERAGE [5]</td><td>INTERCEPTORS - SMALL BORE SEWERAGE [6]</td></tr>
<tr><td rowspan="2">High income [> Rp 3 mln/month] KS3</td><td colspan="2">Ground fall < 2 o/oo</td><td>Ground fall > 2 o/oo</td></tr>
<tr><td>SHALLOW SEWERAGE [5]</td><td>INTERCEPTORS - SMALL BORE SEWERAGE [6]</td><td>CONVENTIONAL SEWERAGE / STP [7]</td></tr>
</table>

Hence, the following range of technologies is appropriate for Bogor conditions:

- 3. MCK;
- 3.1: Communal Treatment systems (CT);
- 5: Shallow Sewerage (SS);

[12] PRAKS, KS2/3 etc. are National indicators of poverty

- 6: Small Bore Sewerage (SBS).

The areas identified for intermediate wastewater systems are shown in Appendix E and details of these systems are in Appendix F.3.

6.6.3 Recommended pilot projects using communal sewerage and treatment systems in Keluhan Panaragan and Housing Estiate Mutiara Bogor Raya

6.6.3.1 Cost effective solutions

Based on the WWMP Final Feasibiltiy Study report which evaluated possible sewerage options for three different intermediate areas, it is recommended that three pilot projects should be executed using the communal sewerage (SBS/SS) technology combined with communal treatment system for the 3 areas in the feasibility study, Kelurahan Panaragan RW5, Kelurahan Panaragan RW2 and Housing Estate Mutiara Bogor Raya. The costings analysis in Table 6.12 shows that the communal sewerage and treatment costs are significantly lower than the costs of conventional "off-site" sewerage systems as applied in the Embryo.

Table 6.11: Comparison of costs for communal sewerage and treatment projects

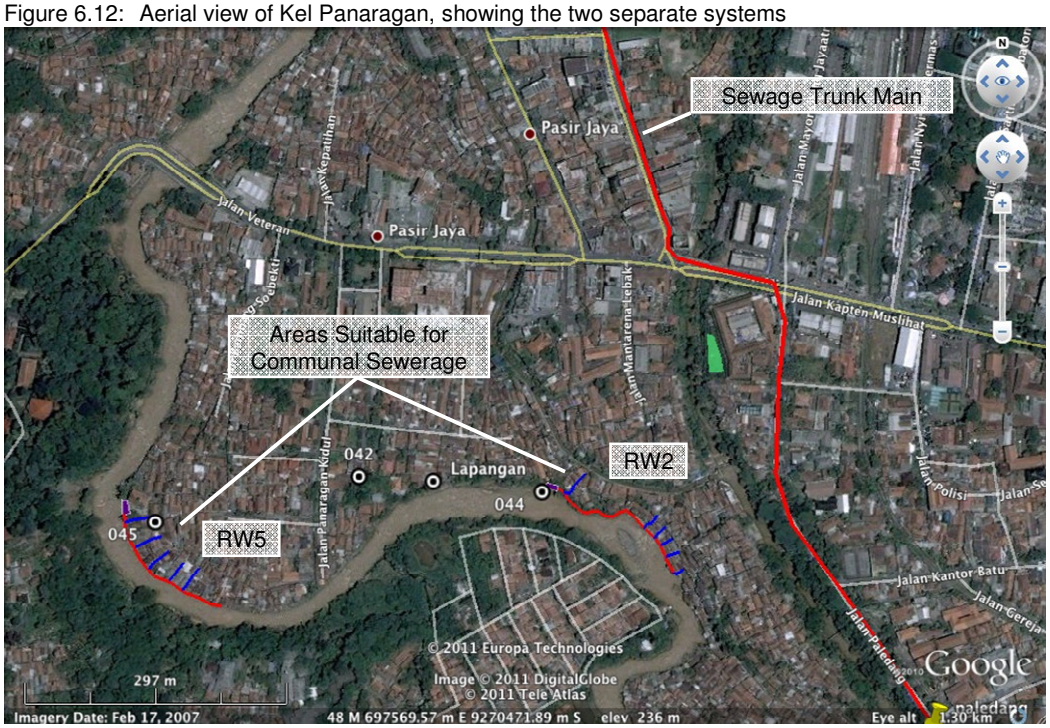
Description	Conventional Sewerage (Embryo) (Rp mln/ connection)	Shallow Sewerage (Mutiara Bogor) (Rp mln/ connection)	Small Bore Sewerage (Panaragan RW5) (Rp mln/ connection)	Small Bore Sewerage (Panaragan RW2) (Rp mln/ connection)	Average communal sewerage (Rp mln/ connection)
Trunk sewer	Rp1.80	Rp0.91	Rp1.54	Rp1.22	Rp1.22
Collector/lateral sewers	Rp3.53	Rp2.17	Rp1.16	Rp1.45	Rp1.59
Electro-mechanical-Pumping stations	Rp1.16	Rp0.36	Rp-	Rp-	Rp0.12
Manholes, connection boxes	Rp1.69	Rp0.88	Rp0.91	Rp0.78	Rp0.86
Flushing, Jacking etc.	Rp0.10	Rp-	Rp-	Rp-	Rp-
House connections	Rp2.00	Rp2.00	Rp1.50	Rp1.50	Rp1.67
STP	Rp3.48	Rp1.40	Rp1.24	Rp1.20	Rp1.28
Base Engineering costs	Rp13.76	Rp7.72	Rp6.34	Rp6.14	Rp6.74

6.6.3.2 Area descriptions

A. Kel Panaragan

There is no space for on-site systems; all grey water is being discharged into the river. Two areas in Keluragan Panaragan have been identified as suitable for communal sewerage; they are RW2 and RW5. Figure 6.12 shows the location of the two separate wastewater systems and Figure 6.13 and 6.14 give an impression of the area.

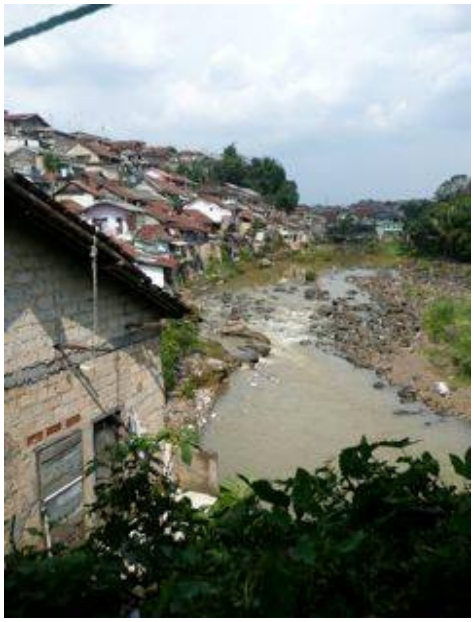
Figure 6.12: Aerial view of Kel Panaragan, showing the two separate systems



Source: Google Earth Professional

Figure 6.13: Street view of Kel Panaragan

Figure 6.14: Riverside community Kel. Panaragan



B. Housing estate Mutiara Bogor Raya

Bogor has many housing estates. Although they are relatively low-density and on-site system are from a technical/environmental point of view possible, PemKot wants to promote shallow sewer systems here because it facilitates the reuse of effluent and sludge. Also many existing private household septic tank systems are implemented poorly and it will take a large effort to improve them on a house-by-house basis. The housing estate Mutiara Bogor Raya was constructed 5 years ago and is situated close to the toll road to Jakarta, most of the people work in Jakarta. Black water is disposed to small square Batako leaching pits in the front garden of the property. The grey water is discharged untreated into the storm-water drains. The area is not connected to the PDAM piped water supply system and people typically have a bore well that is 15-18 m deep under the house with an electric pump. The bore well is quite close to the leaching pit.

6.6.3.3 Technical design

A. Kel Panaragan

1. Sewerage networks in RW2 and RW5 – Small bore or shallow bore sewers
Sewers in the areas are installed in the middle of the paths between the houses; the path is less than 1m wide. The main sewer/interceptor pipe is installed along the edge of the Cisadane River on pipe supports, every 3 meters.

2. Sewage treatment for RW2 and RW5
Specific sites for the two STPs have been identified. As the STPs will be managed by the local community a technology has been selected that requires the least operation and maintenance skills. The anaerobic baffle reactor (ABR) is recommended, for a description of the process technology, see Section 6.2.2.2. The design of the ABR is presented in Table 6.7 of the WWMP Final Feasibility Study report.

See Figures 6.15 and 6.16 below and Appendix F.8 and F.9 of the Feasibilty Study for details of the sewers and the location of the STPs.

Figure 6.15: Kelurahan Panaragan sewerage network RW 2

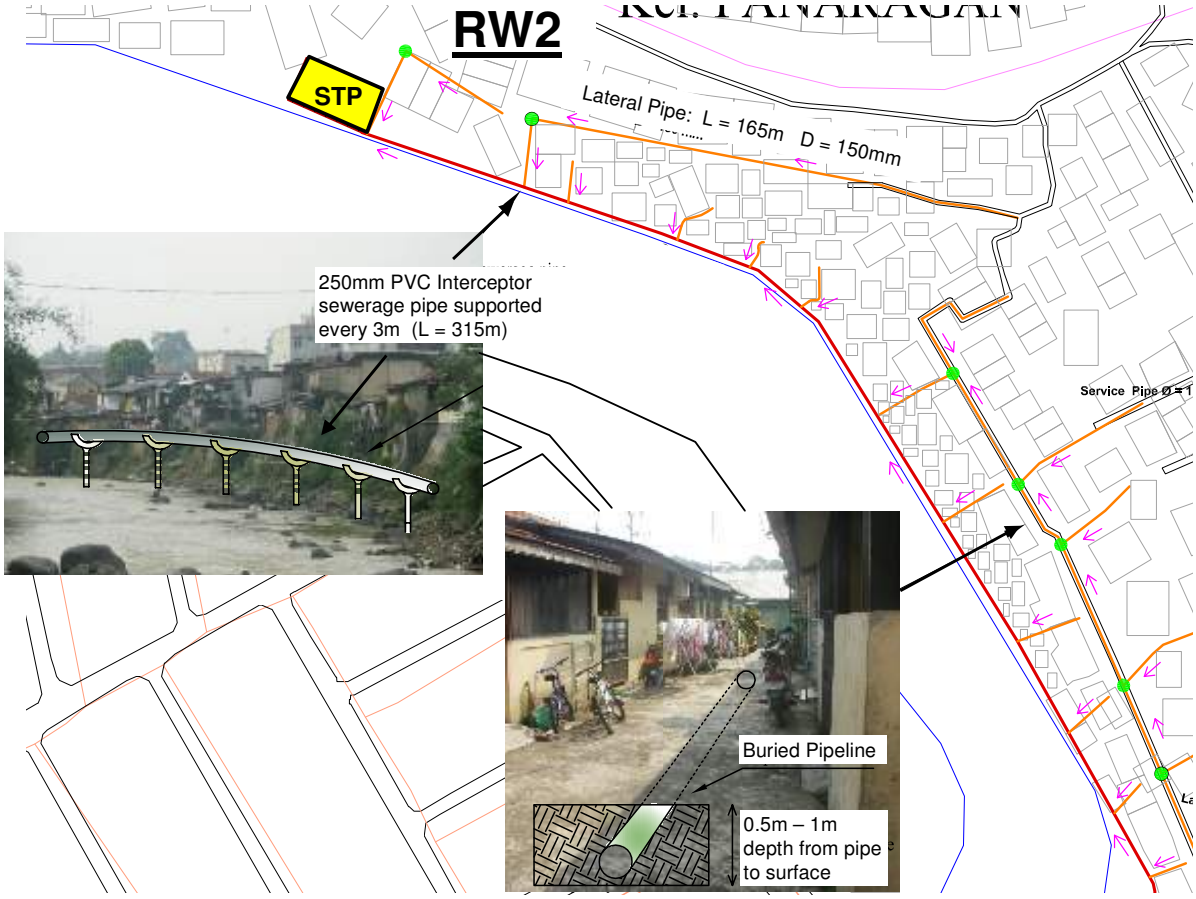
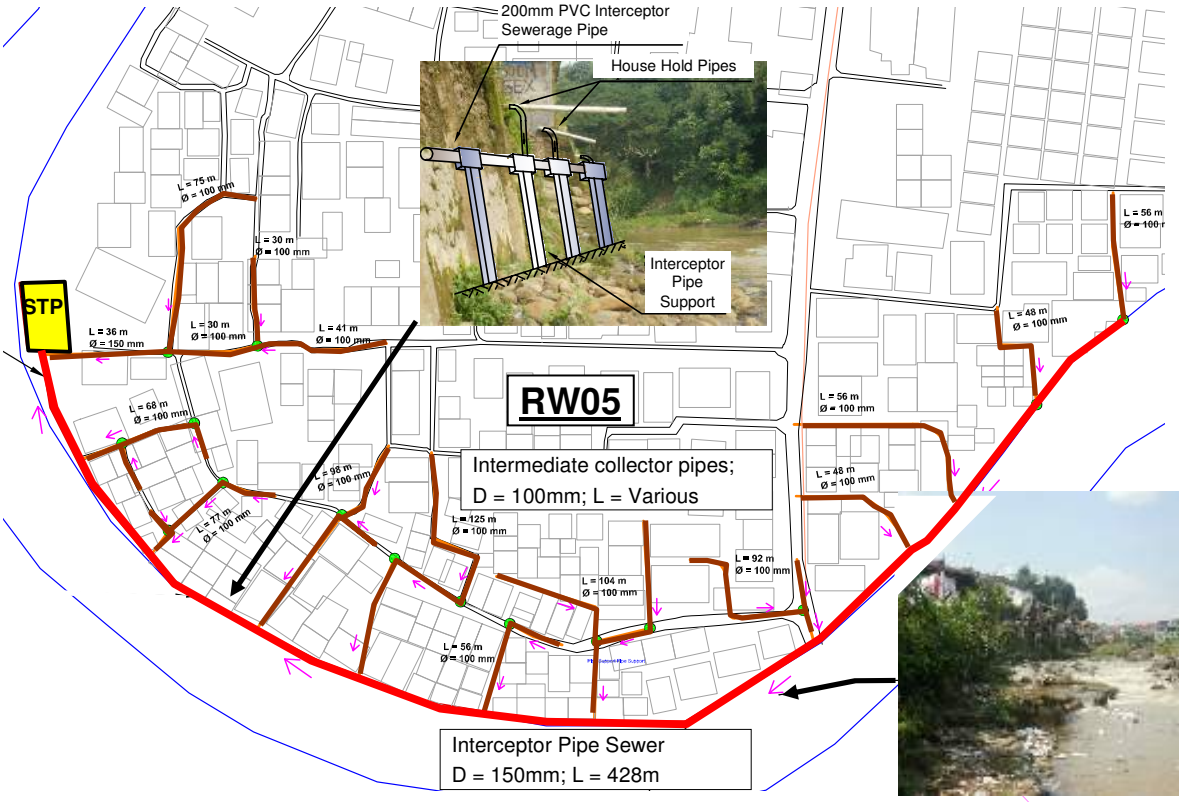


Figure 6.16: Kelurahan Panaragan sewerage network RW 5



B. Housing estate Mutiara Bogor Raya

1. Sewerage system

The septic tanks installed in Mutiara Bogor Raya Residence generally do not fulfil the ISO standard, and therefore a system that can handle the grey water and black water is proposed. The proposed wastewater collection system for the planned location of the STP is divided into two zones, the gravity zone serving 800 connections and the pumping zone serving 300 connections. The proposed sewerage system can be seen in Figure 6.17 and Appendix F.10 of the Bogor WWMP Final Feasibily Study report.

2. Sewage treatment

A location for the STP has been identified, as the site available is restricted, the UASB technology has been selected. See Table 6.8 of the Bogor WWMP Feasibility Study report for the design of the STP.

6.6.4 Recommendations of technology

Based on the results of future pilot projects, the technologies to be recommended for the future sub-projects can be scaled up to cover all 'intermediate areas'. Based on the specific conditions for each

Kecamatan for the different years the most appropriate technologies were identified. We present the result of our analysis in Table 6.13.

Table 6.12: Recommended new intermediate systems

SYSTEM			2010-2015		2015-2020		2020-2030	
			Number HH	%	Number HH	%	Number HH	%
3	MCK+;		1 000	10%	1 000	7%	2 000	11%
3.1.	Communal Treatment systems (CT);	CT	2 500	24%	3 000	20%	6 000	33%
5	Shallow Sewerage (SS);	SS	6 500	58%	10 000	67%	8 000	44%
6	Small Bore Sewerage (SBS).	SBS	1 0 00	8%	1 000	7%	1 000	11%
Total			**11 000**	**100%**	**15 000**	**100%**	**18 000**	**100%**

Some of the proposed SS and SBS schemes are planned to be used in existing housing estates where many of the wastewater systems are malfunctioning and lead to pollution of ground and surface water. To do this in an efficient way it is intended to follow a 'modular' approach by developing a standardized model for communal wastewater collection, treatment and reuse of the treated effluent and septage. If an existing housing estate has a high coverage of on-site systems, the SBS is recommended, for new housing estates traditional sewerage or SS will be recommended.

6.6.5 Incremental improvements

Intermediate systems are by definition systems fit for incremental improvements:

- MCKs can become communal treatment systems, provided they are situated sufficiently low to receive wastewater from neighbouring houses;
- Intermediate SS and SBS neighbourhood systems can be connected to the off-site conventional sewerage system.

6.6.6 Investment cost estimates

The costs are indicated in Table 6.14. We have based the costs on the findings from the WWMP Final Feasibility Study report.

Table 6.13: Cost of program of intermediate systems (Rp million)

Investment costs intermediate system	Unti rate phase1	Unit rate phase 2	2010-2015	2015-2020	2020-2030	Total
- new intermediate facilties	Rp5.9	Rp6.0	Rp65 000	Rp90 000	Rp108 000	Rp263 000
- rehabilitation intermediate facilties	Rp2.5	Rp2.5	Rp2 500	Rp-	Rp-	Rp2 500
Total			Rp67 500	Rp90 000	Rp108 000	Rp265 500
Total (US $ mln.)		Rp9 000	$8	$10	$12	$30

6.6.7 Operation and Maintenance (O&M) costs

The operation and maintenance costs differ from one system to another: besides removing the septage every 2 years, the sewer lines and the decentralized treatment facilities need regular operational checks and maintenance. Hence, O&M requirements are the same % as for conventional sewerage: at around 2% of the investment costs per year: total Rp 5,300 mln/year.

6.6.8 Sustaining the program of planned intermediate systems

There are many risks involved in applying intermediate solutions. The most apparent risk is the poor craftsmanship of contractors, and the inappropriate location of communal systems in low-density areas because when the project was planned it was hard to find space for the treatment facility in high-density areas. Yet it is the population of the high-density areas that need and would benefit from these systems.

In Table 6.15 we indicate the major risks and remedial actions to minimize the risks. The actions have motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural) and have been elaborated in the WWMP Capacity Building Plan report.

Table 6.14: Sustaining the intermediate system program

Risk	Motivational and capacitating activities
Nobody feels responsible for operating and maintaining modular intermediate neighbourhood systems.	Organize construction, operation and maintenance in such a way that the private sector or a neighbourhood organization can make a living. O&M fees should be more than enough to cover the O&M costs.
There are relatively few skilled wastewater personnel and staff in Bogor, including government staff.	Hire experienced consultants and contractors to design, construct and supervise the systems; Cooperation/peer visits with international enterprises who have experience with wastewater operation and maintenance; Hire only staff which has an education in wastewater management; Introduce
Funds collected for operation and maintenance are not used for operation and maintenance.	Transparent management of funds collected for operation and maintenance: e.g. by having the funds in bank account that can be viewed by everybody contributing to the operation and maintenance.
The construction of Sanimas systems has been regarded as a 'present' to the Head of the Neighbourhood and the number of systems is spread evenly over the town: also to areas where they are not appropriate.	Create a sense of ownership among the communities by demanding 50% own contribution.
It is difficult to find space for the communal treatment facilities and they are constructed in low-density areas where on-site sanitation would be possible and more appropriate.	Make clear guidelines where to site the facilities and adhere to these guidelines; Transparent decision mechanisms.
Not all households and enterprises want to connect to the intermediate system, leading to 1. Underperformance of the system and 2. Lack of O&M funds	Campaign to explain the benefits of sewerage; Legislation that 100% of properties need to be connected; All properties pay a fee whether they are connected or not; Install property connections together with the collector sewers; Subsidize households that are not able to pay or cross-subsidize;
Risk: people discharge unwanted	Explain by means of mass media how an intermediate system works and what is

Risk	Motivational and capacitating activities
materials (grease, fat, chlorine, etc.) in the shallow/ small bore sewers.	required from a behaviour point of view; Install grease traps at all property connections.
Contractors do not properly construct the pipes.	Pay contractors only after the whole system has been inspected; Strict supervision during construction; Hire only contractors, who have experience with intermediate systems; Introduce a public grievance and complaint system.
Many households think that intermediate systems are expensive, nobody wants to connect.	Provide good, cost effective solutions; (Cross-) Subsidize the funding of intermediate systems; Micro-credit schemes to assist in the development of an intermediate system; Legislation that 100% of the neighbourhood has to connect; All properties pay a fee, whether they are connected or not.

6.6.9 The challenges of upscaling intermediate systems

Bogor has already some good experiences with the introduction of intermediate systems. To arrive at the targeted number of intermediate systems is as challenging as the introduction of appropriate on-site systems. Hence, an integral part is 'software' on intermediate systems and the creating an enabling environment, as elaborated in the WWMP capacity building report (section 5.7 and Appendix E.4). Activities have a motivational and capacitating nature, including:

- Study performance existing intermediate systems such as the Sanimas
- Pilot projects (sbs, ss) in Panaragan and Mutiara Bogor Raya
- Dissemination results
- Marketing intermediate systems
- Community organization/ NGOs
- Backstopping community initiatives

Activities on the overall creation of an Enabling Environment include:

- Wastewater Information Centre
- School Sanitation
- Puskesmas Sanitation
- Sanitation at institutes
- Training government staff on sanitation
- Blame and shame / Ombudsman / Grievance procedures

See Appendix E.5 of the Capacity Building report.

6.7 Grey water disposal

6.7.1 Grey water disposal when applying off-site systems and communal piped intermediate systems (Communal treatment, SBS and SS)

An important advantage of the off-site conventional sewerage and the piped intermediate systems like SBS and SS is that they can also convey and treat the grey water.

6.7.2 Grey water disposal when applying on-site systems and non-piped intermediate systems (MCK)

The environmental benefits of acceptable "on-site" black water systems and MCKs will be nullified if acceptable on-site grey water management does not accompany them. Grey water improvements should be implemented hand-in-hand with the implementation of the improved and new "on-site" systems. Figure 6.17 shows the technological options matrix for grey water management.

Figure 6.17: Technological options grey water management

Low-Medium density [< 300 cap/ha]				*High density [> 300 cap/ha]*	
Favourable soil		Unfavorable soil (high gwt/low permeability)			
Septic Tanks used for wastewater treatment	Leaching Pits, Low Cost Septic Tanks, Biofilters and other on-site systems receiving only black water	Demand for reuse - Strong community organization required	No demand for reuse - Good solid waste and drainage management	Favourable soil	Unfavourable soil
Large (> 4m3) Septic Tank: Septic Tank / Small (< 4m3) Septic Tank: Soakaway	**Soakaway**	**Treatment and Reuse**	**Anaerobic Upflow Filter /drain**	**Soakaway**	**Small Bore Sewers / Shallow Sewers / Sewerage**

Key:

On-site systems
Intermediate systems

The following technologies are appropriate for grey water treatment:

- Second chamber septic tank;
- Soak-away;
- Anaerobic Upflow Filter and discharge into storm water drains.

6.8 Non-domestic systems

6.8.1 Introduction

This wastewater masterplan mainly deals with domestic wastewater and information was not collected on non-domestic wastewater. Non-domestic wastewater is wastewater from:

- (Large) industries; Bogor has a relatively low number of industries but the impact of the lack of wastewater collection, transport, treatment and reuse/disposal can be rather significant;
- Home industries; especially food related like fish cleaning, tahu production, but also small metal industries etc, can have a large local negative environmental impact;
- Commercial enterprises: hotels, restaurants, malls, etc.;
- Institutes, Government offices etc.

As explained in Chapter 4.1, it has been decided to include commercial enterprises in the proposals for the "embryo" off-site sewerage areas. The reason is not necessarily that these are major polluters, but because they will be able to pay the charges for connection to the system and the improvement of the wastewater situation in the linear commercial areas of Bogor is thought to be a good trigger to get a responsible and responsive wastewater authority off the ground. Institutes and government offices have also been included in the property connection proposals for the "embryo".

6.8.2 The challenge to be met

In order to fulfil the future demands identified in Chapter 4, Section 4.3, the number of commercial enterprises to be dealt during the period of the masterplan, is presented in Table 6.16.

Table 6.15: Program improvement wastewater treatment at commercial enterprises

Description	Unit	2010	2015	2020	2030
Number of commercial enterprises [13]	number	4,500	5,000	7,000	8,000
Population equivalent commercial enterprise	pe/enterprise	20	20	20	20
Wastewater production commercial enterprises	m3/e/day	1.40	1.40	1.40	1.40
- % acceptable treatment units	% commercial enterprises	55%	75%	100%	100%
- % unacceptable treatment units	% commercial enterprises	45%	25%	0%	0%
Programme for Commercial Enterprises					
- new treatment facilities commercial enterprises	number		500	2,000	1,000
- rehabilitation treatment facilities commercial enterprises	number		800	1,300	-

6.8.3 Recommended technologies

If the commercial enterprises are located in the "embryo" off-site system area or the future centralised wastewater catchment areas, then they are recommended to be connected to the sewerage network. However if they are located in areas that are not to be sewered yet, then, specific technologies are recommended as appropriate to the type of business. The businesses considered with general recommended technologies are:

- Institutes – ABR or constructed wetland;

[13] Number of enterprises is based on PDAM Bogor data. Number of inappropriate systems is derived from the environmental assessment.

- Hotels – ABR followed by RBC;
- Restaurants – ABR;
- Shopping malls – Activated Sludge Reactor.

Details can be found in Appendix F.3.

6.8.4 Investment cost estimates

The costs are indicated in Table 6.17.

Table 6.16: Cost of the program for improvement of the wastewater facilities of commercial enterprises (Rp million)

Investment costs commercial enterprises		2010-2015	2015-2020	2020-2030	Total
- new treatment facilities commercial enterprises	Rp 20 mln/unit	Rp 10 000	Rp 40 000	Rp 20 000	Rp 70 000
- rehabilitation treatment facilities commercial enterprises	Rp 10 mln/unit	Rp 8 000	Rp 13 000	Rp -	Rp 21 000
Total	-	Rp 18 000	Rp 53 000	Rp 20 000	Rp 91 000
Total (US $ mln.)	$/Rp 9 000	$ 2m	$ 6m	$ 2m	$ 10m

6.8.5 Operation and Maintenance (O&M) costs

O&M requirements are the same % as for conventional sewerage at around 2% of the investment costs per year: total Rp 1,820 mln/year.

6.8.6 Sustaining the program of improvement of wastewater facilities of commercial enterprises

Several commercial wastewater treatment plants were visited during January 2011, see Chapter 3, Section 3.2.5 for details, the high percentage of poorly constructed and badly maintained facilities indicates that there are many risks involved in applying wastewater treatment improvements at commercial enterprises. In Table 6.18 we indicate the major risks and remedial actions to minimize the risks. The actions have motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural) and have been elaborated in the WWMP Capacity Building Plan report.

Table 6.17: Sustaining non-domestic/commercial wastewater system program

Risk	Motivational and capacitating activities
Commercial enterprises are interested in running their enterprise and have no interest in proper wastewater management.	Explaining the importance of proper wastewater management through the Chambers of Commerce; Awards for best performing enterprises; Strict licensing of the enterprise treatment plants and regular strict monitoring of the treatment plant effluents; Naming and shaming of poorly performing enterprises.

6.9 Septage collection and treatment

6.9.1 The challenge

Field visits have been made to STP Tegal Gundil (IPAL). The septage collected by the City government vacuum trucks is emptied in a chamber near the pumping station for treatment at the IPAL. Table 6.19 shows that at present only 8% of the septage produced is collected and treated.

Table 6.18: Septage collection and treatment

Descriptio	Unit	2010	2015	2020	2030
Annual septage production	litres/cap/year	40	40	40	40
Annual septage production on-site facilities	m3/year	37,079	41,860	52,320	52,910
Monthly septage production	m3/m	3,090	3,488	4,360	4,409
Number of septage collection trucks	number	4	10	24	24
Volume septage collection truck	m3	3	3	3	3
Number of trips septage collection trucks per month	number/m	20	60	60	60
Volume septage collected monthly	m3/m	240	1,744	4,360	4,409
Volume septage treated daily	m3/d	12	87	218	220
Coverage septage collection	%	8%	50%	100%	100%

In fact the calculated figure of 8% is likely to be optimistic, as the vacuum trucks usually take the supernatant wastewater and 'forget' to take the sludge. The compact sludge is left in the tank.

From this analysis, we conclude:

- There is hardly any septage sludge collected at the moment. To arrive at a figure of 50% coverage in 2015 and 100% coverage in 2020, means that the existing 4 vacuum trucks need to be increased to the equivalent of 10 trucks by 2015 and 24 trucks by 2020. This estimate assumes 60 trips per month (3 trips per working day per truck);
- STP Tegal Gundil (see Chapter 6.2, Section 6.2) can easily absorb the 12 m^3/day septage currently being delivered and the 87 m^3/day septage that should be delivered by 2015 as there is still an idle capacity of 300 kg BOD/day and 1400 m^3/day at the STP. (Note - 87 m^3 septage is around 87 m^3x1000/1000 kg/m3 = 90 kg BOD/day, assuming the septage has a strength of 1000 mg BOD/l).

There are many challenges in Bogor concerning septage collection and treatment: Most likely the existing leaching pits and septic tanks are not emptied at all: people wait till the pits and tanks are completely full and backflow, before calling upon a vacuum truck service. It could be the case that more than 8% of the septage produced is being collected but that:

- The vacuum trucks dispose the collected septage to the nearest watercourse; or
- The event of the vacuum tanker emptying at the pumping station near the IPAL is not registered.

Conclusions

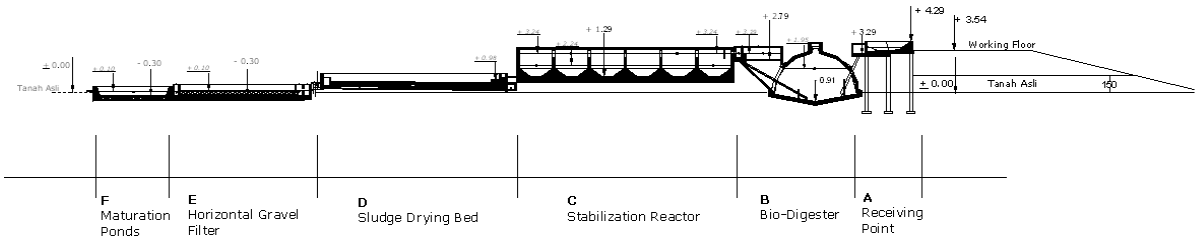
- The situation concerning septage collection and disposal is not clear;

- There is not enough demand for septage removal by the householders: septage removal has a very low priority, people wait until their tanks are full and overflowing;
- Just adding more vacuum tankers will not be a solution: it will have to be accompanied/ preceded by intensive marketing;
- Given the low demand it is unlikely that the private sector will be interested in providing a septage emptying service;
- As the STP Tegal Gundil has a lot of spare capacity up to 2015, it can easily accommodate any improved rate of septage removal and delivery between 2010 and 2015. To facilitate this, a septage disposal facility along the ringroad needs to be constructed. This disposal facility consists of a platform where vacuum trucks can park an a large diameter pipe, a 'shaft', through which the septage can flow under gravity to the STP Tegal Gundil;
- After 2015, when STP Tegal Gundil approaches its maximum capacity, a new septage treatment facility will need to be created.

6.9.2 Planned septage sludge treatment plant at STP Tegal Gundil

PU-CK Jakarta has prepared a DED for a Rp 2.9 bln, septage treatment plant (IPLT) on the site of the STP Tegal Gundil. This includes several stages of treatment including a sludge digestion chamber. See Figure 6.18

Figure 6.18: Proposed sludge treatment at STP Tegal Gundil



This initiative is very interesting, but is considered unnecessary, given that STP Tegal Gundil has spare treatment capacity and should be able to handle the septage that is currently taken there and should also be able to handle the increased amount of septage that will be taken there over the next 5 years if the existing septic tanks are emptied more regularly. If the centralised sewerage system and STPs are constructed as explained in Section 6.1 and 6.2, then the construction of the IPLT at Tegal Gundil is not really necessary.

In addition, the benefit of the methane digester is not understood: after 2 years in the 'tanki septik' the sludge is already well digested and will not produce much methane, plus it is likely that the digester will not function. The design offered for the IPLT to PU-CK by their consultants is technically complicated and given the present operational status of STP Tegal Gundil, it is questionable whether the proposed IPLT can and will be operated properly.

This IPLT project should be reconsidered, however as this is currently in progress, it has been included the latest costs from the PU -CK Consultants, BEMACO, in the cost estimates as shown in Section 6.6.2. of the Bogor WWMP Final Feasibility Study report.

6.9.3 Technology options

6.9.3.1 Motorized collection

Provided it is possible to create sufficient demand for septage collection, there is a need to find environmentally sound and labour-friendly solutions for collecting septage in high density areas where vacuum trucks cannot enter. It is suggested to employing vacuum motorcycles, see Figure 6.19 to collect part of the septage.

Figure 6.19: Motorized small-scale septage collection: vacuum motorcycle

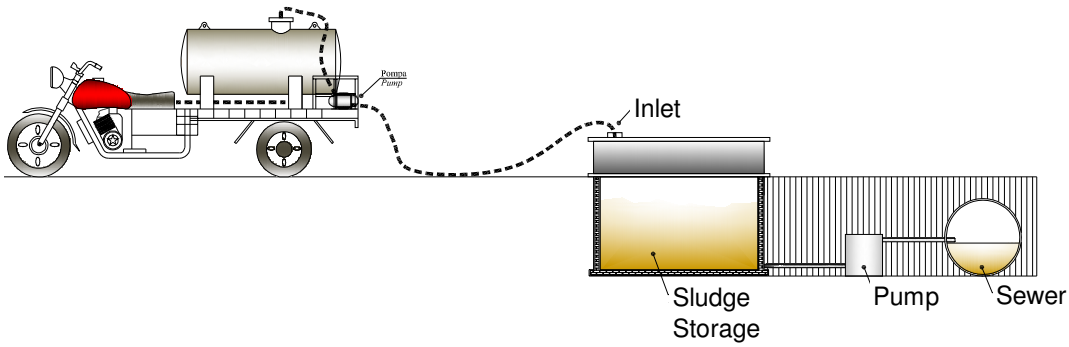
6.9.3.2 Septage Discharge Stations (SDS)

To decrease the distance that vacuum trucks and vacuum motorcycles have to travel, septage discharge stations (SDS) can be developed as discussed below. The vacuum tankers in Bogor already uses such a discharge chamber adjacent to the pumping station at Indraprasta, on the Tegal Gundil wastewater sewerage system, see Figure 6.20.

Figure 6.20: Pumping station and tanker discharge chamber at Indraprasta

Once the trunk sewers and STPs have been installed, SDS can be installed. An SDS is a point along the sewer main that can be legally accessed and used for discharging septage and sludge directly into the sewer so that it can be transported to the STPs, see Figure 6.21. These intermediate transfer points for septage avoid the collection distances and reduce collection costs. Septage is discharged into the SDS and then either released directly into the sewer or held in a temporary storage tank before being released to the sewer at a set time. Timed release can help prevent solids from building up in the sewer line and also help optimize the treatment efficiency of the STPs by reducing peak loading. SDS's are especially appropriate for the dense, urban areas of Bogor where there is no alternative discharge point (e.g. fecal sludge thickening pond) and where there will be a sewer main in the future. By having several SDS across Bogor will help to promote septage removal and reduce illegal septage dumping. The system for issuing permits or charging access fees must be carefully designed so that those who most need the service are not excluded because of high costs, while still generating enough income to be sustainable and well-maintained.

Figure 6.21:Septage discharge station



6.9.3.3 Treatment of septage at the STPs

Once the STPs for the Central and Eastern wastewater collection zones has been constructed at Kayu Manis and Ciluar, respectively, the septage collected by vacuum trucks can be transported to these STPs. The septage should not to be discharged directly into the facultative aerated ponds (FAP): a separate treatment stage is required for the septage. The solid fraction from the septage should be separated from the liquid fraction in an Imhoff tank and the solids pumped to the sludge drying beds, the liquid fraction is conveyed into the FAP.

6.9.3.4 Design criteria and technological aspects

The addition of septage to the STP means an additional pollution load to the planned STPs at Tegal Gundil, Kayu Manis and Ciluar. For example if a very strong septage is discharged to the STPs with a strength of 10,000 mg BOD/litre and the treated effluent quality is still required to meet the effluent standard of 50 mg BOD/l, then an additional 10% surface area would be required. See Appendix F.3 for the design criteria and design for STPs with septage treatment for 2030.

6.9.4 Phasing 2015/20/30

The following phasing is foreseen:

- Marketing (2010-2015):
  - Study the reasons for the low level of septage collection;
  - Based on the outcome of the study on septage collection rates, develop a marketing strategy. The marketing of septage collection could should be an integrated part of the marketing of on-site sanitation systems, for example: 'purchase an approved "on-site" facility and receive free septage collection services for 10 years', ie 5 free empties;
  - Invite the private sector to provide a private septage emptying service, say, with 5 vacuum trucks (3 m^3 each) and 6 vacuum motor cycles (0.5 m^3 each);
  - Improve the existing septage emptying point at Indraprasta, so that it becomes a proper SDS and log the usage properly.
- 'Skeleton' phase (2015-2020):
  - Install SDS on the Central wastewater collection zone trunk sewers from Surya Kencana Street, Merdeka etc. to Kayu Manis and develop integrated septage disposal and treatment facilities at STP Kayu Manis;
- Mature phase: (2020-2030):
  - Install SDS on the Eastern wastewater collection zone trunk sewers and develop integrated septage disposal and treatment facilities at STP Ciluar.

6.9.5 Investment cost estimates

The investment costs are shown in Table 6.20. It is assumed that 6 vacuum motorcycles can be purchased at the cost of 1 vacuum truck. The table also includes the Rp 2.9 bln. IPLT project proposed by PU-CK (Jakarta).

NOTE - As the SDS is part of the of the sewerage network, the investment costs for the SDS are included in the investment costs for the "off-site" centralized sewerage system given in Chapter 6.1. The necessary investment for accommodating the septage at the centralized STPs is included in the investment costs for the STPs in Chapter 6.2.

Table 6.19: Investment costs

Septage collection	Unit rate	unit	2010-2015	2015-2020	2020-2030	Total
- Vacuum trucks/motorcycles (Rp)	Rp 500	mln/truck	3 000	7 000	-	10 000
- UPLT (PU-CK project)	Project cost	-	2 900			2 900
Total (Rp mil)			**5 900**	**7 000**	**-**	**12 900**
Total (US $ mln.)	$/ Rp 9,000		$0.65	$0.77	-	$1.42

6.9.6 O&M costs

O&M requirements are estimated at 10% of the investment costs including costs for diesel, spare parts, and personnel.

6.9.7 Sustaining septage collection and treatment program

As explained above, there are many risks involved in investing in septage collection and treatment. In Table 6.21 we indicate the major risks and remedial actions to minimize the risks. The actions have both a motivational nature (both intrinsic and extrinsic) and a capacitating nature (physical, mental, financial and social/cultural) and are elaborated in the WWMP Capacity Building Plan.

Table 6.20: Sustaining septage collection and treatment program

Risk	Motivational and capacitating activities
Not all households and enterprises with on-site systems use the septage collection services.	Campaigning (mass media, individual approach) to explain the benefits of a good working on-site system; Legislation that 100% of the on-site systems need to be serviced every two years; All properties pay a fee whether they are being served or not; Provide free septage emptying services to the people who purchased an approved "on-site" facility Subsidize households that are not able to pay or cross-subsidize them;
The private sector does not want to provide a septage collection service.	Septage collection by the government and accept running at a loss; Privatize solid waste collection and make septage collection an integrated part of it.
Illegal dumping of septage and unlicensed manual septage removal.	Name and shame companies that are unlicensed or dump septage illegally. .

6.10 Relationship between the CSS and Master Plan

The wastewater Master Plan follows the main strategic aims of the 2010 CSS, with regard to:

- Use of the high sanitation risk assessment, which is based on the scope of the facilities of sanitation (wastewater, garbage, drainage and clean water) obtained from EHRA survey. For identifying the priority of the areas for improvement of the wastewater systems and also for consideration of the timing of the intervention.
- Develop the planning of wastewater integrated management in each area of service through a centralized system with "Cross subsidy" policy
- Increasing access to centralised sewerage for the general society and communal systems for the poor communities where appropriate.
- To improve and optimize facilities for treating domestic wastewater to fulfil environmental standards
- All stakeholders to be responsible for domestic wastewater management including the wastewater facilities for organized housing areas (ie construct by developers), the cost will be charged to the developers and will be included in the price of the house for the purchaser.
- The provision of wastewater systems will be conducted in stages for priority areas with bad sanitation and high population density, in order of the scale of the priority.

The wastewater Master Plan does not follow the CSS with regard to:

- In the CSS, Bogor only considered the installation of septic tanks, whereas at the moment 93% of the systems used are leaching pits (cubluk). Cubluk, Low Cost Septic Tanks and Biotanks are much cheaper and have the same environmental benefits as the septic tank provided they are constructed properly. Low Cost Septic Tanks and Biotanks are also capable of being installed in the densely built up

poor areas. The use of the cubluk, Low Cost Septic Tanks and Biotanks, is more appropriate in many of the areas being targeted for installation of on-site systems.

- The target achievement and stages of achievement as mentioned in the “Delivery of Goals” are not being followed, due to inconsistencies of the numbers in the “target” column and the inappropriate dates in the “planned achievement year” column of the target achievement table.
- EHRA assessments of % toilet usage, a weighted average has been used for the Kelurahan analysis, based on the population of the Kelurahan, this gives a higher percentage for Open Defication at 4.6%, compared with EHRA at 4%.

7. Wastewater institutional arrangements in Kota Bogor

7.1 Overview / identification and evaluation of existing wastewater services and institutional arrangements

7.1.1 Existing wastewater services

In Kota Bogor, black water services for households are now managed by a Technical Service Unit (UPTD-PAL) established within the Cleansing and Parks Services Department (*Dinas Kebersihan dan Pertamanan* – DPK)[14], having been previously operated until 2010 by the Buildings and Settlements Department (*Dinas Pengawasan dan Pemukiman*). The principal service consists of an intermediate piped system, set up as a pilot project in 1996, to serve 600 households, with wastewaters treated at a small plant (IPAL) at Tegil Gundit. In fact, the service is currently used by only 300 households which pay a tariff based on piped water consumption.

The excess capacity of the IPAL is partially absorbed by treatment of sludge from septic tanks conveyed there by a 4-unit vacuum truck fleet also operated by DPK (it is understood there are no licensed privately-owned trucks in the city). Based on the revenue statements for the septage operation, it is estimated that around 5,000-6,000 houses (less than 3% of households) used the service in 2010, indicating a very limited demand. The total capacity utilisation of the IPAL is reckoned at less than 50%.

The UPTD-PAL has a staff of 18. Services are heavily subsidised, with operating ratios of only 7% for the intermediate system and 35% for the sludge removal service (combined operating ratio of 24%), exclusive of salaries.

Community services consist of MCKs and SANIMAS installations connected to small wastewater treatment facilities. There seems to be little institutional responsibility at city government level, with the recently constructed SANIMAS facilities being managed by local community heads (RW/RT). Accountability for user fees appears to be lacking.

Responsibility for grey water services is with the Roads and Water Resources (*Dinas Bina Marga dan Sumber Daya Air* - DBMSDA). As far as investment is concerned, the central government is responsible for primary drainage, the provincial government for secondary drainage, and the city government for tertiary (including grey water) drainage. O&M for all drainage categories is the responsibility of the city. However, in practice, tertiary draiange O&M is left almost entirely to the community.

There are many factors which contribute to sub-optimal sanitary conditions in Bogor and which have an impact on community health. The Bogor City White Book contains the following statistics:

- The 2010 PPSP survey shows that 330 regional government areas, including Bogor City, had inadequate sanitation and drainage infrastructure;
- The percentage of healthy households in Bogor was 44.7% against the Minimum Service Standard of 65%;
- The number of houses equipped with toilets was only 74.3%

[14] Ref: Mayoral Decree (*Perwali*) 43/2010 concerning Basic Responsibilities and Functions (TUPOKSI) and Structural Positions of the Cleansing and Parks Services Department

- The incidence of illnesses (e.g. dengue, diarrhoea, lung and respiratory problems, skin diseases, typhoid and intestinal worms) caused by unsanitary conditions, although showing improvement over 2008, was still unacceptably high.

7.1.2 Current institutional arrangements

Box 1 of Appendix G.1 details the functions and responsibilities of the UPTD-PAL and its manager. They suggest that wastewater management policy is presently oriented towards the achievement of modest performance targets rather than the development of a progressively improving and sustainable sector.

In addition to the acitivies of the UPTD-PAL within the Cleansing and Parks Services Department (DPK), three other city government functional (*dinas*) and three executive (*badan*) departments have responsibilities and functions (TUPOKSI) involving wastewater management. These are the Health Department (*Dinas Kesehatan* – Dinkes), the Building and Settlements Supervision Department (Dinas Pengawasan Bangunan dan Pemukiman - DPBP), the Roads and Drainage Department (DBMSDA), the Environmental Department (*Badan Pengelolaan Lingkungan Hidup* – BPLH), the Permit Issuance and Investment Department (*Badan Pelayanan Perizinan Terpadu dan Penamanan Modal* - BPPTPM) and Bappeda. The city districts (*kecamatan*) are also involved in community aspects of wastewater. Table 7.1 shows the distribution of functions amongst these agencies.

Table 7.1: Bogor City Agencies Involved in Wastewater/Sanitation Management

Function	DKP/ UPTD	Bappeda	Dinkes	BPLH	DPBP	BPPTPM	DBMP	Kecamatan
Planning	V	V	V	V			V	
Implementation	V		V	V			V	V
Technical Supervision	V		V	V			V	
Training / Capacity Building Programs	V	V	V	V	V	V	V	V
Dissemination of Environmental Health Information to the Community	V		V	V	V	V		V
Issue of Building Permit (IMB) for Environmental Health Compliance				V		V		

The above matrix indicates that indivdual TUPOKSI are specifically concerned with each department without reference to other agencies with wastewater management responsibilities. Consequently, a comprehensive approach towards management and improvement of the sector does not exist at present. The proposals made in this section of the Master Plan are intended to provide a pathway for an all-inclusive integrated approach to the management of wastewater disposal and to put an end to the existing fragmentation of responsibilities.

7.2 Leadership by the City executive and legislature

Good governance is a recurring theme in the FOPIP/LIDAP process throughout this capacity-building report. In developing a definition of “good governance”, an example has been taken from the Ottawa (Canada) Institute of Good Governance, which states that “good governance is the process by which

stakeholders articulate their interests, their inputs are absorbed, decisions are taken and decision-makers are held accountable." This definition has been taken into account whilst defining and developing a series of specific activities and FOPIP/LIDAP actions to implement them.

It is therefore appropriate that the initial action in making a commitment of good governance to the wastewater sector through endorsement of the Master Plan and its objectives should be taken by the city's executive, including the mayor, and its legislative branch.

The mayor and the regional government legislature (DPRD) should take the lead in publicly committing to the Master Plan and its strategic objectives. The most suitable time and place for doing this would be in the Mayor's annual accountability speech and policy address to and its adoption by the DPRD, accompanied by extensive media coverage. The first occasion for this would be the adoption of the Master Plan and its incorporation in the Medium-Term Regional Development Plan (RPJMD) and the Investment Plan (RPIJM) before the end of 2011. Successive annual events would be used to report on the progress made in implementing the Master Plan, and to recommend any necessary updates to it, also for incorporation in the RPJMD and RPIPD.

The vision for the wastewater sector could be defined as "progress towards a sustainable environmentally friendly wastewater condition in Bogor by 2015", thus implying that the sector will be managed with a focus on environmental control and health. Based on the city's vision, the mission statement should include the following:

- Creating a policy of progressive and sustainable wastewater management in co-operation with the community;
- Integrating wastewater management with good drainage management in a sustainable manner with community participation;
- Improving public awareness of the link between good wastewater management and good health;
- Increasing community and private sector participation in managing wastewater;
- Improving the quality and quantity of wastewater facilities and utilities towards a greener and more healthy environment;
- Setting up rules and regulations to enhance and sustain environmental quality;
- Improving the institutional management of wastewater through principles of good governance by means of establishing an office for a wastewater regulator and a stakeholder committee representing the interests of off-site customers and the rest of the community with their on-site and intermediate wastewater facilities.

The mission statement, supported by a comprehensive capacity-building technical assistance, will be advanced during the first phase of the Master Plan through the accomplishment of a series of strategic objectives, including:

- Construction of the Paledang off-site wastewater facilities, with small bore sewered system and wastewater treatment plant;
- Rehabilitation and expansion of the Tegal Gundit off-site system;
- On-site domestic systems;
- On-site non-domestic systems;
- Expansion and rehabilitation of existing community intermediate systems;

- Procurement of vacuum trucks;
- Technical support for on-site and community intermediate facilities and tertiary (grey water) drainage;
- Decreasing open defecation by 50% by 2015 towards an Open Defecation Free (ODF) condition in accordance with Indonesia's commitment to the Millennium Development Goal (MDG) of reducing to about 50% of the 2015 population those people without proper access to environmentally-supportive wastewater facilities;
- Increasing the volume of sludge collected from on-site wastewater facilities, to be treated in an environmentally correct manner;
- Increased budgets for physical development of the sector;
- Providing the institutional means to deliver the above services through financial support, appropriate capacity-building measures and good governance..

7.3 Adoption and updating of the masterplan

The following steps should be taken for adoption of the Masterplan and its updating

- A special team will prepare the initial draft of the Mayor's vision and mission statement, employing recommendations from Chapter 7.2 above.
- Another special team will draft a *perda* for the adoption of the Masterplan and its placing in the RPJMD and the RPIJM;
- Institutional successors to the UPTD-PAL (UPTD IPLT+IPAL, embryo BLU-D and full BLU-D) will draft progress reports on the development of the wastewater sector for incorporation in annual policy speeches by the mayor;
- The successors to the UPTD will be responsible for drafting annual updates to the Masterplan and incorporation into the RPJMD and RPIJM.

Table 7.2 summarises the regulatory process required for commitment to and continuing support of wastewater policy.

Table 7.2: Schedule of Perda/Perwali Required for Commitment to Wastewater Policy

Proposed Actions	Target Date	Regulatory Action
Establish team to prepare adoption of Wastewater Masterplan	Sept 2011	New perwali required
Adoption of the Wastewater Masterplan	October 2011	New perda required
Revisions to RPJMD to incorporate provisions of Wastewater Masterplan	October 2011	Revision to Perda No 03/2010
Annual revisions to wastewater component of RPJMD	2012 and thereafter as required	Updates to October 2011 revision of Perda No 05/2010

7.4 Selection of proposed operator/manager

7.4.1 Sewered system service providers in operation in Indonesia

At present, sewered wastewater systems elsewhere in Indonesia are operated by the following regional government service providers.

Operator	Regional Government(s)
Dinas	None
UPTD	DKI Yogyakarta (UPTP), Bogor
BLU-D	Greater Denpasar
PDAM	Balikpapan, Bandung, Cirebon, Medan, Solo
PD-PAL	Banjarmasin, DKI Jakarta

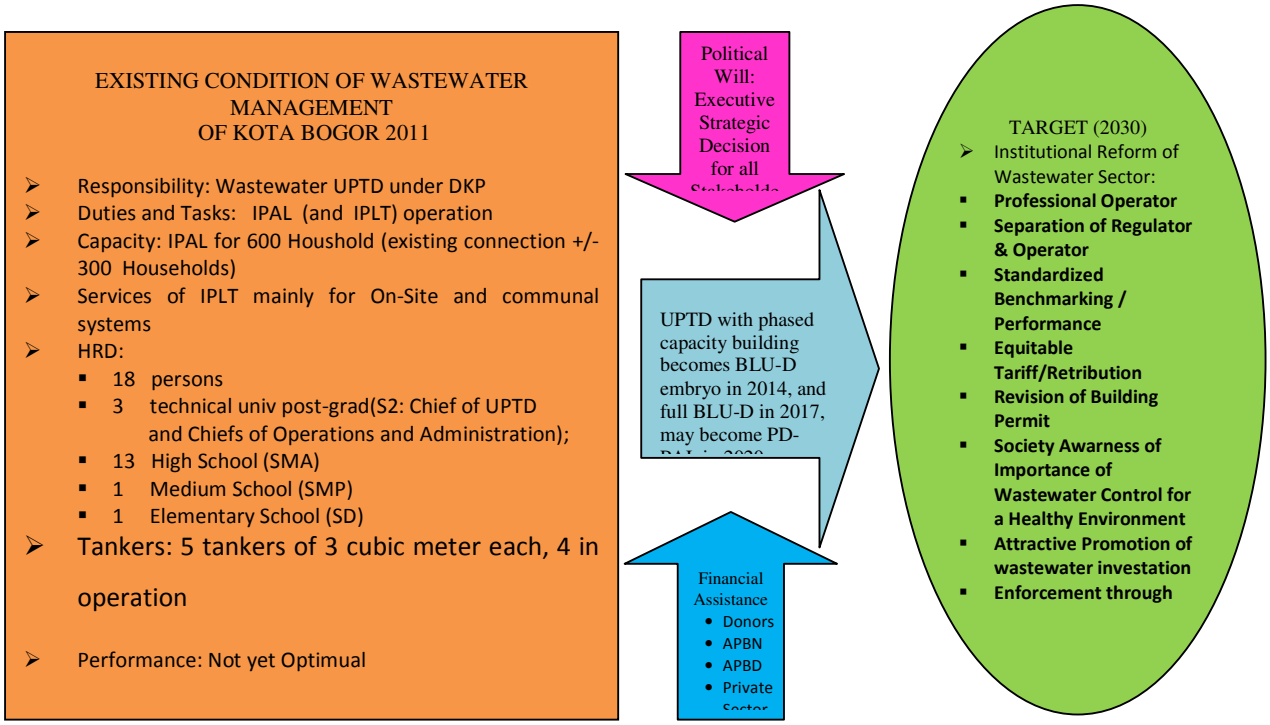
It should be noted that all PDAM operators were appointed before the issue of PP 23/2005 and Ministry of Home Affairs Decree 61/2007, both of which are concerned with BLU and BLU-D.

A brief description of the institutional options available to organise the delivery of the wastewater service is given in Appendix G.2.

7.4.2 Conceptual approach to future wastewater institutional arrangements

As a sector which is going to be almost completely transformed, wastewater management will be involved in many environmental issues which will have to be solved by reaching out to the community through pro-environmental actions which will attract the support of large sections of the community. In an era of regional autonomy, wastewater institutional arrangements will require vision, political initiative and goodwill from the city's chief executive, its legislative body and senior government officials, since appropriate regulatory measures will be much needed to support the programme. Interdependency between these various players is essential to ensure that appropriate synergy is created which will overcome the bureaucratic, conventional approach to the attainment of conservatively-determined physical targets which is unlikely to guarantee sustainability of the sector. Figure 7.1 illustrates this approach.

Figure 7.1: Figure 7.1:Conceptual Approach to Wastewater Master Plan Institutional Arrangements 2011 – 2030



In order to operationalise the new tasks and responsibilities of the upgraded wastewater sector, the existing UPTD will require significant capacity improvements if it is to achieve its long-term goals as illustrated in Box 7.1, irrespective of the choice of "full" operator. These capacity-building measures will be introduced through step-by-step approaches, including: (i) improvements oriented towards focused tasks and responsibilities (TUPOKSI) aimed at efficient management control of a city-wide wastewater service, and (ii) recruitment of personnel with capabilities to fit the task and responsibility requirements. Both of these approaches must take into account performance indicators.

Box 7.1. Indicative Long-Term (2011-2030) Institutional Reforms for the Wastewater Sector

- Establishment of an operator with accountability for implementing the piped serwerage service and the environmentally friendly collection and disposal of human waste sludge;
- Introduction of building permit regulations with appropriate technical standards for wastewater disposal which reflect environmental needs as the wastewater sector is progressively developed;
- Provision of capacity building to establish a regulator for the wastewater sector in accordance with prevailing laws and regulations;
- Improvement of community awareness of the importance of wastewater management;
- Regular preparation of regular strategy and business plans
- Introduction of retributions and recourse to other sources of revenue (such as property taxes) to fund wastewater sector recurrent expenditure (operations, maintenance, administration, community awareness, campaigns, etc);
- Promotion of a full cost-recovery tariff for non-domestic sewered premises;
- Assistance to low-income households for wastewater management
- Establishment of stakeholder committees
- Introduction of enforcement procedures with sanctions for transgressors
- Development of benchmarks
- Encourage meant to the private sector to invest in wastewater management infrastructure on either communal system or private sectors.

7.4.3 The selection process for the sewered system operator

A series of presentations was given to senior officials from technical and executive departments of Kota Bogor, as well as from the POKJA, to allow them to assess the strengths and weaknesses of the potential candidates. Appendix G.3 compares the candidiates by means of a set of relevant institutional issues. In addition, guidance was provided in respect of MPW Decree 16/2008 (concerning National Policy and Strategy for the Development of Domestic Wastewater Management) which, inter alia, recommends the appointment of a semi-autonomous operator and a separate regulator. This would preclude the selection of either a Dinas or a UPTD. Officials were also advised that, in the event of a decision being made to establish a separate division within the PDAM as the operator, the central government would expect any subidies to the operator to be provided by the city government, i.e. that there should be no cross-subsidies from the water supply division tariff revenues.

On 28 February, 2011, city government officials selected a BLU-D as the operator, setting the end of 2017 as the time when the institutional process of establishing a “full” BLU-D would be complete, i.e. in a suitable condition to assume the operation of the off-site sewered system and wastewater treatment facilities as well as supervision of intermediate and on-site wastewater management. This date takes into account the city government’s concern for the completion of the regulatory process and the potential difficulties of recryuiting and training suitably qualified personnel. This decision was endorsed by the Mayor of Bogor at a subsequent meeting on 14 March, 2011. The selection of a BLU-D was made on the basis of the following considerations:

- PDAM’s organization structure can be reasonably replicated in a separate wastewater division with separate fixed assets, personnel and accounting systems;

- PDAM's experience of managing fixed assets and O&M requirements would lead to a more rapid development of sewered wastewater services; but
- PDAM is profit-oriented, whilst a BLU-D is not necessarily a "for profit" agency;
- Wastewater and sanitation are social services with an important focus on environmental control and health, and therefore the BLU-D profile is more appropriate;
- Management and supervision of community on-site and and intermediate wastewater disposal facilities may not be a suitable fit for a BLU-D structure.

7.5 Institutional arrangements for establishment of the wastewater sector

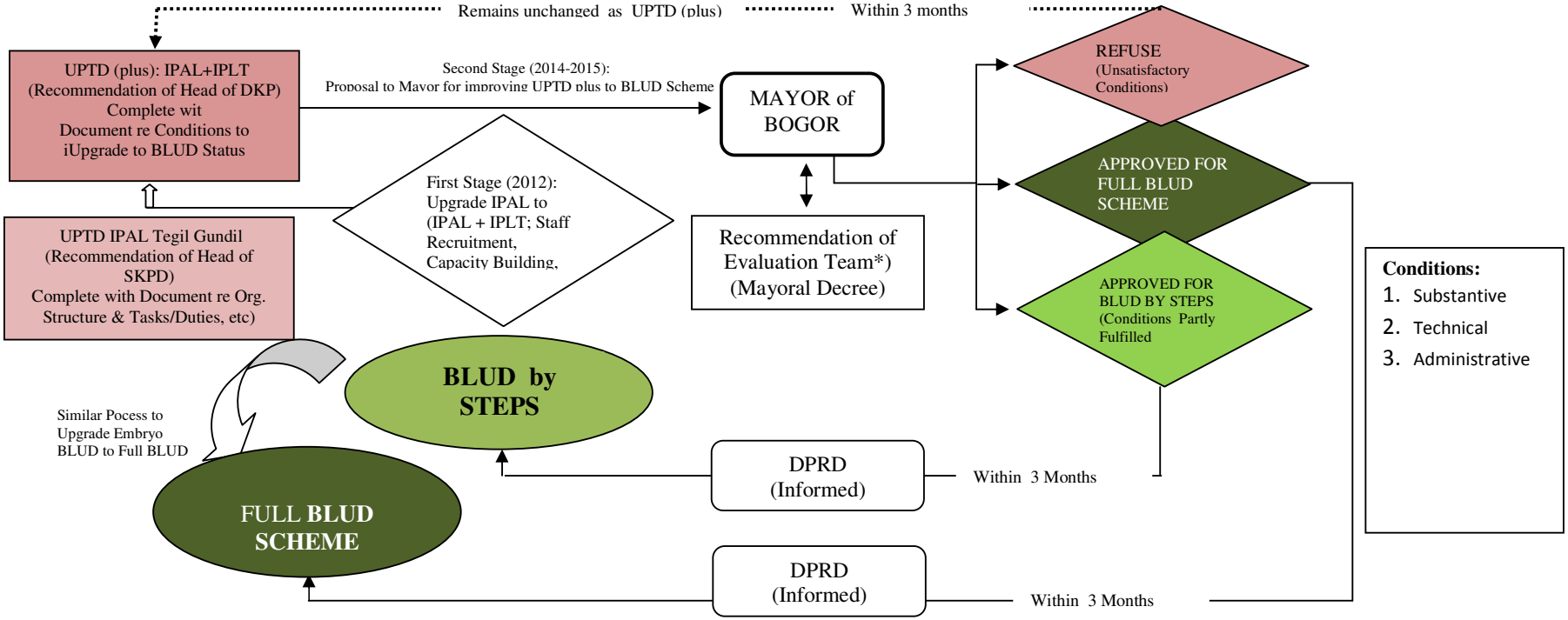
The regulatory process, whereby wastewater management is progressively converted from operation of an under-utilised small off-site sewerage system and dual purpose (IPAL and IPLT) treatment plant to operation of off-site conventional and off-site intermediate small bore sewered systems with wastewater treatment plants, as well as oversight of all other wastewater physical infrastructure in the city, will be carried out in three (3) stages which will go beyond the first phase of the Masterplan. Figure 7.2 shows the entire process of transition from UPTD IPAL to a full BLU-D, whilst Table 7.3 below summarises the regulatory process and provides a proposed schedule for the various pieces of regulation during the first phase of the Master Plan. All stages of these institutional arrangements are clearly set out in existing central government regulations and decrees which can be mirrored by the issue of a series of parallel regional government *perda* and *perwali* decrees.

Figure 7.2: Figure 7.2: Regulatory Process for Upgrading UPTD PAL to Full BLU-D (in accordance with Ministry of Home Affairs Decree No 61/2007)

Procedure for Upgrading Status of UPTD within SKPD to BLUD

(Based on Ministry of Home Affairs Decree No 61/2007)

1. The UPTD should have meets by means of substantively, technically and administratively in a sound operational condition prior to change its status to BLUD
2. If the UPTD does not meet the operating condition, it could first be upgraded to a UPTD Plus. At this stage recruitment of professional staff is recommended
3. The Chief of UPTD issues a Statement of Readiness to apply BLUD scheme. The Statement endorsed by Head of SKPD
4. The Chief of UPTD, via Head of SKPD, submits a letter of proposal for applying BLUD scheme to Mayor, complete with document of administrative condition of UPTD
5. Within 3 months of the date of proposal, based on recommendation of Evaluation Team, the Mayor approves or refuses the upgrade UPTD to BLUD
6. The approval of Mayor has two forms: (1) Agree to upgrade to full BLUD scheme; (2) Agree to iimprove to BLUD by steps (embryo BLUD). DPRD is informed of decision
7. The Mayor may refuse the upgrade due to unsatisfactory condition of UPTD. In such case the status of UPTD will remain unchanged



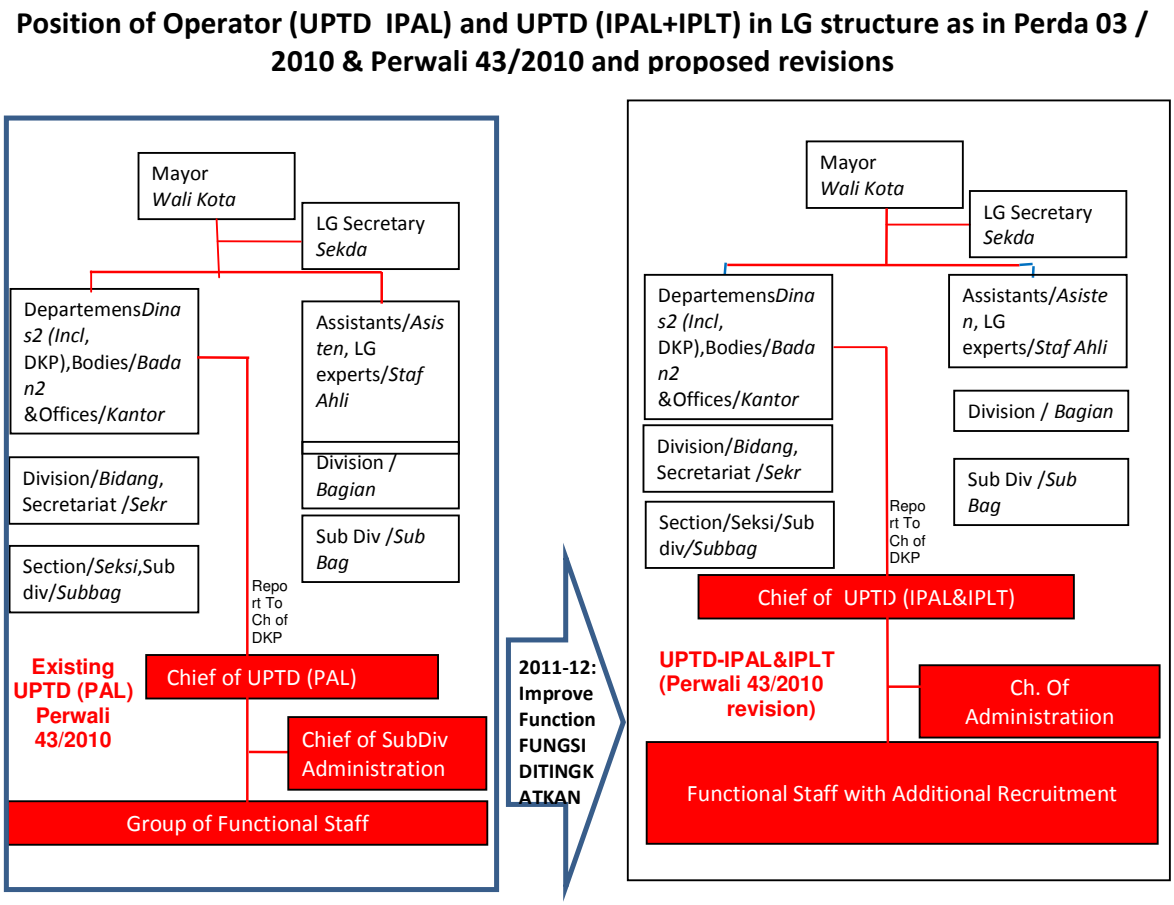
Evaluation Team Consists of:
1. Local Gov. Secretary as Chief of Team and member; 2. PPKD (LG Financial Evaluation Official as Secretary and member; 3. Head of Bappeda as member; 4. Head of DKP as member: and 5. Sector expert as member

The first stage of the process will be the improvement of the existing UPTD-PAL within the Cleansing and Parks Department (DPK) to an upgraded condition as a wastewater services technical unit (UPTD *Layanan Air Limbah* or "UPTD IPAL+IPLT") reporting to the head (*kepala dinas*) of DKP. This stage is required for consistency with the investment programme to construct a septage treatment plant, which will be funded by the central government, by the side of the existing treatment plant at Tegal Gundit.

The UPTD IPAL+IPLT will be tasked with responsibilities for technical supervision of and guidance to individual on-site and intermediate community systems, as well as the operating condition of tertiary (grey water) drainage. In addition, it will progressively manage and co-ordinate the licensing and operation of the private sector vacuum truck and motor cycle operators, and begin the registration and inspection of on-site septic tanks.

These additional tasks and responsibilities will require a revision of *Perwali* No 43/2010 in order to incorporate the new *TUPOKSI*. The organization structure of the UPTD PAL+IPLT will be similar to that of the existing UPTD PAL, but additional professional staff will be required to undertake the new tasks. Figure 7.3 shows the position of the existing UPTD PAL and the to-be-upgraded UPTD IPAL+IPLT within the Bogor Regional Government structure

Figure 7.3: Position of Operator/Manager (UPTD PAL and UPTD IPAL+IPLT) in Bogor Regional Government Structure (in accordance with Perda 03/2010 & Perwali 43/2010 & Proposed Revisions) - Cleansing and Parks Department



It is anticipated that the UPTD IPAL+IPLT will require three (3) years of capacity-building and development before the second stage of the institutional process can be regulated and implemented.

The second stage involves the upgrading of the UPTD IPAL+IPLT into an embryo (*bertahap*) BLU-D (UPTD *Pengelola Air Limbah Domestik PPK BLU-D*), reporting to the head of DPK. This step implies that the UPTD IPAL+IPLT will have met the substantive and technical requirements to become a full BLU-D, but not the administrative requirements by 2014. Services to the community will be much the same as in the first stage, but will be improved, extended and consolidated. In addition, responsibilities will be increased through improvement of human resources development and capacity building so that the embryo BLU-D will be able to operate off-site intermediate small bore sewered systems and can also prepare for the establishment of a full BLU-D which will operate off-site conventional sewered systems with wastewater treatment plant to be implemented in the second phase of the Master Plan.

Irrespective of whether the BLU-D is an embryo or full unit, Section 34 of Ministry of Home Affairs Decree No 61/2007, which concerns the Financial Management of a BLU-D, requires that the agency should have a manager and two (2) divisions, one technical and the other financial. Each division can establish as many

sub-divisions or sections as are necessary to enable it to undertake the role of operator/manager with the required effectiveness and efficiency.

A major feature of the organization structure (Figure 7.6) is the proposed establishment of a Customer and Community Relations (*Hubungan Pelanggan dan Masyarakat*) Sub-Unit, attached to the technical unit. If the regulatory structure had allowed, it would have been proposed as a unit on its own, such is the importance attached to the function.

Remuneration of civil service staff will be determined in accordance with Section 36 of PP No 23/2005.

Figure 7.4 shows the position of the UPTD IPAL+IPLT and the embryo BLU-D within the Bogor Regional Government structure, whilst Figure 7.5 shows the position of the embryo BLU-D and the full BLU-D.

Figure 7.4: Proposed Position of Operator/Manager (UPTD IPAL+IPLT and Embryo BLU-D) in Bogor Regional Government Structure - Cleansing and Parks Department

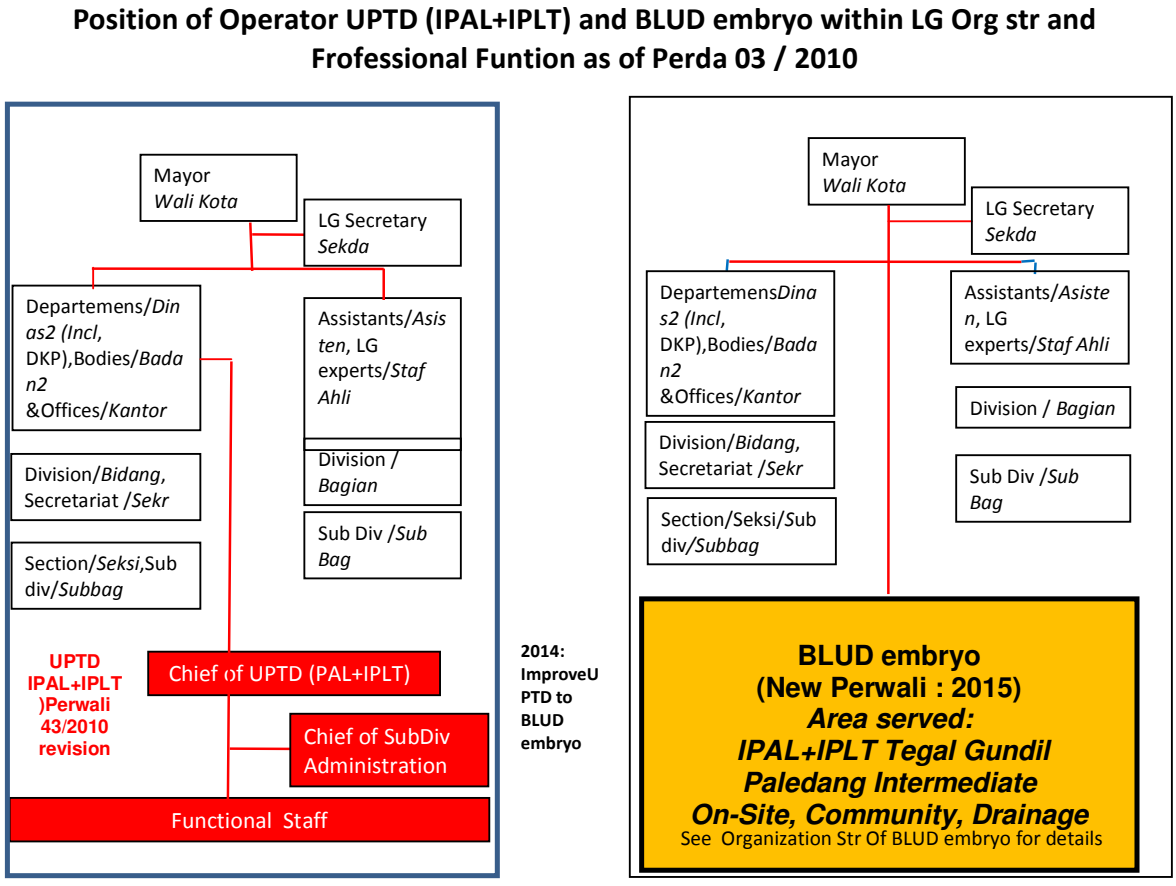
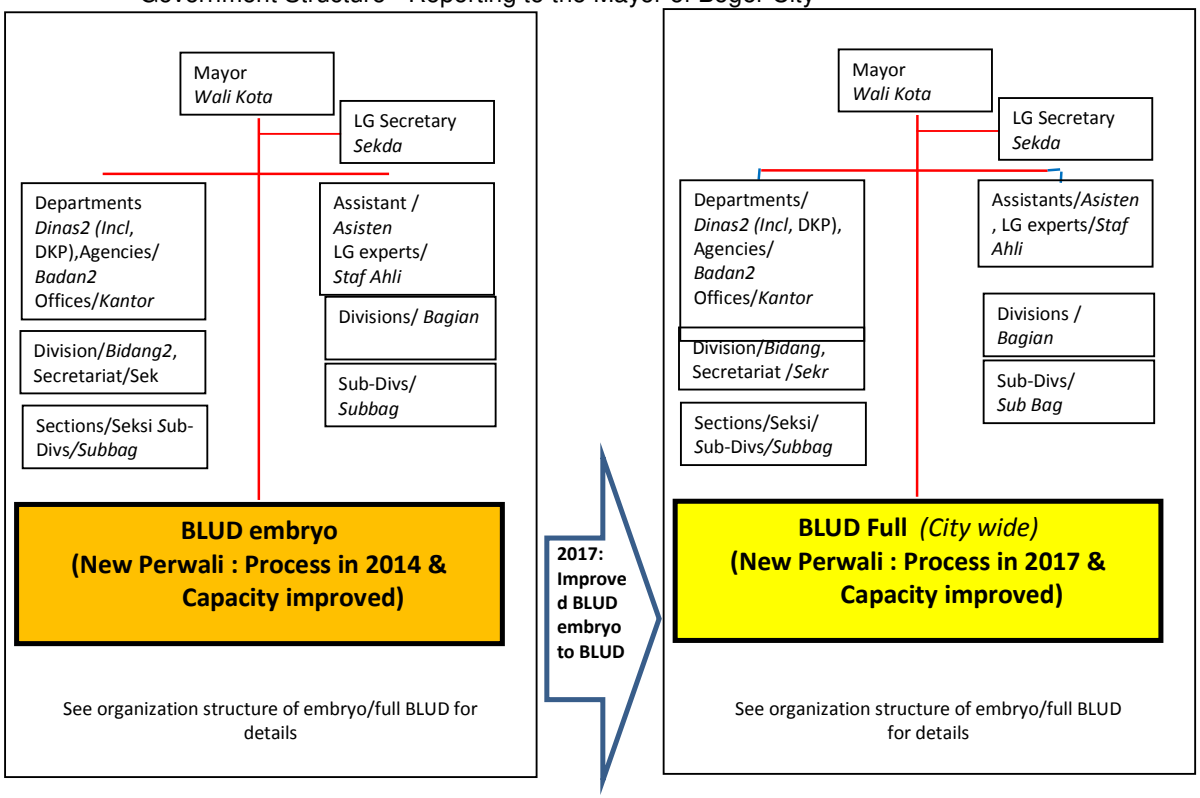


Figure 7.5: Proposed Position of Operator/Manager (Embryo BLU-D and Full BLU-D) in Bogor Regional Government Structure - Reporting to the Mayor of Bogor City

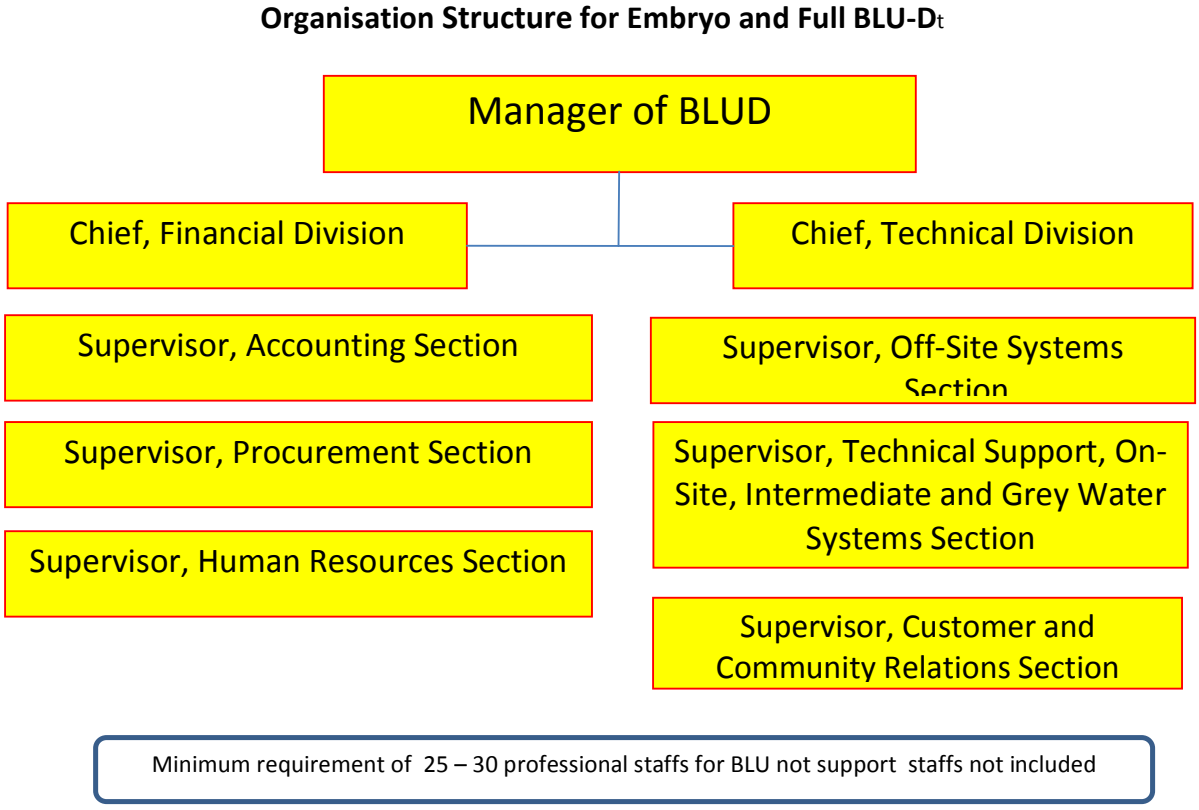


The embryo BLU-D will be managed in accordance with PP No 23/2005. It is proposed that this process would take place by the end of 2014, so that the embryo BLU-D would be in position to operate the new off-site intermediate system to be constructed at Paledang. The new arrangements would be authorised by means of a revision to the 2011 *Perwali* issued to implement the first stage.

The third and final stage concerns the formal establishment of a fully-fledged BLU-D reporting directly to the mayor as the operator of off-site conventional and off-site intermediate small bore sewered systems with wastewater treatment plants, as well as the manager or facilitator of all other wastewater physical facilities, with substantive, technical and administrative responsibilities, as per Section 4 of PP No 23/2005.

Figure 7.6 shows proposed organization structure of the full BLU-D.

Figure 7.6: Organization Structure Satuan Kerja (SKPD) Wastewater Management PPK BLU-D (Full BLU-D) 2018 - Reporting to the Mayor of Bogor City



The establishment of the full BLU-D would be finalised by the end of 2017 through the issue of a revision to the *perwali* for the embryo BLU-D. The three-year interval between establishment of the embryo BLU-D and of the full BLU-D is required by MOF Decree 07/2006, as amended by MOF Decree No 119/2007, and ultimately by Section 5, Sub-Section 6 of PP 23/2005.

Table 7.3: Schedule of Perda/Perwali Required for Institutional Arrangements for Wastewater Management

Proposed Actions	Target Date	Regulatory Action
Establish POKJA to develop framework for regulatory process	October 2011	New Perwali required
Establish wastewater services UPTD (UPTD IPAL+IPLT) in Dinas Kebersihan dan Pertamanan	December 2011	New Perwali required
Upgrade wastewater services UPTD IPAL+IPLT to embryo BLU-D in Dinas Kebersihan dan Pertamanan	December 2014	New Perwali required
Establish full wastewater services BLU-D	December 2017	New Perwali required

7.6 Responsibilities of the BLU-D wastewater operator/manager

The selection by Bogor City of BLU-D as the operator/manager of wastewater services will facilitate an integrated approach to the management of the entire physical infrastructure in the sector, including a strong focus on the social aspects of the services. The BLU-D will directly manage the conventional and intermediate small bore sewered systems, as well as the collection (through private operators after 2014) and disposal of human waste sludge, whilst it will also provide technical supervisory support for community intermediate and on-site systems. In addition, it will collaborate with other soft service deliverers to guide the community, especially low-income households, towards higher standards of hygiene and environmental control. The summary descriptions below of services to be provided by the operator/manager are divided into on-site, community intermediate, conventional and intermediate small bore sewered systems, and grey water disposal.

7.6.1 On-site wastewater services

Registration and inspections

- Identify locations of septic tanks and leaching pits; prepare, maintain and update a central register, divided into household, community, non-household (schools, markets, etc) and commercial categories. It is accepted that it may not be possible to locate all such facilities or to access them with vacuum equipment;
- Ensure that all new buildings have adequate provisions for on-site human waste disposal (toilet construction, waste pipes and septic tanks), that all such facilities are registered, and that approvals are signed off by the operator/manager and returned to the Spatial Planning Division of DCKTR before building permits (IMB) are issued;
- Carry out periodic inspections of all such facilities and report on condition; the report to be recorded on the central register, to include recommendations on requirements to empty or repair septic tanks, provision of subsidies or micro-credit to low-income families on high-density areas to upgrade existing facilities, etc;
- Advise the Health Department on areas with unsanitary wastewater conditions so that intensive focus can be provided to communities on household hygiene;
- Report to the regulator any breaches of environmental regulations;
- Deploy environmental cadres to assist in the provision of the above services as necessary and in accordance with capacity-building progress;
- Liaise with community heads (RW/RT).

On-site facilities desludging and sludge disposal at the IPLT

- Organize vacuum truck and motor cycle desludging as a city government service; operators to remain in the private sector, but will be licensed and their services contracted for by the operator/manager through a standard service contract, with fees regulated by *perda* and published, and based on distance travelled and volume of sludge transported;
- Report to the regulator any breaches of environmental regulations;
- Management, operation and maintenance of the IPLT;
- Authorisation of payments by the city government treasury on production by private sector operators of receipt certifying delivery of sludge to the IPLT.

7.6.2 Community intermediate wastewater services

- Identify locations of all community facilities; prepare, maintain and update a central register;
- Conduct periodic inspections of community facilities; provide technical advice to community supervisors on operation and maintenance;
- Check accounting records to ensure accountability for user fees;
- Identify and make recommendations for installation of new community facilities in areas currently unserved or inadequately served, or the refurbishment of existing facilities; make required budgetary provisions;
- Conduct periodic inspections of intermediate systems and disposal facilities on private residential housing estates and ensure that O&M conditions are in accordance with the building permit;
- Report to the regulator any breaches of environmental regulations;
- Deploy environmental cadres to assist in the provision of the above services as necessary and in accordance with capacity-building progress;
- Liaise with community heads (RW/RT).

7.6.3 Off-site conventional and intermediate small bore sewer wastewater systems

- Operation and maintenance of conventional and intermediate small bore sewered systems, including periodic inspections of mains and manholes;
- Operation and maintenance of the wastewater treatment plant facilities (IPAL);
- Observance of all technical and environmental standards;
- Formulation of technical plans for improving and expanding the system;
- Commercialisation of tariffs for non-household and non-social customers;
- Establishment policies for connection fees and billing and collection procedures;
- Provision of affordable solutions to low-income households with regard to connections, user tariffs and service charges;
- Accountable management of financial and administrative systems in accordance with regulations;
- Responsiveness to customer attitudes and complaints in order to enhance customer satisfaction, including inspections of tertiary mains and connections;

7.6.4 Grey water disposal services

- As part of periodic inspection duties, check functionality and condition of tertiary drainage; record observations in a central register;
- Report problems to responsible city government agency, e.g. blockages, construction and repair problems;

- Advise households community heads (RW/RT) on the need for and methods of corrective action in the case of minor repair problems;
- Provide guidance to households and community heads on the need to maintain drainage in good operating conditions in the interests of hygiene and environmental control;
- Provide guidance to households and community heads on simple repair methods;
- Advise *Dinas Bina Marga dan Sumber Daya Air* of needs for new construction of tertiary drainage;
- Report to the regulator any breaches of environmental regulations;
- Deploy environmental cadres to assist in the provision of the above services as necessary and in accordance with capacity-building progress;

7.7 Office of the regulator

The need to establish an independent regulator to ensure an equitable balance between the requirements of the semi-autonomous wastewater operator/manager, the community and the executive and legislative city authorities is absolutely essential to avoid conflicts of interest and contribute to good governance. The city administration has selected a BLU-D, a not necessarily for profit agency as the operator/manager; therefore the regulator should have a different perspective to that of a supervisory board (*badan pengawas*) of a profit-mandated BUMD such as a PDAM where commercial considerations prevail. The city administration has recognised the need for a more socially and environmentally-oriented supervisory body by nominating the Environment Department (*Badan Lingkungan Hidup*) as the prospective regulator.

The recent law on the Protection and Management of the Environment (Law No 32/2009) places much responsibility on regional governments for sustaining and improving the quality of the environment and advocates a prominent role for participation by the community. It makes provision for the appointment of a regulator within the regional government apparatus (Section 15). However, the necessary central government implementing regulations (PP) have not yet been issued, although all PP required by the law were supposed to have been completed by the end of 2010.

In addition, the office of the regulator should have the responsibility of ensuring that the provisions of Law No 25/2009 on Public Services are carried out in accordance with the service quality requirements laid down for the wastewater sector (these requirements are presently being drafted by the Ministry of Public Works). It is noted that, under this law, the community has the right to its own supervisory institution for the oversight of public services (Section 39.).

Experience of the regulator in Indonesia has, for the most part, been limited to the economic and operational functions stipulated in private sector participation (PSP) infrastructure arrangements, with the objectives of:

- Ensuring that customers receive essential goods and services on a sustainable and affordable basis;
- Encouraging PSP in the development of an infrastructure to provide these goods and services

These functions essentially concern the setting or approving of tariffs and service charges in return for the operator/manager meeting defined indicators for service deliveries, i.e. indicators over which the operator/ manager has a substantial measure of control. However, given the need for tariffs not to exceed a 2% household income ability-to-pay factor and thus the requirement for a public service obligation to be

provided by the city government in order to ensure full recovery of recurrent O&M costs, the tariff issue will probably be of more concern to the city government executive and legislature than to customers. Consequently, in addition to financial and operational benchmarks, some of these performance indicators must relate to environmental and social issues which ought to be of major concern to the regulator of a wastewater management service, but which, to date, have not figured significantly in Indonesia within the regulatory context.

Service delivery standards are defined in a set of internal performance indicators (i.e. annual targets for the operator/manager), a proposal for which is given in Chapter 7.9.1. These would form the basis of any performance contract between the regional government (as the employer) and the operator/manager. Compliance with these indicators would be monitored and evaluated by the regulator, whose decisions and publicised report would be further shaped by discussions with the operator/manager and the stakeholder committee.

In addition, the regulator would participate with the operator/manager and stakeholder committee in the setting and review of a set of external wastewater indicators which would mainly relate to social, health and environmental issues. External wastewater indicators are substantially outside the control of the operator/manager but are extremely relevant to the environment and health of the community. They are, therefore, of much importance for the community and the city executive and legislative authorities. A set of proposed external indicators is given in Chapter 7.9.3.

A further responsibility of the regulator should be the enforcement of sanctions against transgressors of the law on the environment. The ability of the regulator to discharge this task will depend on the contents of the yet-to-be-issued implementing regulations on the function of the regulator, which will be reflected in the decrees (*perda* and *perwali*) which will be required to operationalise the PPs at regional government level. Ideally, these will include the need for public accountability of city government institutions, private businesses and individual contraveners of the law. The responsibilities of the operator/manager in Chapter 7.6 contain a provision for reporting any breach of the law to the office of the regulator for appropriate action.

To summarise, the role of the wastewater regulator is seen as follows:

- **Service standards.** The regulator should participate in the setting of standards for services to be provided by the operator/manager.
- **Advice on policy.** The regulator should review inputs from the operator/manager, stakeholder committee and the city government on policies to be formulated and implemented for the improvement of wastewater service deliveries.
- **Review, issue or cancel approvals.** Based on environmental, social and health considerations, the regulator should make decisions on licensing for issues such as locations for wastewater and septage treatment plants, as well as the methodologies and technologies employed for treatment and disposal.
- **Tariffs and service charges.** The regulator should review tariffs and service charges and take into consideration the views of the stakeholder committee; however, given the need for a PSO to support O&M full cost recovery, this will be of more concern to the city executive and the DPRD (ref Chapters 3.4 and 3.8)
- **Performance.** The regulator should monitor and evaluate the performance of the operator/ manager, either by means of reports submitted by the operator/manager, information from the stakeholder community and other representatives of the community, or independent survey by the regulator. The

evaluation of performance may impact, positively or negatively, upon capital investment in the sector and compensation to the staff of the operator/manager.

- **Stakeholder participation.** The regulator should encourage stakeholder participation in regulatory decision-making by convening meetings on regulatory issues, at which stakeholder comments would be actively solicited.

The delay on the part of the central government in issuing implementing regulations on the role and functions of the environmental regulator, together with the absence of any relevant regulatory precedent in Indonesia, do not provide a firm foundation for identifying and defining the role of the regulator for a regional government service delivery. In such a context, there is currently no basis on which to propose a truly independent office of the regulator. The selection of the Environmental Department of the city government as the location for the office of the regulator represents a compromise between the ideal and the practical. Collaboration between the city and provincial governments may be necessary to reinforce the role of the wastewater regulator in Bogor.

7.8 Review of the building regulations

The current regional government decree (*Perda*) No 07/2006 on Buildings has been reviewed for clarity and adequacy of sections concerning wastewater disposal arrangements required for the issue of building permits. Overall, the contents of the decree are satisfactory for toilets, waste pipes and individual septic tanks, but there is a need for additional regulatory provisions to manage the transition from almost universal on-site systems to the progressive introduction of off-site conventional and intermediate sewered systems.

A revision to *Perda* No 07/2006 is required to include wastewater disposal technical standards and arrangements for off-site conventional and intermediate sewered systems (including intermediate small bore sewer systems on private residential housing estates), and community intermediate installations (MCK Plus and SANIMAS). The revision should cover not only individual household premises, but also commercial establishments and light industrial units.

It is recommended that the Operator/Manager be given authority to sign off on the adequacy of wastewater arrangements for all new building permits. The authority for issuing the permit would remain with the Licensing Department (BPPD).

7.9 Performance indicators

7.9.1 Internal performance indicators

Internal performance indicators are used by an organization to monitor actions for improvement which are within the control of the organization's management. The basic concept is to identify the mission, objectives, customers and traceable outputs to find the best indicators so that the process becomes a systematic tool to foster continuous improvement.

The performance indicators selected should be an appropriate blend of management, operational and financial results, each of which is compared with a target within a single concise report. This is commonly

known as the balanced scorecard. The report is not meant to replace traditional management reports, but rather a focused, succinct summary which captures the information most relevant to its recipients.

In the wastewater sector, the balanced scorecard report should be studied by the operator/manager itself and the regulator, in consultation with the city government executive and legislature and the stakeholder committee, to determine the financial, legal, technical, environmental, management and institutional implications of performance indicator outcomes. This will enable all parties to consult and decide what corrective actions, including policy changes, are needed to remedy unsatisfactory performance and also to yield the expected benefits. The report can also be used by the regulator and the city government to determine the future pattern of investment in the wastewater sector and to provide incentives, including material incentives, to the staff of the operator/manager.

The operator/manager, regulator and stakeholder committee should agree on a set of internal performance indicators. This will be a work in progress for the first 3-4 years, especially in the case of development of the indicators for the sewered systems which will be the last of the wastewater system typologies to become operational. The regulatory requirements schedule of Table 7.3 anticipates this. Thereafter annual discussions of the number and nature of the indicators reaches a (more or less) permanent status.

The operator/manager will take a prominent role in discussions and decisions and actions to be taken when annual reviews of the internal performance indicators take place.

A set of potential internal performance indicators is shown in Table 7.4 below. It has been designed with the particular objectives and characteristics of the full BLU-D in mind; that is an efficient, effective and productive service with social and environmental priorities and not necessarily for profit.

Table 7.4: Proposed Internal Performance Indicators

No	Internal Performance Indicator	Unit
A	**Financial (Sewered Systems Only)**	
1	Change in annual investment budget (+/-)	%
2	Change in annual revenues (+/-)	%
3	Actual accrued revenue	Rp
4	Average tariff	Rp/m3
5	O&M cost	Rp/m3
6	O&M cost recovery factor from Tariff	%
7	Change in PSO required (+/-)	Rp/connection
8	Collection efficiency	
B	**Operational**	
1	Number of connections on sewered systems	no
2	Number of manholes opened	no
3	Number of septic tanks inspected	no
4	Number of septic tanks emptied	no
5	Tertiary drainage inspected	km
6	Number of complaints received	no
7	Number of complaints resolved	no
8	Average response time to complaints	days
9	Number of sewage back-ups reported	no
10	Number of sewage overflows reported	no

No	Internal Performance Indicator	Unit
11	**Wastewater treatment plant (IPAL)**	
11.1	Average hours per day in operation	hrs
11.2	Annual capacity utilisation	%
11.3	Volume of wastewater treated	M3
11.4	Electricity consumption	Rp/m3
12	**Septage treatment plant**	
12.1	Average hours per day in operation	hrs
12.2	Annual capacity utilisation	%
12.3	Volume of wastewater treated	M3
12.4	Electricity consumption	Rp/m3
13	**BOD**	
13.1	Effluent at wastewater treatment plant (IPAL)	mgBOD/lit
13.2	Effluent at septage treatment plant (IPLT)	mgBOD/lit
13.3	Overload at wastewater treatment plant (IPAL)	%

7.9.2 Performance contract

The use of performance contracts is an effective means of improving the performance of government-owned enterprises, agencies and departments. Essentially, a performance agreement is an agreement between a government (including a regional government) and a public or private agency which establishes goals for the agency. It usually includes a variety of incentive-based mechanisms for controlling outputs rather than the process itself. Performance agreements are now considered an essential tool for enhancing accountability for results and good governance in the public sector.

Recourse to a performance contract between the regional government and the operator/manager is an obvious consequence to the process of formulating and reviewing internal performance indicators. However, it should be borne in mind that the wastewater management sector in Indonesia is at a very early stage of development and that the proposals outlined for implementation of infrastructure and technical support services are wide-ranging and ambitious, and have yet to be fully confirmed by the city government. In other words, the future pathway of the wastewater sector is yet to be fully formulated and may have to be modified during its evolution because of the need to consider budget constraints which could impact upon the length of time needed to phase in the technical support for the non-revenue generating services. It is therefore considered that recommendations for a performance contract are premature.

It is suggested that internal performance indicators are used for guidance and training during the first phase of the Master Plan, rather than as a carrot-and-stick approach with incentives and disincentives. The development of a performance contract could be included as an activity for the late stages of the proposed comprehensive capacity-building technical assistance assignment when progress to full wastewater service management by the BLU-D should have become clearer. The performance contract could thus come into effect during the second phase of the Master Plan when the full BLU-D is operational.

7.9.3 External performance indicators

The operator/manager, the regulator and the stakeholder committee should agree on a set of external performance indicators. The list should be limited to those indicators which can be collected with relative ease.

Examples of external performance indicators, which should be collected by the regulator, with the assistance of other city government agencies, such as the Health Department and the Statistics Office, and disseminated to the general public, are given in Table 7.5 below.

Table 7.5: Proposed Internal Performance Indicators

Indicator	Measurement	2012	2013	2014	2015
Toilet coverage	%				
Open defecation	%				
E-coli in groundwater	Nrs /100ml				
E-coli in surface water	nrs/100ml				
Incidence of diarrhoea	no				
Tertiary drainage built	km				
Number of times per year wastewater is discussed in the DPRD	no				

8. Wastewater financing and financial management

8.1 Sources of funds for investment

8.1.1 Identification and evaluation of existing and potential sources

Bogor City's plans for development of the wastewater sector require major investments in the construction and, where, appropriate, rehabilitation of three (3) types of wastewater services.

- **Off-Site systems** which collect household black and grey waters, which are conveyed through a sewered pipe system to a wastewater treatment plant (WWTP);
- **Intermediate systems** (such as SANIMAS and MCK Plus), each of which collects and treats the black water of approximately 50 households;
- **On-Site Systems** which collect the black water of individual households in septic tanks (or similar storage facilities); once the tank is full, it is emptied by a vacuum truck, which transports the sludge to a dedicated septage treatment facility (IPLT).

In addition to these physical investment requirements, the city will need to invest in improving the capacity of institutions involved and the awareness of the community during the first phase of the Master Plan. The total cost of the required investment is estimated at Rp 1.9 over the 20-year period of the Master Plan (Table 8.1) estimated in mid-2011 constant engineering base costs, excluding physical contingencies and PPN tax,

Table 8.1: Investment Costs for Wastewater Services in Bogor City 2011-2030 (Rp Billion, Indicative)

Service	Phase I 2011-2015	Phase II 2016-2020	Phase III 2021-2030	Total 2011-2030
Off-Site*	59	211	680	950
Intermediate	58	99	108	265
On-Site	128	268	164	560
Commercial Facilities	18	53	20	91
Capacity Building**	52	-	-	52
Total	260	624	972	1,918

* Including septage collection and treatment
** Including "software component"

8.1.2 Allocation of responsibilities for financing wastewater services

In 2008, the Ministry of Public Works (MPW), which is responsible for regulation of the wastewater sector in accordance with PP No 38/2007 on the Division of Responsibilities between Central, Provincial and City/Regency Governments, issued Decree No 16/2008 on the National Policy and Strategy for the Development of Domestic Wastewater Management. It stipulates that central government is responsible for financing: (i) provisions to encourage the mobilisation of funds for household wastewater management (*dana stimulan*); (ii) the facilitation private-public participation (PPP) for wastewater services and (iii) the initial investment in piped sewerage and wastewater treatment facilities, which would be further developed by regional governments. Since the issue of this decree, MPW has been involved in the preparation of one (1) major wastewater project – the Metropolitan Wastewater Management and Health Project (MSMHP). The Directorate General of Human Settlements (DGHS) in MPW has confirmed that the financing principles

used for MSMHP will also apply for investments and O&M for Phase I of the WWMP in Bogor, as described below and as shown in Table 8.2.

- **Off-Site**: MPW will finance the costs of new primary and secondary piped sewerage systems and their wastewater treatment plants, provided these costs are eligible for financing from a multilateral or bilateral loan. City governments are responsible for tertiary pipes and connections and the expansion of existing systems, all O&M, plus non-eligible costs such as land acquisition and resettlement. Households and businesses will finance private toilets and plumbing to connect to the sewer system.
- **Communal**: MPW and the city government will provide funds to communities to construct communal wastewater facilities (MCK and SANIMAS types); communities (households) are responsible for O&M.
- **On-Site**: Households/businesses will finance toilets and septic tanks; vacuum trucks by either the city government or the private sector; the city government, possibly supported by the province is responsible for investments in septage treatment facilities.
- **Drainage**: MPW is responsible for investment in primary drainage, the provincial government for secondary drainage and the city government for tertiary drainage. The city government is responsible for O&M of all drainage.
- **Capacity Building**: MPW wishes to use its own training centres or to finance this activity from external grants. Multilateral loans may be used to fund comprehensive sector-wide capacity building management. The city, community groups, NGOs and the private sector will be encouraged to support activities in high-density, low-income areas.

Table 8.2: Financing Responsibility for Wastewater Services

Service	Investment				O&M	
	MPW	Province	City	Private	City	Private
Off-Site						
Private Toilet				*		*
Connections Tertiary Sewer Pipes15			*		*	* (fees)
Primary & Secondary Sewer Pipes	*	**	***		*	* (fees)
IPAL	*				*	* (fees)
Communal Wastewater						
MCK	*		*			*
SANIMAS	*		*			*
On-Site						
Private Toilet Septic Tank				*		*
Vacuum Truck			*	*	* (fees)	* (fees)
IPLT		*	*			* (fees)
Capacity Building						
Land Acquisition						

[15] Defined as all pipes located in alleys (*gang*)

Service	Investment	O&M
Resettlement		

** costs not eligible for external loan financing
*** system expansion only

8.1.3 Identification of available funding sources

The following sources of funding will likely be available for financing wastewater sector investments in the short and medium-term (Table 8.3).

- **Central, provincial and city government budgets.** DGHS, West Java province and Bogor City itself may allocate funds from their own budgets to co-finance investments. Because the wastewater sector competes for scarce funding with other sectors, it is not possible to forecast available funds.
- **Foreign Loans.** DGHS plans to utilise US$ 400 million of ADB loan funds to finance eligible costs of off-site systems in 16 metropolitan and large secondary cities, including Bogor City. DGHS is also currently mobilising foreign loan funds to finance SANIMAS facilities in West Java and other provinces (a lump sum of Rp 350 million would be made available for each facility). Until such loan funds become effective, DGHS will use its own budget (APBN) to finance SANIMAS facilities for which there is a demonstrated demand.

Table 8.3: Investment Costs for Wastewater Services in Bogor City 2011-2030 (Rp Billion, Indicative)

Service	DGHS	Province	City	Private
Off-Site				
Private toilet				Own funds Micro-credit
Sewer connections Tertiary sewer pipes			APBD-City OBA	
Primary and secondary sewer pipes, WWTP	APBN, foreign loans passed on as grants	APBD-Prov	APBD-City, Municipal bonds	
Intermediate				
Communal sanitation	APBN, foreign loans passed on as grants		APBD-City OBA	
On-Site				
Private toilet				Own funds Micro-credit
Vacuum truck			APBD-City Bank loans	
IPLT		APBD-Prov	APBD-City	
Land Acquisition and Resettlement			APBD-City	
Capacity Building	APBN foreign grants			

Source: Ministry of Public Works, DGHS

- Foreign grants (including OBA). IndII is expected to have a budget available for output-based aid (OBA). Under this scheme, a city government would be reimbursed for installation of sewer connections or communal sanitation facilities financed from its own resources. Foreign grants may also be used for capacity building.
- Own funds. Households and businesses will finance part of the investments (toilet, septic tanks, internal plumbing) from their own savings.
- Bank loans (including micro-credit). The track record of domestic banks, both state-owned and private, in providing finance for regional government long-run infrastructure services has been dismal to date, notwithstanding exhortations from Ministry of Finance and Bank Indonesia. Contractors have been more successful than regional governments in obtaining this kind of finance, but only at high interest rates and short loan tenors, the costs of which eventually have to work their way into tariffs. It would be optimistic to expect a change of policy on the part of the domestic banks any time soon, At present, domestic banks can finance investments with relatively short economic life cycles (5-7 years), the costs of which can be fully recovered from user charges. At present, only vacuum trucks meet these criteria. Low-income households may have difficulties to finance sewer connections or septic tanks from their own, often very limited savings, and the city government may wish to encourage the use of micro-credit to enable borrowers to pay for such services in instalments.
- Municipal bonds. Ministry of Finance regulations (PP No 30/2011 and PMK No 147/2006) allow regional governments to issue bonds for financing revenue-generating public infrastructure delivery services. PMK No 147/2006 does not require full cost recovery from the services, with payment of interest and repayment of bond principal being supported by the issuer's general cash flows. No such bonds have yet been issued in Indonesia, but DKI Jakarta and East Kalimantan Province plan to do so. One of the four (4) projects to be funded from the DKI bond issue is an expansion of the sewered system in the Central Business District at estimated cost of Rp 253 billion.

8.2 Physical investment programme - Phase I (2011-2015)

8.2.1 Project costs

The total cost of the Phase I programme for Bogor City is estimated at Rp 206.7 billion in current prices, or about US$23.0 million equivalent (Table 8.4). This amount excludes investments in on-site wastewater facilities (such as the procurement of toilet bowls and indoor plumbing), which will be undertaken and financed by households and businesses without an active involvement of the city government.

Table 8.4: Costs of Phase I Programme, Bogor City, 2011-2015 (Rp Billion)

Cost Item*	Cost Estimate (Rp b)		Expected Outcome
	Base Costs**	Current Costs	
Physical Investment	116.7	147.4	
Construction of the Paledang off-site system ("embryo")	47.3	57.5	Construction of 3,100 new off-site sewer connections
Rehabilitation and expansion of the Tegal Gundil off-site systems	8.9	10.7	Capacity increase from 300 to 900 off-site sewer connections
Rehabilitation and expansion of intermediate systems	57.5	75.7	Construction of small-scale sewerage and community-based wastewater systems for 10,000 households, rehabilitation of community-based systems for 1,000 households
Procurement of vacuum trucks	3.0	3.6	Increase in sludge collection capacity
Supporting Programmes	52.4	59.3	
"Software" activities	28.9	35.8	Improved capacity of city government, wastewater services providers and communities to manage wastewater services
Capacity building programme	22.7	22.5	
Establishment of regulator	0.8	1.0	Independent regulation of wastewater charges and public service obligations
TOTAL	**169.0**	**206.7**	

* Excluding on-site systems (to be financed by households and businesses)
** Base cost in mid-2011 prices (excluding physical contingencies, price contingencies, and taxes)

8.2.2 Financing plan.

The total cost of the proposed Phase I investments, which is estimated at Rp 206.7 billion, will be financed from the following sources (Table 8.5):

- central government grants, likely to be financed by ADB or other foreign lenders (Rp 111.3 billion);
- grants from bilateral donors, to co-finance the software activities and the capacity building programme (Rp 30.8 billion);
- the city government's own resources, APBD-Kota (Rp 38.2 billion), and
- private sector investments (Rp 24.6 billion).

Table 8.5: Financing Plan of Phase I Programme, Bogor City, 2011-2015 (Rp Billion)

Cost Item*	Funding Source						
	Foreign Loan	Foreign Grant	APBN	APBD-Prov	APBD-City	Private Sector	TOTAL
Physical Investment Programme	110.3	-	2.9	–	30.7	3.6	147.4
Construction of the Kali Asin off-site system ("embryo")	40.1	-	–	–	17.4	-	57.5
Rehabilitation and expansion of the Tegal Gundit off-site systems	4.6		2.9		3.2		10.7
Rehabilitation and expansion of intermediate systems	65.6	-	–	–	10.1	-	75.7
Procurement of vacuum trucks						3.6	3.6
Supporting Programme	-	30.8	–	–	7.5	21.0	59.3
"Software" activities	-	8.3	–	–	6.5	21.0	35.8
Capacity building programme	-	22.5	–	–	-	-	22.5
Establishment of regulator	-	-	–	–	1.0	-	1.0
TOTAL	**110.3**	**30.8.3**	**2.9**	**–**	**38.2**	**24.6**	**206.7**
% Total	53%	15%	1%	0%	18%	12%	100%

* Excluding on-site systems (to be financed by households and businesses)

8.2.3 Flow of funds

The proposed subprojects will be financed from 4 (four) different sources of funds:

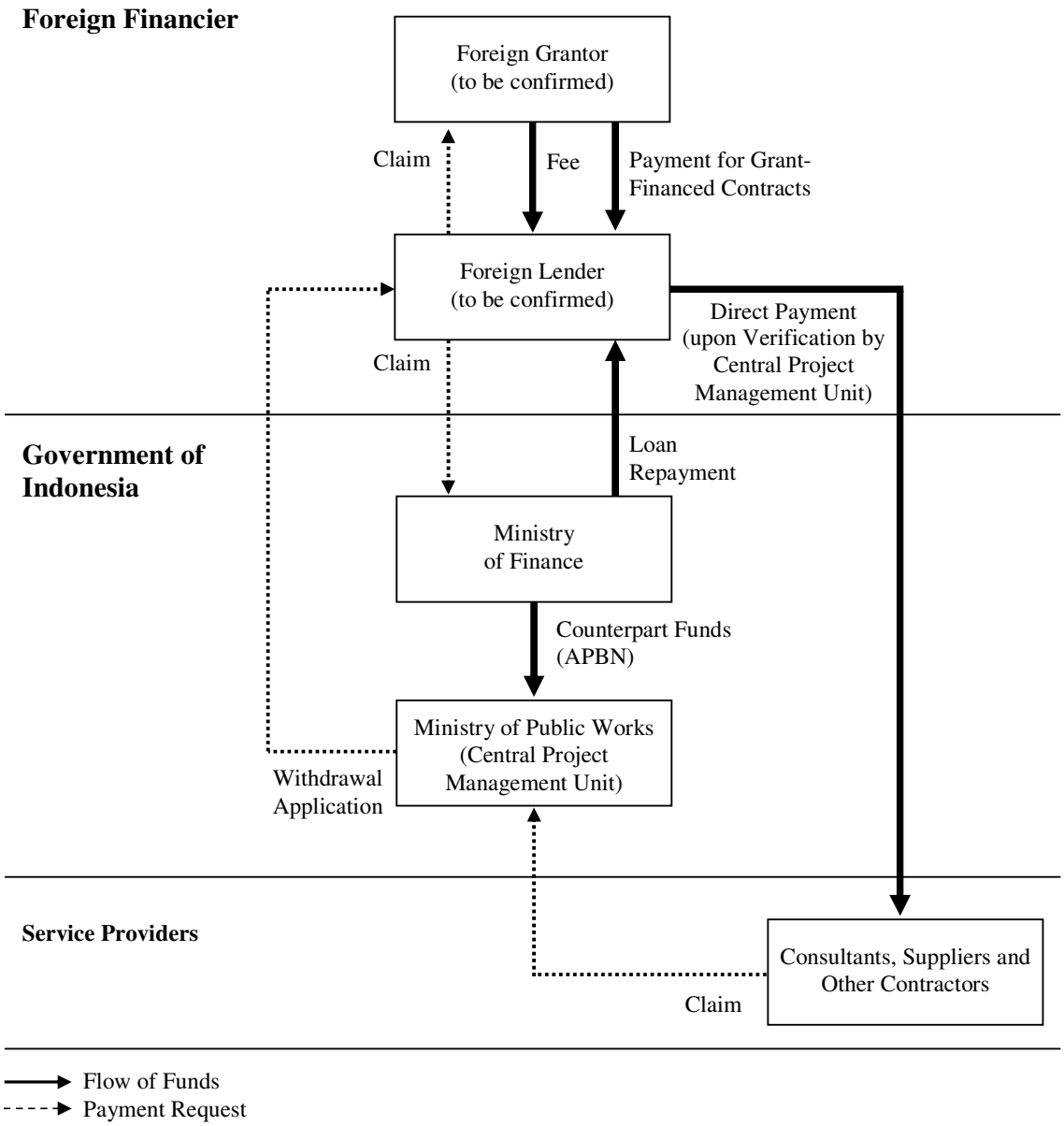
- foreign loans
- foreign grants
- city government budgets (APBD)
- private sector investments and contributions.

Foreign funds

Over 50% of the estimated project cost will be financed from the proceeds of foreign loans. In addition, it is anticipated that foreign grants will finance the full cost of the proposed capacity building program, as well as a major portion of the cost of the software component, and possibly a portion of the cost of community-based sanitation systems (SANIMAS). It is assumed that foreign grants will be managed by the prospective foreign lender in return for an administration fee. This is a common practice whereby a central project management unit (CPMU), probably located in MPW, approves payment requests and submits a claim to the grantor for reimbursement.

The funds channelling arrangements for foreign loan and grant funds are summarized in Figure 8.1 below.

Figure 8.1: Indicative Flow of Foreign Loan and Grant Funds



Domestic funds

The balance of the project costs will be financed off the national budget (APBN) and city government budget (APBD) and by means of private sector investments and contributions. The APBN will fund the rehabilitation and expansion of the Tegal Gundit off-site system. The APBD will fund civil works, goods and service contracts not financed from foreign sources. Private sector investments include the purchase of sludge vacuuming vehicles and environmentally acceptable septic tanks. Private sector contributions consist of two types: (i) contributions towards the operations and maintenance of community-based

sanitation systems, and (ii) donations of private enterprises to finance selected software components, as part of the corporate social responsibility (CSR) programme of such enterprises.

8.3 Tariff policy for off-site conventional and intermediate sewerage systems

Commercial and industrial customers should be required to pay full O&M cost recovery tariffs. The city government will decide whether social organizations (schools, hospitals, places of worship, etc) and city government offices should also pay the full rate. However, it is not possible to apply the full O&M cost recovery principle to households in view of the DGHS policy that monthly household sewered wastewater charges should not exceed 2% of monthly household income. This limitation is likely to result in total revenues being insufficient to fully cover O&M expenditures; in which case, a subsidy in the form of an annual public service obligation will be required. Potential sources for funding the PSO are discussed in Chapter 8.8.

The operator/manager, expected to be in the form of an embryo BLU-D or the UPTD IPAL+IPLT on behalf of the incoming embryo BLU-D, will prepare a tariff policy as part of the business plan. It is recommended that tariff policy is based on limiting the number of interventions by the city government executive (mayor) and legislature (DPRD) to a minimum. This could be achieved by having the initial tariff approved, based on investment and annual recurrent costs, with usage in cubic metres estimated at 80% of piped water consumption. This arrangement would be accompanied with an agreement that the tariff (plus related connection maintenance fees and administrative charges) would be allowed automatic annual increases for the following four (4) years based on official inflation statistics. After five (5) years, the tariff would be rebased as a function of fixed asset values and recurrent costs, and would again require the approval of the mayor and DPRD, with the same arrangements for annual adjustments. The operator/manager will draft a *perda* to this effect.

The initial tariff calculation will be based on full O&M cost recovery. Weights would be attached to the basic tariff (low-income households) and applied to other household categories, as well as social, commercial and industrial customers. The weighting system used by PDAM would probably be suitable, at least as a proxy indicator. Ability-to-pay factors of 2% of average household income would then be applied to the weighted tariff based on full O&M cost recovery and the subsidised tariff calculated accordingly. This will allow the operator/manager to calculate the total PSO required for inclusion in the annual APBD.

Non-payment of water supply and electricity bills is sanctioned by disconnecting supply, but without financial or other penalties. Failure to pay the wastewater tariff cannot be met by cutting the supply, and therefore means to enforce payment, or otherwise to oblige the defaulting customer to face legal proceedings, must be incorporated in the *perda*.

8.4 Connection installation fee policy for off-Site conventional and intermediate sewerage systems.

Connection installation fees will be based on the same pricing principles as the tariff in terms of customer category. Installation fee costs and monthly maintenance fees will be incorporated in the same *perda* policy and tariff schedule as per Chapter 8.5.

Whilst it is likely that the first sewered mains and, probably, most subsequent sewered installations during the master plan period will be along city protocol streets, which are usually lined with commercial establishments and high-income households with strong ability-to-pay, the operator/manager may wish to consider introducing a credit scheme for connection installations by low-income families. This could be a scheme administered by the operator/manager, or a bank specialising in micro-credit arrangements, such as Bank Rakyat Indonesia (BRI), could be invited to manage the initiative.

BAPPEDA will co-ordinate city government policy on whether to subsidise household connections in whole or in part or not at all. The same consideration will apply to connections for social agencies (e.g. schools, clinics, hospitals, places of worship). It is expected that commercial establishments and light industrial premises will pay the full connection installation fee.

BAPPEDA will also ensure that all subsidy arrangements are appropriately funded on the annual city government budgets.

8.5 Compulsory connection policy for off-site conventional and intermediate sewerage systems

Results from the household survey indicate a low willingness-to-connect to off-site conventional and intermediate sewered systems in Bogor City. Government at all levels is prepared to invest significant sums in improving wastewater service and the environmental health of communities. It is therefore recommended, irrespective of the nature of the policy decision on subsidizing connection installation fees, that the city makes it compulsory for all households and other establishments with premises which have access to the sewered pipe line alignment to have the connection installed.

The operator/manager will draft a *perda* on the capital levy one (1) year before the first off-site sewered system becomes operational. The levy should comprise a connection maintenance charge, service charges, plus a monthly retribution based on an assumed wastewater discharge. Enforcing sanctions should be incorporated on the *perda* for owners of premises who are non-compliant.

8.6 Billing and collection procedures

In the early years of off-site conventional and intermediate sewered systems operation, the number of monthly bills issued will be relatively small. It would therefore not be cost-effective for the BLU-D to have its own billing, bill delivery and collection system. It is therefore recommended that this process be outsourced to the PDAM which would include charges as a separate item to its own water supply bills. This solution is particularly appropriate since sewered system user charges are linked to piped water consumption and almost all users will be connected to the PDAM system (the PDAM has a 60% household coverage).

The alternative would be to ask the provincial office of the state electricity company to bill these charges as a separate item. The advantage is that PLN has an almost 100% coverage; however, this is outweighed by the fact that PLN would need access to PDAM bills in order to calculate the wastewater usage charges. Furthermore, PLN would almost certainly be unwilling to entertain such a proposal and, since it is a state-owned enterprise, the city government has little leverage in the matter.

The operator/manager should negotiate an agreement with PDAM before the first small bore sewered off-site system becomes operational. The general practice in other cities where PDAM incorporates the bills of other organizations (e.g. solid waste) into its monthly bills is to make an administrative charge of 5% on the value billed and to deduct this amount before passing on the revenue proceeds to the PDAM.

8.7 Other revenue sources to fund wastewater services

In addition to the PSO to cover any shortfall in O&M full cost recovery, as discussed in Chapters 8.4, a sustainable wastewater management service is going to require significant financial inputs from the city government in order to provide for technical support to intermediate community systems, on-site systems and tertiary (grey water disposal) drainage operations. This will be especially important in high-density, low-income areas where improved environmental health and control is so crucial to the success of overall wastewater management.

The most appropriate sources of funds would be either to levy a specific wastewater retribution, to be applied to occupiers of all premises in the city, or an allocation from the two property taxes which are now within the administrative control of regional governments; or a mix of contributions from both sources. These are discussed below.

8.7.1 Wastewater retribution

The rationale for introducing a universal wastewater retribution, except for those already paying the sewered system tariff or the capital levy, is known as the “polluter pay” principle, i.e. that all households and other establishments discharge wastewaters which, to varying degrees, contribute to environmental degradation, and, therefore, that they should all be required to make a financial contribution towards the proper disposal of such wastes.

The earliest feasible target date for introduction of the wastewater retribution is 2013. In early 2012, the entity responsible for wastewater management, proposed to be a UPTD IPAL+IPLT, should calculate the cost of technical support required to support non-sewered wastewater services (sewered systems are not expected to enter into service until 2015).

The cost information calculated by the UPTD IPALT+IPAL would be passed to the Revenue Department (*Dinas Pendapatan*) which would draft a *perda* for the retribution, including a methodology for assessment of the tax. The retribution could be graduated, depending on typology and/or area of the building, or it could be calculated as a factor against the property tax assessment. The method of collection could be as an addition to the property tax (PBB) bill; this would be much more equitable an easier than using the PDAM as the billing agent because of the efficiency of property tax coverage and collection.

8.7.2 Property taxes

These consist of the land and buildings annual property tax (PBB) and the land and buildings property transfer tax (BPHTB). Until recently, both were administered by the Directorate of Taxation at the Ministry of Finance, with receipts allocated to the various levels of government as shown in Table 8.6.

Table 8.6: Allocatrion of property tax receipts

Tax	% MOF (for admin)	% Province	% Kab/Kota (specific)	% Kab/Kota (general)	Incentives
PBB	9.0%	16.2%	64.8%	6.5%	3.5%
BPHTB	-	16.0%	64.0%	20.0%	-

In the latest revision to the law on regional government taxes (Law No 28/2009), both taxes were devolved in their entirety to city/regency (*kota/kabupaten*) regional governments. All regional governments are required to begin administering these taxes by January 2014 at the latest. Bogor City has already taken over the administration of the BPHTB. However, the extensive capacity-building required to meet the necessary readiness criteria will probably delay the city from taking over control of the PBB until January 2014

Although the PBB revenue yield and its contribution to GDP are low when compared internationally, it is highly efficient in terms of tax object identification and revenue collection. Bogor City's income from this source will rise by at least 40% as a result of the re-allocation of tax proceeds. The increase from the BPHTB is 56%. Both taxes have considerable scope for growth, especially the BPHTB, as the property market develops and matures, and truer property sales transactions will be registered.

8.7.3 Allocation of property taxes to fund wastewater management services

The practice in Indonesia for funding specific activities is to nominate a generic source, e.g. APBD and APBN revenues. However, in many countries, property tax legislation contains provisions for allocating stipulated percentages of annual property tax receipts for investments in and O&M of specific urban delivery services such as street lighting and wastewater and solid waste collection and disposal. In addition, any need for incremental wastewater services, such as payment by the city government for the compulsory desludging of septic tanks, could be funded by absorption of the costs into the next round of property tax valuations (*nilai jual obyek pajak* – NJOP). It would be more difficult to do this through an adjustment to the wastewater retribution.

In early 2012, the entity responsible for wastewater management, proposed to be a UPTD IPAL+IPLT, should calculate the cost of technical support required to support non-sewered wastewater services (sewered systems are not expected to enter into service until 2015 at the earliest). As in the case for the wastewater retribution, the revenues allocated from PBB and BPHTB receipts would be used towards funding the following wastewater services:

- Provision of a regular technical service to households equipped with on-site septic tanks. All septic tanks (at least those which can be located) would be registered with the wastewater management office. After 2014, private vacuum truck operators would be licensed and contracted by the city government to empty tanks at specific periods and paid against proof that the sludge had been delivered for treatment at the IPLT;
- Setting of standards and periodic inspections of intermediate communal systems and of small bore sewered systems and treatment facilities on private residential housing estates;
- Provision of family toilets (*jamban*) and septic tanks to poor households through a micro-credit system, with seed money provided to a bank;
- Inspection of tertiary drainage systems and provision of advice to community heads on repair and grey water disposal procedures;

- Co-ordination with the Health Department in terms of providing public health and hygiene education to the community ;
- Vetting technical standards of provisions for wastewater disposal as a requirement for the issue of new building permits.

When off-site conventional and small bore sewered systems are operational, there will be calls for additional funding, such as:

- A PSO for any shortfall in the ability of tariffs to fully recover O&M;
- A credit system for low-income household purchasing the sewer connection, unless the city government decides to subsidise the cost of the connection

It will be the responsibility of BAPPEDA, in collaboration with other agencies, such as the Revenue Department (*Dinas Pendapatan*), to determine the sources of funding, or the mix of sources of funding (i.e. retribution and property taxes) required to fund the non-revenue generating technical support services, the PSO and any other approved arrangements. This will require a calibrated approach to annual APBD budgeting, e.g. the pace at which septic tanks will be desludged at the expense of the city government will be determined by the availability of revenues which can be applied such expenditures.

8.8 Regulatory requirements

The schedule of *perda/perwali* required to authorise the various financial issues discussed above is given in Table 8.7 below.

Table 8.7: Schedule of Regulatory Requirements for Finance-Related Issues

Proposed Actions	Target Date	Regulatory Action
Provisions for wastewater capital and operating budgets	December 2011	APBD Perda
Wastewater Retribution (if required)	December 2012	Perda required
Provisions for wastewater capital and operating budgets	December 2012	APBD Perda
Approval of tariff policy and schedule for wastewater usage, connection fee and connection maintenance and administrative service charges. Sanctions and enforcement	December 2014	Perda required
Introduction of capital levy	December 2014	Perda required
Provisions for wastewater capital and operating budgets, including PSO for domestic tariff	December 2014	APBD Perda
Approval of 5-year business plan	December 2014	Perwali required
Provisions for wastewater capital and operating budgets, including PSO for domestic tariff	December 2014	APBD Perda

9. Capacity building

9.1 Capacity building initiatives in the community

A number of specific capacity-building initiatives to provide an enabling environment for the community have been built into the first phase of the Master Plan in order to assist the community to improve their existing wastewater systems. These are products of the technical support to the community, private sector support to the community, revising building permits and micro-credit schemes described above as specific tasks, and accompanied by FOPIP and LIDAP implementing requirements, and will require a blend of city government support together with the active assistance of community-based organizations (CBOs), NGOs and environmental cadres). These initiatives are summarised below, with detailed frameworks, which set out the aims and objectives, targets, activities results, means of verification and critical assumptions: Appendix E.3 of the Institutional Development Report for on-site systems, Appendix E.4 for intermediate systems, and Appendix E.5 for capacity-building through city government institutions

a) On-site systems

- Study performance of existing on-site systems
- Development of new low-cost on-site systems
- Dissemination of results of new low-cost on-site systems within the community
- Marketing of low-cost on-site systems
- Community-based organizations/NGOs, environmental cadres for on-site systems
- Training sanitarians to market on-site systems
- Backstopping community initiatives for on-site systems

b) Intermediate systems

- Study of existing practices of intermediate systems
- Development of intermediate system pilot projects
- Dissemination of results of intermediate system pilot projects within the community
- Marketing of intermediate systems
- Community-based organizations/NGOs, environmental cadres for intermediate systems
- Backstopping community initiatives for on-site systems

c) Capacity building through Institutions

- Establishment of a mobile wastewater information centre
- Exposure to sanitation and hygiene at school
- Exposure to sanitation and hygiene at clinics (*Puskesmas*)
- Exposure to sanitation and hygiene at other government institutions
- Backstopping commercial enterprise initiatives for improved wastewater management
- Sanitation campaigns/persuasion

9.2 Institutional capacity building

As a complement to the capacity-building initiatives to provide an enabling wastewater environment for the community, similar initiatives are required to ensure sustainable institutional arrangements. These are as follows:

9.2.1 Institutional capacity building for on-site system desludging

Specific tasks have been designed with the objective of creating an efficient and effective private sector septic tank desludging service which would be regulated by the wastewater operator/manager, with the sludge delivered for disposal at the city-government managed sludge treatment plant (IPLT). The objective is to improve the quality of ground and surface water, and hence, environmental health. The activities proposed are:

- Study of existing practices of septage removal
- Organising septage removal and environmentally correct disposal

Details of objectives, activities, results, performance, means of verification and critical assumptions are provided in Appendix I.1.

9.2.2 Institutional capacity building for off-site sewerage systems

The aims of this capacity-building component are to use an embryo small bore sewered system and treatment plant ("embryos") as a platform for the management and operation of conventional sewered systems and wastewater treatment plants at a later stage. The major target of the component is to have 9,000 households and commercial establishments committed to connect to the embryo system in the Paledang area of Bogor. The activities proposed, are in synthesis:

- Marketing the embryo
- Organizational set-up for O&M of the embryo off-site sewered system and wastewater treatment plant

Details of objectives, activities, results, performance, means of verification and critical assumptions are provided in Appendix I.2.

9.2.3 Institutional capacity building for the Pokja

During the wastewater master plan period, the dedicated city government working group (*kelompok kerja* or *Pokja*) has played an important role as a facilitator and stakeholder. As a result, it has by now acquired a considerable knowledge base. This role should now be made formal so that the *Pokja* is transformed from an ad hoc working group into a recognised player in the wastewater sector. It should take the lead in organizing the training of city government staff so that they are aware of the need for improved wastewater management and can disseminate information to their communities.

- Formalizing the role of the *Pokja*
- Training city government staff in sanitation

Details of objectives, activities, results, performance, means of verification and critical assumptions are provided in Appendix I.3.

9.2.4 Institutional capacity building and management cooperation workshops

During the first phase of the Master Plan, it is proposed to hold a series of workshops, with two themes: strengthening of institutional capacity and strengthening management cooperation for wastewater services.

Appendix I.4 provides details of the course, number of days per course, the course operator and related city government institutions, number of participants and their organization and the time frame. Workshop topic summaries are given below.

Workshop for Institutional capacity building

- Public service organization (attended by the mayor, city government officials, DPRD, district and community heads, university leaders and representatives of the private sector
- Management training for wastewater services
- Performance training for wastewater services
- Wastewater infrastructure and facilities assets management
- Financial Management
- UPTD IPAL+IPLT Comparative Management Study
- Embryo BLU-D Comparative Management Study

The first workshop is an orientation course of one (1) day. The other six (6) workshops are of three (3) days duration each, specifically related to the principal facets of wastewater management and therefore with more restricted audiences in terms of numbers attending. Three (3) sets of these workshops will be held in 2011, 2012 and 2014 for the UPTD-IPLT, UPTD IPAL+IPLT and the embryo BLU-D respectively, each being progressively more focused as the services to be provided by the operator/manager increase in scope.

Workshop for strengthening wastewater services management partnership o-operation with the community

- Wastewater operator partnership training
- Training of community group wastewater operators
- Sewer pipes and lateral household pipe connections training
- Wastewater channel pipe use and maintenance training
- Monitoring and supervision training for wastewater management services implementation

The first workshop is a community course of one (1) day for neighbourhood community heads (RW/RT), youth organisations, CBOs/NGOs, environmental cadres, university leaders and representatives from the private sector. There will be three (3) such courses (2011, 2012 and 2014) for each of three (3) institutional arrangements (UPTD-IPLT, UPTD IPAL+IPLT and embryo BLU-D) to be made during the first phase of the Master Plan. There will also be a further four (4) workshops within the same time and institutional arrangements framework with community organization cadres working in partnership with the wastewater services operator/manager.

Large meeting rooms will be required for some of these workshops, for which attendances will range between 150 and 300. Five (5) representatives from each sub-district (*kelurahan*) will be invited.

10. Private sector development

The strategic objective in developing customer and community relations in all aspects of wastewater services management is to ensure that necessary wastewater services are provided efficiently, effectively and economically, even though not necessarily by the city government itself directly.

10.1 Legal and regulatory framework

Within the regional government context, the legal basis for private sector partnership in infrastructure service deliveries is Law No 32/2004. The cross–sector regulatory framework at all levels of government is defined by Presidential Decree (PerPres) No 67/2005 (as amended by PerPres No 13/2010), concerning PPP in Infrastructure. Its objectives are:

- Meeting financial requirements in a sustainable manner in providing infrastructure through the mobilisation of private sector funds;
- Improving the quantity, quality and efficiency of service through fair competition;
- Improving the quality of management and maintenance in the provision of infrastructure;
- Encouraging the principle of users paying for services received, taking into account ability-to-pay in certain cases.

The guidelines applicable to the preparation and procurement of private sector infrastructure services are determined by the source of funding. If the funding is sourced from the central/regional budget (APBN/APBD), PerPres No 54/2010 on Procurement, superseding KepPres No 80/2003, will generally apply whilst the wastewater management institution is a UPTD, a UPTD IPAL+IPLT or an embryo BLU-D. When the embryo becomes a full BLU-D, it will be able to exercise its own discretion as to whether apply PerPres 54/2010 in whole or on part or not at all, as the case may be provided always that procurement arrangements are efficient and effective (ref (i) elucidations to Section 20, Sub-Section 1 of PP No 23/2005 on Financial Management of BLU and (ii) Section 100, Sub-Sections 1 and 2, of Ministry of Home Affairs Decree No 61/2007 on Technical Guidelines for Financial Management of a BLU-D). If, however, the funding comes from the private sector, the procurement process laid out in PerPres No 67/2005 (as amended) will apply. This is relevant for concession/build-operate-transfer (BOT) agreements and, to some extent, operations and maintenance (O&M) contracts.

There are various externalities which influence the decision of the private sector whether or not to participate in a project, all of which impinge upon the project's ability to generate a satisfactory return on investment. These include demand (take-or-pay), tariffs, land availability, security of contract and other political risks. The government contracting party is encouraged to provide guarantees against these risks, although not operational risks. Central government has now established PT Penjaminan Infrastruktur Indonesia (Indonesian Infrastructure Guarantee Fund) to issue guarantees in order to compensate a private sector party if there is a failure on the part of the government host agency to meet its commitments in these respects.

Engagement of the private sector in the delivery of wastewater services is one of the key policy objectives of Ministry of Public Works Decree No 16/2008, which sets out the National Policy and Strategy for the Development of Domestic Wastewater Management.

10.2 Privatisation of desludging septic tanks

Desludging of septic tanks is currently being carried out by a 4 unit, vacuum truck fleet operated by the Cleansing and Parks Services Department (DPK) which, through its UPTD PAL operates the wastewater treatment plant (IPAL) currently being used also as aseptage treatment plant (IPLT). Based on the revenue statements for the septage operation, it is estimated that around 5,000-6,000 houses (less than 3% of households) used the service in 2010, indicating a very limited demand.

It is understood there are no licensed privately-owned trucks in the city. Although it has not been possible to confirm whether there are any unlicensed operators, it would be an unusual situation for a large secondary city like Bogor. If there are such operators, it is almost certain that the sludge is disposed of by methods which are environmentally unacceptable (water courses, storm drains, fields, etc).

The city government intends to continue operating the desludging activity until the end of 2014, when the embryo BLU-D will be established. At that point, it plans to privatise the service entirely, with the principal objective that it should be regulated in such a way that all human waste sludge disposal is handled in an environmentally correct manner.

This would involve all operators being licensed by the operator/manager, and any trucks not licensed will be turned away from the IPLT (which, in any case, they would be unlikely to visit). Furthermore, the problems of environment degradation from septic tank leakages and illegal dumping of sludge by unlicensed operators would be done away with by making desludging compulsory and the city government making it a free-of-charge service.

It is therefore proposed that the procedure should be changed whereby the contract is no longer an arrangement between private sector operator and household, but a service contract between the wastewater operator/manager (embryo or full BLU-D) and the private sector operator for which the city government will pay. The private sector operator could be the owner of a vacuum truck, or a motor cycle with vacuum equipment for tanks located in areas difficult to access with a truck. The desludging schedule will be determined by periodic inspections of septic installations carried out by the wastewater operator/manager. The private sector operator will receive authorisation for payment only upon presentation of receipt of the sludge at the treatment facility, signed by the IPLT manager.

The funding of this arrangement will need significant financial inputs from the city government. Chapter 8.8 recommends that this could be provided through a city-wide specific waste water retribution or, preferably, through the two (2) property taxes recently transferred from central government to the city/regency governments through the latest revision to the law on regional government taxes (Law No 28/2009).

The same procedure of septic sludge transportation and disposal should be followed for commercial premises, except the service would not be free of charge but would be billed to and paid for separately by the customer. In the case of social service premises (schools, hospitals, government offices, etc), service for payment or free-of-charge would be at the discretion of the city government.

Consequently, there is a need for enabling decrees concerning the operational licensing of vacuum tanker operators, as well as tariffs based on volume and distance to the IPLT and the mode of payment to operators by the city government. No specific compliance with PSP/PPP or procurement regulations is required, as the service will be non-competitive, with service contracts being awarded to licensed operators based on regulated published fees.

The process for establishing this arrangement should include the following sequential steps:

- The city government should determine the stages by which the service is developed. This will depend primarily on the availability of subsidy funding. However, in the event of funding constraints, it is recommended that low-income, high-density population areas be given priority as these constitute the greatest environmental risk. The service would be expanded as a function of more subsidised funds becoming available.
- The necessary regulations to establish the privatised service would include a new *perda* for licensing private sector operators and establish desludging and transport fees, payable by the city government, based on volume and distance. The *perda* should contain provisions for payment only on production by the private sector operator of a receipt acknowledging delivery of the sludge at the IPLT and contain provisions for sanctions for unlicensed operators and illegal tipping. Enforcement would be a duty of the wastewater operator/manager.
- The city government, through the operator/manager, will advertise for private sector operators and license only that number required to service the designated areas, on the basis of, say, a septic tank being emptied every four (4) years.

10.3 Privatisation of septic tank inspection service

The inspection service for septic tanks, community intermediate facilities and tertiary (grey water) drainage should begin in 2013 before the privatisation of septic tank desludging is authorised. It is unlikely that the UPTD IPLT+IPAL located within DPK will have sufficient qualified personnel to undertake these services. It is therefore proposed that a private contractor be hired to assist in the preparation of registers for septic tanks, community intermediate facilities and tertiary drainage and train UPTD IPLT+IPAL personnel in inspection procedures.

It is estimated that a contract of one (1) year should be sufficient for the required training. Septic tank manufacturers would probably be able to provide suitably qualified inspectors. However, the city government may find it more efficient and economic to continue the privatised service after one year, or tender a multi-year contract, rather than employ additional permanent civil service staff with their attendant overhead

The inspection service should be competitively tendered in accordance with PerPres No 54/2010.

10.4 Future privatisation initiatives

Research carried out during the Masterplan phase suggested little enthusiasm by the private sector for participating in activities on a larger scale, such as construction and management of wastewater/sludge disposal facilities under BOT or concession arrangements through competitive tendering under PerPres No 67/2005 (as amended). It is possible that some interest may be shown in operations and maintenance of an IPLT, but not until the second stage of the Master Plan (2015-2020) at the earliest.

In conclusion, it may be said that the central government has provided a fair regulatory framework and guarantee incentives which could make privatisation for BOT and concession agreements feasible; however, regional governments have shown little interest to date in making the most of the opportunities presented. Until this outlook charges, the private sector will not be very willing to engage in investment in urban infrastructure, especially the wastewater sector which is still in the early stages of development.

Table 10.1: Schedule of Regulatory Requirements for PSP Proposals

Proposed Actions	Target Date	Regulatory Action
Funding for septic tanks, community intermediate facilities and tertiary drainage inspection service	December 2012	FY 2013 APBD
Revised conditions for licensing of private sector operators for desludging service, together with tariff schedule, with operations beginning January 2015	June 2014	Perda required
Effective from January 2015, compulsory desludging of septic tanks with city government to pay for service	June 2014	Perda required
Funding for privatised desludging operations	December 2014	FY 2015 APBD

11. Conclusions and recommendations

Referring to the strategic objectives of the masterplan outlined in Chapter 4, Section 4.1, we conclude that by 2030, if the activities proposed in the masterplan are implemented, Bogor can meet its 3 main aims. These are:

- Reach ODF status by 2015 by a mix of on-site and intermediate facilities;
- Make improvements in all areas with relatively unhealthy living conditions by a mix of on-site and intermediate solutions by 2020;
- Reduce the environmental pollution load from wastewater in Bogor by 50% by 2030 compared to the 2010 pollution load.

Reduction of the BOD load to the City

The main strategic objective relating to the existing environmental pollution of Bogor is the reduction in BOD load to the environment. With the planned investment of Rp 1.8 trillion (US $ 206 mln) included in the masterplan by 2030, the daily BOD load discharged to the environment is expected to reduce to be around 8 tons BOD, compared with the current load of 17 tons BOD. The total investment costs per kg of BOD removed by 2030 will be around Rp 40 mln. Besides, new infrastructure and the improvement and upgrading of existing wastewater infrastructure, a change in the behaviour of the communities is crucial to the success of reducing the pollution load to this level by 2030. See Table 11.1 for the forecast decrease of pollution loads over the masterplan period.

Table 11.1: Pollution load Bogor 2010-2030

Calculation pollution load		2010	2015	2020	2030
BOD load-non served households	kg BOD/day	1 298	0	0	0
Treatment efficiency Sewage Treatment Plant	% BOD removal	0%	95%	95%	95%
BOD load off-site	kg BOD/day	42	28	107	344
Treatment efficiency acceptable intermediate facilities	% BOD removal	60%	75%	90%	95%
BOD load acceptable intermediate systems	kg BOD/day	112	504	406	331
Treatment efficiency unacceptable intermediate facilities	% BOD removal	20%	20%	20%	20%
BOD load unacceptable intermediate systems	kg BOD/day	112	0	0	0
Treatment efficiency acceptable on-site facilities	% BOD removal	80%	80%	80%	80%
BOD load acceptable on-site facilities	kg BOD/day	2 068	4 299	6 530	7 230
Treatment efficiency unacceptable on-site facilities	% BOD removal	20%	20%	20%	20%
BOD load unacceptable on-site facilities	kg BOD/day	12 409	9 300	3 061	0

Calculation pollution load		2010	2015	2020	2030
Treatment efficiency acceptable treatment facilities commercial enterprises	% BOD removal	80%	75%	90%	95%
BOD load acceptable facilities commercial enterprises	kg BOD/day	276	524	391	223
Treatment efficiency unacceptable treatment facilities commercial enterprises	% BOD removal	20%	20%	20%	20%
BOD load unacceptable commercial enterprises	kg BOD/day	905	559	0	0
Total BOD load	kg BOD/day	17 221	14 433	10 495	8 128
Pollution load	% BOD produced	57%	42%	23%	15%

Identification of the 20 year investment requirements for wastewater infrastructure

See table 11.2 for the total investment costs are included in the masterplan and the unit cost of BOD reduction.

Table 11.2: Investment program Bogor 2010-2030

COST ESTIMATE (mln)	Cost Ph1	Cost Ph2&3	2010-2015	2015-2020	2020-2030	Total	% Cost
Off-site Paledan/Kayu Manis and Cianjur							
- new off-site house connections: hc+lateral sewers	Rp8.5	Rp10	Rp26 000	Rp92 000	Rp340 000	Rp458 000	25%
- new off-site house connections costs for trunk sewers	Rp1.8	Rp5	Rp6 000	Rp46 000	Rp170 000	Rp222 000	12%
- new off-site house connections costs for STP	Rp3.5	Rp5	Rp11 000	Rp46 000	Rp170 000	Rp227 000	12%
Off-site Tegalgundil							
- new off-site house connections: hc+lateral sewers	Rp11	Rp11	Rp6 430	Rp22 505	Rp-	Rp28 935	2%
- Rehabilitation STP	Rp800		Rp800	Rp-	Rp-	Rp800	0%
- Intensification STP	nil		nil	Rp-	Rp-	Rp-	0%
On-site							
- new on-site facilties	Rp3	Rp3	Rp72 000	Rp156 000	Rp108 000	Rp336 000	18%
- rehabilitation on-site facilities	Rp2	Rp2	Rp56 000	Rp112 000	Rp56 000	Rp224 000	12%
Intermediate							
- new intermediate facilties	Rp5.9	Rp6	Rp65 000	Rp90 000	Rp108 000	Rp263 000	14%
- rehabilitation intermediate facilties	Rp2.5	Rp2.5	Rp2 500	Rp-	Rp-	Rp2 500	0%
Septage collection and treatment							
- Vacuum	Rp500	Rp500	Rp3 000	Rp7 000	Rp-	Rp10 000	1%

COST ESTIMATE (mln)	Cost Ph1	Cost Ph2&3	2010-2015	2015-2020	2020-2030	Total	% Cost
trucks/motorcycles							
- IPLT Tegalgundil	Rp2 900		Rp2 900	Rp-	Rp-	Rp2 900	0%
Commercial							
- new treatment facilities commercial enterprises	Rp20	Rp20	Rp10 000	Rp40 000	Rp20 000	Rp70 000	4%
- rehabilitation treatment facilities commercial enterprises	Rp10	Rp10	Rp8 000	Rp13 000	Rp-	Rp21 000	1%
Total investment cost	-	-	**Rp259 630**	**Rp624 505**	**Rp972 000**	**Rp1 866 135**	**100%**
Cumulative investment cost			Rp325 630	Rp884 135	Rp1 866 135		
Cumulative investment cost US$ (mln)		$/Rp9 000	$29m	$98m	$207m		
Total investment cost per kg BOD removed (mln)	Rp/kg BOD removed		Rp 13m	Rp 25m	Rp 41m		

In addition to the 3 main aims above, the following interventions are identified and included in the masterplan.

Commencement of the development of the city-wide sewerage system

The City has been divided into three wastewater Zones, the Western zone is essentially to be dealt with by on-site systems, the Central and Eastern wastewater collection zones are to be dealt with by a mixture of off-site , onsite and intermediate systems. Two main sewer lines have been identified that will be part of the long-term (post 2030) city wide sewerage system. One trunk sewer running in the Central wastewater collection zone, with a potential wastewater collection area of 1200 ha, the trunk sewer runs North from Jalan Sukasari to a STP at Kayu Manis. The second trunk sewer runs in the Eastern wastewater collection zone, with a potential wastewater collection area of 1400 ha, the trunk sewer runs North East from Jalan Raya Pajajaran to a STP at Ciluar, there will also be a main sewer connecting the Tegal Gundil wastewater collection zone to the Eastern trunk sewer. Early confirmation of these routes will allow decisions on spatial reservations for the STP to treat the wastewater at Kayu Manis (of at least 8.5 ha) and at Ciluar (of at least 4 ha), the planned improvements at Tegal Gundil fit within the existing site. Spatial reservations for the routes of the proposed trunk sewers and main sewers also need to be made.

A starter off-site wastewater collection system, referred to as the “embryo”, has been identified: this system covers some high density mixed housing areas and a commercial and business area. The wastewater collection zone covers part of Kelurahan Gudang, Kel Sukarasi, Kel Paledang and Bakakan Pasar, connections will be made to about 2665 households and 435 commercial properties with a population of about 15,000. Wastewater from this areas is planned to be treated at a temporary RBC installation at bhe back of the Dinas Kebersihan office. At a later date the embryo wastewater collection system can be connected to the Central zone trunk sewer for treatment at Kayu Manis STP;

Expansion of the existing wastewater collection zone of the Tegal Gundil STP is being proposed by the City government. 2,400 properties can be connected to the existing STP if it is operated properly and with technical improvements at the STP this could be increased to 3,000 properties. At a later date this wastewater collection system can be connected to the Eastern zone trunk sewer for treatment at Ciluar STP.

Improvements to private onsite domestic systems

Even by 2030, off-site systems will only serve 14% of the population of Bogor. On-site sanitation will remain the prime wastewater management system covering 74% of the population. However more than 60% of the present septic tanks/leaching pits are not watertight and leach their hazardous contents straight into surface and groundwater. 'Normal' septic tanks are however very expensive and beyond the reach of most of the urban poor. Hence the City government has decided it wants to promote an alternative modern technology which can be afforded by the low and medium income groups. They propose a septic tank at the price of a leaching pit. This masterplan introduces the Low Cost Septic Tank with a soakaway and the "Biotank" with a soakaway.

Septage collection is a big challenge in Bogor, at present only about 8% is collected for disposal. This can probably be attributed to the fact that the soil is in generally permeable and water tables are low. Hence is takes a long time before the leaching pits or septic tanks fill up and overflow. For good on-site wastewater systems, regular septage removal is crucial and this message has to be conveyed to the population through intensive marketing efforts.

Improvements to septage removal

As stated above, very little septage is collected across Bogor. To make it easier for the vacuum trucks to discharge the septage, septage discharge points can be installed on the centralized sewerage system. A septage discharge station (SDS) already exists near STP Tegal Gundil, this type of emptying facility can be introduced to other parts of Bogor as "off-site" sewerage and treatment is introduced. To make septage removal easier in the high-density areas with narrow gangways, vacuum motorcycles could be introduced, they can enter the gangways and remove the septage in an environmentally sound way.

Development of intermediate systems

In high-density areas on-site solutions are not possible, due to lack of space and off-site solutions may not always be technically or financially feasible. For these areas the Master Plan introduces 'intermediate systems'. Bogor has three types of intermediate systems; all systems will include wastewater treatment:

- MCK;
- Shallow Sewerage (SS);
- Small Bore Sewerage (SBS).

For the high density areas where off-site solutions are practical, but they are located too far from the trunk sewers to be connected, then SS or SBS systems are planned, each system will have a modular wastewater treatment plant.

It is recommended that three pilot projects on these communal sewerage systems should be implemented early during the first period of the masterplan, One in the medium income housing estate Mutiara Bogor Raya and two in the low-income Kelurahan Panaragan (RW 2 and RW 5). The experience from these can then be used for the development of the other sub-projects that need to be developed to ensure Bogor attains OD Free status by 2015.

Identification of the operator for the improved wastewater systems

The city has decided to establish a regional government services agency (BLU-D) by 2017 to be the operator and provider of an integrated wastewater service. The BLU-D will manage the embryo off-site wastewater system, operate the existing IPAL, co-ordinate the activities of the private sector septage removal operators to ensure that sludge is disposed of in an environmentally friendly manner, to provide guidance for the operation and maintenance of on-site septic tanks and intermediate wastewater systems as well as grey water drainage systems. In the interim period a UPTD will be set up to operate the wastewater systems that are implemented prior to 2017.

Identification of proposals for financing the improved wastewater systems

It is recommended that financial support in the form of a public service obligation be made available by the City for domestic wastewater services. Proposals are made that the funding source could be from the property taxes which the city now manages in its own right, or from targeted retribution, or from both sources.

12. Priority projects and follow up actions

12.1 Priority projects

The following wastewater projects have been identified for inclusion during the first five years (period 1) of the masterplan.

Table 12.1: Priority wastewater projects

Program 2010-1015	Volume	Units	Unit price	unit	Costs	
Off-site Paledang/Kayu Manis and Ciluar						
- new off-site house connections: hc+lateral sewers	3 100	nrs	Rp8.5	mln/conn	Rp26 000	10%
- new off-site house connections costs for trunk sewers	3 100	nrs	Rp1.8	mln/conn	Rp6 000	2%
- new off-site house connections costs for STP	3 100	nrs	Rp3.5	mln/conn	Rp11 000	4%
Off-site Tegal Gundil						
- new off-site house connections: hc+lateral sewers	600	nrs	Rp10.7	mln/conn	Rp6 430	2%
- Rehabilitation STP	item	ls	Rp800	mln	Rp800	0%
On-site						
- new on-site facilties	24 000	hh	Rp3	mln/hh	Rp72 000	28%
- rehabilitation on-site facilities	28 000	hh	Rp2	mln/hh	Rp56 000	22%
Intermediate						
- new intermediate facilties	11 000	hh	Rp5.9	mln/hh	Rp65 000	25%
- rehabilitation intermediate facilties	1 000	hh	Rp2.5	mln/hh	Rp2 500	1%
Septage collection and treatment						
- Vacuum trucks/motorcycles	6	equivalent truck	Rp500	mln	Rp3 000	1%
- IPLT Tegalgundil	item	ls	Rp2 900	mln	Rp2 900	1%
Commercial						
- new treatment facilities commercial enterprises	500	facilities	in embryo	mln/conn	in embryo	n.a.
- rehabilitation treatment facilities commercial enterprises	800	facilities	Rp10	mln/conn	Rp8 000	3%
Total					**Rp259 630**	**100%**
Total (US $ mln.)		Rp9 000			$29 m	

The following individual projects are included in Table 12.1 above:

- Paledang off-site “embryo” wastewater system Rp 43 bl
- Extension of the Tegal Gundil STP wastewater collection zone Rp 11 bil
- Rehabilitation of Tegal Gundil STP Rp 800 mln
- On-site systems, rehabilitation and new Rp 128 bl
- Intermediate systems, rehabilitation and new Rp 67.5 bl
- Non domestic systems, rehabilitation and new Rp 8 bl

- Septage emptying vehicles Rp 3 bl
- IPLT at Tegal Gundil STP Rp 2.9 bil

12.2 Recommended interventions and studies

To overcome the present shortcomings of the wastewater systems in Bogor, to sustain the interventions and to arrive at healthy living conditions in Bogor, we recommend that the following actions are needed:

- Improve the operation of STP Tegal Gundil, by operating the existing waste stabilization pond technology properly, we estimate that the present facility can serve up to 2400 households.
- Seek operational management support for STP Tegal Gundil from experienced wastewater operators;
- Motivate the population in areas with poor sanitation to improve their defecation habits and practices
- Motivate the population, commercial enterprises and institutes to implement, operate and maintain adequate wastewater facilities;
- Develop simultaneously : physical, financial and technical capabilities regarding wastewater improvements;
- Work at all levels simultaneously : government, institutes, commercial enterprises, neighborhood and community to promote all wastewater initiatives;
- Implementation of the motivational and capacitating activities identified in Chapter 6 and focus on:
  - Education of responsible government staff;
  - The implementation of a WIKI: Wastewater Improvement Kantor Informasi or WRC: Wastewater Resource Centre, where contractors and the general public can obtain information on appropriate technologies (models, construction drawings, etc.) especially the Low Cost Septic Tank;
- Elaboration of the concept of the Low Cost Septic Tank and develop scale models of the other on-site and intermediate systems suited to Bogor conditions, with displays at government offices, hospitals, schools, Puskesmas;
- Execute a number of studies to back-up and refine the planned interventions by:
  - Studies, monitoring and evaluation of the performance of communal treatment systems such as the ABR;
  - Studies into the reasons and causes of the present extremely low coverage of formal septage collection services: is there really no demand for services or is the present demand served by illegal/informal practices?
  - Develop a good marketing strategy to persuade the owners of on-site systems to have the septage removed at regular intervals;
- Publish the effluent quality statistics of all licensed wastewater treatment facilities in Bogor on the internet (Wiki-leaks Bogor);
- Develop proposals for “Award and Reward” for the best working wastewater treatment facility, visit by the mayor and generate publicity.
- Start the construction of sewers only after land has been purchased for the sewage treatment plants at Kayu Manis and Ciluar and the construction of the STPs is underway

- Subsidize the purchase of on-site systems for the urban poor;
- Develop micro-credit schemes to assist in the purchase of on-site systems for the medium-level income groups and/or develop “Arisan” schemes to purchase on-site systems
- Consider and implement legislation to ensure that 100% of the community connects to off-site systems or neighbourhood intermediate systems where they are available for connection;
- Consider and implement legislation to ensure that all properties pay a wastewater fee, whether they are connected to off-site and intermediate systems or they are not connected.

A number of these interventions have been elaborated in the WWMP Final Capacity Building Plan report.

12.3 Implementation schedule

The implementation schedule for all the projects in the masterplan period are presented in Table 12.2. The schedule includes the recommended studies, milestones, hardware and software.

Table 12.2: The implementation schedule

Nr.	Description	Period 1					Period 2					Period 3									
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1.000	**STUDIES**																				
1.010	Masterplan and Feasibility Study																				
1.020	Detailed Engineering Design Pilot Intermediate Systems																				
1.030	Detailed Engineering Design Embryo Paledang																				
1.040	Env. Man. (UKL) & Mon. (UPL) Plan Sewerage Embryo & intermediate systems																				
1.050	AMDAL STP Kayumanis (Bogor Central)																				
1.060	AMDAL STP Ciluar (Bogor East)																				
1.070	AMDAL Sewerage Bogor Central																				
1.080	AMDAL Sewerage Bogor East																				
1.090	Detailed Engineering Design STP Kayumanis & Sewerage Bogor Central																				
1.100	Detailed Engineering Design STP Ciluar & Sewerage Bogor East																				
2.000	**MILESTONES**																				
2.010	Acceptance Masterplans and Feasibility study																				
2.020	Presentation Bappenas/'Blue Book'																				
2.030	Land acquisition STP Paledang (Embryo Paledang)																				
2.040	Land acquisition STP Intermediate pilot systems Mutiara Bogor Raya and Bondongan																				
2.050	Land reservation STPs Kayumanis and Ciluar																				
2.060	Land acquisition STPs Kayumans and Ciluar																				
2.070	Release of Loan ADB/Hibah Bogor																				
3.000	**HARDWARE (PHYSICAL IMPLEMENTATION)**																				
3.100	**Off-site**																				
3.101	- Construction STP Paledang																				
3.102	- Construction sewerage system Embryo Paledang		3,100 conn.																		
3.103	- Construction STP Kayumanis (Bogor Central)																				
3.104	- Trunk sewer/sewerage system Bogor Central							9,200 conn.				21,700 connections									
3.105	- Rehabilitation STP Tegalgundil (Subsystem Bogor East)																				
3.106	- Upgrading STP Tegalgundil into FAP (Subsystem Bogor East)																				
3.107	- Extension sewerage system Tegalgundil (Subsystem Bogor East)	600 connections					2,100 connections														
3.108	- Construction STP Ciluar (BogorEast)																				
3.109	- Trunk sewer/sewerage system Bogor Surabaya East											12,300 connections									
3.110	- Connection intermediate systems to trunk sewers																				

Nr.	Description	Period 1					Period 2					Period 3									
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
3.110	**On-site systems**																				
3.111	- Pilot projects low-cost Bogor fit system (100 hh)																				
3.112	- Rehabilitation existing on-site systems																				
3.113	- Implementation new on-site systems																				
3.210	**Intermediate systems**																				
3.211	- Preparation & DED 2 pilots 'community sewerage modules																				
3.212	- MoU with the community for O&M																				
3.213	- Construction of 2 pilot 'community sewerage module'		1,510 hh																		
3.214	- Preparation & DED 'community sewerage modules'			5 * 1,000 hh																	
3.215	- MoU with the community for O&M																				
3.216	- Construction 'community sewerage modules'				5 * 1,000 hh																
3.217	- DED & Construction of 'community sewerage modules'						13 * 1,000 hh					14 * 1,000 hh									
3.218	- Implementation MCKs	10 * 100 hh					10 * 100 hh					20 * 100 hh									
3.219	- Implementation Communal Treatment Systems	25 * 100 hh					30 * 100 hh					60 * 100 hh									
3.310	**Septage collection and treatment**																				
3.311	- Construction of Septage Discharge Stations in Trunk Sewers																				
3.312	- Purchase of vacuum motor cycles																				
3.313	- Septage Treatment at STPs																				
4.000	**SOFTWARE**																				
4.100	**Off-site**																				
4.101	- Marketing embryo																				
4.102	- Organization set-up for Operation sewerage & stp																				
4.103	- Legislation, Law Enforcement																				
4.200	**On-site systems**																				
4.201	- Study performance existing on-site systems																				
4.202	- Develop Bogor fit system																				
4.203	- Dissemination results																				
4.204	- Marketing on-site systems																				
4.205	- Community organization/ NGOs																				
4.206	- Training sanitarians																				
4.207	- Backstopping community initiatives																				
4.300	**Intermediate systems**																				
4.301	- Study performance existing intermediate systems																				
4.302	- Pilot projects (sbs, ss) subsidy																				
4.303	- Dissemination results																				
4.304	- Marketing intermediate systems																				

Nr.	Description	Period 1					Period 2					Period 3									
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
4.305	- Community organization/ NGOs																				
4.306	- Backstopping community initiatives																				
4.400	**Septage collection**																				
4.401	- Study existing practices																				
4.402	- Develop alternative manual desludging																				
4.403	- Marketing septage collection																				
4.404	- Organizing septage collection																				
4.405	- Law Enforcement																				
4.500	**Enabling Environment**																				
4.501	- Formalizing role Pokja																				
4.502	- Wastewater Information Centre (mobile)																				
4.503	- School Sanitation																				
4.504	- Puskesmas Sanitation																				
4.505	- Sanitation at institutes																				
4.506	- Training government staff on sanitation																				
4.507	- Blame and shame / Ombudsman / Grievance procedures																				
4.508	- Backstopping commercial enterprises																				
5.000	**IMPLEMENTATION of the LIDAP**																				
6.000	**IMPLEMENTATION of the FOPIP**																				
7.000	**MONITORING AND EVALUATION**																				
7.010	M&E Embryo Paledang																				
7.020	M&E Pilot on-site sanitation																				
7.030	M&E Pilot intermediate system																				
7.040	M&E Off-site																				
7.050	M&E On-site																				
7.060	M&E Intermediate																				
7.070	M&E Septage collection and treatment																				
8.000	**IMPLEMENTATION SUPPORT**																				
8.100	TA Implementation																				